MAGHERAMORE WIND FARM
Environmental Statement

Volumes 2 - Main Report



MANAGEMENT SYSTEM CERTIFICATION
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Introduction & Policy Context

1 Introduction & Policy Context

Background

1.1 This Environmental Statement (ES) has been prepared by RES Limited (RES) to accompany a planning application that has been made to the Northern Ireland Causeway Coast & Glens **B**C for permission to construct, operate and decommission a wind farm known as Magheramore Wind Farm, hereinafter referred to as 'the Development'. The purpose of the ES is to aid Causeway Coast & Glens **B**C in the assessment of the likely significant environmental effects resulting from the Development and to establish the need for mitigation measures to reduce such effects.

1.2 The application site is located approximately 4 km south of Dungiven, Co. Derry/Londonderry, as shown in **Figure 1.1: Site Location** and **Figure 1.2: Planning Application Boundary.**

1.3 This chapter is supported by:

- Technical Appendix 1.1: Letter of Intention to Submit an Environmental Statement;
- Technical Appendix 1.2: Causeway Coast & Glens BC response to Intention to Submit an Environmental Statement.

The Applicant

1.4 The application for planning permission is made by RES ('the Applicant').

1.5 RES is one of the world's leading independent renewable energy project developers with operations across Europe, the Americas and Asia-Pacific. At the forefront of renewable energy development for over 30 years, RES has developed and/or built almost 16,000 MW of renewable energy capacity worldwide. In the UK alone, RES currently has more than 1,000 MW of projects either constructed, under construction or consented. RES is active in a range of renewable energy technologies including onshore and offshore wind, solar, as well as enabling technologies such as energy storage.

1.6 RES has been building wind farms in Ireland since the early 1990s and from our office in Larne, Co.Antrim we have a team of over 20 working across a range of disciplines. In Northern Ireland, RES has developed and / or built seventeen wind farms with a total generation capacity of nearly 229 MW.

EIA Process

Scope of Environmental Statement

1.7 The Environmental Impact Assessment (EIA) has assessed the environmental impacts associated with the construction, operation and decommissioning the Development, which comprises 6 three-bladed, horizontal axis wind turbines, each up to a maximum of 149.9 m to tip height, with a total installed capacity of up to 21.6 MW. The Development would include associated external electricity transformers, underground cabling, a newly created site entrance, access tracks, turning heads, crane hardstandings, control building and substation compound and energy storage containers. During construction and commissioning there would be a number of temporary works including a construction compound with car parking, temporary parts of crane hardstandings and welfare facilities.

1.8 A full description of the Development is provided in **Chapter 2: Proposed Development.**

1.9 RES has undertaken informal scoping with Causeway Coast & Glens BC regarding the Development and a letter of Intention to Submit an ES was lodged, which is included in **Appendix 1.1**. An Intention to Submit response from Causeway Coast & Glens BC is included in **Appendix 1.2**. Consultation responses from consultees have been considered in the individual chapters of this ES.

1.10 An EIA has been undertaken in accordance with the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017, (the "EIA Regulations"), to identify and assess the likely environmental effects of the Development and establish an appropriate range of mitigation measures in order to reduce adverse impacts where possible. This ES contains the findings of the EIA.

1.11 The Development will represent a 'Schedule 2' development, as defined under the "EIA Regulations". Development that is listed in Schedule 2 requires an EIA if it is likely to have an impact on the environment by virtue of factors such as its size, nature or location. Therefore, any potential effects of the construction, operation and decommissioning of the Development deemed to have significant environmental effects are subject to an EIA.

1.12 The scale of the Development means that there is the potential for significant environmental effects to arise. Consequently, it was deemed appropriate to undertake an EIA.

1.13 EIA is a process by which information about the environmental impacts of a project is collected, evaluated and taken into account in its design and the decision as to whether it should be granted planning permission. The applicant presents the information on the project and its likely environmental impacts in an ES. This enables decision-makers to consider these impacts when determining the related planning application. The EIA process has a number of key characteristics:

- It is systematic, comprising a sequence of tasks defined both by regulation and by practice;

- It is analytical, requiring the application of specialist skills from the environmental sciences;
- It is impartial, its objective being to inform the decision-maker rather than to promote the project;
- It is consultative, with provision being made for obtaining information and feedback from statutory agencies and key stakeholders; and
- It is iterative, allowing opportunities for environmental concerns to be addressed during the planning and design of a project.

1.14 This final point is particularly important with respect to the design of the Development where a number of design iterations have taken place in response to environmental factors identified during the EIA process (**Chapter 3: Design Evolution and Alternatives**).

1.15 The EIA for the Development has been carried out in accordance with the latest regulations, guidance and advice on good practice, comprising:

- Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017;
- Environmental Impact Assessment: A guide to procedures (Department for Communities and Local Government, amended reprint 2001); and
- Guidelines for Environmental Impact Assessment (Institute of Environmental Management and Assessment, 2004).

1.16 Individual technical assessments have been undertaken in accordance with a variety of legislation, guidance and best practice. Relevant details are contained within the Legislation and Policy Framework section where applicable to each technical chapter.

The Assessment Method

1.17 Appropriate methodologies have been used to assess the effects relating to each of the environmental topics that have been investigated as part of the EIA. These methodologies are based on recognised good practice and guidelines specific to each subject area, details of which are provided within each individual technical section.

1.18 The design team employed an iterative approach to the design of the Development where the design evolved throughout the EIA process as different constraints and potentially adverse impacts were identified and evaluated. This method is considered best practice as mitigation measures can concurrently be integrated into the design throughout the EIA process. This approach allowed the design team to alleviate or remove potentially adverse impacts and incorporate measures into the design to enhance positive impacts. The final evaluation of significance assesses the residual impacts assuming all mitigation measures are applied.

1.19 Each technical chapter assesses the impacts that could arise as a result of the Development. Impacts are assessed as being either adverse, beneficial, permanent, temporary or reversible. Significance is determined by assessing the magnitude and sensitivity of each likely impact.

1.20 The ES complies with current planning policy and will be submitted in conjunction with a planning application. This report is a formal ES as required by Causeway Coast & Glens BC under the Planning (EIA) Regulations (Northern Ireland) 2017. The ES is designed to provide information for the purpose of assessing the likely impact upon the environment.

Structure of the Environmental Statement

1.21 Schedule 4 of the "EIA Regulations" states that the following must be included within the ES:

- A description of the development (description of the physical characteristics (site, design and size of the development), land-use requirements, production processes) and an estimate of expected residues and emissions resulting from the operation of the proposed development.
- An outline of the alternatives studied by the applicant and explanation of why the particular option was chosen.
- A description of the aspects of the environment likely to be significantly affected by the development (including population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage and landscape) and the inter-relationship between the above aspects.
- A description of the likely significant effects of the development on the environment (to include direct, indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, beneficial and adverse effects of the development).
- A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment.
- The data required to identify and assess the main effects that the development is likely to have on the environment.
- An indication of any difficulties (technical deficiencies or lack of know-how) encountered.
- A non-technical summary of the information contained within the ES.

1.22 This ES has been prepared in accordance with the "EIA Regulations" described above. The ES comprises the following volumes:

- **Volume 1**: Non-technical Summary (NTS) of the ES
- **Volume 2**: Main Text
- **Volume 3**: Figures (the illustrations that accompany the ES)
- **Volume 4**: Technical Appendices (technical information relating to the environmental topics such as detailed methodologies, baseline data information and data analysis).

1.23 Volume 2 is organised as follows:

- **Chapter 1**: Introduction & Policy Context
- **Chapter 2**: Proposed Development
- **Chapter 3**: Design Evolution and Alternatives
- **Chapter 4:** Landscape and Visual
- **Chapter 5:** Archaeology and Cultural Heritage
- **Chapter 6**: Ecology
- **Chapter 7:** Ornithology
- **Chapter 8:** Fisheries
- **Chapter 9:** Geology and Water Environment
- **Chapter 10**: Acoustic
- **Chapter 11:** Traffic and Transport
- **Chapter 12:** Shadow Flicker
- **Chapter 13:** Socioeconomics
- **Chapter 14:** Summary of Mitigation.

1.24 Climate Change is covered within Chapter 1; Biodiversity is covered under Chapters 6, 7, 8 & 9; Human Health is covered under Chapters 10 & 12. A summary of effects and mitigation is described in Chapter 14.

1.25 Chapters 1, 2, 3, 10, 11, 12 & 14 have been authored by RES using their in-house professionally qualified expertise in respect of these topics. The Environmental Statement has been compiled by RES, primarily by Garth McGimpsey (Senior Development Project Manager) who is a Chartered Planning & Development Surveyor (MRICS) and Practitioner of the Institute of Environmental Management & Assessment (PIEMA) with over 14 years' experience of planning, assessing and developing renewable energy projects.

1.26 In general, for each environmental topic, the following format has been adopted with regard to the presentation of information:

- Introduction
- Scope of Assessment
- Legislation and Policy Framework
- Consultation
- Assessment Methodology
- Baseline Assessment
- Assessment of residual impacts
- Design Evolution and Mitigation Measures
- Residual Impacts
- Cumulative Impacts
- Summary and Conclusions
- References.

1.27 A number of individual disciplines have adopted variations from this format as a result of specific assessment methodologies and appropriate reporting structure.

Planning Application

1.28 In April 2018, Causeway Coast & Glens BC confirmed that the planning application should be submitted to the Council, in accordance with Section 26 of the Planning Act (Northern Ireland) 2011, regarding the Department's jurisdiction in relation to developments of regional significance.

Policy Context

1.29 This section provides a summary of the Global, European Union (EU), National, Regional and local energy and planning policies that are relevant to the Development and highlights how the development fits with such policies. The policies relating to individual disciplines are examined in detail in the relevant technical chapters contained in this ES.

Climate Change

Paris Agreement

1.30 The Paris Agreement (12 December 2015) sets out the need to hold the increase in global average temperature to "well below 2^{o}C above pre-industrial levels and to pursue "efforts to limit the temperature increase to 1.5^{O}C". To achieve this long-term temperature target, the text states "parties aim to reach global peaking of greenhouse gas emissions as soon as possible". The document also includes a ratcheting mechanism on climate action, with countries having to communicate nationally determined contributions to reducing global emissions.

1.31 It is clear that moving to a low carbon economy is now a globally shared goal and will require absolute emission reduction targets. For the first time, some 195 countries, including the world's largest emitters have now committed to act together to address climate change and to be held equally accountable. Countries will also be legally obliged to make new post-2030 commitments to reduce emissions every five years.

1.32 In October 2018, the landmark Intergovernmental Panel on Climate Change (IPCC) Report highlighted the importance of the limiting temperature increases to 1.5 degrees C. The report concludes that human-induced warming reached approximately 1^{o}C above pre-industrial levels in 2017 and at the present rate, global temperatures would reach 1.5^{o}C around 2040. The IPCC's report recognises that in order to meet our climate change targets, up to 85% of global power generation needs to come from renewables by 2050.

Committee for Climate Change

Reducing emissions in Northern Ireland

1.33 In February 2019, the Committee on Climate Change published a paper on "*Reducing emissions in Northern Ireland*", which was prompted by the Permanent Secretary for the of the Department of Agriculture, Environment & Rural Affairs (DAERA) in Northern Ireland requested the Committee's advice on how Northern Ireland could reduce greenhouse gas emissions between now and 2030.

1.34 Whilst Northern Ireland does not have any specific climate change legislation, greenhouse gas emissions from Northern Ireland contribute to the UK total under the Climate Change Act and therefore Northern Ireland has a key role to play in meeting our obligations under the Paris Agreement.

1.35 It is recognised in the report that Northern Ireland has ground to make up with other parts of the UK, both in terms of ambition and a definitive plan of action, which is evidenced by current predictions that Northern Ireland will achieve a 32% reduction on 1990 levels whereas Northern Ireland's contribution to the fifth carbon budget requires reduction of at least 35% (which is a smaller reduction against the 1990 baseline than targets the Committee has recommended for other parts of the UK).

1.36 The Committee accept that the ongoing EU negotiations and the lack of a sitting Executive could have a significant impact on the ability of Northern Ireland to implement decarbonisation policies in the near future.

1.37 The report recognises the challenges that are unique to Northern Ireland, such as:

- Heavily livestock-based farming sector accounting for 30% of all greenhouse gases in Northern Ireland compared to 10% in the rest of the UK.
- Gas network not being as extensive as in Great Britain, and three-quarters of homes being in Northern Ireland being reliant on oil or electric sources for heating.
- Unlike the rest of the UK, the land use, land-use change and forestry sector is a net carbon source rather than sink. Forest coverage is 40% lower in Northern Ireland than the UK as a whole. If emissions from degraded peat are included this could add 9% to Northern Ireland emissions.

1.38 The report recognises the opportunities that are unique to Northern Ireland, such as:

- Northern Ireland has devolved responsibility for energy policy. Northern Ireland is a member of the all-island Single Electricity Market (I-SEM) shared with the Republic of Ireland.
- The geographical size of Northern Ireland presents an opportunity for a more rapid uptake of electric vehicles because of range anxiety may be less of a concern for consumers. However, this is offset by the prevalence of longer

cross-border journeys and the need for adequate public charging infrastructure on both sides of the border.

1.39 It is evident from the opportunities highlighted that aligning energy policy on both sides of the border is critical given the nature of the all-island Single Electricity Market (I-SEM).

1.40 The Committee highlight a number of proposals where policy makers should focus on to close the policy gap and potentially deliver 40% in Northern Ireland against the 1990 baseline by 2030 and one of these is the lack of market for new low-cost intermittent renewables, especially onshore wind, in the electricity sector.

1.41 The Committee recognise that the cost-effective path to decarbonisation in Northern Ireland requires action across all sectors of the economy and a joined up approach. The total annual cost of meeting the fifth carbon budget in 2030 is less than 1% of GDP for the whole of the UK.

Net Zero – The UK's contribution to stopping global warming

1.42 This report was published in May 2019, following a request from the Governments of the UK, Wales and Scotland, asking the Committee to reassess the UK's long-term emissions targets. The new emissions scenarios draw on ten new research projects, three expert advisory groups, and reviews of the work of the IPCC and others.

1.43 The report's key findings are that:

- The Committee on Climate Change recommends a new emissions target for the UK: net-zero greenhouse gases by 2050.
- In Scotland, we recommend a net-zero date of 2045, reflecting Scotland's greater relative capacity to remove emissions than the UK as a whole.
- In Wales, we recommend a 95% reduction in greenhouse gases by 2050.

1.44 A net-zero GHG target for 2050 will deliver on the commitment that the UK made by signing the Paris Agreement. It is achievable with known technologies, alongside improvements in people's lives, and within the expected economic cost that Parliament accepted when it legislated the existing 2050 target for an 80% reduction from 1990.

1.45 However, this is only possible if clear, stable and well-designed policies to reduce emissions further are introduced across the economy without delay. Current policy is insufficient for even the existing targets.

1.46 Following the publication of this report, the UK Government committed to enshrining in law a commitment to reach net zero carbon emissions by 2050 through an amendment to the Climate Change Act.

Renewable Energy Policy

European Policy

1.47 The EU is responsible for about 14% of the world's greenhouse gas emissions, but has only 5% of its population (EU, 2009). The EU recognises that it must take a lead in reducing emissions and has responded to the threat of climate change. The European targets for greenhouse gas reductions under the Kyoto Protocol are set at an 8% decrease in greenhouse gas emissions by 2012 compared to 1990 levels of 14%. Furthermore, all countries will need to make an additional effort, including cuts of 80-95% by 2050 by developed countries. An EU target of 20% by 2020 is just the first step to put emissions onto this path (EU, 2010).

1.48 In the last decade, the EU has introduced several Directives aimed at addressing energy issues within Europe. Directives have imposed obligations to introduce and facilitate competition, both within and between Member States (Internal Market in Electricity (Directive 2003/54/EC)) whilst the Renewables Directive (2001/77/EC) required the active promotion and maximisation of renewable energy sources. In addition, the Energy Trading Directive (2003/87/EC) has introduced mechanisms to incentivise reductions in greenhouse gas emissions.

1.49 The Emissions Trading System Directive (2009/29/EC) amended Directive 2003/87/EC to improve and extend the greenhouse gas emission allowance trading scheme of the Community and aims to reduce overall emissions by 20% below 1990 levels by 2020 (or 30% if an international agreement can be reached).

1.50 The need to promote electricity produced from renewable energy sources within the internal electricity market of the EU was established in September 2001 within Directive 2001/77/EC. Article 3 of this Directive required Member States to "take appropriate steps to encourage greater consumption of electricity produced from renewable energy sources in conformity with…national indicative targets".

1.51 The 2009 EU Renewable Energy Directive (Directive 2009/28/EC) furthers the common framework for the promotion of energy from renewable sources and sets mandatory national targets for the overall share of energy between each member state.

1.52 In order to achieve the targets laid down in the Directive more easily, each Member State must promote and encourage energy efficiency and energy saving.

1.53 Member States were required to bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 5 December 2010, except for Article 4 on the adoption of national renewable energy action plans which takes immediate effect. In June 2010, each Member State presented a national renewable energy action plan which it will adopt, setting out national targets for the share of energy from renewable sources consumed in transport, electricity and heating and cooling in 2020, and taking into account the effects of other policy measures relating to energy efficiency on final consumption of energy.

1.54 The UK and Northern Ireland targets, which implement this Directive, are discussed below.

UK Policy

1.55 The UK Government has undertaken in recent years a number of studies designed to inform its renewable energy policies. The UK has its own 2020 target to provide for 15% of its energy needs from renewable sources, including 30% in electricity. In 2017 the UK was only at 10.2%[1] of total energy from renewable energy. This means the UK has only 68% of the renewable energy sources required to meet the 2020 renewable target.

1.56 Although evidence suggests that the UK has made substantial progress in the renewable electricity sector, due to slower progress in the heat and transport energy sectors, the UK is not on track to achieve the overall 15% target.

It is relevant to take UK energy policy into account as wind farm proposals will contribute to the wider public benefit in terms of renewable energy and electricity generation regardless of whether or not they are required in order to achieve UK targets by 2020.

1.57 Key policies to emerge from these studies include:

Meeting the Energy Challenge: UK White Paper on Energy 2007

1.58 The UK Government's Energy White Paper, 'Meeting the Energy Challenge' sets out a framework for action to address the energy challenges facing the UK. It sets out four key energy policy goals:

1.59 to put the UK on a path to cutting CO_2 emissions by 60% by 2050, with real progress by 2020;

- to maintain the reliability of energy supplies;
- to promote competitive markets in the UK and beyond; and
- to ensure that every home is adequately and affordably heated.

1.60 This Paper states that renewables are key to the UK strategy to tackle climate change and deploy cleaner sources of energy. It also highlights the importance of lowering practical barriers to renewables investment, such as improved planning inquiry rules.

National Renewable Energy Action Plan for the United Kingdom

1.61 This plan sets out the key energy objectives and subsequent targets for 2009-2020 and beyond. It acts as an over-arching referral document containing a summary of all energy strategies from each of the four countries of the UK.

1.62 The plan outlines three main objectives:

- Financial support for renewables;
- Unblocking barriers to delivery;

- Developing emerging technologies

UK Renewable Energy Strategy (Action Plan) 2009

1.63 The UK Renewable Energy Strategy provides an action plan to ensure 15% of energy comes from renewable sources by 2020, in implementation of Directive 2009/28/EC.

1.64 This strategy aims to tackle climate change, reducing the UK's emissions of CO_2 by over 750 million tonnes between now and 2030. It also promotes increasing the security of energy supplies, reducing overall fossil fuel demand by around 10% and gas imports by 20–30%, against what they would have been in 2020.

1.65 The strategy recognises that acceleration of the uptake of renewable energy will help meet the goal of decarbonising energy production in the UK, while ensuring secure and safe energy supplies and exploiting the significant economic opportunities of the move to a low-carbon economy. The strategy will enable the UK to meet its EU renewable energy target to source 15% of energy from renewables by 2020. Renewable energy is therefore a key part of the overall UK Low Carbon Transition Plan, which outlines how the UK will meet the 34% cut in emissions on 1990 levels by 2020.

1.66 The strategy identifies Northern Ireland's potential to make significant progress in increasing the amount of energy from renewable sources in order to contribute to policy goals on security of supply, reduction of greenhouse gases, as well as contributing to business competitiveness, increasing competition in power generation and presenting opportunities for enterprise activity.

UK Energy Act 2013

1.67 The UK Energy Act 2013 was passed in December 2013. It establishes a legislative framework for delivering secure, affordable and low carbon energy and includes provisions on decarbonisation, electricity market reform, nuclear regulation and consumer protection.

1.68 The act discusses the UK's obligation to increase the use of renewable sources and reduce carbon emissions.

1.69 The Energy Act amalgamates the individual energy regulations of England, Scotland, Wales and Northern Ireland.

The Industrial Strategy White Paper entitled 'Building a Britain fit for the Future'

1.70 The Strategy's overall aim published by the UK Government in November 2017[2], is to create an economy that boosts productivity and earning power throughout the UK. The 'key policies' in the strategy relate to ideas, people, the business environment, places and infrastructure. Clean growth is addressed at page 42 and it is set out that "*we will maximise the advantages for UK industry – through leading the world in development, manufacture and use of low carbon technologies, systems and services which cost less than high carbon alternatives*".

1.71 This is a recognition by the UK government that low carbon energy provision is important not just on environmental grounds but to ensure the UK remains a competitive environment for business.

Northern Ireland Policy

Strategic Energy Framework 2010

1.72 In September 2010, the Department for Enterprise, Trade and Investment (DETI) published a new Strategic Energy Framework (SEF) 2010 which details Northern Ireland's energy future over the next ten years and illustrates the key energy goals in terms of building competitive markets, ensuring security of supply, enhancing sustainability and developing energy infrastructure. It also sets out a new and ambitious renewable electricity target for 2020, 40% of electrical energy needs to be sourced from renewables by 2020.

1.73 The 2010 SEF notes that electricity generated by onshore wind farms is the most established, large-scale source of renewable energy in Northern Ireland. It also states that onshore wind farms will play a vital role in meeting the new renewable electricity target.

1.74 The SEF also highlights that there will continue to be concerns around planning and the infrastructure required to deal with increased wind generation and argues that it must be recognised that the integration of renewable technologies will incur additional costs in terms of new grid network management requirements.

1.75 The Development will play a key role in meeting the 40% target for 2020.

1.76 It is noted that in the Planning Appeals Commission (PAC) Decision (Appeal Ref 2009/A0363) Gaelectric, Commissioner T A Rue acknowledged *"that wind farms will play a vital role in meeting the new target"* and that *"it is noteworthy that the 40% is a minimum target and not a cap"*.

Northern Ireland Programme for Government 2011-2015

1.77 The Northern Ireland Programme for Government sets both the Budget and the Investment Strategy for Northern Ireland. It provides an over-arching set of priorities. These are:

- Growing a sustainable economy and investing in the future;
- Creating opportunities, tackling disadvantage and improving health and well-being;
- Protecting our people, the environment and creating safer communities;
- Building a strong and shared community;

- Delivering high quality and efficient public services.

Investment Strategy Northern Ireland 2011-2021

1.78 The Investment Strategy highlights the importance of renewable sources in electricity generation. The long-term targets are emphasised, underlining that the UK Climate Change Act 2008 legislated for an 80% mandatory cut in the UK's carbon emissions by 2050 (compared to 1990 levels), with a target of 35% by 2025.

1.79 It is stated in the Strategy that Northern Ireland needs to become less reliant upon fossil fuels.

1.80 "In energy generation, we will work with the utility companies to migrate from a reliance on imported fossil fuels to clean renewable generation in the future. If we act decisively, we can create new jobs and develop local expertise in this growing sector, building on our natural resources for wind and wave power and also on the engineering prowess of local companies and our universities and FE colleges".

Onshore Renewable Energy Action Plan 2013-2020

1.81 This plan considers the contribution of onshore renewable technologies to the 40% renewable energy target by 2020. It realises the implications that onshore wind has on the electricity network in Northern Ireland. The significance of onshore is emphasised with the plan stating;

1.82 "*Large scale onshore wind is the most mature and cost effective of renewable technologies and as such helps the transition to a low carbon future with less pressure on fuel bills. It will continue to play a key role in renewable generation in Northern Ireland in the medium term*".

Republic of Ireland Policy

1.83 The Republic of Ireland (ROI) will fall short of their 2020 renewable energy target of 16% of energy to come from renewables and whilst they are also aiming to comply with an EU target of 40% (currently at 30.1%) of electricity from renewable sources by 2020, it is unlikely that this target will be met, resulting in EU fines as a result.

1.84 The European Parliament has been critical of regarding Ireland's commitment to tackling climate change and the lack of progress towards targets and a perceived lack of ambition for its 2030 emissions target when compared to other EU member states.

1.85 On 25th March 2019, the Irish government announced a wide-ranging Climate Action Plan to tackle climate change, which includes a commitment to 70% of Ireland's electricity supply to be generated from renewables by 2030.

1.86 Minister Bruton said, "We have a short window of opportunity to act. We must act now and leave a better, healthier, more sustainable Ireland for future generations. This plan provides our way forward. We are currently 85% dependent on fossil fuels. This plan sets out radical reforms, which will cut our reliance on carbon."

1.87 On 17th June 2019, the Irish Government published their *Climate Action Plan 2019*, the aim is to make Ireland a world leader in responding to climate change. The goal in the energy sector is to make Ireland less dependent on imported fossil fuels. To achieve this energy needs to be decarbonised by harnessing renewable resources, particularly wind (both onshore & offshore), solar, PV and biomass powered CHP.

Northern Ireland & Republic of Ireland – Policy disconnect

1.88 Until recently the renewable energy targets on the island of Ireland were aligned in aiming for 40% of electricity from renewable sources by 2020, however there is now a policy disconnect and the opportunities that exist within Northern Ireland because energy policy is devolved are unlikely to be realised until there is a sitting Executive.

1.89 The Northern Ireland Renewables Industry Group, Solar Trade Association and British Hydropower Association have called for a target to supply 70 per cent of Northern Ireland electricity from renewables by 2030. A comprehensive report by leading energy and utilities experts Baringa says it is technically possible and cost neutral for Northern Ireland to use renewable energy to supply 70 per cent of our electricity by 2030[3].

1.90 Rachel Anderson, NIRIG Chair, **said:** “When we set renewable energy targets for 2030 we will be shaping our energy and climate action policies for a generation. The evidence from the Baringa report is clear. An electricity system using 70 per cent renewable energy by 2030 is not only practical, it is – at a minimum – cost neutral for the consumer.

1.91 “With the right leadership we can be ambitious for our energy future and for our role in the fight against climate change. What we need is an energy policy to drive investment and jobs for the next decade by setting a 70 per cent target for renewable electricity.”

Planning Policy

1.92 Key relevant planning policy documents for Northern Ireland were reviewed in respect of the proposed development. This included the Strategic Planning Policy Statement (SPPS), Planning Policy Statements (PPSs), Local Development Plans, Development Control Advice Notes (DCANs) and other publications.

1.93 The relevant policies and guidance in each of the planning policy documents are set out below, together with an analysis of how the proposed development complies with these policies.

Regional Policy

- The Regional Development Strategy: Shaping our Future 2025;
- The Regional Development Strategy: Shaping our Future 2025 (Adjustments);

[3] https://www.iwea.com/images/files/70by30-report-final.pdf

- The Regional Development Strategy: Building a Better Future 2035;
- The Sustainable Development Strategy: Everyone's Involved 2010
- PPS 1: General Principles;
- PPS 2: Natural Heritage:
- PPS 3: Access, Movement and Parking;
- PPS 6: Planning, Archaeology and the Built Heritage;
- PPS 13: Transportation and Land Use
- PPS 15: Planning and Flood Risk;
- PPS 18: Renewable Energy;
- Best Practice Guidance to Planning Policy Statement 18: Renewable Energy;
- Wind Energy Development in Northern Ireland's Landscapes - Supplementary Planning Guidance to PPS 18;
- PPS 21: Sustainable Development in the Countryside;
- 'Strategic Planning Policy Statement for Northern Ireland (SPPS): Planning for Sustainable Development';
- A Planning Strategy for Rural Northern Ireland;
- DCAN 10: Environmental Impact Assessment; and
- DCAN 15: Vehicular Access Standards

The Regional Development Strategy – Shaping our Future

1.94 The Regional Development Strategy: Shaping Our Future 2025 (RDS) was finalised in September of 2001 and offers a strategic and long-term perspective on the future development of Northern Ireland up to the year 2025. The RDS addresses a range of economic, social, environmental and community issues and provides the spatial planning context for:

- Strengthening the competitiveness of the regional economy and tackling social and economic disadvantage.
- Protecting and enhancing the physical, natural and man-made assets of the region.
- Housing, transport, air and water quality, energy and waste strategies, and for infrastructure providers and public service promoters.
- Development plans and for guiding public and private investment decisions relating to land use.

1.95 The recurring theme of sustainability is dominant throughout the RDS. It is recognised that:

> "The effects of climate change will have implications for lifestyles and the form of development in the future. Strategic planning will be more cost effective than reacting to climate change impacts such as global warming and taking retrospective action."

1.96 This is reinforced in Policy SPG-ENV 5 which states that it wishes:

"To respond to the implications of climate change and promote more prudent and efficient use of energy and resources, and effective waste management".

1.97 This policy is split into a further four parts of which ENV 5.1 considers the implications of climate change and ENV 5.3 relates to the restraint of emissions of greenhouse gases by "the exploitation of renewable sources of energy and alternative energy technology".

1.98 Policy SPG-ENV 6 aims to "create healthier living environments and to support healthy lifestyles". Part 3 of ENV 6.1 ensures that "industrial emissions are minimised and effectively controlled and promotes more sustainable energy sources and a diversification of fuel supplies".

1.99 The main themes in the RDS with regard to the environment are:

- Protection of the environment (SPG-ENV 1).
- Protection of the natural environment including the coast (SPG-ENV 2).
- Conservation of the built environment (SPG-ENV 3).
- Wise use of the environment (SPG-ENV 5).
- Healthier living environment (SPG-ENV 6).
- Access to recreational and cultural amenities (SPG-ENV 7).
- Maintenance of a working countryside with a strong mixed use rural economy (SPG-RNI 1).

Shaping Our Future – Adjustments to the Regional Development Strategy – 2025

1.100 The purpose of this document is to set out the adjustments to the Regional Development Strategy (RDS) 2025 as a result of the first 5-year Review of the Strategy, which reflects the Executive's Programme for Government and re-emphasises the key objective to ensure that all parts of Northern Ireland share in sustainable, economic and social development which is equitable across the region. Adjustments were made to some of the Objectives, Strategic Planning Guidelines (SPGs), and the Supporting Actions of the SPGs as detailed below.

1.101 A number of SPGs were adjusted to reflect up-to-date policy and research on climate change and waste management and to meet obligations under the Habitats Regulations, (as described in Shaping Our Future – Adjustments to the RDS):

- SPG ENV 1 (1.1, 1.2) was adjusted to meet obligations under the Habitats Regulations and includes two new Supporting Actions (1.5 and 1.6);
- SPG ENV 2 (2.2) was adjusted to refer to the Water Framework Directive;
- SPG ENV 5 (5.1, 5.2, 5.3 and 5.4) was adjusted to reflect up to date policy and research on climate change and waste management by taking actions to reduce emissions of greenhouse gases by promoting the use of cleaner and more efficient fossil fuels and through the exploitation of renewable resources of energy;

- SPG ENV 6 (6.1) was updated to include reference to the Environment (NI) Order 2002; and
- SPG ENV 6 (6.2) was reallocated to SPG ENV 1 (1.5) and ENV 6 (new 6.5).

The Regional Development Strategy - Building a Better Future– 2035

1.102 The Regional Development Strategy – Building a Better Future 2035 is the spatial strategy of the Executive, which recognises the importance of Belfast and Londonderry in generating regional prosperity. The plan aims to deal with climate change as a key environmental and economic driver and complements the Sustainable Development Strategy.

1.103 Regional Guidance (RG) focuses on the 3 sustainable development themes of Economy, Society and Environment throughout the region and the main themes in relation to the environment;

- Deliver a secure and sustainable energy supply (RG5);
- Reduce our carbon footprint and facilitate mitigation and adaption to climate change whilst improving air quality (RG9);

1.104 The RDS considers Renewable Energy to be Regionally Significant Infrastructure Projects and highlights strengthening electricity grid and interconnection as key issues to facilitate increased renewable energy in line with the SEF ambitious 40% target.

Everyone's Involved: Sustainable Development Strategy - 2010

1.105 The Sustainable Development Strategy for Northern Ireland (2010) is intended to reinforce commitment to ensure that the principles of sustainability reach into all activities of Government. It aims to build a future characterised by economic prosperity, equality and social cohesion; strong confident communities and a high quality environment.

1.106 The Executive has set out a number of guiding principles that express the ambitions of the strategy. Two of these principles cover the overarching ambitions of the strategy:

- living within environmental limits; and
- ensuring a strong, healthy, just and equal society.

1.107 There are four further principles which describe the necessary conditions for the achievement of sustainable development:

- Achieving a sustainable economy.
- Promoting good governance.
- Using sound science responsibly.
- Promoting opportunity and innovation.

1.108 These six principles continue to echo those adopted by the previous Sustainable Development Strategy for Northern Ireland - First Steps towards Sustainability (2006).

1.109 The strategy focuses on six 'priority areas of action':

1. building a dynamic, innovative economy that delivers the prosperity required to tackle disadvantage and lift communities out of poverty;
2. strengthening society such that it is more tolerant, inclusive and stable and permits positive progress in quality of life for everyone;
3. driving sustainable, long term investment in key infrastructure to support economic and social development;
4. striking an appropriate balance between the responsible use and protection of natural resources in support of a better quality of life and a better quality of environment;
5. ensuring reliable, affordable and sustainable energy provisions and reducing our carbon footprint; and
6. ensuring the existence of a policy environment which supports the overall advancement of sustainable development in and beyond government.

1.110 Priority three is addressed by the Development. The proposed scheme is a driver for sustainable, long term investment which can support social and economic development. Further details are provided in **Chapter 13**. The Development also addresses priority five. There is a requirement to reduce the amount of fossil fuels needed and the proposed scheme addresses this.

A Planning Strategy for Rural Northern Ireland (PSRNI)

1.111 A Planning Strategy for Rural Northern Ireland, produced in 1993, sets out the factors that the Department takes into account when considering development proposals outside the Belfast urban area, and the adjacent towns of Carrickfergus, Bangor, and Londonderry.

1.112 The Strategy, "establishes the objectives and the policies for land use and development appropriate to the particular circumstances of Northern Ireland and which need to be considered on a scale wider than the individual District Council Area".

1.113 The Strategy has been reviewed and significantly updated with the introduction of various Planning Policy Statements (PPSs). However, the Strategy remains in force with respect to those topics not covered by PPSs for those areas outside of settlement development limits.

1.114 The strategic objectives of the PSRNI, set out as part of the planning strategy, include:

- To protect and enhance the natural and man-made environment.
- To meet the future development needs of the rural community.
- To facilitate regeneration of the rural economy.
- To accommodate change, while maintaining the character of the countryside.

- To revitalise rural towns and villages in order to make them more attractive places in which to live and work.
- To promote a high quality of design in new development.

1.115 Specific relevant policies contained within the PSRNI are discussed in **Chapter 13**, Socio-Economic and Tourism Assessment.

'Strategic Planning Policy Statement for Northern Ireland (SPPS): Planning for Sustainable Development'

1.116 Strategic Planning Policy Statement for Northern Ireland was introduced in September 2015.

1.117 It consolidates the twenty previous policy publications and sets out strategic subject polices on a wide range of planning matters including renewable energy in accordance with the Regional Development Strategy 2025.

1.118 The aim of the SPSS to plan for sustainable development is based on three overarching principles:

- Meeting the needs and aspirations of our society including supporting rural regeneration and progressing policies, plans and proposals that can improve the health and well-being of local communities;
- Economic sustainability including the promotion of recovery and balancing growth;
- Environmental sustainability including the protection and enhancement of heritage assets landscape and seascape character, ensuring that the planning system contributes to a reduction in energy usage and greenhouse gas emissions by continuing to support growth in renewable energy sources and promoting high quality development and good design.

1.119 In the renewable energy section, it is stated that Northern Ireland has significant renewable energy resources and a vibrant renewable energy industry that makes an important contribution towards achieving sustainable development and is a significant provider of jobs and investment across the region.

1.120 The main aim of the SPPS in relation to renewable energy is to facilitate the siting of renewable energy generating facilities in appropriate locations within the built and natural environment in order to achieve Northern Ireland's renewable energy targets and to realise the benefits of renewable energy without compromising other environmental assets of acknowledged importance.

1.121 The regional strategic objectives for renewable energy are to:

- ensure that the environmental, landscape, visual and amenity impacts associated with or arising from renewable energy development are adequately addressed;
- ensure adequate protection of the region's built, natural, and cultural heritage features; and

- facilitate the integration of renewable energy technology into the design, siting and layout of new development and promote greater application of the principles of Passive Solar Design.

1.122 The Regional Strategy Policy sets out the guidelines for how Local Councils should deal with renewable energy planning applications.

1.123 In addition, paragraph 5.72 of SPPS states *"Planning authorities should be guided by the principle that sustainable development should be permitted, having regard to the local development plan and all other material considerations, unless the proposed development will cause demonstrable harm to interests of acknowledged importance".*

Planning Policy Statements

1.124 Planning Policy Statements (PPS) set out the policies of the DOE on particular aspects of land use planning. Their contents are taken into account in preparing Development Plans and they are also material to decisions on individual planning applications and appeals. PPSs specific to assessments undertaken in this EIA addressed in those chapters.

PPS 1: General Principles

1.125 PPS 1 sets out the principal functions of DOE, namely, formulating planning policies, making development plans, and exercising control of development. It also highlights the key themes of sustainable development, mixed use, quality development and design that underlie DOE's approach to planning.

PPS 2: Natural Heritage

1.126 PPS 2 sets out the Departments planning policies for the conservation, protection and enhancement of our natural heritage. Natural heritage is defined as *"the diversity of our habitats, species, landscapes and earth science features"*. **Table 1.1** contains policies NH 1 to N H5 contained within PPS 2 and the relevant environmental topic of the ES.

Table 1.1: Policies NH 1 to NH 5 of PPS 2

Policy RE 1: Renewable Energy Developments *Applications for wind energy development will also be required to demonstrate all of the following:*	**Environmental/Technical Topic**
NH 1: European and Ramsar sites - International	Chapter 6: Ecology Appendix 6.8: Information to inform a Habitat Regulations Assessment
NH 2: Species protected by law	Chapter 6: Ecology Chapter 7: Ornithology Chapter 8: Fisheries
NH 3: Sites of nature conservation importance - National	Chapter 6: Ecology
NH 4: Sites of nature conservation importance - Local	Chapter 6: Ecology
NH 5: Habitats, species or features of natural heritage importance:	Chapter 6: Ecology Chapter 9: Geology and the Water Environment
NH 6: Areas of Outstanding Natural Beauty	Chapter 4: Landscape and visual

PPS 3: Access, Movement and Parking

1.127 PPS 3 (Revised) Access, Movement and Parking sets out the Department's planning policies for vehicular and pedestrian access, transport assessment, the protection of transport routes and parking. It forms an important element in the integration of transport and land use planning. It embodies the Government's commitments to the provision of a modern, safe, sustainable transport system, the improvement of mobility for those who are socially excluded or whose mobility is impaired, the promotion of healthier living and improved road safety. PPS 3 and PPS 13 should be read in conjunction with one another and both have been addressed in **Chapter 11**, Transport Assessment which has addressed this policy.

PPS 6: Planning Archaeology and the Built Heritage

1.128 PPS 6 Planning, Archaeology and the Built Heritage sets out the policies relating to the protection and conservation of archaeological remains and features of the built heritage.

1.129 Of particular relevance are Policies BH1, BH2, BH4 and BH11, which deal with the Preservation of Archaeological Remains of Regional Importance and their Settings, the Protection of Archaeological Remains of Local Importance and their Settings, Archaeological Mitigation and Development Affecting the Setting of a Listed Building respectively. **Chapter 5**, Archaeology and Cultural Heritage Assessment has addressed this policy.

PPS 13: Transportation and Land use

1.130 Planning Policy Statement, PPS 13 "Transportation and Land Use" has been prepared to assist in the implementation of the RDS. It will guide the integration of transportation and land use, particularly through the preparation of development plans and transport plans, prepared respectively by Causeway Coast & Glens BC and DfI Roads. It will also be a material consideration in dealing with individual planning applications and appeals. The main objective of PPS13 is to integrate planning and transport at the national, regional, strategic and local level and to promote "a modern, sustainable, safe transportation system which benefits society, the economy and the environment and which actively contributes to social inclusion and everyone's quality of life." **Chapter 11**, Traffic and Transport has addressed this policy.

PPS 15: Planning and Flood Risk

1.131 PPS 15 sets out policies to "minimise flood risk to people, property and the environment", emphasising on sustainable development and the conservation of biodiversity. **Chapter 9**, Geology and the Water Environment, has addressed these policies.

PPS 18: Renewable Energy

1.132 PPS 18 sets out policies for development that generates energy from renewable resources and that requires the submission of a planning application with the aim of *"facilitating the siting of renewable energy generating facilities in appropriate locations within the built and natural environment in order to achieve Northern Ireland's renewable energy targets and to realise the benefits of renewable energy."*

1.133 Of particular relevance is Policy RE 1 - Renewable Energy Development:

"Development that generates energy from renewable resources will be permitted provided the proposal, and any associated buildings and infrastructure, will not result in an unacceptable adverse impact on:

- public safety, human health, or residential amenity;
- visual amenity and landscape character;
- biodiversity, nature conservation or built heritage interests;
- local natural resources, such as air quality or water quality; and
- public access to the countryside.

1.134 **Table 1.2** indicates the details of Policy RE1 and the relevant ES chapter where these have been addressed.

Table 1.2: Policy RE1 of PPS 18

Policy RE 1: Renewable Energy Developments *Applications for wind energy development will also be required to demonstrate all of the following:*	**Environmental/Technical Topic**
(i) that the development will not have an unacceptable impact on visual amenity or landscape character through the number, scale, size and sitting of turbines.	**Chapter 4**: Landscape and Visual
(ii) that the development has taken into consideration the cumulative impact of existing wind turbines, those which have permissions and those that are currently the subject of valid but undetermined applications.	Cumulative impacts have been considered in the assessments contained in this ES.
(iii) that the development will not create a significant risk of landslide or bog burst.	**Chapter 9**: Geology and Water Environment
(iv) that no part of the development will give rise to unacceptable electromagnetic interference to communications installations; radar or air traffic control systems; emergency services communications; or other telecommunication systems.	**Chapter 3**: Design Evolution and Alternatives
(v) that no part of the development will have an unacceptable impact on roads, rail or aviation safety.	**Chapter 3:** Design Evolution and Alternatives **Chapter 11**: Traffic and Transport
(vi) that the development will not cause significant harm to the safety or amenity of any sensitive receptors (including future occupants of committed developments) arising from noise; shadow flicker; ice throw; and reflected light.	**Chapter 2**: Proposed Development **Chapter 10**: Noise **Chapter 12:** Shadow Flicker
vii) that above-ground redundant plant (including turbines), buildings and associated infrastructure shall be removed and the site restored to an agreed standard appropriate to its location.	Details on decommissioning are contained in **Chapter 2:** Proposed Development. The effects of decommissioning have been assessed in each ES topic.
viii) Any development on active peatland will not be permitted unless there are imperative reasons of overriding public interest.	**Chapter 6**: Ecology
For wind farm development a separation distance of 10 times rotor diameter to occupied property is recommended, with a minimum distance not less than 500 m, will generally apply.	**Chapter 3:** Design Evolution and Alternatives

Policy RE 1: Renewable Energy Developments *Applications for wind energy development will also be required to demonstrate all of the following:*	**Environmental/Technical Topic**
The supplementary planning guidance 'Wind Energy Development in Northern Ireland's Landscapes' will be taken into account in assessing all wind turbine proposals.	**Chapter 4**: Landscape and Visual

1.135 Policy RE1 of PPS 18 also states that "The wider environmental, economic and social benefits of all proposals for renewable energy projects are material considerations that will be given significant weight in determining whether planning permission should be granted." It is noted that in the High Court of Justice in Northern Ireland Judicial Review decision (Ref: 2013, NIQB 24), Mr Justice Treacy quashed the Planning Appeals Commission (PAC) decision to refuse planning permission for the proposed Mullaghturk wind farm near Draperstown, Co. Londonderry after identifying mistakes in the assessment of the socio-economic benefits of the proposed wind farm. Mr Justice Treacy stated *"I am persuaded that the Commissioners assessment of the socio-economic benefit is legally flawed".* He continued to say that *"On any showing in the context of this case such a figure (£350,000 on local rates and £3.5 million on local spend) would be not an insignificant contribution to the local economy and it is not apparent that this figure was fully grasped".*

1.136 The socioeconomic impacts (including beneficial impacts) of the Development are addressed in **Chapter 13**.

Best Practice Guidance to Planning Policy Statement 18 'Renewable Energy' (2009)

1.137 Best Practice Guidance to Planning Policy Statement 18 'provides advice and guidance on wind farms'. Guidance is provided on:

- technology of wind turbines;
- spacing of turbines;
- required infrastructure of a wind farm;
- operation and maintenance;
- wind resource;
- planning and specific issues;
- safety;
- proximity to roads and railways; and
- decommissioning and reinstatement.

Wind Energy Development in Northern Ireland's Landscapes - Supplementary Planning Guidance to PPS 18 (2010)

1.138 This Supplementary Planning Guidance accompanies Planning Policy Statement 18: Renewable Energy, and is based on the sensitivity of Northern Ireland's landscapes to wind energy development and contains an assessment of each of the 130 Landscape Character Areas (LCAs) in Northern Ireland by referencing the characteristics and values associated with each LCA.

1.139 Full details on the SPG to PPS18 are addressed in **Chapter 4**, Landscape and Visual.

PPS 21 Sustainable Development in the Countryside (2010)

1.140 PPS 21 aims to, "Manage development in the countryside in a manner consistent with achieving the strategic objectives of the Regional Development Strategy for Northern Ireland 2025".

1.141 The policy provisions of PPS 21 will take precedence over many of the provisions of 'A Planning Strategy for Rural Northern Ireland'.

Objectives of PPS 21 include:

- Manage growth in the countryside to achieve appropriate and sustainable patterns of development that meet the essential needs of a vibrant rural community.
- Conserve the landscape and natural resources of the rural area and to protect it from excessive, inappropriate or obtrusive development and from the actual or potential effects of pollution.
- Facilitate development necessary to achieve a sustainable rural economy; including appropriate farm diversification and other economic activity.
- Promote high standards in the design, siting and landscaping of development in the countryside.

1.142 Of particular relevance is Policy CTY1 which relates to development in the countryside and states that there are a range of types of development which in principle are considered to be acceptable in the countryside and that will contribute to the aims of sustainable development. Other types of development will only be permitted where there are overriding reasons why that development is essential and could not be located in a settlement, or is otherwise allocated for development in a development plan. These exceptions include renewable energy developments in accordance with PPS 18.

1.143 Policy CTY 1 -Development in the Countryside:

"There are a range of types of development which in principle are considered to be acceptable in the countryside and that will contribute to the aims of sustainable development... Other types of development will only be permitted where there are overriding reasons why that development is essential and could not be located in a settlement, or it is otherwise allocated for development in a development plan...Planning permission will be granted for non-residential development in the countryside in the following cases…renewable energy projects in accordance with PPS18".

Local Policy

Northern Area Plan 2016

1.144 The Northern Area Plan 2016 was adopted by the Department in accordance with the provisions of Part II of the Planning (NI) Order 1991 in 22nd September 2015. The Plan was formulated in the context of the strategic and regional planning policy framework provided by Planning Policy Statements and the Department's document "A Planning Strategy for Rural Northern Ireland".

1.145 Planning powers were transferred from the Department to Council in April 2015, however, the legislative powers to allow the Department to adopt the Northern Area Plan 2016 were retained by the Department. The Northern Area Plan 2016 becomes the local development plan for the Council area until the Council adopts its own Local Development Plan, which is at the Preferred Options Paper stage.

1.146 The key objectives of the Northern Area Plan include:

- To facilitate and promote sustainable development throughout the Northern Plan area in accordance with the Regional Development Strategy;
- To promote the continued development of Coleraine and Limavady as main hubs, and Ballymoney and Ballycastle as local hubs, consistent with their identified roles in the Regional Development Strategy;
- To consolidate and sustain small towns and villages as important rural service centres, in accordance with the Regional Development Strategy;
- To provide opportunities for single houses or small groups of houses and small scale economic and community development that act as a focal points for the local rural community;
- To allocate land for housing development within settlements consistent with the Regional Development Strategy;
- To identify land for housing development, including social housing, at locations that will create compact and more sustainable settlements, with preference for sites within the urban areas;
- To promote development that enhances the character and identify of existing settlements, avoids urban sprawl and protects the countryside;
- To facilitate economic development and the creation and maintenance of employment, consistent with the Anti-Poverty and Social Inclusion Strategy;
- To promote the vitality and viability of town centres;
- To improve access to, and the range of employment, commercial, health, education and community services;
- To promote the integration of public transport, cycle and footpath networks and new development, in order to ease congestion, reduce

dependence on the private car, and encourage the use of more sustainable forms of travel, particularly walking and cycling;

- To protect and enhance the coastline, river corridors, mountains and other natural and man-made environs in terms of their character, quality and biodiversity;
- To promote equality of opportunity between persons and groups identified under Section 75 of the Northern Ireland Act 1998 and good relations between persons of different religious beliefs, political opinion or racial groups.

1.147 In addition:

- The Plan proposals constitute considerations that will be taken into account in determining planning applications within the Plan Area. The contents of the contents of the Plan must be read as a whole as often several designations, policies and proposals may be relevant to a particular development proposal.
- Section 6(4) of the Planning Act (Northern Ireland) 2011 provides, ‘Where in making any determination under this Act regard is to be had to the local development plan, the determination must be made in accordance with the plan unless material considerations indicate otherwise’.
- The contents of the Plan must therefore be read in conjunction with the relevant contents of regional planning policy publications, supplementary planning guidance documents and with policy publications of other Government Departments.

The Need for the Development

1.148 A key policy driver for the development of renewable energy in Northern Ireland is the need to increase security of supply. There are also potential adverse impacts on local populations and the economy through high volatile fuel costs, contributing to fuel poverty and high energy costs for businesses and industry. In addition, increasing focus on renewable energy can deliver environmental and climate change gains, reductions in carbon emissions, as well as investment and employment opportunities. With a lack of indigenous fossil fuel and no nuclear power stations, Northern Ireland is keen to develop the full range of its available renewable energy resources to optimise the contribution that renewables make to the overall energy mix.

1.149 Northern Ireland’s current renewable energy target is that 40% of electricity consumption should be met from renewable sources by 2020 (DETI 2010). Figures from the Department for the Economy show that between April 2018 and March

2019, 38.6%[4] of NI electricity was generated by renewable sources located in Northern Ireland and 83% was generated from wind energy.

1.150 If approved, the proposed Magheramore Wind Farm could account for up to 21.6 MW, a material contribution to renewable energy production in Northern Ireland. This is the equivalent of approximately 22,000 homes based on an output of 21.6 MW.[5]

1.151 The Development is a 21.6 MW wind farm consisting of six x 3.6 MW turbines. The amount of electricity that could be produced by the Development is estimated at 87 gWh per year which is enough electricity to meet the needs of 22,700 homes each year.[6] This is equivalent to 40.6 percent of the housing stock in Causeway Coast and Glens Borough Council area.[7]

1.152 The Development is also estimated to reduce CO_2 emissions by 40,000 tonnes each year. This equivalent to 25,200 newly registered cars.[8]

1.153 It is also important to highlight that energy production is not static and additional renewable generation will be required to be connected to maintain the NI targets and subsequently achieve and maintain the UK renewable targets. Therefore, it is imperative that we maximise the production of electricity from renewable sources in suitable locations such as Magheramore, which with an estimated connection date of 2022/2023, can make an important contribution to Northern Ireland and the UK meeting and maintaining their respective renewable targets.

Summary

1.154 The identified documents are considered relevant and form material considerations to this application for planning consent for the Development. The relevant policies have been assessed in the various chapters of this EIA to determine that the proposed development is in compliance with the relevant policies and their objectives. Where the assessment has found that there may be any likely significant environmental effects mitigation measures to reduce or remove such impacts have been suggested.

1.155 The theme of sustainable development is recurrent in the above-mentioned documents and it is recognised that differing interests must be reconciled so that conservation and development is integrated through a mix of coordinated

[4] https://www.economy-ni.gov.uk/news/electricity-consumption-and-renewable-generation-northern-ireland-year-ending-march-2019

[5] The 22,000 homes equivalent has been calculated by taking the predicted annual electricity generation of the site (based on RES assessments has predicted capacity factor of 46% - based on the 3.6MW turbine) and dividing this by the annual average electricity consumption figures from the Department of Business, Energy and Industrial Strategy (BEIS) showing that the annual UK average domestic household consumption is 3828 kWh (2018).

[6] For Magheramore, a load fact of 0.46 was provided by RES and applied to Oxford Economics' calculations. This load factor allows us to account for wake and electrical losses using typical wind speeds/directions etc. to give a realistic prediction of electricity output (rather than using a theoretical maximum level whereby it is assumed that wind blows for 24 hours a day 365 days a year on every wind farm site.)

[7] Oxford Economics Internal Model Suite.

[8] https://www.gov.uk/government/publications/new-car-carbon-dioxide-emissions

economic, environmental and social measures. The documents outline that there is clear government policy support for the Development, as outlined in the Strategic Energy Framework (2010) and the recent Directive 2009/28/EC.

1.156 The Development, which will generate electricity from renewable resources, is the result of an extensive EIA process. This process has sought to minimise environmental impacts and will not result in an unacceptable adverse impact, in accordance with Policy RE1 – Renewable Energy Development.

Commenting on the ES

1.157 An electronic version of the reports supporting the application, including the ES, will be available to download free of charge from http://www.magheramore-windfarm.co.uk

1.158 Copies of the ES can be obtained at a cost of £50 from the address below:

RES Ltd
Willowbank Business Park
Willowbank Road
Millbrook
Larne
BT40 2SF
Email: garth.mcgimpsey@res-group.com
Phone: 028 2844 0580

1.159 The application documentation is also available for public inspection (and CD copies available free of charge) at the following address during normal opening hours:

Dungiven Library
107 Main Street
Dungiven
County Londonderry
BT47 4LE
Phone: 028 7774 1475

List of References and Figures

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Figures

Figure 1.1: Site Location

Figure 1.2: Planning Application Boundary

2

Proposed Development

2 Proposed Development

Introduction

Site Description

2.1 The Proposed Magheramore Wind Farm, hereafter referred to as 'the Development' is located on privately owned agricultural lands. The main wind farm site is located approximately 4 km south of Dungiven, Co. Derry/Londonderry.

Proposed Development

2.2 The Development comprises 6 three-bladed, horizontal axis wind turbines, each up to a maximum of 149.9 m to tip height, with a total installed capacity of up to 21.6 MW. The Development would include a newly created site entrance, access tracks, crane hardstandings, control building and substation compound, electricity transformers, underground cabling, energy storage containers and drainage works. During construction there would be a number of temporary works including a temporary enabling works compound, construction compound with car parking, temporary parts of crane hardstandings and welfare facilities.

2.3 The Planning Application Boundary (red line boundary) is shown on **Figure 1.2**. This boundary contains the main wind farm site, including positions of the turbines and associated infrastructure, with 50 m micro siting. The Planning Application Boundary lies fully within Land under the Applicant's Control (blue line boundary), as shown in **Figure 1.2.** The measures contained in the Outline Habitat Management Plan (Appendix 6.4) are contained within the blue line boundary.

2.4 A detailed plan of the Development showing the position of the turbines and other infrastructure is shown on **Figure 2.1**: **Infrastructure Layout**.

2.5 This chapter provides a description of the physical characteristics of the Development for the purpose of identifying and assessing the main environmental impacts of the proposal.

2.6 In this chapter to differentiate between land take and infrastructure that will be present for the wind farm life time, and land take and infrastructure which is only required for short term works during the construction period, the term 'permanent' is used to describe the former and 'temporary' used to describe the latter. However, it should be noted that the Development would have a temporary operational lifetime of approximately 30 years from the date of commissioning, after which the above ground infrastructure would be removed, and the land remediated. Therefore, the effects are largely long-term temporary as opposed to permanent.

2.7 Planning permission is being sought for the Development comprising the following:

- 6 three-bladed horizontal axis wind turbines of up to 149.9 m tip-height
- Turbine foundations
- Hardstanding areas at each turbine location for use by cranes erecting and maintaining the turbines
- Electricity transformers
- Approximately 2.2 km of new access track and 2.1 km of upgraded access track
- Wind farm substation compound containing a control building
- Energy Storage Containers
- On-site electrical and control network of underground (buried) cables
- Connection from the substation to the local grid network
- Temporary construction compound
- Permanent and temporary drainage works
- Associated ancillary works
- Temporary enabling works Compound
- New site entrance from the public road.

Site Layout and Flexibility

2.8 Although the design process and evolution seek to combine environmental and economic requirements, the Applicant would nevertheless wish some flexibility, where necessary, in micro siting the exact positions of the turbines and routes of on-site access tracks and associated infrastructure (50 m deviation in plan from the indicative design). Any repositioning would not encroach into environmentally constrained areas. Therefore, 50 m flexibility in turbine positioning would help mitigate any potential environmental effects: e.g. avoidance of unfavourable ground conditions or archaeological features not apparent from current records. See **Figure 2.1: Infrastructure Layout** for details.

Land Take

2.9 The turbines need to be spaced a suitable distance apart (considering the prevailing wind direction), so as not to interfere aerodynamically with one another (creating array losses). The actual land developed is limited to the substation, wind turbine towers, transformers, permanent crane hardstandings, energy storage hardstanding and the access tracks, which account collectively for about 7.63 % of the total area within the Planning Application Boundary.

2.10 The area of infrastructure created following construction of each turbine (including temporary areas) will be approximately 1647 m². Of this, approximately 630 m^2 would be temporary hardstanding (see **Table 2.1** under crane pads and laydown areas). The turbine foundation formation level is approximately 25 m diameter in area and 3.5 m below ground level. The walls of the excavation will be battered to approximately 1:1, yielding a ground level excavation area of approximately 32 m diameter.

2.11 The excavation area around each turbine is significant in terms of both its scale and duration of the works and as such requires consideration. Ancillary excavation works and material storage around other parts of development, such as those for cable trenching, would have a negligible impact on environmental receptors due to the very minor scale of the excavation, or duration of the works and are not considered further in the ES.

2.12 Following completion of the turbine installation, the permanent hardstanding would be approximately 189 m^2 at each turbine site, which includes the concrete plinth to which the steel tower is attached, and a 5 m wide maintenance track/path around the base of the turbine (**Figure 2.12**). The external transformer (if required) would take an additional 28 m^2 of land at each turbine. The completed foundation is covered with soil approximately 1.5 m deep, leaving only the concrete plinth exposed at ground level, to which the steel tower is attached. Movement of livestock around the tower would be unrestricted.

2.13 Additionally, crane hardstanding areas would be constructed adjacent to each wind turbine. **Figure 2.13** shows the general hardstanding arrangement at each turbine. The permanent hardstanding of each turbine for the life of the Development is 800 m^2, with a temporary hardstanding of 630 m^2 during construction, if required by the final choice of turbine supplier. If constructed, the temporary hardstanding areas would be reinstated following construction.

2.14 The Development would result in the construction of approximately 2.2 km of new track and 2.1 km of upgraded access track. The running width of the track would be 4.5 m on straight sections, with 0.25 m wide shoulders on each side, totalling 5 m. The permanent hardstanding area for the new track would be approximately 12,168 m^2, plus 10,205 m^2 of upgraded access track, totalling 22,373 m^2.

2.15 The total area taken up by the control building and associated infrastructure is expected to be 1,436 m². This is to include the building, rear compound, all associated welfare, access and parking (**Figure 2.3**).

2.16 A temporary construction compound (**Figure 2.10**) measuring 2430 m^2 will be constructed. On completion of the wind farm construction, 1,056m2 of temporary construction compound will be utilised permanently for Energy Storage and the remaining 1,374m2 will be reinstated to their original form following construction.

Table 2.1 - Summary of Temporary and Permanent Hardstanding

Wind Farm Element	Temporary hardstanding[1] in m^2	Permanent Hardstanding[2] in m^2
Turbines and transformer pads	N/A	226 per turbine = 1,356
Crane pads and laydown areas	630 per turbine = 3,780	800 per turbine = 4,800
On-site access tracks (new)	N/A	12,168 m^2
On-site access tracks (upgraded)	N/A	10,205 m^2
Control building & substation compound with permanent hardstanding	N/A	1,724
Construction Compound / Energy storage hardstanding	1,374	1,056
Enabling Works Construction compound	400	N/A
Total hardstanding in m^2	**5,554**	**31,309**
Total Hardstanding in ha	**0.55 ha**	**3.13 ha**
Total Hardstanding as % of total area within the Planning Application Boundary (41.01ha).	**1.35%**	**7.63%**

2.17 Thus, in summary, the Development would require approximately 3.13 ha of hardstanding lasting throughout the life of the project of this 1.02 ha is existing infrastructure upgraded. An estimated further 0.55 ha would be occupied by hardstanding on a temporary basis.

Habitat Management

2.18 An Outline Habitat Management Plan (HMP) has been developed to enhance habitats on site. Please see **Chapter 6: Ecology**, for further details.

Project Description

Wind Turbines

2.19 The wind turbine industry is evolving at a remarkable rate. Designs continue to improve technically and economically. The most suitable turbine model for a particular location can change with time and therefore a final choice of machine for the Development has not yet been made. The most suitable machine will be selected before construction, with a maximum tip height of 149.9 m.

[1] Temporary hardstanding: this refers to ground which will be occupied by hardstanding / built structures during the construction of the Development. However, once the Development has been constructed this land will be reinstated and available for grazing.

[2] Permanent hardstanding: this refers to ground which will be occupied by hardstanding / built structures throughout the lifetime of the Development.

2.20 For visual and acoustic assessment purposes, the most suitable candidate turbine available in the market place (currently of 3.6 MW nominal capacity and with an overall tip height of 149.9 m) has been assumed. Most of the dominant wind turbine manufacturers are now producing turbines that are classed as suitable for the wind regimes typical of Northern Ireland and many are also producing turbines that meet the up to 149.9 m tip height specification being suggested for the Development. Exact tower and blade dimensions vary marginally between manufacturers. A diagram of a typical 149.9 m tip height turbine is given in **Figure 2.2.**

2.21 Turbines begin generating automatically at a wind speed of around 3 to 4 metres per second (m/s) and have a shut-down wind speed of about 25 m/s. It is proposed to install infrared lighting on a turbine(s) in a pattern that is acceptable to the Ministry of Defence (MoD) for aviation visibility purposes. Infrared lighting allows military aircraft with night vision capability to detect and avoid wind farms. Infrared lighting cannot be detected with the naked eye, thereby reducing visual impact.

2.22 Each turbine would have a transformer and switchgear. The transformer's function is to raise the generation voltage from approximately 690 volts to the higher transmission level that is required to transport the electricity into the grid. Depending on the turbine supplier, the transformer and switchgear may be located inside or outside each turbine.

Foundations and Hard Standing

2.23 The wind turbines would be erected on steel re-enforced concrete foundations. It is anticipated that the foundations would be of gravity base design, but there may be the requirement to use piled foundations where ground conditions dictate. Final base designs will be determined after a full geotechnical evaluation of each turbine location. **Figure 2.12** provides an illustration of a typical gravity base wind turbine foundation design.

2.24 During the erection of the turbines, crane hardstanding areas would be required at each turbine base **(Figure 2.13).** Typically, these consist of one main permanent area of 800 m^2 adjacent to the turbine position, where the main turbine erection crane will be located. The other areas, totalling 630 m^2, will be temporary and used during the assembly of the main crane jib. The hardstanding will be constructed using the same method as the excavated access tracks. This involves the topsoil being replaced with suitable structural fill to finished level.

2.25 After construction operations are complete, the temporary crane pad areas, shown on **Figure 2.14**, will be reinstated. There will be a requirement to use cranes on occasion during the operational phase of the Development, so the main crane hardstanding (800 m^2) will be retained to ease maintenance activities. This approach complies with current best practice guidance[3] which recommends crane hardstandings are left uncovered for the lifetime of the Development.

Site Tracks

2.26 The on-site access track layout has been designed to minimise environmental disturbance by maximising the use of upgraded site track and avoiding sensitive habitats where possible and keeping the length of track commensurate with the minimum required for operational safety. The track route also takes cognisance of the various identified environmental constraints. Approximately 2.2 km of new access tracks and 2.1 km of upgraded access tracks are proposed to access the various turbine locations totalling approximately 4.3 km in length. Typical access track designs are shown in **Figure 2.10**.

2.27 The number of watercourse and drainage crossings has been minimised through the principle of avoidance at the layout design stage, and several culverts have been sited to coincide with existing culverts which will be upgraded. Proposals submitted in conjunction with this assessment indicate:

- Two crossings of a significant watercourse (Stream C and tributary), both at locations where an existing culverted track exists.
- Seven crossings of minor watercourses, the majority of which comprise existing track-side drains.

2.28 Culverts will be designed to accommodate track crossings and minimise length of affected channel to comply with Revised PPS15 policy FLD4. An example of the watercourse crossing design is shown in **Figure 2.16**.

2.29 For more detail please see **Chapter 8**: **Fisheries** and **Chapter 9: Geology and the Water Environment**,

Electrical Connection

2.30 Assuming the use of the currently available models, each wind turbine would generate electricity at 690 V and would have an ancillary transformer located either within or outside the base of the tower to step up the voltage to the required on-site distribution voltage. Each turbine would be connected to any adjacent turbines by underground cables.

2.31 The wind farm substation is proposed to be located on the central part of the site as shown in **Figure 2.1: Infrastructure Layout**. All power and control cabling on the wind farm will be buried underground in trenches located, where possible, along the route of site access tracks. These trenches will be partially backfilled with topsoil. The vegetation soil tuft will be stripped and laid beside the trench

[3] SNH, Scottish Renewables, SEPA and the Forestry Commission Scotland (2010) "*Good Practice during Wind Farm Construction*"

and used to reinstate the trench to the original ground level immediately after the cables have been installed.

2.32 The connection of wind farms to the electrical grid typically follows a separate consenting process and it is normally the responsibility of the network operator to progress the relevant consent, where required. The Best Practice Guidance to PPS 18 states that whilst the routing of such lines by Northern Ireland Electricity (NIE) is usually dealt with separately to the application for the wind farm, developers will generally be expected to provide details of indicative routes and method of connection. The exact means of grid connection is unknown at the time of writing but based on RES's knowledge of the grid connection system and NIE's published plans for future grid upgrades, RES has been able undertake an assessment to determine the grid connection option most likely favoured by NIE.

2.33 RES considers connection to the grid system via a combination of overhead line and underground cables following the public road to the proposed Agivey Cluster Substation as the most likely option. Although not a part of the planning application for the Development, proposed grid connection route is illustrated, and the environmental effects have been assessed and these are presented in **Appendix 2.1**.

RES Control Building & Substation Compound and Energy Storage

2.34 The control building will be designed and constructed to the standard required by NIE for the accommodation of substation equipment. Where possible, local building materials and finishes will be used to ensure that the appearance is in keeping with other buildings in the area.

2.35 The control building and substation compound will contain power quality improvement equipment, including up to two auxiliary transformers. The control building will accommodate metering equipment, switchgear, the central computer system and electrical control panels. A spare parts store room, and welfare facilities will also be in the control building. The building will be attended by maintenance personnel on a regular basis.

2.36 Following an assessment of foul treatment options through a review of Pollution Prevention Guidelines 4, it was determined that both the toilet, wash hand basin and sink should drain to a small package treatment plant located adjacent to the control building, which would follow the Controlled Activities Regulations (CAR) guidelines and be constructed and located in accordance with the relevant Building Standards and agreed with the Council.

2.37 A permanent external environmental waste storage area will be provided with a minimum of 6 m clearance from the buildings. The area will consist of a concrete plinth surrounded with a palisade fence and double gate.

2.38 Four permanent containers housing energy storage devices, inverters and other ancillary equipment will be positioned adjacent to the control building and substation compound on hardstanding used originally for the temporary construction compound. These units are a means of storing electrical energy just like a rechargeable battery, cell phone or electric car. These are means by which power can be stored and released. The application is of course of a larger scale, but the basic principle is the same.

2.39 One of the basic roles of energy storage is to act as a power reserve, when electricity generation drops below demand. This reserve capacity can be called on at a moment's notice to enable the necessary balancing of the emerging low carbon electrical system.

2.40 Another example of the flexibility services that energy storage could provide includes distribution, reinforcement and deferral services. These enable existing electrical network assets such as substations and overhead lines to have their capacity increased without the need for building new grid infrastructure.

2.41 All of these uses of energy storage involve charging a battery system with electricity, storing electricity for a period, or discharging electricity. Ultimately the proposed development will make a valuable contribution to a secure, low carbon and affordable electrical system.

Description of Access

2.42 The proposed access route for the delivery of large turbine components, known as abnormal indivisible loads (AILs), is shown in **Figure 11.1 – Turbine Delivery Route**. The site entrance is directly accessed off the Magheramore Road. Depending on the port of delivery vehicles could potentially access the site from the west (Lisahally Port) via Derry or from the east (Belfast Port) via Dungiven.

2.43 **Appendix 11.1** shows a swept path analysis of all points along the turbine delivery route that require either overrun or oversail beyond the road edge.

2.44 Normal HGV load delivery routes (including stone and concrete) will utilise the Banagher and Carnanbane Roads from the Feeny Road and / or the Magheramore Road, with sources of material to be confirmed prior to construction. No passing bays will be required as the roads are largely two way with adequate passing bays located where the road is narrower to accommodate traffic to and from the existing quarry on the Magheramore Road.

2.45 At the end of the construction period and in consultation with DfI Roads, any reinstatement required to any street furniture which may be removed on a temporary basis will be undertaken. In the unlikely event that a replacement blade is required during the operational phase of the wind farm, any works will be undertaken following consultation with DfI Roads.

2.46 Further details are in **Chapter 11: Traffic and Transport**.

Typical Construction Activities

2.47 Prior to commencement of construction, detailed method statements will be prepared to address best practice working methods. As a minimum, the following best practice construction methods will be adhered to:

- Where possible and in order to minimise impacts of earthworks, excavations will be kept to a minimum with granular material being reused where appropriate
- Consideration will be given to weather conditions when stripping soil. For example, during periods of heavy rain (>25 mm in 24 hours), significant snow event (>75 mm lying) or an extended period of freezing conditions (ground penetration >100 mm), soil stripping works will be reviewed to take in account any adverse weather conditions and where deemed applicable, works will cease until site conditions prevail that are compatible with this activity
- Vegetated turves shall be stripped and stockpiled separately prior to excavation of topsoil/peat in all work areas
- Vegetated turves will be reused as quickly as possible
- Excavations will be monitored for changing soils types to prevent cross mixing of soils in stockpiles
- Topsoil shall be stripped and stored carefully for use in reinstatement works, which shall be carried out as soon as possible after sections of work are complete. Topsoil will be stripped prior to excavation of subsoil in all work areas
- Any remaining subsoil will be excavated down to a suitable bearing stratum and set-aside for later use in landscaping, backfilling around structures and verge reinstatement
- Reinstatement will be ongoing as the works are constructed to minimise the amount of time in which any material will be stockpiled
- Where required, all stockpiled material will be sited in areas with shallow peat depths, negligible peatslide risk and avoiding all 50 m watercourse buffer zones, ecological and cultural heritage constraints
- All stockpiles shall be shaped to promote run-off. Detailed SUDS drainage and silt control methods shall be designed for each stockpile
- Additionally, a “toolbox talk” will be provided by the site management team to highlight possible events causing slope instability and provide guidance on best practice when operating in areas of peat and/or increased slopes. In addition, a workforce engagement event shall be performed at least once for the project and shall be organised by the project team and be attended by RES and project contractor’s workforce. The event will set and

communicate the required safety culture and working practices for the project.

Construction of Temporary Enabling Works Compound

2.48 A temporary enabling works compound will be located on the site, as illustrated in **Figure 2.1: Infrastructure Layout** and will provide facilities until the Temporary Construction Compound is insitu**.** Details of the temporary enabling works compound layout are included in **Figure 2.17.** The compound will include the following:

- Temporary gatehouse for monitoring of incoming vehicles and welfare facilities
- - Self-contained toilets with provision for waste storage and removal
- - Containerised storage areas for tools, small plant and parts
- - An area for limited site vehicle parking

2.49 Once the Temporary Construction Compound is completed the enabling works compound will be used primarily as a gatehouse for the monitoring of incoming vehicles. On completion of the construction work these facilities will be removed and will be reinstated.

2.50 The location of the temporary enabling works compound has been selected for reasons of safety and security. The proposed temporary enabling works compound area will be constructed by top soil excavation in a similar manner to the access tracks, laying stone over a geotextile membrane.

2.51 During construction, temporary fencing will be erected, around the enabling works construction compound. This is illustrated in **Figure 2.17.**

Access Tracks

2.52 The access track itself will be constructed of inert material of suitable grade to withstand the expected traffic loading. Road construction techniques and roadside ditches will be designed to minimise the effect on natural hydrology as much as possible.

2.53 The depths of the ditches will be kept to the minimum required for free drainage of the road. Individual drain lengths will be minimised to avoid significant disruption of natural drainage patterns and avoid accumulation of large volumes of water within an individual drain.

2.54 Drains will not directly flow into watercourses, but into a buffer zone. Buffer zones are used to allow filtration of suspended solids in the water and reduction of runoff velocities. This reduces the flashiness of response, encourages deposition of sediments and allows pollutants to be filtered out.

Construction of Temporary Compound and Energy Storage

2.55 A temporary construction compound will be located on the site, as illustrated in **Figure 2.1: Infrastructure Layout.** Details of the temporary compound layout are included in **Figure 2.10.** The compound will include the following:

- Temporary portable cabins for office accommodation, monitoring of incoming vehicles and welfare facilities
- - Self-contained toilets with provision for waste storage and removal
- - Containerised storage areas for tools, small plant and parts
- - An area for site vehicle parking and storage of larger material items
- - A standing and turning area for vehicles making deliveries to the site
- - A bunded area for storing fuels, oils and greases.

2.56 On completion of the construction work these facilities will be removed and the areas not being used for energy storage will be reinstated.

2.57 The location of the temporary compound has been selected to avoid environmental constraints and for reasons of security, practicality and to obtain suitable ground conditions. The proposed temporary compound area will be constructed by top soil excavation in a similar manner to the access tracks, laying stone over a geotextile membrane.

2.58 During construction, temporary fencing will be erected as required, around the construction compound. This is illustrated in **Figure 2.11.**

2.59 On completion of the construction phase work on the wind farm, 1,436m2 of the temporary construction compound will be removed and reinstated to agriculture with the remaining 1,056m2 utilised for Energy Storage devices.

2.60 The Energy Storage will comprise four permanent containers housing energy storage devices, associated inverters and ancillary equipment. Permanent fencing will enclose the containers. These are illustrated in **Figure 2.6: Energy Storage Layout Plan** and **Figure 2.7: Energy Storage Elevation.**

Sustainable Drainage System

2.61 The drainage measures and Sustainable Drainage System (SuDS) designs have been directed by recommendations in **Chapter 9: Geology and Water Environment**

2.62 The runoff drainage system will be designed to mimic natural conditions to mitigate against increased flashiness in water courses and reduced groundwater recharge. The SuDS will protect the status of water courses and ground waters. A proposed SuDS Design Statement is included within the Water Framework Directive Assessment in **Appendix 9.1.**

2.63 Construction will be carried out according to Department of Agriculture, Environment & Rural Affairs (DAERA) and Construction Industry Research and Information Association (CIRIA) guidance for site works. Pollution control measures during the construction phase will be included in the Construction & Decommissioning Method Statement (CDMS), which will be agreed with Causeway Coast & Glens BC before starting construction work on site.

2.64 Mitigation measures to minimise the hydrological effect of constructing the access tracks have been proposed in **Chapter 9: Geology and Water Environment** of this ES.

Crane Hardstanding Construction

2.65 **Figure 2.13** shows the crane hardstanding layout configuration in plan. The hardstanding would be constructed using the same method as the excavated access tracks. This involves the topsoil and subsoil being replaced with imported stone, ensuring an adequate bearing capacity has been achieved to carry the anticipated loads. The final position of the hardstanding would be decided at detailed design stage and prior to construction and shall be based on a number of considerations, including; size of crane required, depth of excavation required, hydrological/ecological features in the vicinity, local topography (it is preferable to position the crane hardstanding on the same level, or higher level to the turbine foundation level since this eases lifting operations).

Turbine Foundation Construction

2.66 The turbine towers are fixed to a concrete foundation. The foundation proposed in **Figure 2.12** comprises a gravity base design. Each foundation typically consists of a tapered octagonal block of concrete, and formation will be approximately 3.5 m below ground level. The volume of concrete used to make each foundation is approximately 500 m^3, which is reinforced by approximately 50 tonnes of steel bar. The depth of the foundation varies for each turbine location according to the depth to suitable formation level. The excavation area for each foundation will be approximately 650 m^2. The foundation is typically poured in two parts, with a suitable construction joint between them. This will be detailed in the CDMS. Following the pouring and curing of the concrete, the foundation is backfilled with material which is initially excavated and meeting the density requirements, leaving only the tower plinth, typically 4.5 m – 5.5 m diameter, sitting at ground level. Surplus excavated material will be stored in appropriate areas as identified in the Figure 6 - Peat Spoil Management Plan of the Phase 1 Geotechnical Study as provided in **Appendix 9.3**. Further details will be produced as part of CDMS prior to construction.

2.67 The exact quantities of concrete, reinforcement, depth and dimensions will vary on the final choice of turbine model. In the detailed pre-construction design of each foundation, geotechnical tests are carried out to determine the strength of the subsoil layers beneath the turbines and the soil behaviour under loading over time. This information is used to confirm a final design and incorporates factors for safety.

2.68 An earthing mat or electrode consisting of up to three interconnected concentric rings of bare stranded copper conductor is laid around the foundation of each tower and transformer, approximately 0.5 m below the finished ground level. In addition, earthing rods padded by bentonite (a water retaining clay mineral) are required at set locations around the foundation, and are positioned vertically below the earth mat. The number of rods and length is dependent upon the electrical resistivity of the soil which is confirmed during the site investigation, prior to construction.

2.69 Sulphate resistant cement, or higher cement content, within the concrete will be used if the site is identified to have waters with potentially low pH. This is so that they do not have a corrosive effect on turbine bases.

Wind Turbine Erection

2.70 Wind turbine towers, nacelles and turbine blades will be transported to the site as abnormal loads as described in **Section 2.43**. The tower sections and other turbine components will be stored at each turbine hardstanding until lifted into position.

2.71 The components would be lifted by adequately sized cranes and constructed in a modular fashion. Assembly, in general requires only fixing of bolts, torquing of nuts and electrical and hydraulic connections.

Cabling, Substation and Control Building

2.72 The location of the substation and control building is shown in **Figure 2.1: Infrastructure Layout**. Layout and elevation drawings for these buildings are presented in **Figures 2.3, 2.4** and **2.5**. All cabling between the turbines and the substation on the site will be connected using underground trenched cables. Where excavated, the top layer of soil will be removed and used to reinstate the excavation following the installation of the cables. Where cables are being laid in areas of peat, the various different layers will be separated and replaced appropriately. Cabling would generally run parallel to the adjacent site tracks. **Figure 2.14** presents a typical underground cable cross-section. In addition, and to ensure that the cable trench does not act as a preferential drain, impermeable bunds will be installed perpendicular to the cable direction at suitable intervals (considering local ground conditions and topography).

Re-instatement

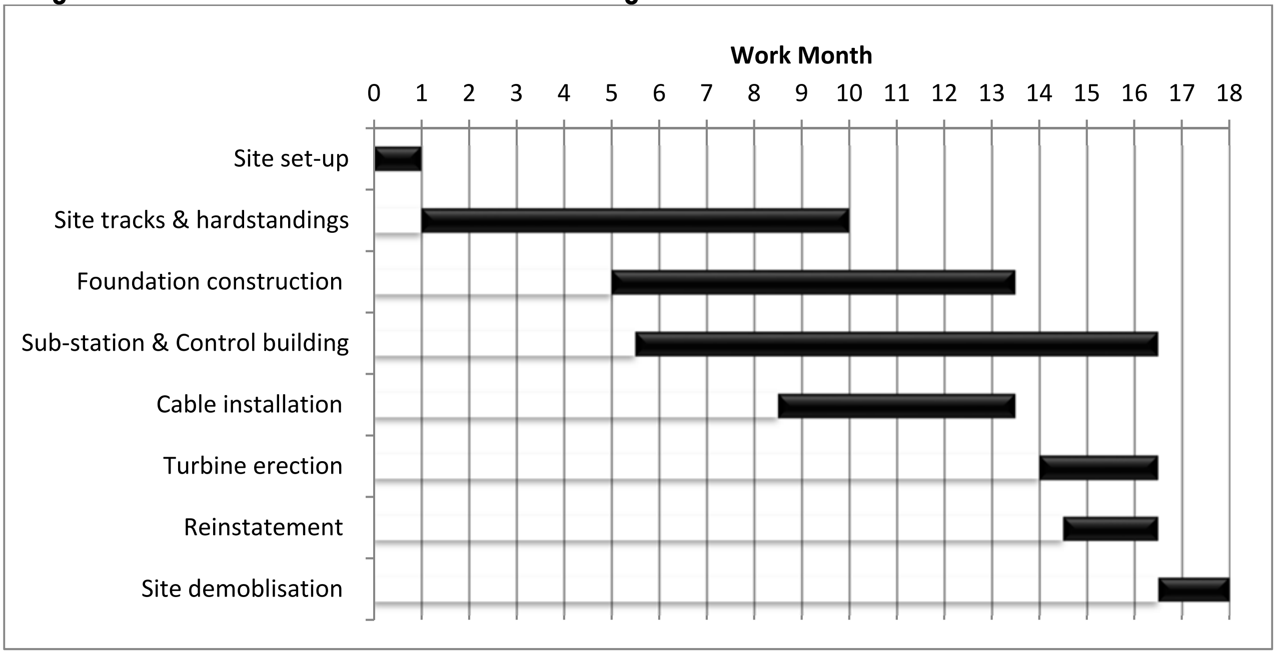
2.73 A programme of reinstatement would be implemented upon completion of construction. This would relate to the construction compound, temporary areas of the crane hardstandings, cable trenches and track shoulders where appropriate. There remains a potential to use cranes during the operational phase of the Development, therefore the main crane hardstanding will remain uncovered.

2.74 It is essential that the access track width is retained during the operation of the Development to allow occasional access if required. Therefore, no works to reduce the track width, post turbine erection, are proposed.

Construction Programme

2.75 It is anticipated that the construction could take 18 months (worst case). The indicative construction programme shown in **Diagram 2.1** shows the anticipated scheduling of construction activities.

Diagram 2.1 - Indicative Construction Programme



Hours of Work

2.76 Construction work will take place between the hours of 0700-1900 Monday to Saturday. Outside these hours, work at the Site shall be limited to turbine erection, testing/commissioning works and emergency works. Deliveries may occur outside these times to minimise disruption to local residents.

Construction Traffic and Plant

2.77 In addition to staff transport movements, construction traffic will consist of heavy goods vehicles (HGVs) and abnormal load deliveries.

2.78 As outlined in **Chapter 11: Traffic and Transport**, taking into account forecast vehicle numbers from construction activities (3,613 trips) and forecast staff vehicle numbers (6,283 private car, mini bus or land rover trips), the total number of two-way vehicle movements generated during the construction period would therefore be 9,897 journeys. Approximately 60 abnormal load deliveries would be generated for the turbine erection stage which would typically result in three deliveries per day. However, the actual number will be determined in the development of the Traffic Management Plan (TMP) which will be written in consultation with Department for Infrastructure (DfI) and Causeway Coast & Glens BC, post-consent.

2.79 Turbine components will be supervised during their transportation using appropriate steerable hydraulic and modular trailer equipment where required. Axle loads would be appropriate to the roads and access tracks to be used. The transportation of turbine components would be conducted in agreement with the relevant roads authorities and local police. RES will notify the police of the movement of abnormal length (e.g. turbine blade delivery) and any abnormal weight (e.g. crane) vehicles and obtain authorisation from DfI prior to any abnormal vehicle movements.

2.80 Vehicle escorts will be used where necessary and the appropriate permits obtained for the transportation of abnormal loads, to ensure that other traffic is aware of the presence of large, slow moving vehicles. Where long vehicles have to use the wrong side of the carriageway or have potential to block the movement of any vehicles travelling in the opposite direction, a lead warning vehicle will be used, and escort vehicles will drive ahead to hold oncoming traffic. Vehicles will also be marked as long/abnormal loads. For return journeys, the extendible trailers used for wind turbine component delivery will be retracted to ensure they are no longer than that of a normal HGV.

Construction and Decommissioning Method Statement

2.81 A Construction and Decommissioning Method Statement (CDMS) will be prepared once planning consent has been gained. This will be submitted to Causeway Coast & Glens BC prior to any construction works taking place. This will describe the detailed methods of construction and working practices, work to reinstate the site following completion of construction activities and methods to reinstate the site post operation.

Operation and Management

Life of the project

2.82 The expected operational life of the wind farm is 30 years from the date of commissioning. At the end of this period, a decision is made whether to refurbish, remove or replace turbines. If refurbishment or replacement were to be chosen, relevant planning applications will be made. Alternatively, if a decision is taken to decommission the Development, this would entail the removal of all the turbine components, transformers, the substation and associated buildings. Specific sections of the access tracks may remain on-site to ensure the continued benefit of improved access for the landowners. The concrete foundations will normally remain in place to avoid the unnecessary intrusion to the ground. The exposed concrete plinth may be removed to a specified depth, but the entire foundation will be graded over with topsoil and replanted appropriately to restore the land to its original conditions.

Maintenance Programme

2.83 Wind turbines and wind farms are designed to operate largely unattended. Each turbine at the Development would be fitted with an automatic system designed to supervise and control a number of parameters to ensure proper performance (e.g. start-up, shut-down, rotor direction, blade angles etc.) and to monitor condition (e.g. generator temperature). The control system would automatically shut the turbine down should the need arise. Sometimes the turbines would re-start automatically (if the shut-down had been for high winds, or if the grid voltage had fluctuated out of range), but other shut-downs (e.g. generator over temperature) would require investigation and manual restart.

2.84 The Development itself would have a sophisticated overall Supervisory Control and Data Acquisition system (SCADA) that would continually interrogate each of the turbines and the high voltage (HV) connection. If a fault were to develop which required, an operator to intervene then the SCADA system would contact duty staff via a mobile messaging system. The supervisory control system can be interrogated remotely. The SCADA system would have a feature to allow a remote operator to shut down one or all of the wind turbines. This is monitored 24 hours a day, 7 days a week.

2.85 An operator would be employed to operate and maintain the turbines, largely through remote routine interrogation of the SCADA system. The operator would also look after the day-to-day logistical supervision of the Development and would be on-site intermittently.

2.86 Routine maintenance of the turbines would be undertaken approximately twice yearly to ensure the turbines are maintained to Industry Standard. This would not involve any large vehicles or machinery.

2.87 If a fault should occur, the operator would diagnose the cause. If the repair warranted the Development being disconnected from the grid, then the operator would contact NIE. However, this is a highly unlikely occurrence as most fault repairs can be rectified without reference to the network utility. If the fault was in the electrical system, then the faulty part or the entire Development would be automatically disconnected until the fault is rectified.

2.88 Signs would be placed on the Development giving details of emergency contacts. This information would also be made available to the local emergency services and NIE.

Decommissioning

2.89 One of the main advantages of wind power generation over other forms of energy production is the ease of decommissioning and the simple removal of components from the site. The residual impact on the site is limited to the continued presence of the foundations and access tracks. All above ground structures can be removed from the site.

2.90 If the Development obtains planning approval it is expected that a planning condition would be set to provide for the decommissioning and restoration of the site in accordance with a scheme agreed in writing with Causeway Coast & Glens BC, which would consider the long-term restoration of the site at the end of the lifetime of the Development.

2.91 The Development will be decommissioned in accordance with best practice at that time and/or in compliance with any planning conditions. Current best practice includes the removal of all above ground structures (e.g. turbines, substation etc); the removal of certain underground structures where required (e.g. cables); and reinstatement of disturbed areas all of which will be subject to any necessary consents. Consideration will be given to the retention of wind farm access tracks if they utilise pre-existing farm infrastructure or are not located on sensitive habitats if such continued use could lead to the long-term degradation of these habitats.

Construction and Decommissioning Management

2.92 This section details the environmental management controls that would be implemented by RES and its contractors during the construction of the Development to ensure that potential significant adverse effects on the environment are, wherever practicable, prevented, reduced and where possible offset.

2.93 A CDMS will be agreed with the relevant statutory consultees prior to construction commencing. The purpose of the CDMS is to:

- Provide a mechanism for ensuring that measures to prevent, reduce and where possible offset potentially adverse environmental impacts identified in the ES are implemented;
- Ensure that good construction practices are adopted and maintained throughout the construction of the Development;
- Provide a framework for mitigating unexpected impacts during construction;
- Provide a mechanism for ensuring compliance with environmental legislation and statutory consents;
- Provide a framework against which to monitor and audit environmental performance.

2.94 The CDMS will, as a minimum, include details of the following:

- Pollution prevention measures
- Peat slide, erosion and compaction management
- Control of contamination/pollution prevention
- Drainage management
- Control of noise and vibration
- Control of dust and other emissions to air.

Site Induction

2.95 The principal contractor would ensure that all employees, sub-contractors, suppliers and other visitors to the site are made aware of the content of the CDMS and its applicability to them. Accordingly, environmental specific induction training would be prepared and presented to all categories of personnel working on and visiting the site.

2.96 As a minimum, the following information would be provided to all inductees:

- Identification of specific environmental risks associated with the work to be undertaken on site by the inductee
- Summary of the main environmental aspects of concern at the site as identified in the CDMS
- Environmental Incident and Emergency Response Procedures (including specific Environmental Communication Plan requirements).

2.97 A conveniently sized copy of an Environmental Risk Map or equivalent would be provided to all inductees showing all the sensitive areas, exclusion zones and designated washout areas. The map would be updated and reissued as required. Any updates to the map would be communicated to all inductees through a tool box talk given by specialist environmental personnel. Regular tool box talks would be provided during construction to provide ongoing reinforcement and awareness of environmental issues.

Pollution Prevention, Water Quality Monitoring and Emergency Response Plan

2.98 The CDMS will detail a number of measures to deal with pollution prevention, including RES' policies and procedures such as 'Environmental Requirements of Contractors', 'Water Quality Monitoring Procedure' and 'Procedure in the Event of a Contaminant Spill'.

2.99 Contractors and sub-contractors would be required to follow all pertinent Pollution Prevention Guidance. The following pollution control measures will be incorporated into the CDMS:

- Equipment shall be provided to contain and clean up any spills to minimise the risk of pollutants entering watercourses, waterbodies or flush areas
- Trenching or excavation activities in open land shall be restricted during periods of intense rainfall and temporary landscaping shall be provided as required to reduce the risk of oil or chemical spills to the natural drainage system
- Sulphate-resistant concrete[4] shall be used for the construction of turbine bases to withstand sulphate attack and limit the resultant alkaline leaching into groundwater
- All refuelling will be undertaken at designated refuelling points. There will be no refuelling within catchments contributing to water supply points
- Equipment, materials and chemicals shall not be stored within or near a watercourse. At storage sites, fuels, lubricants and chemicals shall be contained within an area bunded to 110%. All filling points shall be within the bund or have secondary containment. Associated pipework shall be located above ground and protected from accidental damage
- Any on-site concrete wash-out shall occur in allocated bunded areas
- Drip trays shall be placed under machinery left standing for prolonged periods
- All solid and liquid waste materials shall be properly disposed of at appropriate off-site facilities
- Routine maintenance of vehicles shall be undertaken out with the site
- There shall be no unapproved discharge of foul or contaminated drainage from the Development either to groundwater or any surface waters, whether direct or via soakaway
- Sanitary facilities shall be provided and methods of disposal of all waste shall be approved by regulatory bodies

[4] BS EN206:1 : 2000 Concrete Part 1: Specification, performance, production and conformity and BS 8500 – 1 : 2006 Concrete – Complementary British Standard to BS EN 206 – 1 Part 1

- A programme of surface water quality monitoring would be undertaken during the construction phase to provide assurances as to the absence of water quality impacts
- RES has a policy that no wind turbines, auxiliary and electrical equipment would contain askarels or Polychlorinated biphenyls (PCBs).

2.100 In the unlikely event of an environmental pollution incident, there will be an emergency response procedure to address any accidental pollution incident. For example, a procedure requiring the use of spill kits to contain the material and procedures to ensure that NIEA is notified on their Pollution Hotline number (0800 807060) within 30 minutes of an incident (unless unsafe to do so), will be applied.

General Drainage Design

2.101 As set out in **Chapter 9:** Geology and the Water Environment, buffers to watercourses have taken account of and infrastructure designed in accordance with best practice guidance.

2.102 The potential impact of preferential routing of drainage and associated erosion and sediment wash-off within the sub-catchments draining the site would be mitigated through the following measures which would be incorporated into the SuDS Design:

- Site track construction materials would be free draining, strong, durable and well graded
- Attenuation ponds and silt fences would be provided adjacent to the drains to prevent pollution and sedimentation of watercourses
- Direct drainage into existing watercourses would also be avoided to ensure that sediment and runoff from disturbed ground is not routed directly to the watercourses
- Larger drains would be piped directly under the track through appropriately sized drainage pipes or culverts. Appropriate scour prevention and energy dissipation structures would be constructed at each culvert outlet. Where appropriate, a shallow, lateral drainage swale would be installed at the toe of site track cuttings to intercept the natural runoff. This lateral drain would be piped under the track at regular intervals through correctly sized cross drains away from watercourses. Appropriate scour prevention and energy dissipation structures would be constructed at each culvert outlet
- Flow and sediment transport in any track drainage swales would be minimised by reducing concentrated flows, installing regular cross culverts and the use of check dams placed at regular intervals within the trackside drainage swales
- Track drainage swales, where required, would discharge into attenuation ponds excavated on the downslope side, or silt fences. A shallow drainage swale would be cut directly downhill as a fan and at minimum slope until

the bottom of the swale reaches the natural surface level. The discharge point of track drains would be constructed to minimise concentrated flows and ensure flows are dispersed over a large area with appropriate surface protection

- The depth of individual drainage swales would be kept to the minimum necessary to allow free drainage of the tracks and swale lengths would be minimised to avoid disruption of natural drainage paths. Direct drainage into existing watercourses would be avoided to ensure that sediment and runoff from disturbed ground is not routed directly to the watercourses.

Runoff and Sediment Control Measures

2.103 The following measures would be used to mitigate any potential impacts on the water quality of the sub-catchments through peat erosion, stream acidification and metals leaching during construction. These are incorporated into the CDMS:

- Appropriate sediment control measures (silt fences, attenuation ponds, etc.) would be used in the vicinity of watercourses, springs or drains where natural features (e.g. hollows) do not provide adequate protection
- Sediment control measures (e.g. check dams, silt fences etc.) would be employed within the existing artificial drainage network during construction. These would be regularly checked and maintained during construction and for an appropriate period following completion
- Watercourses would be monitored throughout the construction period by the ECoW to identify any enhanced scouring of the catchment surface. If sediment from disturbed peat is excessively mobilised through the minor channels network these would be mitigated by temporary sediment control measures (e.g. geotextiles/straw/bales/brash)
- The extent of all excavations would be kept to a minimum and during construction activities surface water flows shall be captured through a series of cut-off drains to prevent water entering excavations or eroding exposed surfaces. If dewatering of excavations is required, pumped discharges would be passed through attenuation ponds and silt fences to capture sediments before release to the surrounding land
- Where there is a permanent relocation of peat, the ground would be reinstated with vegetation as soon as practicable
- Where practicable, vegetation over the width of the cable trenches would be lifted as turfs and replaced after trenching operations to reduce disturbance
- The movement of construction traffic would be controlled to minimise soil compaction and disturbance. Vehicle movements outside the defined tracks and hardstandings would be avoided

- Trenching or excavation activities in open land would be restricted during periods of intense rainfall and temporary landscaping would be provided, as required, to reduce the risk of sediment transport to the natural drainage system
- Construction of the track and cable crossings will cease during periods of heavy rain (>25mm in 24 hours), significant snow event (>75mm lying) or extended period of freezing conditions (ground penetration>100mm). If necessary, upstream of the crossing would be dammed and water pumped around the construction zone. The construction period would be minimised as far as practicable.

Peat Slide, Erosion and Compaction Management

2.104 Management of the risk of peat slides is now recognised in literature, and a range of measures have now become standard engineering practice for construction of roads over peat. These measures would be adopted, as appropriate, on site, ensuring that:

- Concentrated loads, such as those arising from stockpiling of material from turbine foundation excavations, would not be placed on marginally or potentially marginally stable ground
- Concentrated water flows arising from any aspect of construction or operation of the Development would not be directed onto peat slopes and unstable excavations
- Construction would be supervised on a full-time basis by engineers fully qualified and experienced in geotechnical matters
- Robust drainage plans would be developed
- Work practices would be reviewed, modified as necessary and adopted to ensure that existing stability is not compromised
- Appropriate ground investigation and movement monitoring practices would be adopted.

2.105 The major contributory factor resulting in peat slide is heavy rain. Almost invariably, peat-slide events are preceded by unusual weather conditions typically characterised by a long dry summer that leads to desiccation cracking of the peat profile followed by a prolonged continuous rainfall including exceptionally heavy rainstorms.

2.106 A separate Phase 1 Geotechnical Study includes a Peat Slide Risk Assessment and is provided as **Appendix 9.3**. This document would be updated during the detailed design stage and agreed with Causeway Coast & Glens BC prior to construction.

Traffic Management Plan

2.107 As detailed in **Chapter 11: Transport and Traffic**, a Traffic Management Plan (TMP) would be developed to ensure road safety for all users during transit of development loads. The TMP would outline measures for managing the convoy and would set out procedures for liaising with the emergency services to ensure that police, fire and ambulance vehicles are not impeded by the loads. The TMP would be developed in consultation with DfI, the police and the local community and agreed before deliveries to the Development commence.

Outline Construction Environmental Management Plan

2.108 An Outline Construction Environmental Management Plan (CEMP) is included in Appendix 6.5 and would be finalised post consent alongside the CDMS, to set out the measures required to protect and enhance ecology and hydrology at the Development during the construction phase, including pre-construction surveys, habitat management and biodiversity enhancement. The final details of the CEMP would be prepared and agreed with Department for Environment Agriculture & Rural Affairs (DEARA) and Causeway Coast & Glens BC prior to commencement of construction.

Potential Construction and Decommissioning Phase Environmental Impacts

2.109 Construction is predominantly a civil engineering operation and would be phased over an approximate 18-month period (worst case). Construction of tracks and foundations would be progressive, minimising the number of simultaneously active locations and ensuring that traffic density is kept low. Erection would span approximately six weeks toward the end of the work programme.

2.110 A programme of site reinstatement and enhancement would be put in place to minimise the visual and ecological impacts on the land, in accordance with the Outline Habitat Management Plan (Appendix 6.4).

2.111 The Development would operate for approximately 30 years and would require only limited maintenance and inspection visits.

2.112 A detailed restoration plan / Decommissioning Method Statement would be prepared and agreed with the relevant authorities towards the end of the Development's operational life.

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3

Design Evolution & Alternatives

3 Design Evolution & Alternatives

Introduction

3.1 In this chapter a description is given of the site selection process and design strategies that have been adopted to arrive at the Development described in **Chapter 2: Proposed Development**. Firstly, the general design principles adopted by RES are outlined and potential key issues which have affected the design are identified. Thereafter, a description is given of how the turbine layout and infrastructure design has evolved in response to constraints identified through the EIA process.

3.2 **Figures 3.1 – 3.3** are referenced in the text where relevant.

Current land use and site context

3.3 The location of the Development is shown in **Figure 1.1: Site Location**. The 'Planning Application Boundary' (red line) and 'Land Under Applicant Control' (blue line) are shown on **Figure 1.2**: **Planning Application Boundary**. The 'Land Under Applicant Control' formed the Preliminary Site Boundary, hereinafter referred to as 'the Site'.

3.4 The Site is located approximately 4 km to the south of Dungiven in County Derry/Londonderry. The Site is positioned on an upland plateau in the north eastern part of the Sperrins Area of Outstanding Natural Beauty (AONB). The Site is accessed via the Magheramore Road and is linked to the tertiary road network to Dungiven.

3.5 The Site is currently used for sheep and cattle grazing and predominantly comprises improved agricultural land, with small distinct areas of wet marshy grassland and wet heath. The lands are well managed with extensive stoned farm tracks providing access to agricultural fields bounded by mature double row hedgerows and strategically placed coniferous shelter belts. The Site is open and exposed to the north but is bounded to the south by the Altnaheglish River and associated broadleaf woodland within Banagher Glen. Further south there are extensive areas of commercial forestry that form Banagher Forest.

Key Issues and Constraints

3.6 The design of a wind farm is optimised to produce a layout that maximises the use of the land available for wind power generation balanced against the overall environmental impact of the development. The optimal layout of a wind farm depends on a range of technical, economic and environmental criteria. There following are site specific factors determining the viability of a wind farm:

- Wind Speeds/Energy Yields: Sufficiently high wind speeds to ensure energy production from the wind turbines that would yield an adequate return on investment;

- Planning: A site which complies with planning policy and, avoids unacceptable effects on areas that have been designated by statutory agencies; maintains appropriate distances from dwellings to avoid unduly impacting local amenity and; avoids impeding or interfering with major electromagnetic transmission and airport communication systems;
- Area of Site: A site must have sufficient area to accommodate the number of wind turbines required for economic viability;
- Access: Adequate vehicular access to a site using existing roads wherever possible to minimise the amount of civil works, particularly during the construction phase;
- Local Terrain and Topography: Terrain and topography affect wind flow across a site and need to be considered in relation to turbine performance, specification and life-span;
- Ground Conditions: A site must have suitable ground conditions for the construction of wind turbine foundations, erection of the machines and the provision of access tracks and cables.

3.7 There are additional factors which also influence the scale and viability of a wind farm including:

- Turbines must be separated by specific distances both perpendicular to, and in line with, the prevailing wind direction to minimise turbulent interaction between the wind turbines (i.e. wake effect). This needs to be considered to balance turbine performance with energy extraction, and to protect the life-span of the turbines. Spacing requirements vary between turbine manufacturers and are also subject to wind conditions;
- Wind turbines have to be located at a distance sufficiently far from occupied residential property to ensure adherence to relevant noise criteria and to ensure that shadow flicker impacts are minimised;
- The implications of locating turbines near environmentally sensitive features and areas (ecology, archaeology, hydrology etc.) need to be carefully considered; and
- Landscape and visual design considerations need to be taken into account.

3.8 The apportioning of weight to each element is a site-dependent consideration and results in bespoke design approaches and strategies for each site.

3.9 For this Development, the upland nature of the Site creates a number of sensitivities that need to be carefully addressed through appropriate design of the wind farm. The following sections identify potential issues and outline how these have been addressed through appropriate design.

3.10 The basis of the design process is the evaluation of the various constraints that have been identified through the environmental surveying that was undertaken between 2014 and 2019. The constraints identified through these surveys, along with other technical constraints and appropriate buffers are presented in **Figure 3.3**: **Combined Constraints and Infrastructure** and are discussed in sections 3.28 – 3.57.

Potentially significant effects

3.11 Following consultation and baseline characterisation of the Site, the following key environmental issues have been identified:

- Landscape and visual
- Archaeology and cultural heritage
- Ecology
- Ornithology
- Fisheries
- Geology and the water environment
- Noise and shadow flicker
- Traffic and transport.

3.12 The issues listed above have been considered during the iterative design process with the aim of designing out significant effects. Where it is not possible to mitigate these effects through design, the issues are considered further as part of the Environmental Impact Assessment process (EIA) which is described in this Environmental Statement (ES).

Consultation

3.13 Prior to and during the production of this ES, RES and the Consultant project team consulted with various stakeholders and, where appropriate, incorporated the outcome of this into the various chapters of this ES.

3.14 Throughout the EIA process, continual scoping has occurred to ensure that the ES fully, but concisely, addresses all potentially significant issues.

3.15 A summary of the telecommunications and aviation consultations are provided in **Table 3.1**. Details of consultation undertaken in the preparation of each of the technical chapters of this ES (chapters 4 to 13) are presented in the relevant chapter.

Table 3.1 - Summary of Consultation

Consultee	Date of Consultation	Nature and Purpose of Consultation
OFCOM	30/05/2018 03/06/2018	OFCOM were consulted to establish the identity of telecom infrastructure owners in the vicinity of the Development OFCOM responded to advise BT had a link in the area and that Atkins and JRC should also be contacted
Atkins Global	19/06/2018 18/07/2018	Atkins Global were consulted to establish the location of any radio links they manage Atkins Global confirmed they had no concerns but suggested consultations with Northern Ireland Water
BT	19/06/2018 27/06/2018	BT were consulted to establish the location of any radio links they manage BT confirmed they had no concerns as the single link highlighted by OFCOM is no longer in use
JRC	19/06/2018 21/06/2018	JRC were consulted to establish the location of any radio links they manage JRC Northern Ireland Water confirmed they had no concerns
Northern Ireland Water	18/07/2018 01/08/2018	Northern Ireland Water were consulted to establish the location of any NIW radio links they control Northern Ireland Water confirmed they had no concerns
Defence Infrastructure Organisation		DIO has not been consulted directly as there are no military bases or radars within 100 km of the site
City of Derry Airport		City of Derry Airport has not been consulted. The recommended CAA consultation distances for an aerodrome with no radar is 17 km. The closest turbine is 22.2 km from the airport reference point (centre of the runways) and there is terrain shielding between the aerodrome and the turbines.

Public Consultation

3.16 RES is committed to finding effective and appropriate ways of consulting with all its stakeholders, including local residents and community organisations, and believes that the views of local people are an integral part of the development process. RES began the engagement process more than four months prior to the submission of the planning application, to facilitate a constructive consultation process which helped RES to understand and address any concerns as the project developed.

3.17 A public exhibition was held on 26th March 2019 in the Dromboughil Community Centre. The exhibition included detailed maps and information about the proposals, including: a map of the proposed layout; photomontages representing how the proposed layout would appear from a range of viewpoints, and; Zone of Theoretical Visibility (ZTV) diagrams. (A ZTV is a map-based diagram illustrating where and how many wind turbines, or wind farms, would theoretically be visible from all parts of a given area. The methods for preparing ZTVs and their uses within the EIA process are described in **Chapter 4: Landscape and Visual Impact Assessment**. RES staff where available to answer questions and feedback was encouraged.

3.18 A Pre-Application Community Consultation (PACC) Report has been produced and is available for viewing at the locations listed in **Chapter 1: Introduction & Policy Context**.

Alternatives

3.19 RES considers a range of potential options when selecting and designing wind farm sites. The following sections outline the broad design alternatives that have been considered in terms of the EIA Regulations.

Do-Nothing Alternative

3.20 The "do-nothing" scenario is a hypothetical alternative considered as a basis for comparing the potential significant effects of a development proposal. In the case of the Development the "do-nothing" scenario would be to have the Site continue to be managed for sheep and cattle grazing by the landowners. It is likely that current land management activities, including agricultural improvements would continue.

Alternative Sites

3.21 RES has a robust site selection methodology, using a Geographical Information System (GIS) to aid identification of potential wind farm sites.

3.22 The Development site meets the criteria listed in section 3.28 of this chapter. The GIS model was used to identify potential constraints which could restrict development, or would need to be addressed in the design process.

Alternative Layout Designs

3.23 There have been iterations of the turbine and infrastructure layouts. From the outset the following design principles have been employed when making design decisions:

- Mitigation by design should be the principle method of reducing potential environmental impacts
- Utilisation of existing infrastructure should be implemented whenever possible to avoid unnecessary development
- All site infrastructure should be designed as efficiently as possible to reduce the overall extent of development whilst maximising the renewable energy generation potential.

3.24 A key tool in the design process is the combined constraints drawing which integrates all potential constraints that need to be considered in the design process. The finalised combined constraints map is shown as Figure 3.3.

3.25 The combined constraints drawing is iteratively updated as new information from surveys, site visits and consultation is received. The following surveys informed the combined constraints drawing:

- Breeding and wintering bird survey
- Ornithological vantage point survey
- National Vegetation Classification (NVC) Phase 2 survey
- Terrestrial fauna surveys
- Fisheries survey
- Peat probing
- Hydrology assessment
- Archaeology and cultural heritage surveys
- Landscape field survey
- Transport and traffic reconnaissance trip
- Technical and engineering site walkovers.

3.26 The final site layout for the Development (Figure 2.1: Infrastructure Layout) balances the need to optimise the energy yield whilst paying due regard to environmental and technical sensitivities. Wind farm design is an iterative process and is influenced by potential environmental effects identified throughout the EIA process: policy recommendations; environmental, technical, engineering and landscape design considerations; and takes into consideration feedback from consultees.

3.27 The following sections describe the evolution of the turbine and infrastructure layouts.

Design Evolution

Turbine Layout

3.28 There were two principle iterations of the turbine layout, the latter two are shown in **Figure 3.1: Turbine Layout Evolution**, which were developed at the following two key stages in the project process:

- Initial Turbine Layout (Layout 1), when turbines were located based on preliminary constraints only and prior to baseline environmental surveys being completed;
- Primary Turbine Layout / EIA baseline data stage (Layout 2) when baseline surveys were complete and constraint information gathered and final refinements were made to the layout.

Initial Turbine Layout (Feasibility Stage)

3.29 At the beginning of the development process an initial layout was produced to show the maximum potential extent of the development within the space available at the time and in accordance with the design principles, prior to baseline surveys having been commenced. The layout was informed by the following constraints:

- Preliminary watercourse buffers

- Slope
- Known private water supply locations
- Separation from housing (1000m) / Double the minimum separation distance of 500 m.
- 164.9 m buffer (tip height + 10%) to public roads, in accordance with the Best Practice Guidance to PPS 18[1].

3.30 This identified that the Site could potentially accommodate 7 turbines with a 112m rotor diameter.

3.31 This initial feasibility layout was reviewed by the Landscape Consultant. A Zone of Theoretical Visibility diagram (ZTV) and wirelines were produced for a provisional 7-turbine layout and the potential landscape and visual issues that would need to be considered if a wind farm were to be proposed on this site were considered in broad terms based on previous experience of assessing wind farms in other this part of the Study Area. This included a preliminary analysis of the site in its wider landscape context, including its location within the Sperrin AONB and its potential relationship with other wind farms.

3.32 The feasibility appraisal concluded that the site was likely to meet the criteria for acceptable development as set out in planning policy and supplementary guidance. The 7-turbine layout presented a small ZTV in terms of its geographical coverage, but the wirelines illustrated some clustering of turbines in the centre of the layout, which may need to be reviewed to create a more balanced layout.

Primary Turbine Layout (EIA Baseline Stage)

3.33 Prior to detailed site assessments being undertaken by external consultants, RES technical analysts undertook site visits to check that there were no physical characteristics on site that may impact upon the turbine performance such as topography and the proximity and height of forestry in relation to the turbines.

3.34 RES engineering and construction undertook site visits with ecological and geology/hydrology consultants to review the turbine locations and to agree principles for the design of the onsite infrastructure based on the constraints determined to date.

3.35 Following further consultation with landowner(s), Turbine 7 was omitted, and this necessitated other changes to maximise the efficiency of the turbines and to create a balanced layout.

3.36 The revised layout was informed by the original constraints with the following amendments:

- 165 m buffer to power lines;
- Hydrological buffer 50 m;
- Hydrological buffer 10 m;

[1] Best Practice Guidance to Planning Policy Statement 18: Renewable Energy, DOE Planning & Environmental Policy Group, August 2009.

- Archaeological features;

3.37 The removal of Turbine 7 from the western-most side of the wind farm enabled some refinements to the layout.

- T4 moved south west (turbine separation);
- T1-T3 moved closer together (to avoid boundary overfly).

3.38 The resulting 6 turbine layout with 112.0 m rotor diameter produced a more compact layout as detailed below in 3.40.

Combined Constraints

3.39 To ensure that all requirements were captured a combination of desktop and site-based surveys were undertaken to refine constraints. Detailed environmental and technical surveys were carried out to characterise the baseline environmental conditions on the Site and associated study areas, as described in more detail in chapters 4 to 13 of this ES. Any constraints to development resulting from the baseline surveys were used to build up the combined constraints drawing.

Landscape & Visual

3.40 As mentioned above a Landscape Consultant was involved throughout the design process to provide advice regarding the scale of the Development and turbine heights and geometry.

3.41 The 6-turbine option that is that is presented in the EIA is the result of this iterative design process. The ZTV for the 6-turbine layout is not significantly altered from the 7-turbine layout but the reduction in the number of turbines has resulted in several benefits, namely:

- The turbines can be more evenly spaced in relation to each other and to the site topography which has resulted in a simpler layout with fewer variations in tip heights in relation to contour AOD levels;
- There are fewer instances where 'stacking' of turbines occurs. Stacking is where two or more turbines will appear directly in front of each other in a view and will therefore result in a 'heavier' or more solid, and hence more prominent appearance;
- The reduction in the number of turbines has allowed the turbines to be located at elevations away from the summit of Teeavan Hill and this has slightly reduced the level of visibility from the following parts of the Sperrin AONB: around the summit of Slieve Gallion to the south; Banagher Road to the west; B40 North Sperrins Scenic Drive to the south west.
- Ensuring that the turbines remain clear of the summit of Teeavan Hill also means that the Development is viewed as a small feature that is subordinate to the wider sequence of summits which stretch in a crescent-shaped arc

from Binevenagh in the far north of the Study Area into the main Sperrin Mountain range across the western part of the Study Area. Visual effects on the AONB and this sequence of views along the Binevenagh and Sperrin ranges of uplands are minimised in all instances.

3.42 Provisional Viewpoints were analysed as part of the LVIA and the cultural heritage assessment (Chapter 5) to identify potentially significant effects that might result from the turbine layout, as well as from the effects of the wind farm as a whole. The Provisional Viewpoint were discussed with the Planning Department of Causeway Coast & Glens BC and the Department of Communities: Historic Environment Division, (DfC:HED) and their suggestions fed into the selection of a final list of Viewpoints that are presented and analysed in detail in **Chapters 4: Landscape & Visual** and **Chapter 5: Archaeology & Cultural Heritage**.

Archaeology

3.43 There are two scheduled monuments within the site boundary / land under applicant control. These sites were mapped and avoided accordingly. No construction works would occur within the fenced area of moorland where they are situated.

Vegetation

3.44 Much of the site, particularly around its margins, consists of agricultural fields that support species-poor improved and semi-improved grassland, with variable cover of rushes in the wetter fields. Some fields are separated by mature coniferous shelter belts, and a more extensive area of coniferous plantation is present along one field boundary. Fields on lower ground are often separated by hedgerows or discontinuous shrubs, and occasionally mature trees. Hedgerows are invariably species-poor and support species-poor basal vegetation communities.

3.45 The higher ground formerly supported extensive blanket bog and heath communities, as is evidenced by the presence of the degraded and heath habitats that are present in some of the more extensive field units. The peat substrate has been almost universally cut over and has since become fully vegetated. Many fields retain thin peat that now supports marshy grassland and which may be dominated by rush *Juncus* species or purple moor-grass *Molinia caerulea*, or may support patchy acid grassland.

3.46 Grassland habitats have low species diversity and are generally of low botanical interest. Minor streams or active drains are present in parts of the site; their banks generally support vegetation that is similar to that of the adjacent fields, or may be marked by increased rush growth

3.47 Given the nature of the site peat probing was limited to within close proximity of the existing access tracks that are to be upgraded, where new access tracks are proposed and at main infrastructure elements e.g. turbines, crane hardstanding’s and substation.

3.48 A Phase 1 Geotechnical Study including Peat Slide Risk Assessment was undertaken and concluded that the majority of the site exhibits a peat depth of under 0.5m, which is generally considered to have a negligible peat slide potential. Peat depth in areas where development is proposed has been determined by the assessment to vary to a maximum depth of 1.3m. Peat in many of these areas is noted to have appeared to have been historically treated resulting in an increased shear strength further reducing the risk.

Terrestrial Fauna

3.49 No badger setts have been identified within the survey area (although badgers are known to be present within the wider environs of the site).

3.50 All turbines have been positioned to maintain a minimum 57.57m buffer (50m stand-off distance from the tip of the turbine blade to the top of the adjacent habitat feature). This is based on a (blade length of 56m, hub height of 94m and a feature height of 25m).

3.51 The results of bat activity surveys confirmed that most of commuting and foraging was along linear features such as watercourses and edges of adjacent industrial tree monoculture plantations. The infrastructure layout has taken account of bat activity along these features and turbines have been sited to avoid these areas. In addition, it is proposed to clear-fell the existing coniferous shelterbelts for a distance of 100m surrounding all turbines (as shown on Figure 6.2).

Water Environment and Fisheries

3.52 The hydrology consultant recommended watercourse buffers of 50 m and 10 m depending on the catchment size of the watercourse, which were agreed as appropriate by the fisheries consultant.

Public Roads

3.53 165 m buffers were applied to nearby public roads in line with the Best Practice Guidance to PPS18 which recommends a setback distance of at least tip height plus 10% between turbines and roads.

Powerlines

3.54 There is an existing 11kV line that runs through the site and NIE Networks safety policy for clearance distances to 11kV is tip height plus 6 metres. A 165 m buffer has been applied to provide a setback distance of at least tip height plus 10% between turbines and overhead line.

Finalising Turbine Layout - EIA Baseline Stage - Final Layout

3.55 Using design principles agreed with environmental, engineering and technical disciplines, the infrastructure layout was developed and used to undertake baseline assessments.

3.56 During the course of the baseline surveys one minor change was made to the turbine layout as Turbine 4 was moved southeast by 7 metres to take into account latest mapping of site / landowner boundary.

3.57 The revised turbine layout is illustrated in Layout 2 – Figure 3.1.

3.58 A 50 m micro siting radius was applied to each of the turbines. The extent of this was then reduced such that the micro siting avoids any of the combined constraints. The final micro siting areas are included in **Figure 2.1: Infrastructure Layout**.

Infrastructure Design Evolution

3.59 The infrastructure design has evolved through the EIA process as illustrated in **Figure 3.2: Infrastructure Design Evolution**, Designs 1 to 2.

Engineering considerations

3.60 The following general principles were taken into consideration when designing the supporting infrastructure:

- Avoidance of environmental and technical constraints (as shown in Figure 3.3)
- Design of the track layout to follow natural contours as far as possible, to avoid unnecessary amounts of excavation and reduce adverse hydrological impacts using the following methods:
  - Maximise the use of existing track locations via upgrades;
  - Minimisation of the overall length of access track;
- Minimisation of the number of watercourse crossings, as far as possible
- Avoidance of steep slope areas to minimise earthworks (except where existing farm access tracks where in situ);
- Incorporation of measures to improve the visual appearance of the scheme, including reinstatement of temporary infrastructure following the construction period;
- Sympathetically locating control room building / substation / energy storage facility within the site surroundings.

3.61 A number of amendments were made to the design of the infrastructure between Design 1 and Design 2 on (as shown on Figure 3.2) for engineering reasons and these are summarised below:

- Addition of temporary enabling compound near site entrance for safety and security purposes;
- Realignment of the track to T3 including using bell mouth at junction to accommodate temporary crane hard standings;
- Realignment of access track on approach to T6, realignment of T6 crane pad and access track between T6 & T5 so that track follows contours thereby reducing extent of earthworks;
- The configuration of substation, associated car parking and temporary construction compound / energy storage facility was refined;

- Access track to T2 and T1 was simplified and no longer includes a dedicated spur to T2 thereby reducing length of access track;
- Minimization of land take by combining bell mouths at junctions / turning heads with areas of temporary crane hard standing to reduce the extent of infrastructure.

3.62 Key adjustments in response to constraints made through the design evolution are summarised in the following sections.

Vegetation

3.63 The engineering considerations minimised impact on sensitive habitats by utilising the existing track locations via upgrades where possible. This minimised the length of new track and where new access track is proposed, it is predominantly located in agricultural fields and coniferous shelterbelts of low ecological value.

Water Environment

3.64 The number of watercourse and drainage crossings has been minimised through the principle of avoidance at the layout design stage, and a number of culverts have been sited to coincide with existing culverts which will be upgraded. Proposals submitted in conjunction with this assessment indicate:

- Two crossings of a significant watercourse (Stream C and tributary), both at locations where an existing culverted track exists.
- Five crossings of minor watercourses, the majority of which comprise existing track-side drains.

3.65 Minor watercourses, characteristic of cut peat drainage and existing track drainage, are proposed to be diverted to permit siting of turbine bases and infrastructure at Wind Turbine Generator (WTG) 5 and 6. The drains shall be diverted as enabling works prior to undertaking main civil earthworks

3.66 The location and nature of watercourse crossings were reviewed with the hydrology and fisheries consultants as detailed in Chapter 8: Fisheries and Chapter 9: Geology & Water Environment.

Site Entrance Location

3.67 The site entrance is located at an existing access to farm lands on the south side of the Magheramore Road where two stone pillars and walls mark a well-defined farm entrance. The existing access will be upgraded to provide suitable access. As specified in DCAN 15, visibility splays measuring 120m x 4.5m are provided in both directions.

3.68 Following construction, the site entrance will be reinstated to reduce the extent of hardstanding back to its original pre-construction state. Stone pillars and walls removed to allow access will be reinstated as will stock proof fencing.

Control Building and Substation

3.69 The buildings will be centrally located within the turbine array and set back from the northern edge of the plateau and immediately bounded to the west by coniferous shelterbelt and a further shelter belt to the south, which will further screen views. Visibility will be limited from out with the site. The building will be orientated to be accessed from the south.

3.70 The buildings will be traditional in nature with rendered walls and tiled roofs, common characteristics of many rural buildings. The appearance of the buildings has been selected to reflect the rural character of the area to maximise the integration of the buildings within the wider landscape.

Temporary Construction Compound / Energy Storage

3.71 The temporary construction compound is required to be located close to the main bulk of the construction works and the energy storage facility is co-located adjacent to the Control Building and Substation.

3.72 Energy storage containers will utilise the southern portion of the temporary construction compound on a permanent basis with the remainder of the temporary construction compound being removed and returned to farmland.

Temporary Enabling Works Compound

3.73 A temporary enabling works compound will be located on the site to provide facilities until the Temporary Construction Compound is in situ**.**

3.74 The location of the temporary enabling works compound has been selected for reasons of safety and security. Once the Temporary Construction Compound is completed, the enabling works compound will be used primarily as a gatehouse for the monitoring of incoming vehicles. On completion of the construction work these facilities will be removed and will be reinstated.

Final Infrastructure Layout

3.75 The final infrastructure layout is shown in Design 2 of **Figure 3.2: Infrastructure Design Evolution**. Once finalised, the Planning Application Boundary was redrawn, ensuring sufficient space within the boundary for all features including SUDS.

3.76 The final infrastructure layout and combined constraints is shown in **Figure 3.3: Combined Constraints & Infrastructure**.

Residual Design Considerations

Electromagnetic Interference / TV

3.77 Wind turbines can potentially interfere with communication systems that use electromagnetic waves as the transmission medium (e.g. television, radio or microwave links). Wind turbines therefore may cause interference to television reception in the proximity of a wind farm, primarily for receptors in the ‘shadow’ of the turbines with aerials pointing through the wind farm, causing loss of picture detail, loss of colour or loss of audio. Microwave links can also be affected by the reflection, scattering, diffracting and blocking of the electromagnetic signal caused by wind turbines.

3.78 If the Development is consented, RES would agree a scheme of assessment and mitigation with Causeway Coast & Glens BC to be implemented in the case of complaints associated with television reception. Should interference to reception occur as a result of the Development, a range of viable mitigation measures can be considered, with the most suitable method chosen on a case by case basis. Any necessary work would be undertaken in a timely manner following receipt of a valid complaint and would be funded by the wind farm operator.

3.79 RES has consulted with all organisations operating microwave links which could be affected by the Development and these are listed in **Table 3.1** above. No existing links cross the Site and as such there will be no interference experienced.

Ice Throw

3.80 Under certain climatic conditions, ice can build up on turbine blades which may be thrown from the blades during blade rotation or fall when blades are stationary.

3.81 The International Energy Association (IEA) has recommended an empirical formula to calculate the maximum distance that ice may be thrown from an operating turbine based on turbine geometry. For the proposed turbine envelope this ice throw risk distance has been calculated and used in the wind farm design to locate turbines away from public roads and therefore the potential for ice throw to affect members of the public is considered to be negligible.

Summary

3.82 The final layout of the Development reflects the need to optimise the energy yield whilst minimising potential effects on environmental sensitivities. Wind farm design is an iterative process and the design has been influenced by potential environmental effects identified through the EIA process. The proposed layout has evolved in response to policy recommendations, environmental, technical, engineering and landscape and visual design considerations.

List of Figures

3.1 Turbine Layout Evolution

3.2 Infrastructure Design Evolution

3.3 Combined Constraints and Infrastructure

4

Landscape & Visual

4 Landscape and Visual Impact Assessment

Executive Summary

The Purpose of this Chapter

4.1 This chapter is a Landscape and Visual Impact Assessment (LVIA) of the proposed Magheramore Wind Farm (hereinafter referred to as the Development). An LVIA is a formal part of the Environmental Impact Assessment (EIA) process and the methodology used to prepare this chapter is defined by the requirements of the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017 (hereinafter referred to as the EIA Regulations) and best practice guidance publications relating both to the LVIA process in general and in specific relation to wind farm developments (refer to Technical Appendix 4.1 for further details).

4.2 The Development comprises 6 turbines with rotor diameters of 112 m, hub heights of 94 m and overall heights to blade tip of 149.9 m. The turbines are located around the north western to south western sides of Teeavan Hill in the townland of Magheramore approximately 4 km to the south of Dungiven town centre in County Derry. The Study Area for this LVIA covers an area that extends to a 30 km radius from the Development and is further described in paragraph 4.73.

4.3 The objectives of an LVIA are to:

- Present an objective analysis of the landscape and visual character of a defined area (i.e. the '*baseline conditions*' within the '*Study Area*' for this LVIA) in so far as they relate to the Development;
- Identify the potential effects of the Development on these baseline conditions including direct, indirect, permanent, temporary and cumulative effects;
- Clearly distinguish between *landscape effects* – the effects on the physical landscape as a resource in its own right – and *visual effects* – the effects on specific views and general visual amenity as experienced by people;
- Propose appropriate mitigation measures to address likely significant effects, where possible, and to assess any residual effects that remain following the implementation of these measures;
- Present all information clearly and objectively with a well-reasoned methodology that is in accordance with best practice guidance and in a manner that will inform the decision making process.

Statement of Authority

4.4 This LVIA has been prepared by Shanti McAllister Landscape Planning & Design on behalf of the applicant, RES Ltd (hereinafter referred to as RES). Shanti McAllister is an independent consultant and Chartered Landscape Architect with over 17 years' experience of preparing LVIAs for major development proposals including a large number of wind farms in Northern Ireland.

4.5 All information presented in this LVIA has been prepared in accordance with a methodology that is derived from a suite of best practice guidance (see Technical Appendix 4.1). A summary of the LVIA process and the key elements of this methodology are provided at paragraph 4.20 and are described in full detail in Technical Appendix 4.2. The identification and objective analysis of the landscape and visual effects of the Development is made using professional expertise and impartial judgement. The conclusions of the LVIA are based on whether or not the Development is likely to result in significant effects on landscape and visual elements of the Study Area.

Feasibility Appraisal and Design Iterations

4.6 The Development that is being assessed in this LVIA has evolved through an iterative design process that has been informed by a careful analysis of the constraints and opportunities presented by the site location and the characteristics of the Development itself. A Zone of Theoretical Visibility diagram (ZTV) and wirelines were produced for a provisional 7-turbine layout and the potential landscape and visual effects of proposing a wind farm in this location were considered in broad terms based on previous experience of assessing wind farms in other this part of the Study Area. The 7-turbine layout presented a small ZTV in terms of its geographical coverage but the wirelines illustrated some clustering of turbines in the centre of the layout. The removal of one turbine from the western-most side of the wind farm enabled some refinements to the layout. The 6-turbine is smaller and more evenly spaced and has allowed the turbines to be located at slightly elevations away from the summit of Teeavan Hill. The ZTV is not significantly altered but has slightly reduced the level of visibility from the following parts of the Sperrin AONB: around the summit of Slieve Gallion to the south; Banagher Road to the west; B40 North Sperrins Scenic Drive to the south west.

Establishing Baseline Conditions and Analysing Effects

4.7 The Baseline Assessment has considered statutory landscape designations that are contained within current planning policy in Northern Ireland and which cover the Study Area. The primary policy guidance on the assessment of landscape and visual effects of wind farm development is the Strategic Planning Policy Statement for Northern Ireland (SPPS) which should be read in conjunction with PPS 18 and its Supplementary Planning Guidance (SPG). In addition there are a number of guidance documents and Development Plans, which contain relevant statutory planning designations for the Study Area. These documents are analysed in the Baseline Assessment where applicable. It is noted that Northern Ireland’s planning system was re-structured in 2014. Further changes in planning policy and updates to development plans are expected to take place over the coming years as Planning Policy Statements, supplementary guidance and existing Development Plans become superseded by the SPPS and emerging Local Development Plans.

Viewpoint Selection Process and Consultation with the Local Planning Authority

4.8 A desk-based analysis identified potential parts of the Study Area and visual receptors that should be considered in the search for Provisional Viewpoint locations (PVPs). This included:

- Locations within the two AONBs in the Study Area – Binevenagh and the Sperrins - because these areas are statutorily designated as nationally recognised high quality landscapes. They are likely to attract visitors by virtue of this designation and contain various visitor amenity sites and attractions;
- Locations from which the Development would be seen within the wider landscape context of the Study Area including the various ranges of uplands – the Sperrins and foothills, Binevenagh, Loughermore Hills, Glenshane slopes and Carntogher mountain – and locations within the setting for two AONBs such as the Roe Valley and A6 road corridor;
- Locations from public rights of way, scenic drives and cycling routes where viewers are likely to be present for the primary purpose of appreciating scenic views. Such locations might include the Ulster Way network of footpaths including waymarked trails through Banagher and Glenshane Forests, around the summit of Benbradagh, the Binevenagh range of uplands to north, the National Cycle Network including parts of the route which traverse Binevenagh and the Roe Valley, classified scenic driving routes in the Sperrins AONB, the Roe Valley, the Binevenagh Scenic Drive which terminates at viewing areas on the summit of Binevenagh Mountain and parts of the Causeway Coast scenic driving route along the A2 at the northern edge of the Study Area;
- Residential properties and areas of rural settlement in close proximity to the Development where viewers may be static and obtain views for long periods of time as well as views from in and around Dungiven where the site of the Development may contribute to the setting of the town.

4.9 Using this search criteria, 43 PVPs were identified and analysed through the production of a preliminary Zone of Theoretical Visibility diagram (ZTV – refer to Technical Appendix 4.2, starting at paragraph 4.20), preliminary wirelines and map-based research. During initial discussions with the Applicant the Council requested that consideration be taken of potential effects on Banagher Glen and Altnaheglish Dam. This is reflected in the selection of PVP and final Viewpoint locations.

4.10 A total of 22 final viewpoints have been selected for consideration in this LVIA as a result of the viewpoint selection process. A detailed description of this process and a full list of PVPs are provided in Technical Appendix 4.4. The locations of PVPs and final viewpoints are shown on Figure 4.4. The final selection of Viewpoints includes a proportionate number of locations representing typical views of the Development, key visual receptors and key locations within the Study Area. For ease of analysis these shortlisted viewpoints were categorised as follows:

A. Views from rural roads in proximity to the Development;
B. Views from Dungiven and approaches to the town;
C. Elevated views from within the Sperrin AONB;
D. Elevated views from within the Binevenagh AONB;
E. Views overlooking the Roe Valley and the landscape in the north west of the Study Area.

4.11 Detailed descriptions of the final viewpoints are an integral part of the Visual Impact Assessment section of the LVIA (starting at paragraph 4.114). The locations of final viewpoints are indicated on all map-based Figures (Figures 4.1 – 4.12) and visualisations to accompany the detailed written analysis of these Viewpoints are provided in Figures 4.13 – 4.33.

Overall Significance of Landscape and Visual Effects

4.12 The overall conclusion is that the Development would have no significant landscape effects and a significant visual effect on only one of the 22 Viewpoints which were chosen to represent typical views within the Study Area. In recognition of its location within the Sperrin AONB and the Sperrin Mountains LCA the layout and position of the Development has been designed to minimise its effect on the AONB as a whole and this has been achieved by locating it away from the core area containing the majority of visitor attractions and key landscape features. The proposed site is used primarily for grazing. Adjacent areas are dominated by large coniferous plantations with degraded field boundaries and are suffering from increasing amounts of coniferous forestry, which the NILCA identifies as the most detrimental force of landscape change in this LCA. In relation to the LCA and the wider AONB, Teeavan Hill on which the Development would be located is a low rounded hill that is surrounded on all sides by higher ground and occupies a relatively discreet position within the wider landscape.

4.13 The location of the Development is neither prominent nor highly visible from the majority of the Study Area and most notably from the Sperrin AONB or other parts of the Study Area with good views to the core part of the AONB. This is illustrated by the very small extent of its ZTV in relation to the wider Study Area, the Sperrin AONB and also in relation to the very low levels of additional visibility indicated on the cumulative ZTV diagrams. The Development would have a simple compact layout and where it would be visible from elevated locations from where the best views towards the heart of the AONB may be appreciated, it would generally be viewed against a backdrop of land rather than on the skyline. Where it does appear on the skyline it would either form a minor and subordinate element in much more expansive view or it would be seen at close range where it would be, as is to be expected[1], a prominent feature but often for relatively short periods of time (for example along the middle section of the Magheramore Road).

4.14 The Development is generally deemed to have No Significant effects on visual character for similar reasons. Of the 22 viewpoints that have been analysed, only one was deemed to experience a significant visual effect resulting from the Development (Viewpoint 6) and none would experience significant cumulative effects. In respect of Viewpoint 6, significant visual effects would occur in relation to a tertiary road in close proximity to the Development where there would be no views into the wider landscape that occur more commonly across the rest of the Study Area. The Development would therefore become the dominant feature in this Viewpoint. However, this level of effect would be limited to the area in immediate proximity to this Viewpoint and would not be experienced from other roads in the area or from the other Viewpoints that have been selected to represent close range views. The Development would appear in views along a relatively short section of the road corridor in and around Viewpoint 6 and would be appreciated largely by road users. From elsewhere along the Magheramore Road views including the Development would either be wider in extent, or restricted by roadside vegetation where the Development would appear less prominent or, in some instance, not visible. All policy documents (the SPPS, PPS 18 and its best practice and supplementary guidance) recognise that wind farms may be prominent elements in close range views but that this does not necessarily equate to unacceptable development.

4.15 The Development is not located within a cluster and would be well separated from clusters of wind farms within the Study Area. It would also be located in a manner which reflects the general pattern of locating wind farms on the outward facing edges of the AONB. It would occupy a relatively discreet position on the side slopes of a low hill which is surrounded on all sides by higher ground. The effect of this location on the visibility of the Development is illustrated by the very small extent of its ZTV in relation to the wider Study Area, the Sperrin AONB and the cumulative ZTVs. It would more often be visible in sequential rather than simultaneous cumulative views from close range viewpoints where it is likely to be more prominent and therefore its effect on cumulative views would be of a lesser magnitude. In instances where it appears simultaneously with other wind farms in the Study Area it will be viewed with good separation distances and often also from transient viewpoints on busy road corridors such as the A6. Wind energy development is already a prominent visual element in all parts of the Study Area and the Development would have a negligible incremental effect on the manner in which wind energy development is perceived generally across the Study Area. Furthermore it reflects the general pattern of the location of wind farms on the outer-facing slopes of the Sperrin AONB where they may be perceived as small,

[1] see Best Practice Guidance to PPS 18 summarised at paragraphs 4.60 and 4.63

subordinate features within wider views along these extensive upland areas but where they will have little to no visibility from within the majority of the AONB.

4.16 Taking into account that no parts of the Study Area are deemed to experience significant landscape or cumulative effects and only one of the 22 viewpoints assessed as part of the LVIA are deemed to experience significant visual effects, the LVIA concludes that the Development is acceptable in landscape and visual terms.

Summary of the Methodology for this Landscape and Visual Impact Assessment

Best Practice Guidance

4.17 An LVIA is a formal assessment, which is carried out as part of the EIA, a process defined by the EIA Regulations. In accordance with these Regulations the LVIA takes an objective approach to the identification of the baseline conditions within an appropriate 'Study Area'. In this instance the Study Area extends to a 30 km radius from the Development.

4.18 The LVIA methodology used for this Development has been developed by the author in accordance with the Regulations and the suite of available best practice guidance on the preparation of LVIAs in both general terms and specifically in relation to wind energy development. The latter is published by Scottish Natural Heritage and has been adapted by the author to suit the Northern Ireland context. A full list of this best practice guidance is provided in Technical Appendix 4.1 and a detailed description of the Methodology is provided in Technical Appendix 4.2.

4.19 This LVIA must be read in conjunction with these Technical Appendices in order to be properly understood. The criteria used to identify and analyse both the nature of landscape and visual receptors (their 'Sensitivity'), the nature of landscape and visual effects ('Magnitude') and the Signficance of these effects are all key LVIA terms which are defined in the Methodology.

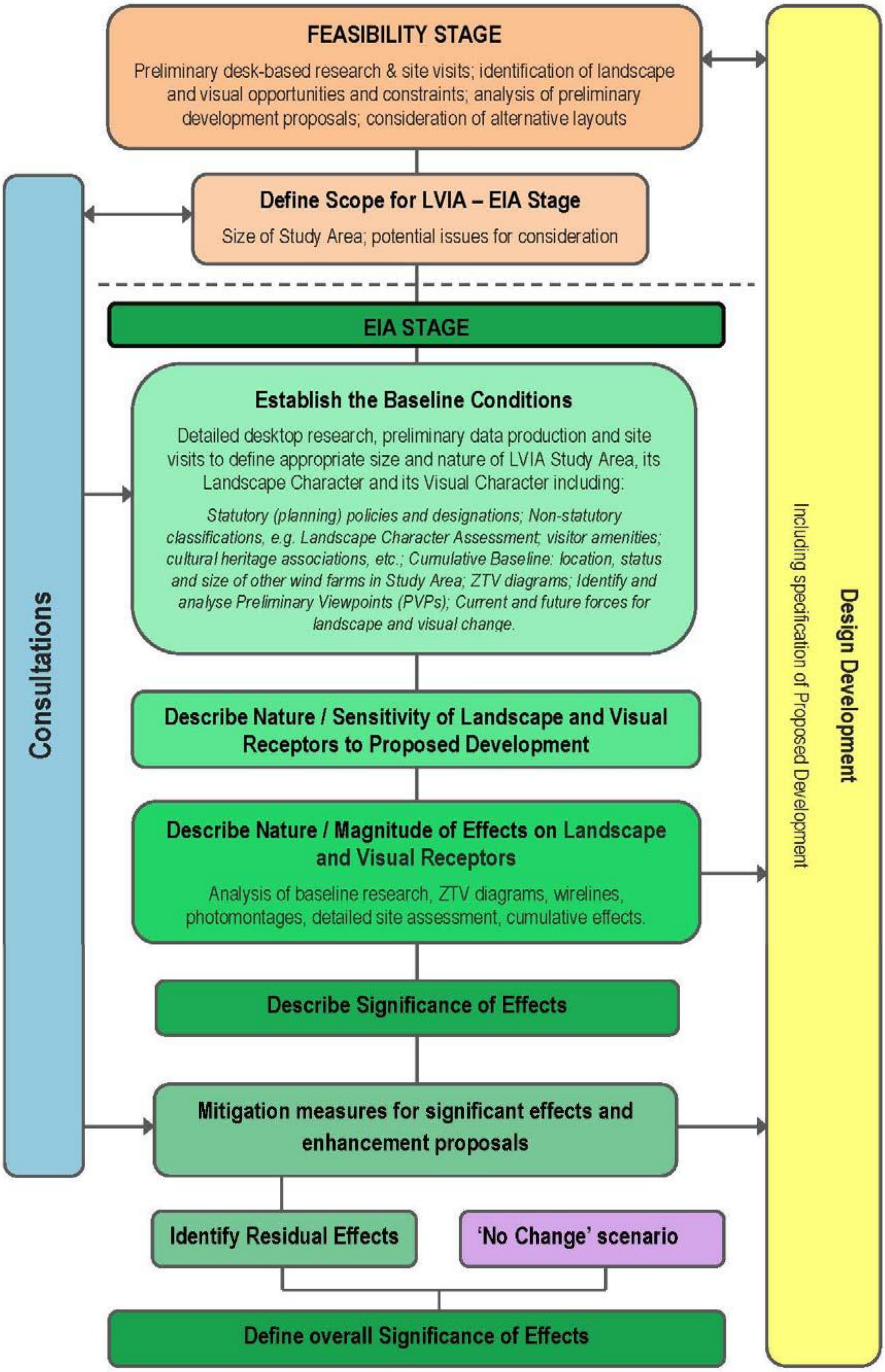
The LVIA Process

4.20 The LVIA begins with an assessment of baseline conditions combining existing desktop information, such as maps and documents, with site surveys of the Study Area by an experienced Landscape Architect. A review of relevant planning policies is carried out in order to identify any elements or parts of the Study Area which are recognised for their landscape or visual qualities and any locations that may have been identified by the SPG as being more or less suitable for wind energy development. It also evaluates likely levels of acceptable change for various parts of the Study Area in accordance with current definitions of landscape and visual sensitivity which are contained within planning policy documents (see paragraph 4.52).

4.21 Potential landscape and visual effects on the baseline conditions are then assessed as separate but linked issues. Both require a combination of quantitative and qualitative evaluation. The magnitude of landscape effects is derived from the extent to which physical changes resulting from the Development would cause changes in landscape character and value. Visual effects relate to changes in the composition of views and people's perception of/responses to these physical changes.

4.22 For both landscape and visual effects the Significance of effect is derived from the assessment of Landscape Value, Sensitivity and Magnitude of change and also by using objective professional judgement in relation to site circumstances. It is important to recognise that the landscape is constantly evolving and that opinions on the beneficial or adverse effects of wind farms are highly subjective. Therefore, in order to ensure the that the LVIA presents information objectively, whilst a judgement is made on the significance of effects, no judgement is made on whether these effects are beneficial or adverse.

Plate 4.1: The LVIA Process



Key LVIA Terminology and Assessment Criteria

4.23 The following terms and assessment criteria form the basis for the LVIA. They are fully described in Technical Appendix 4.2 and summarised below.

The Nature of Landscape and Visual Receptors

4.24 The baseline assessment element of the LVIA gathers information on the 'nature' of landscape and visual receptors which is then correlated with the nature of the Development and its anticipated 'effects' on these receptors in order to draw conclusions on the 'significance' of these effects.

4.25 This LVIA uses the term 'Landscape Sensitivity' to refer to the overall nature of landscape receptors (refer to the landscape attributes described in Technical Appendix 4.2, paragraph 4.18) and their susceptibility to the changes caused specifically by the Development.

4.26 The consideration of key landscape attributes enables a considered judgement to be made on the level of Sensitivity to be apportioned to each defined LCA within the Study Area specifically related to the Development. The following criteria outline the general principles that are used to inform and guide the assessment of Landscape Sensitivity:

- ***High Landscape Sensitivity:*** A landscape where the majority of attributes are unlikely to withstand change without causing a change to overall landscape character to the extent that it would be difficult or impossible to restore. The frequency and sensitivity of receptors may be high but not exclusively so;
- ***Medium Landscape Sensitivity:*** A landscape with a combination of attributes that is capable of absorbing some degree of change without affecting overall landscape character. There are unlikely to be large numbers of sensitive receptors;
- ***Low Landscape Sensitivity:*** A landscape where the majority of attributes are robust and/ or tolerant of change to the extent that change or development would have little or no effect on overall landscape character. It is likely to be easily restored and the frequency and sensitivity of receptors may be Low but not exclusively so.

4.27 Visual effects relate to changes in the composition of views and people's responses to these changes. The nature of visual receptors is determined through the analysis of ZTV diagrams, site assessment and viewpoints representing both typically occurring views within the Study Area and views from specific locations or those likely to be experienced by specific visual receptors (for example, visitors to a specific site such as the Giant's Causeway). 'Visual Sensitivity' refers to the overall nature of views and viewers (visual receptors) and their likely sensitivity to the changes in views that would be caused specifically by the Development. The following criteria outline the general principles that are used to inform and guide the assessment of Visual Sensitivity:

- ***High Visual Sensitivity***: may typically include residents of properties where the main view is orientated towards the Development, or people undertaking recreation where the landscape within which the Development is seen is the primary reason for attraction (e.g. walkers, cyclist and drivers on scenic routes). Receptors are more likely to be within a designated landscape and could be attracted to visit more frequently, or stay for longer, by virtue of the view;
- ***Medium Visual Sensitivity***: may typically involve people undertaking active recreational pursuits where the wider landscape within which the Development is not seen as the primary reason for attraction (e.g. golf, water sports, theme and adventure parks, historic sites, parks and gardens). Receptors are less likely to be within a designated landscape and could be attracted to visit more frequently or stay for longer by virtue of the facilities and features of the particular attraction rather than by the value of the view;
- ***Low Visual Sensitivity***: may typically include vehicular travellers; outdoor workers (e.g. farm and forestry workers); people in indoor workplaces and community facilities; and residents within larger settlements. Receptors are unlikely to be within a designated landscape and are most likely to be present at a given viewpoint by virtue of some other need or necessity unrelated to the appreciation of the landscape or visual value.

The Nature of Landscape and Visual Effects

4.28 This LVIA uses the term 'Magnitude' to cover assessment of the degree of change that would result from the introduction of the Development into the baseline landscape and visual context.

4.29 The nature of landscape effects is dependent on the degree of change that would result from the introduction of the Development in terms of size or scale, geographical extent, duration and reversibility of the proposed change and whether the effects would be experienced directly or indirectly (refer to Technical Appendix 4.2 paragraph 4.28 for further detail). The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of landscape effects:

- ***High Landscape Magnitude***: The Development would be immediately apparent and would result in substantial loss or major alteration to key elements of landscape character to the extent that there is a fundamental and permanent, or long-term, change to landscape character. The change may occur over an extensive area;

- ***Medium Landscape Magnitude***: The Development would be apparent in the view and would result in loss or alteration to key elements of landscape character to the extent that there is a partial long-term change to landscape character. The change may occur over a limited area;
- ***Low Landscape Magnitude***: The Development would result in minor loss or alteration to key elements of landscape character to the extent that there may be some slight perception of change to landscape character. The change may be temporary and occur over a limited area;
- ***Negligible Landscape Magnitude***: The Development would result in such a minor loss or alteration to key elements of landscape character that there would be no fundamental change.

4.30 The nature of visual effects is dependent on factors including, for example, the prominence of the Development with the view in question; the number of turbines that would be visible and the geographical extent of turbines across the whole view; the angle and relative elevation of the viewpoint in relation to the Development; and the context within which the Development will be seen (refer to Technical Appendix 4.2 paragraph 4.36 for further detail). The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of visual effects:

- ***High Visual Magnitude***: The Development would be a dominant and immediately apparent feature that would affect and change the overall character of the view and to which other features would become subordinate;
- ***Medium Visual Magnitude***: The Development would form a visible and recognisable new element within the overall view and would be readily noticed without changing the overall nature of the view;
- ***Low Visual Magnitude***: The Development would form a component of the wider view that might be missed by the casual observer. Awareness of the Development would not have a marked effect on the overall quality of the view;
- ***Negligible Visual Magnitude***: The Development would be barely perceptible, or imperceptible, and would have no marked effect on the overall quality of the view.

The Significance of Landscape and Visual Effects

4.31 The EIA Regulations require the LVIA to identify and assess the acceptability of significant effects. Best practice guidance recognises that the significance of effects is not absolute and is related specifically to the Development. It is also dependent on the relationship between sensitivity and magnitude.

4.32 This LVIA uses the following criteria to inform and guide the assessment of the Significance of Landscape Effects:

- ***Significant Landscape Effects:*** Effects that would occur when the majority of landscape attributes are deemed to be highly sensitive and the magnitude of change would alter landscape character to the extent that it would become defined, or considerably influenced, by the presence of the Development;
- ***No Significant Landscape Effects***: Effects would not be significant when the majority of landscape attributes are not deemed to be highly sensitive and where the Development would have little, or no, effect on existing landscape character. This would also occur where the Development can be integrated into the existing Study Area without the loss of key landscape attributes landscape effects. Where the Development is easily noticeable but the number and sensitivity of landscape attributes decreases, so landscape character will become less defined by the Development and more so by other landscape attributes.

4.33 This LVIA uses the following criteria to inform and guide the assessment of the Significance of Visual Effects:

- ***Significant Visual Effects***: Effects that would occur when the majority of visual receptors are deemed to be highly sensitive and the magnitude of change would alter visual character to the extent that it would become defined, or considerably influenced, by the presence of the Development;
- ***No Significant Visual Effects***: Such effects would occur when the majority of visual receptors are not deemed to be highly sensitive and where the Development would have little or no effect on existing views. The Development would be likely to constitute a minor component of the wider view, which might be missed by the casual observer, and awareness of the Development would not have a marked effect on the overall quality of the view. Where the Development is easily noticeable but the number and sensitivity of visual receptors decreases, so overall visual character will remain less defined by the Development and more so by other elements of the existing view.

Cumulative Landscape and Visual Effects

4.34 The purpose of the cumulative impact assessment is to measure the incremental effect of the Development on the Cumulative Baseline rather than to assess the combined effects of all, or some, of the Cumulative Baseline with the Development[2]. The magnitude of cumulative change is dependent on a number of factors, including the presence of other wind farms and the degree to which these already influence landscape and visual character and the distance between the Development and other wind farms (see Technical Appendix 4.2, paragraphs 4.60 and 4.65 for further detail).

[2] Scottish Natural Heritage (March 2012), 'Assessing the Cumulative Impacts of Onshore Wind Energy Development s' paragraphs 7 and 55, paraphrased from the GLVIA para 7.12

4.35 There are clusters of existing, consented and proposed wind farms in other parts of the 30 km Study Area and these are considered to form part of its baseline character which informs the assessment of landscape and visual effects, particularly the analysis of effects on viewpoints for this LVIA. The additional cumulative effects of the Development when considered with other wind farms and wind farm clusters in the cumulative baseline, are assessed from paragraph 4.188.

4.36 Cumulative landscape effects relate to the incremental degree of change to the existing landscape character or physical fabric of the Study Area that would result from the introduction of the Development over and above that of the Cumulative Baseline. The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of Cumulative Landscape Effects:

- ***High Cumulative Landscape Magnitude***: The introduction of the Development to the Cumulative Baseline would be immediately apparent and would result in substantial incremental loss of, or major alteration to, key elements of landscape character to the extent that there would be a fundamental and permanent, or long-term, change to landscape character. The change may occur over an extensive area;
- ***Medium Cumulative Landscape Magnitude***: The introduction of the Development to the Cumulative Baseline would be immediately apparent and would result in the incremental loss of, or alteration to, key elements of landscape character to the extent that there would be a partial long-term change to landscape character. The change may occur over a limited area;
- ***Low Cumulative Landscape Magnitude***: The introduction of the Development to the Cumulative Baseline would result in minor incremental loss of, or alteration to, key elements of landscape character to the extent that there may be some slight perception of change to landscape character. The change may be temporary and occur over a limited area;
- ***Negligible Cumulative Landscape Magnitude***: The introduction of the Development to the Cumulative Baseline would result in such a minor incremental loss of, or alteration to, key elements of landscape character that there would be no fundamental change to landscape character.

4.37 The significance of cumulative landscape effects is dependent on landscape sensitivity, the magnitude of cumulative change, and the relationship between these two factors. The following criteria outline the general principles that are used to inform and guide the assessment of the Significance of cumulative landscape effects:

- ***Significant Cumulative Landscape Effects***: Effects that would occur when the majority of landscape attributes are deemed to be highly sensitive and the incremental effects of the Development would alter landscape character to the extent that it would become defined or considerably influenced by the presence of wind farms, taking account of Cumulative Baseline conditions;

- ***No Significant Cumulative Landscape Effects:*** Such effects would occur when the majority of landscape attributes are not deemed to be highly sensitive and where the Development would have little or no incremental effect on the existing landscape character. Where the Development can be integrated into the existing Cumulative Baseline, without the loss of key landscape attributes, cumulative landscape effects would also be deemed as Not Significant. This level of significance would also occur where the Development is easily noticeable but its incremental effects would not cause the landscape character to become more defined by wind farms than it currently is, or to become more defined by wind farms than by other landscape attributes

4.38 Cumulative visual effects relate to the degree to which wind energy developments feature in particular views or sequences of views, and the resulting effects of this upon visual receptors. This LVIA considers simultaneous and sequential cumulative visual effects that may arise within the Study Area and in relation to the selected viewpoints. The LVIA principally considers the degree to which the Development would contribute to wind energy development becoming a significant or defining characteristic of visual character. The following criteria outline the general principles that are used to inform and guide the assessment of the Magnitude of cumulative visual effects:

- ***High Cumulative Visual Magnitude***: The Development would increase the scale of wind turbines in the landscape to a level at which the view would become dominated by wind farms;
- ***Medium Cumulative Visual Magnitude***: The Development would result in a noticeable increase in turbines but this increase would not result in wind farms being the dominant feature of the view;
- ***Low Cumulative Visual Magnitude***: The Development would be visible but would constitute a component of the view that might be easily missed by the casual observer and would not contribute to the overall prominence of wind farms within the view;
- ***Negligible Cumulative Visual Magnitude***: The Development would be barely perceptible, or imperceptible, and would have no effect on the perception of wind turbines within the view.

4.39 The following general principles are used to inform and guide the assessment of the Significance of Cumulative Visual Effects:

- ***Significant Cumulative Visual Effects***: Effects that would occur when the majority of visual receptors are deemed to be highly sensitive and the addition of the Development to the Cumulative Baseline would result in the view becoming defined, or considerably influenced, by wind turbines;

- ***No Significant Cumulative Visual Effects***: Such effects would occur when the majority of visual receptors are not deemed to be highly sensitive and where the Development would have little or no incremental effect on existing views. The Development is likely to constitute a barely perceptible, or imperceptible, component of the wider view, which might be missed by the casual observer. Awareness of the Development would not have a marked effect on the overall quality of the view. Where the Development may still be a noticeable addition to views containing wind farms in the cumulative baseline but it would not cause the overall visual character of the view to become defined by wind turbines rather than by other elements of the existing view the overall effects would also be deemed to be Not Significant.

Description of the Development

4.40 The Development is located on a site that encompasses the north west to south west side slopes of Teeavan Hill between approximately 0.3 – 1.2 km from the summit. Current land uses on the site are grazing land interspersed with a number of farm access tracks, some of which are lined with native mixed hedgerows, and narrow angular belts of coniferous forestry. The Development itself comprises 6 wind turbines with a maximum blade tip height of 149.9 m located between approximately 270 m – 310 m AOD. A detailed description of the Development is provided in Chapter 2 of the ES, including the turbines, infrastructure, sub-station, energy storage compound, site access arrangements, site layout, construction methods and anticipated programme of construction work.

4.41 The construction period will be approximately 18 months and the visual effects of construction traffic and work on site will be short term and experienced only in close range views. Construction traffic will use existing site access tracks with the exception of a small section in the northern part of the site where a dog-leg in the existing track will be straightened. Some sections of hedgerow and belts of forestry will be removed during the construction period to facilitate turbine access routes. The former will be replanted during the construction phase. Ground where forestry removal has occurred will be graded to tie in with adjacent site gradients and will in some cases form part of the hardstanding around the base of turbines.

4.42 During the operational phase of the Development, anticipated to be 30 years, the landscape and visual effects would primarily relate to the presence of the turbines themselves as described and analysed in the following section of this LVIA. Day-to-day site activity would be minimal and there would be no further discernible changes to the landscape or visual character of the site resulting from site maintenance activities.

4.43 In addition to the turbines, there will be a sub-station building located below the northern extent of the plateau formed by Teeavan Hill. An energy storage compound will be located behind the sub-station on the hardstanding used during the construction phase. It will comprise of four metal storage containers surrounded by mesh fencing. The sub-station and compound will not be prominent features in views because they will be screened by existing shelterbelts to the west. They will also be positioned to reflect the alignment of forestry belts on the hill and the building will be of a design and scale that will reflect the local vernacular and the general alignment of buildings and forestry within this landscape. Visibility of these structures is likely to be limited to within the confines of the site.

4.44 Following the cessation of the sites function as a wind farm, all above-ground structures would be dismantled and removed from site (unless further consent has been given to extend the operational life of the wind farm or replace the turbines) in accordance with an agreed decommissioning and restoration plan which will be agreed with the local planning authority prior to decommissioning of the wind farm.

Feasibility Appraisal, Design Evolution and Iteration

4.45 The Development that is being assessed in this LVIA has evolved through an iterative design process that has been informed by a careful analysis of the constraints and opportunities presented by the site location and the characteristics of the Development itself.

4.46 RES began the development process by identifying 7 potentially suitable turbine locations on this site. These locations were chosen by correlating on-site constraints such as hydrology, ecology and ground conditions with off-site constraints such as aviation. Next, a Zone of Theoretical Visibility diagram (ZTV) and wirelines were produced for a provisional 7-turbine layout and the potential landscape and visual issues that would need to be considered if a wind farm were to be proposed on this site were considered in broad terms based on previous experience of assessing wind farms in other this part of the Study Area. This included a preliminary analysis of the site in its wider landscape context, including its location within the Sperrin AONB and its potential relationship with other wind farms.

4.47 The feasibility appraisal concluded that the site was likely to meet the criteria for acceptable development as set out in planning policy and supplementary guidance. The 7-turbine layout presented a small ZTV in terms of its geographical coverage but the wirelines illustrated some clustering of turbines in the centre of the layout. The removal of one turbine from the western-most side of the wind farm enabled some refinements to the layout.

4.48 The 6-turbine option that is that is presented in the EIA is the result of this iterative design process. The ZTV for the 6-turbine layout is not significantly altered from the 7-turbine layout but the reduction in the number of turbines has resulted in a number of benefits, namely:

- The turbines can be more evenly spaced in relation to each other and to the site topography which has resulted in a simpler layout with fewer variations in tip heights in relation to contour AOD levels;

- There are fewer instances where 'stacking' of turbines occurs. Stacking is where two or more turbines will appear directly in front of each other in a view and will therefore result in a 'heavier' or more solid, and hence more prominent appearance;
- The reduction in the number of turbines has allowed the turbines to be located at slightly elevations away from the summit of Teeavan Hill and this has slightly reduced the level of visibility from the following parts of the Sperrin AONB: around the summit of Slieve Gallion to the south; Banagher Road to the west; B40 North Sperrins Scenic Drive to the south west.
- Ensuring that the turbines remain clear of the summit of Teeavan Hill also means that the Development is viewed as a small feature that is subordinate to the wider sequence of summits which stretch in a crescent-shaped arc from Binevenagh in the far north of the Study Area into the main Sperrin Mountain range across the western part of the Study Area. Visual effects on the AONB and this sequence of views along the Binevenagh and Sperrin ranges of uplands are minimised in all instances.

Consultation

4.49 Consultation and discussion has been ongoing between RES and the Council throughout the EIA process in relation to the iterative development of turbine layouts, turbine dimensions and the selection of final viewpoints. This is described in the Executive Summary section of this chapter (paragraph 4.8). The viewpoints that are analysed in this LVIA include locations that the Council indicated were likely to be of importance.

4.50 A public exhibition was held in March 2019 to present and discuss the Development with interested parties from the local and wider community. A map-based figure was presented to illustrate the theoretical visibility of the Development overlaid with other key features of the Study Area including AONB boundaries, the location of other wind farms, scenic driving routes, public footpaths, cycle routes and visitor attractions and also the location of all PVPs and shortlisted Viewpoints. Wirelines and photomontages of eight Viewpoints were also presented to illustrate how the Development would appear from some of the key viewpoints in the surrounding area (Viewpoints 1, 2, 4, 6, 8, 10, 13 and 15). Baseline photographs of each of these Viewpoints were also presented with annotations showing the location of areas of forestry that it is proposed to remove as part of the Development (the photomontages show the views as they would be with forestry removed).

4.51 Every effort has been made to address the comments that were received during the public exhibition in relation to landscape and visual effects in this LVIA.

Baseline Assessment

Legislation and Planning Policy

4.52 The primary policy guidance on the assessment of landscape and visual effects of wind farm development is the Strategic Planning Policy Statement for Northern Ireland (SPPS) which should be read in conjunction with Planning Policy Statement 2 (PPS 2), Planning Policy Statement 18 (PPS 18) it's Supplementary Planning Guidance (SPG) and Best Practice Guidance (BPG)[3]. Further changes in planning policy and updates to development plans are expected to take place over the next few months and years as Planning Policy Statements, supplementary guidance and existing Development Plans become entirely superseded by the SPPS and emerging Local Development Plans.

Strategic Planning Policy Statement for Northern Ireland (SPPS): Planning for Sustainable Development

4.53 The SPPS sets out strategic subject policies, including renewable energy, and is intended to provide core principles to underpin the delivery of the new two-tier planning system where the new local councils have primary responsibility for the implementation of development control. However, for the transitional period whilst Local Development Plans are being prepared, the existing suite of Planning Policy Statements, supplementary and best practice guidance and relevant provisions within the *'Planning Strategy for Rural Northern Ireland'* will remain in place.

4.54 The aim of the SPPS is to facilitate for sustainable development based on three overarching principles of supporting rural regeneration; promoting economic growth and environmental sustainability. The latter principle includes for the protection of landscape character as well as a reduction in greenhouse gas emissions, and the mitigation and adaptation to the effects of climate change is a key principle in the SPPS and the promotion of renewable energy systems is one of the means by which the planning system will achieve this principle.

4.55 'Subject Polices' for Renewable Energy are covered in paragraphs 6.214 - 6.234 of the SPPS and the SPG remains in place. The SPPS retains the European Landscape Convention's definition of 'landscape' to mean "*an area, as perceived by people, whose character is the result of the action and interaction of natural and / or human factors*"[4]. The SPPS also recognises that Northern Ireland has significant renewable energy resources and that the renewable energy industry makes an

[3] Department of the Environment Northern Ireland (September 2015) 'Strategic Planning Policy Statement for Northern Ireland (SPPS): Planning for Sustainable Development' , (2013) 'Planning Policy Statement 2: Natural Heritage); (2009) 'Planning Policy Statement 18: Renewable Energy' and (August 2010) 'Wind Energy Development in Northern Ireland's Landscapes, Supplementary Planning Guidance to Accompany Planning Policy Statement 18 'Renewable Energy'; (2009) 'Best Practice Guidance to Planning Policy Statement 18: Renewable Energy'

[4] Definition of landscape used in the European Landscape Convention (2000, Article 1.a) Council of Europe and 'Northern Ireland's Landscape Charter' (January 2014) NIEA

important contribution to sustainable development and investment in the region. Renewable energy also reduces our dependence on imported fossil fuels and benefits our overall health, well-being and quality of life. "*The aim of the SPPS in relation to renewable energy is to facilitate the siting of renewable energy generating facilities in appropriate locations within the built and natural environment in order to achieve Northern Ireland's renewable energy targets and to realise the benefits of renewable energy without compromising other environmental assets of acknowledged importance.*" (SPPS paragraph 6.218).

4.56 The strategic regional objectives are to ensure that environmental, landscape and visual amenity impacts are adequately addressed, and that natural and cultural heritage features are adequately protected. However, the SPPS also expects that the emerging Local Development Plans will support a diverse range of renewable energy developments whilst taking account of both local circumstances and the wider recognised benefits of renewable energy. Whilst the SPPS advises that a cautious approach should be applied to proposals within designated landscapes which are of significant value, and their wider settings where it may be difficult to accommodate renewable energy developments without detriment to the regions cultural and natural heritage assets it also notes that *"It will not necessarily be the case that the extent of visual impact or visibility of wind farm development will give rise to negative effects; wind farm developments are by their nature highly visible yet this in itself should not preclude them as acceptable features in the landscape. The ability of the landscape to absorb development depends on careful siting, the skill of the designer, and the inherent characteristics of the landscape such as landform, ridges, hills, valleys, and vegetation*." (SPPS paragraphs 6.230 - 231).

Planning Policy Statement 2: Natural Heritage

4.57 Policy NH 6 of PPS 2 states that permission will only be granted for new development in AONBs where it is of an appropriate design, size and scale for the locality and meets three criteria including; siting that is sympathetic to the special character of the AONB in general and also the particular locality; it respects or conserves features of importance to this character and; it respects vernacular styles and materials.

4.58 PPS 2 notes that "*the quality, character and heritage value of the landscape of an AONB lies in their tranquillity, cultural associations, distinctiveness, conservation interest, visual appeal and amenity value*" (PPS 2, paragraph 5.15). It refers to LCAs and AONB Management Plans for further information.

Planning Policy Statement 18: Renewable Energy

4.59 The aim of PPS 18, which is broadly aligned with that of the SPPS, is "*to facilitate the siting of renewable energy generating facilities in appropriate locations within the built and natural environment in order to achieve Northern Ireland's renewable energy targets and realise the benefits of renewable energy*" (PPS 18, section 3.1).

Policy RE1 states that proposals must demonstrate that they "*would not have an unacceptable impact on visual amenity or landscape character through: the number, scale, size and siting of turbines; that the development has taken into consideration the cumulative impact of existing turbines, those which have permissions and those that are currently the subject of valid but undetermined applications*".

Best Practice Guidance to accompany PPS 18

4.60 This document provides technical information and potential considerations in relation to planning applications for wind energy projects. It refers to the SPG for guidance on the landscape and visual analysis process and advice on the indicative type of development that may be appropriate but is not prescriptive. The BPG notes that "*There are no landscapes into which a wind farm will not introduce a new and distinctive feature. Given the Government's commitment to addressing the important issue of climate change and the contribution expected from renewable energy developments, particularly wind farms, it is important for society at large to accept them as a feature of the Region for the foreseeable future.*" However, it also notes that the locations of developments should be carefully considered in order to reduce their impact and aid integration into the local landscape even though they may be highly visible. (BPG section 1.3.18 - 19).

4.61 The BPG reiterates the SPPS in its recognition that visibility doesn't necessarily equate with levels of acceptability and notes that there are three considerations when considering the capacity of a landscape to accommodate wind farm development (BPG 1.3.21):

- The degree of impact the development will have on the existing character of the landscape;
- The sensitivity of the character of the landscape; and
- The extent to which this impact can be modified and reduced by design.

4.62 The BPG also refers to the inherent characteristics of a landscape, such as land form and vegetation, the careful siting and skilful design of developments all playing an important role in the ability of a landscape to absorb development. Turbine layouts must also be appropriate to the local landform and landscape characteristics; groups of turbines can normally appear acceptable as single isolated features in open, undeveloped landscapes whereas rows of turbines may be more appropriate where there are formal field boundaries within flatter agricultural landscapes. Wind farms should not appear visually confusing in relation to the character of the landscape and should ideally be separate from surrounding features to create a simple image (sections 1.3.22 & 1.3.26).

4.63 In relation to visual impact the BPG notes that wind farms in an open landscape setting are likely to be prominent features at distances below 2 km, and relatively prominent at up to 5 km. Between 5 – 15 km they are more likely to be seen as part of the wider landscape and prominent only in clear visibility. Beyond 15 km they are only likely to be seen in clear visibility and as a minor element in the landscape (section 1.3.25).

4.64 It is noted that Scottish Natural Heritage's best practice guidance in relation to the siting and design of wind farms has been updated since the BPG was published and no longer refers to specific distances in relation to visual prominence (see Technical Appendix 4.1, paragraph 4.3). Their research has found that other factors such as weather conditions, time of day/year, angle of view, and composition of other elements in the view, all contribute to the assessment of visual effects and visual prominence.

Supplementary Planning Guidance to accompany PPS 18

4.65 The SPG is intended to provide broad strategic guidance on appropriate locations for wind energy development based on the definition of LCAs within the Northern Ireland Landscape Character Assessment (NILCA). It advises that the detailed assessment of the nature of a wind farm's effects on landscape character should be dealt with on a case-by-case basis via an LVIA. The SPG itself is non-prescriptive with regards to turbine heights and groupings. Its assessment of landscape sensitivity is intended to provide broad guidance but not to exclude development. Rather it places an onus on developers to demonstrate, via the EIA process, that wind farms can be developed without unacceptable effects on LCAs as a whole.

4.66 The SPG recommends a 20-30 km radius Study Area for medium or large commercial height turbines, which has informed the selection of a 30 km Study Area for this Development. The SPG includes recommendations that are specific to the potential effects of wind energy developments on the character of individual LCAs. The SPG as it relates to the Development is analysed starting at paragraph 4.96.

4.67 The assessment of Landscape Value and Sensitivity for some LCAs has been altered from the SPG where detailed site survey in relation to Development has revealed variations in particular areas. This is in accordance with the SPG, which states that, "*It should be noted that within many LCAs there is considerable variation in sensitivity level across the area, reflecting the fact that the LCAs are broad character or identity areas. The overall sensitivity level is therefore the level that prevails over most of the LCAs geographic area. Localised areas of higher or lower sensitivity may also exist and these are generally identified in the sensitivity descriptions within each LCAs assessment sheet. The overall sensitivity level of a LCA is indicative of the relative overall sensitivity level of each LCA. A high sensitivity level does not necessarily mean that there is likely to be no capacity for wind energy development within the LCA and conversely a low sensitivity level does not mean that there are no constraints to development*" (SPG section 2.3).

Emerging Council Policy

4.68 Changes in planning policy and updates to development plans are expected to take place over the coming months and years as Planning Policy Statements, supplementary guidance and existing Development Plans become superseded by emerging Local Development Plans, which will be primarily informed by the SPPS.

Analysis of the Developments Effects on Planning Policy

4.69 Although the Development is located within the Sperrin AONB, which is an environmental asset of acknowledged importance (the Developments effects on the AONB are analysed starting at paragraph 4.82) the Development is in an appropriate location within the AONB and is located in accordance with the main stipulations of relevant planning policies and guidance.

4.70 The SPPS, which is the overarching policy document, recognises that renewable energy is a beneficial type of development provided it is appropriately located. The SPPS also reiterates the European Landscape Convention's definition of landscape as being a result of both natural and human factors. This site conforms to these policy stipulations because it is largely characterised by human-influences including forestry and agricultural activities on site and in adjacent areas, and it is bounded by large areas of coniferous forestry, areas of urban and rural settlement and a primary road corridor – the A6 - which is currently being re-routed which will bring it into closer proximity to the site.

4.71 PPS 2, Policy NH6 notes that the special qualities of AONB's include tranquillity cultural associations, distinctiveness, conservation interest, visual appeal and amenity value. The evidence of long-standing use of some parts of the site and surrounding landscape for forestry have lessened its landscape quality and condition but good farming practices have ensured that it is in good physical quality and therefore has a robustness of landscape character. There are expansive views to the north and west from elevated parts of the site but it is private land with no public access. Features of amenity value and cultural interest in the surrounding landscape include the dam at Altnaheglish, and the large area of forestry at Banagher.

4.72 PPS 18 and its Best Practice Guidance are generally promotive of wind energy development in appropriate locations and note that the capacity of a landscape to accommodate such development is dependent on the existing character of the landscape, which in this case is already influenced by a number of other dominant human factors which reduce the sensitivity of the receiving landscape character. Furthermore, through a process of iterative design, the Development has been refined to minimise its effects on key landscape and visual features. The site has visual appeal and value by virtue of its location within the Sperrin AONB. However, the Development would have minimal visibility across the Study Area in general and notably from most parts of the two AONBs which are located within the Study Area. It occupies a small peripheral site on the north eastern side of the Sperrin AONB and will not be visible from the majority of the AONB, or from the most parts of the Binevenagh AONB which is located approximately 25 km to the north east. The SPGs guidance on landscape character considerations for wind energy development in LCA 29 Sperrin Mountains is considered in further detail starting at paragraph 4.97.

Baseline Landscape Character Assessment and Analysis of Effects

The Site and the Study Area

4.73 The Study Area for this LVIA extends to a radius of 30 km from the centre of the Development (An map-based analysis of the Study Area is provided in Figure 4.1 and the extent of the Study Area is indicated on all map based figures in Section 4, Volume 3 of the ES). In broad terms the Study Area is split from the north east to south west between Counties Derry and Tyrone and it can be divided into three distinct parts:

- A distinctive crescent-shaped series of uplands which run through the centre of the Study Area from the north east to the south west. The northern end is a relatively narrow band formed by the Binevenagh range of uplands. This broadens in the central part of the Study Area where it merges with the summits of Carntogher Mountain, Benbradagh and the Glenshane uplands which are dissected by the A6 road corridor linking Belfast and the eastern side of the Province to Derry in the north west. These uplands broaden further into the extensive bowl-shaped formation of the Sperrin Mountains and outlying hills which combine to form the Sperrin AONB. This latter series of uplands encircle and physically enclose the Glenelly Valley which forms the heart of the AONB. There are a series of large coniferous forestry plantations and clusters of existing and consented wind farms located along this profile of uplands (the latter are further described from paragraph 4.188;
- The western quarter of the Study Area comprises largely of pastoral countryside lying within the Roe Valley and the low lying floodplain on the southern shores of Lough Foyle. The southern edge of this part is defined by the A6 road corridor and the north-facing edge of the Sperrin Foothills. The eastern edge is contained by the Binevenagh uplands and AONB. At the north and north-western edges are the city of Derry and industrial development around its periphery. There are small towns and villages located along and linked together by the primary and secondary road network in this part of the Study Area. There are also rural dwellings scattered throughout the countryside including the upland parts. In the centre of this part of the Study Area the Loughermore Hills forms a broad rounded upland profile which contains a large cluster of wind farms and coniferous forestry plantation;
- The north eastern to south eastern part of the Study Area also comprises largely of a pastoral landscape crossed by a network of primary, secondary and tertiary roads along which there are a series of small towns, villages

and rural dwellings. The western edge of this part of the Study Area is contained by the Binevenagh, Glenshane and Slieve Gallion uplands. The north eastern side is contained by the Long Mountain ridge of hills which is located just beyond the edge of the 30 km Study Area (and includes a further cluster of existing and consented wind farms), and the south eastern edge becomes flatter and more low-lying in proximity to the shores of Lough Neagh which are also located just beyond the edge of the Study Area.

4.74 The proposed site is located around the north western to south western side slopes of a small rounded hill – Teeavan Hill – which has a summit at 329 m AOD. It is in the townland of Magheramore approximately 4 km to the south of Dungiven town centre. The proposed turbines would be located approximately 0.3 km from the summit at their nearest point (T2) and 1.2 km at their furthest (T4) at base heights between approximately 270 m (T4) – 310 m (T2) AOD. There is much evidence of human influence on the site which is currently used as grazing land interspersed with a number of farm access tracks, some of which are lined with native mixed hedgerows, and narrow angular belts of coniferous forestry which are distinctive features on the upper slopes.

4.75 Teeavan Hill is the lowest and northern-most hill within a small group of hills which form an outlying upland area on the north western edge of the Sperrin Mountain range where these mountains meet and merge with the Binevenagh and Glenshane uplands. Together they combine to physically contain the southern end of the Roe Valley. Teeavan Hill is divided from the other hills in this group by the Altnaheglish River and Reservoir which are located at the southern base of the hill. Beyond this the land rises further to a group of three higher summits - Altnaheglish Hill (397 m AOD), Streeve Mountain (390 m AOD) and Crockalougha (407m AOD) - which are covered by an expansive coniferous plantation – Banagher Forest. This merges with Moyladamlaght and Altbritain Forests on either side of the B40 road corridor to the south of the Development. There are also large plantations at Glenshane to the east of the site, and in the wider Study Area at Loughermore in the north west, a series of large plantations along the Binevenagh range of upland in the north east, and several in the heart of the Sperrin AONB around the B47, Davagh Forest near Lough Fea and Gortin Glen to the south west. Coniferous forestry is a dominant land use in immediate proximity to the Development and on upland areas throughout the wider Study Area, including much of the Sperrin AONB.

4.76 There are a number of large towns and also Derry city which are located within the Study Area but they tend to be located at some distance from the Development and outwith the ZTV. These towns include Limavady (which is approximately 16 km to the north); Coleraine 9 km to the north east); Magherafelt (25 km to the south east); Cookstown (28 km to the south east). Derry city is located on the north western edge of the Study Area. Dungiven and Feeny are the nearest settlements to the Development – the former is a small town located approximately 4 km to the north, the latter a small village located approximately 6 km to the west. There are many other small towns and villages around the outskirts of the Sperrin AONB including Park, Claudy and Dunamanagh across the central western part of the Study Area and Garvagh, Swatragh, Maghera, Tobermore and Draperstown to the east. There are also residential dwellings located along the rural road network throughout the lowland parts of the Study Area between larger settlements. There are more rural dwellings and farmsteads throughout the lowland slopes to the west of the proposed site which give this part of the Study Area a managed pastoral character.

4.77 Around its northern and western bases Teeavan Hill is defined by tributaries to the River Roe and a network of tertiary rural roads with rural settlement along all parts of the road network. Both road and river corridors are well vegetated and there are attractive areas of mixed woodland along the River Roe and Altnaheglish River corridors and Banagher Glen in particular. The latter is a popular visitor attraction in the local area. Beyond the immediate base of Teeavan Hill there is a secondary road network linking the villages of Feeny and Park to the town of Dungiven and the A6 road corridor which is located to the north of the Development. The landscape surrounding these road corridors is largely in good condition and attractive. There is a complex mix of pastoral fields divided by trees and hedgerows and interspersed with rural dwellings, farmstead and some ribbon development extending from Dungiven town.

4.78 The town itself is located at the southern end of the Roe Valley and the A6 crosses the river at the western side of the town. The majority of the town is located on the northern side of the A6 road corridor which currently forms the main street but which is in the process of being re-routed to bypass the southern side of the town and it will dissect the countryside to the west. Dungiven Castle is prominently located on the edge of the town overlooking the wooded river corridor and environmental park at the southern edge of the town with expansive views along the northern edge of the Sperrin AONB beyond this.

4.79 The site is located within the Sperrin AONB near its north eastern edge overlooking the Roe Valley and within the Sperrin Mountains LCA as defined in the NILCA, both of which are described in detail below. There are no statutory designations of relevance to the LVIA within or immediately adjacent to the site other than the AONB. There are however a number of landscape classifications in proximity to the Development which allow public access and enjoyment of this part of the Sperrin AONB. A section of the Ulster Way waymarked trail runs along Tamniarin Road approximately 3 km to the east of the site on the opposite side of Banagher Forest. It then loops into Moyladamlaght and Glenshane Forests further to the south east and east. The North Sperrins Scenic Drive follows a number of roads which encircle the Development including parts of the B40 and B74 to the south west and north west. There are also footpaths in Banagher Glen providing access to the mixed woodland along the river corridor and terminating at Altnaheglish Dam and reservoir. In the wider Study Area there are a number of other Scenic Drives, footpaths and cycle routes (see paragraph 4.109).

Landscape Designations

4.80 The European Landscape Convention (2000) requires member states to recognise that all landscapes can have value, and this value may vary from person-to-person. Statutory designations are one of the criteria used to assess the Significance of effects on landscape character and visual amenity in an objective manner. Whilst it is recognised that all landscapes have some subjective importance, particularly for those who live and work in them, or use them for leisure, designation gives an indication of a landscape's 'value to society'. Landscapes are designated by statute, and policies for their protection, use, and management are included in Development Plans, usually following a consultation process (which seeks to reach a consensus opinion, thereby reducing subjectivity). The national, regional and local designations that have been identified as being relevant to the landscape and visual character of this Study Area are described in the following paragraphs and illustrated in Figures 4.1 - 4.3.

4.81 Statutory landscape designations are contained within the current planning policy and guidance which cover the Study Area. The primary designated landscape within the Study Area is the Sperrin AONB and policy guidance in relation to this designation is contained within the SPPS, PPS 2, PPS 18 and SPG which are described in the preceding paragraphs. The nature of the Sperrin AONB and the effects of the Development on this landscape are analysed starting at paragraph 4.82. Other AONBs and statutorily designated landscapes within the Study Area are analysed in subsequent paragraphs.

Sperrin Area of Outstanding Natural Beauty

4.82 AONBs are the principal landscape conservation designation in Northern Ireland. The designation gives statutory recognition to the high scenic quality and distinctive landscape character of an area and the need to ensure that sensitive conservation measures take place to preserve these qualities alongside measures to allow public access and enjoyment of the area. The needs of local communities, including their social and economic well-being, is a key management objective, although development deemed to be detrimental to environmental quality is not permitted within AONBs. The landscape around AONBs performs an important function by providing context, particularly in view to and from the AONB and from key approach routes.

4.83 There are two AONBs within the Study Area for the Development. The Binevenagh AONB is located approximately 20 km to the north of the Development and the potential effects of the Development on the AONB are described in subsequent paragraphs. The Sperrin AONB is regarded as the primary designation to be considered in this LVIA because the Development and a large proportion of representative viewpoints are located within it. Its landscape characteristics, including their potential sensitivity to the Development, and the potential nature, or Magnitude of effects on this AONB are described below. The sensitivity, magnitude and significance of visual effects on receptors located within the AONB are described and analysed in the assessment of Visual Effects. The AONB boundary is shown on all map based figures that accompany the LVIA (Figures 4.1 – 4.12).

4.84 Sperrin is the largest AONB in Northern Ireland, covering 118,206 hectares, and was one of first to be designated in 1968. In 2008 it was re-designated to increase its boundary slightly in most directions to encompass areas around its previous boundary which share similar scenic qualities. Overall the landscape character of the AONB comprises broad rounded mountains and high plateaus dissected by narrow glens and lowland moorland. The landscape is often relatively remote and sparsely populated with little access via roads or footpaths, but the fringes are less remote and more strongly characterised by human influence as evidenced by the forestry, primary road corridor, agricultural land and small towns and villages located around the part of the AONB in which the Development is located.

4.85 The LVIA baseline assessment could not identify the existence of a published strategy for the Sperrin AONB, such as a management plan the like of which does exist for other AONBs in Northern Ireland. Therefore, specific information on the Sperrin AONB has been gleaned from a number of other sources including: the NIEA website, which contains a brief and general summary; the Northern Ireland Landscape Character Assessment series, which provides fairly detailed information on landscape and visual character of the various parts of the AONB; and the Supplementary Planning Guidance to PPS 18 (SPG) which provides further analysis of this character specifically in relation to wind energy developments.

4.86 The primary means of access for visitors to this AONB is by road. There are four scenic driving routes on parts of the secondary and tertiary road network in this AONB which allow visitors to appreciate many parts of the AONB and its various amenity sites and visitor attractions. The majority of these tend to be located in lower lying rather than upland parts of the AONB which are generally less accessible. The North Sperrin Scenic Drive is a 50 mile long route which passes in close proximity to the Development. The National Cycle Network also covers small parts of the tertiary road network around Claudy and Park villages on the northern edge of the AONB, and around Gortin and Davagh Forest in the central southern part of the AONB. The Ulster Way is primarily focussed around the north eastern part of the AONB around Benbradagh and across the centre of the AONB in the Glenelly Valley. There are very few footpaths providing access to the highest summits in the heart of the AONB. Scenic drives, cycle routes and footpaths have been taken cognisance of in the viewpoint selection process. A number of Provisional Viewpoints were identified within the Sperrins AONB (Technical Appendix 4.4 and Figure 4.4) and several were selected for more detailed analysis (Viewpoints 1 - 8, 12 – 15, 16 and 18 starting from section 4.126). However, the majority of these Viewpoints are located at relatively close range to the

Development and the ZTV indicates very limited visibility of the Development in the AONB as a whole. No viewpoints were identified in the majority of the AONB, including the heart of the area formed by the Sperrin Mountain range itself.

4.87 The descriptions of the thirteen LCAs that are located within the Study Area and AONB boundary provide the most detailed information on landscape and visual characteristics of the various parts of the AONB. The Development is located towards the north eastern edge of LCA 29 Sperrin Mountains which is located in the centre of the AONB and this is analysed in detail starting at paragraph 4.97. Parts of LCAs 30, 36, 37 and 41 also fall within AONB and the ZTV for the Development and a summary of their Value and Sensitivity to the Development is included in Technical Appendix 4.3. LCAs 24, 25, 26, 28, 39, 40, 43 and 51 would contain few to no views of the Development. They have not been analysed further for this reason. The location of all LCAs is shown on Figure 4.3.

4.88 Although the Development is located within LCA 29 it is not located near the core of the AONB. However, it is recognised that the proposal is within the AONB and that the site has merit in terms of its contribution to the AONB's landscape and visual character. The layout and position of the Development has therefore been designed to minimise its effect on the AONB as a whole. This has been achieved by locating it away from the core area containing the majority of visitor attractions and key landscape features such as the highest summits centred on Sawel Mountain and the Glenelly Valley, and attractions such as Gortin Glen, the Ulster American Folk Park, An Creagan Visitor Centre and Beaghmore Stone Circle[5]. It is also in a location that is neither prominent nor highly visible from the rest of the AONB nor from other parts of the Study Area with good views to the core part of the AONB.

4.89 The proposed site is used primarily as grazing land with some forestry. Adjacent areas are dominated by large coniferous plantations with degraded field boundaries and are suffering from increasing amounts of coniferous forestry, which the NILCA identifies as the most detrimental force of landscape change in this LCA. Elsewhere in the AONB quarrying is also identified as a detrimental activity. The nearest quarries are approximately 1.3 km from the Development on the Magheramore Road and approximately 1.2 km to the east on Creebarky Road. There are also quarries along the A6 and on Keady Mountain as well as a number of sand and gravel extraction sites around Slieve Gallion to the south east. There is a pattern of clustering wind farm developments on upland areas around the periphery of the AONB and also along the uplands which continue northwards. The Development maintains this pattern and is less detrimental to the overall landscape character of the AONB than forestry or quarrying because it will not have permanent presence. Whilst forestry and quarry both leave permanent marks on the landscape, wind farms are considered to be long term temporary rather than permanent developments which will ultimately be removed and the sites reinstated back to their previous uses. The site of the Development does not contribute significantly

[5] https://exploreomaghsperrins.com ; https://discovernorthernireland.com/explore/the-sperrins/

to the unique character attributed to the high summits and heart of the AONB. Neither does it contain significant visitor amenity facilities that are likely to attract the most sensitive receptors – the main tourist attractions tend to be located within the core of the AONB and look inwards rather than outwards into the surrounding countryside. The four scenic driving routes in the AONB offer a series of visual experiences and links to a number of points of interest throughout most landscapes around the edges of the AONB and the central south western area. All these scenic driving routes are likely to feature views towards existing and consented clusters of wind farms in other parts of the Study Area. Only two roads on the North Sperrins Scenic Drive would be located in proximity to the Development.

Other Areas of Outstanding Natural Beauty

The Binevenagh AONB

4.90 This AONB is located at some distance - approximately 18 – 20 km to the north east of the Development and is unlikely to experience any significant effects on landscape character. However, it contains a number of landscape features and tourist attractions including parts of the Ulster Way and a scenic driving route to the summit of Binevenagh and the ZTV indicates potential visibility from the south west-facing side. Therefore, it was considered during the PVP selection process and two Viewpoints (Viewpoints 19 and 20) were selected to illustrate potential visual effects (see paragraph 4.177).

Other Statutorily Designated Landscapes in the Study Area

Register of Historic Parks, Gardens and Demesnes

4.91 The Register identifies sites that are considered to be of exceptional importance within Northern Ireland, which have historic significance, and which may also contribute to local landscape character. It is maintained by NIEA Built Heritage. Inclusion on the Register affords sites protection through the SPPS and Planning Policy Statement 6 (PPS6)[6] which requires NIEA to make comment on the protection of such sites as part of the planning consultation process. The SPPS states that permission would not be granted for development that would harm the overall character of site's integrity, overall quality or setting and its contribution to local landscape character should be maintained where possible.

4.92 There are a large number of registered sites located within the Study Area particularly on the edge of settlements. However, few are likely to have views of the Development due to screening factors such as surrounding built development, high levels of tree cover and flat topography in low lying areas. Only Dungiven Castle is likely to have clear views of the Development and it is not understood to be publicly accessible at present, however effects are detailed in Chapter 5: Archaeology and Cultural Heritage. No registered sites have been identified for detailed landscape and visual assessment.

[6] Department of the Environment (March 1999) 'Planning Policy Statement 6: Planning, Archaeology and the Built Environment'

Non-Statutory Landscape Classifications

The Northern Ireland Landscape Character Assessment

4.93 The NILCA classifies the landscape into six broad regions and 130 smaller areas of distinct and separate character called Landscape Character Areas (LCAs). The SPG accompanying PPS 18 provides further broad guidance on these regions and LCAs including the overall sensitivity of LCAs specifically in relation to wind energy developments. The descriptions of landscape and visual character in this LVIA are based on the NILCA and the SPG which includes descriptions of both. They are also inextricably linked to the description of the key characteristics of the Sperrin AONB and some elements of the subsequent LCAs have already been analysed in the preceding sections.

4.94 There are 26 LCAs within the Study Area of which 12 are located wholly or partially within the Sperrin AONB. They are illustrated on Figure 4.3. The Development is located within LCA 29 Sperrin Mountains and would therefore have a direct physical effect on small part of this area, which is described in detail below. The Development may also have a potential indirect effect on the setting of parts of a further 4 LCAs which are in close proximity to it, or which contain viewpoints used in this LVIA. These LCAs are listed in Appendix 4.3. There are 21 LCAs within the Study Area which have not been assessed in detail because, following the Baseline Assessment and site surveys, they are unlikely to be significantly affected by the Development. In particular, LCAs on the periphery of the Study Area and the ZTV, and those which do not contain viewpoints have not been subject to a detailed assessment. These LCAs are also listed in Appendix 4.3. The ZTVs are illustrated in Figures 4.6 – 4.10.

4.95 The SPG accompanying PPS 18 provides further broad guidance on the LCAs that are defined in the NILCA, including their overall sensitivity, specifically in relation to wind energy developments. Broad landscape and visual character issues to be considered in relation to wind farm development in the North West are provided in section 3.3.2 of the SPG:

- Effects on a number of specific skylines, separation distances and thresholds of wind energy developments on a number of specific ridge lines, none of which are located in proximity to the Development or from which the Development is likely to be visible from and are therefore not considered to be of relevance to this LVIA. It is also noted that the term threshold is not quantified in the SPG or in any related policy or guidance documents as far as we are aware;
- Effects on the wild character of some landscapes, and effects on the landscape character, scenic value and setting of the Sperrins of any development in the Sperrin Foothills and Carrickmore Hills LCAs. The Development is not located within either of these LCAs. It is located within the Sperrin LCA but not a part which could be described as wild and

the ZTV indicates that there is minimal potentially visibility within the Sperrin LCA as whole or the wider AONB. Potential landscape effects on the setting and scenic value of the Sperrins are analysed from paragraph 4.82. Visual effects are analysed from paragraph 4.114;

- Effects on transport corridors and important tourist routes including the A6 which is of particular relevance to this LVIA. A series of viewpoints (Category B Viewpoints) have also been selected to illustrate sequential views along the A6 road corridor. Effects on scenic driving routes are analysed via the inclusion of a number of viewpoint locations on the four Sperrin scenic driving routes and also the Binevenagh Loop (Viewpoint 20) and Roe Valley scenic drives (the latter was addressed during the PVP selection process and discounted due to lack of visibility, see Technical Appendix 4.4;
- Visual effects on the Erne Lakelands and cumulative effects with trans-boundary development in Co. Donegal are issues that are not deemed to be of relevance to this LVIA because both issues fall well outwith the geographical coverage of this Study Area.

4.96 General and area-specific principles for the layout, siting and design of wind farms are provided in section 3 of the SPG. Of particular relevance to the Development are:

- Adequate and appropriate spacing depends on landscape character, including pattern and rhythm, and the degree of intervisibility between wind farms. It is necessary to maintain areas of undeveloped landscape between wind farms in order to prevent a landscape becoming dominated by them, although the SPG also recognises that clustering a number of wind farms together may also be an appropriate means of creating coherent groups of turbines. The Development maintains adequate separation distances between the nearest wind farms to it which are at Ballyhanedin approximately 6.7 km to the north west and the Carntogher cluster approximately 8.2 km to the north east at its nearest point. The latter is very rarely intervisible with the Development except in views located to the north of the Development where it maintains the pattern of wind farm development on the side slopes of the ridges between Binevenagh and central Sperrins. This rhythm can be seen in the Figures illustrating Viewpoints 19 – 22. The Development occupies a lower and more subordinate position within the wider expanse of uplands on which these other wind farms are located;
- Small turbine groupings, such as that of the Development, are likely to fit best in small scale and more intricate landscapes. Landscapes with a strong horizontal form are more likely to accommodate larger groupings. Complex and varied landforms may experience undesirable flattening effects from the latter. The Development is located on a broad rounded

hill and has a simple compact layout which reflects that of the underlying topography and relates well to the more complex and varied land cover elements of the pastoral landscape in the lowlands surrounding Teeavan Hill. It is not physically located within these lowland and is clearly distinguishable from it. The upland character of Teeavan Hill provides adequate separation between lowland and upland areas. The elevation of the site in relation to the higher uplands which surround it mean that the turbines will remain well below the skyline in views where it is seen within the wider landscape context;

- The turbine layout is simple and coherent and would not be directly comparable to any other wind farms in close proximity to it which is reflective of the principles in the SPG;
- The SPG notes that the central part of upland areas will often be the least visible from adjoining lowland landscapes but in this case the central part of the uplands are the most sensitive because they form the heart of the Sperrin AONB. The nature of the topography in the AONB means that locations around the edge of these uplands are likely to be less prominent and will also reflect the pattern and rhythm of wind farm development around the fringes of the AONB that are already being implemented through the construction and consent of other wind farms;
- The SPG also advises that less prominent side slopes are often better to minimise the prominence of turbines and the Development has been located in accordance with this principle;
- Sites characterised by heather moorland and bog are described as having a wilder character but sites containing forestry and improved grassland, such as the site of the Development, are regarded as being of less sensitivity. Proximity to scale indicators such as lines of forestry is noted as having the potential to increase apparent turbine heights. The Development includes proposals to remove some shelter belts of coniferous forestry in proximity to two of the turbines which will reduce the number of visually distractive land uses which currently exist. In some cases the areas of retained forestry also serve to provide some element of screening. This is also the case of off-site forestry which serves to screen views from, for example, Viewpoint 1 and 2 in part (Figures 4.13 and 4.14);
- Commercial forestry also introduces a man-made influence to landscapes that may otherwise seem natural, thereby reducing sensitivity. There are large expanses of coniferous forestry across the uplands in the Study Area. The landscape within the Study Area is also influenced by other man-made elements including quarries, television aerials, roads, and clusters of existing and consented wind farms;

- Sites should relate well to the broad grain of the topography and not distract from or obscure important character distinctions such as the transition between uplands and lowlands. The Development is a relatively neat and compact layout that reflects the character of Teeavan Hill on which it is located and which is also a relatively small, compact and rounded hill located at the edge of the Sperrin LCA.
- Siting should respect landscape settings and skylines, particularly those around distinctive landform features, settlements, historic landmarks and areas designated for scenic quality. The Development would be clearly visible from the summit of Benbradagh and the town of Dungiven but would occupy a relatively small proportion and lower elevation than the wider crescent-shaped expanse of mountains and uplands which define these settings and form the skyline as well as the edge of the Sperrin AONB. Viewpoint 15 which is located near the summit of Benbradagh clearly illustrates the position of the Development in relation to the wider landscape and edge of the AONB (from paragraph 4.168 and Figure 4.27);
- Prominent and highly visible skylines, for example at the edge of upland areas, as well as significant effects on key views from important viewpoints and popular scenic routes should be avoided. The Development is located at the edge of an upland area but not on a prominent or highly visible skyline. Key viewpoints and scenic routes were analysed as part of the Viewpoint selection process (Technical Appendix 4.4) and viewpoints located on some scenic driving routes in the Sperrin and Binevenagh AONBs and along the A6 have been selected as viewpoints 2, 3, 10, 11, 15 and 20 (Figures 4.14, 4.15, 4.22, 4.23, 4.27 and 4.31);
- Landscapes that do not form distinctive backdrops tend to be less sensitive. There are a number of summits and uplands within the Study Area, such as Binevenagh, Rigged Hill, Benbradagh, Slieve Gallion, Slieve Kirk, Loughermore and the central Sperrin mountains which all have very distinctive profiles and which combine with each other to form a distinctive crescent-shaped profile of uplands that extends across much of the Study Area to provide a backdrop to the lowland parts of the Study Area and the settlements located within it (see Figure 4.1). The Development's position on the side slope of a secondary hill within the Sperrin LCA means that it does not make a prominent contribution to the overall Sperrin range or to the function of this expansive sequence of uplands as a distinctive backdrop.
- Other principles of the SPG to which the Development conforms include: forming a coherent group of turbines with relatively consistent heights and spacings; avoiding a location that is wild or remote; minimising the overlapping of turbines; few instances where only the blades of turbines would be visible and would create a distracting image below upland edges;

utilising a site that has a network of existing tracks and access points and is characterised by human influence and land uses.

Landscape Character Area 29: Sperrin Mountains

4.97 The SPG's assessment of the Sperrin Mountains LCA, within which the Development is located, briefly summaries its landscape characteristics, defines its overall sensitivity to wind energy and its capacity to accommodate certain turbines groups and heights.

The SPG's description of Key Landscape and Visual Characteristics and Values

4.98 The SPG describes the Sperrin Mountains LCA as dramatic east-west spine of mountains running across the North West of Northern Ireland. The ridges have a broad rounded profile whilst the summits often have rocky pointed profiles averaging 500m in height and rising to 678m at Sawel Mountain which is the highest summit and which is located approximate 9.9 km to the south west of the Development. The lower slopes are often softened and broken up by mounds and terraces formed by glacial deposits with deep branching gullies and streams in the lower valley areas between the mountains. The LCA is generally open and exposed with some areas of coniferous forestry. Summits have extensive areas of bog and heather moorland and stone walls which follow historic townland boundaries. The lower valleys often retain a historic agricultural field pattern divided by earth banks, hedgerows and stone walls with a patchwork of broadleaved woodland.

4.99 The SPG notes man-made influences in this LCA as being localised and including a wind farm at Owenreagh, conifer plantations prevalent in the eastern section and at Banagher Forest forming dark geometric blocks on slopes and a number of quarries. It is also noted that there are extensive areas of forestry and clusters of wind farms located in several of the LCAs surrounding the Sperrin LCA which combine to form the AONB, particularly to the north but also to the south west and south east (see Figures 4.1 and 4.5). Within this LCA there is also the dam at Altnaheglish within Banagher Forest and a registered park and garden at Learmount near Park village which are wholly man-made landscapes, the latter with little relationship to the key upland features of this LCA.

4.100 Whilst there are many prominent ridge lines in this LCA the skyline in the eastern part of the LCA is described as being generally lower and more broken with the main skyline features including Knockavoe and Owenreagh Hill as well as other smaller individual hills. To the west the ridge broadens and increases in height. It is noted that Knockavoe and Owenreagh are in fact located in the western section of the LCA and it is assumed therefore that the increase in ridge height is located to the east of these hills and towards the middle and eastern side of the LCA where they conjoin with the adjacent uplands of Binevenagh and Glenshane. This LCA forms the wider setting for surrounding towns including Strabane to the west, Dungiven to the north east and Draperstown to the south east. The LCA is also described as iconic feature in south and westward views from the A6 road corridor.

4.101 The Development site is located some distance from the highest parts of the LCA and the rounded summit, although meeting the SPG's description of being open and exposed with some coniferous forestry, is well below the average height of the majority of hills within the LCA, rising to only 329 m (the summit of Sawel Mountain the heart of the Sperrin Mountain range is at 678 m AOD and the summits immediately surrounding the site range from 390 m – 407 m, see paragraph 4.74), and is also more agricultural in character that the wild remoteness that the SPG attributes to the core parts of this LCA. The turbines would be located at heights of 270 m – 310 m AOD.

The SPG's description of Landscape Value of LCA 29: Outstanding

4.102 The SPG describes this LCA as a stunning mountain landscape of very high scenic quality which forms the heart of the Sperrin AONB and which represents wildness more strongly than any other part of Northern Ireland apart from the Mourne Mountains. The scenic quality is noted as being a key attraction for tourists and walkers although much of the LCA is also described as being remote and inaccessible, particularly towards the eastern end of the ridge. However, despite the lack of formal footpaths over the higher upland areas there are some waymarked trails available via tourist publications and marked in some locations within the LCA. The Glenelly Valley and Sperrin Foothills LCAs which lie adjacent to the Sperrin Mountains are easily accessible by road and there are small towns and villages located around its boundaries so, although the SPG describes the landscape character as wild, there are no parts of the LCA that are located any great distance from areas of settlement or that are not influenced by human land uses. Visitor attractions and cultural heritage sites tend to be located in and around the network of tertiary roads.

4.103 The physical condition of the landscape does not match its scenic quality. The historic field pattern on lower slopes has become derelict and overgrown with rushes and scrub in areas where poor soils have resulted in an abandonment of agricultural practices. The extensive coniferous plantations at Banagher and the smaller areas of forestry in other parts of the LCA, including several narrow bands and blocks on the site of the Development, are also visually detractive man-made features.

4.104 A more detailed consideration of the proposed site in relation to the overall description of this LCA has concluded that it is in relatively good physical condition and is managed primarily for grazing with shelter belts of coniferous forestry and farm access tracks. It is located at the north eastern edge of this LCA but does not conform to the SPGs description of this side of the LCA increasing in ridge height. The site itself is a distinct and lower rounded hill backed by higher ground. There are rural properties along many parts of the tertiary road network around the base of the hill and it has a closer physical relationship to the adjoining Roe Valley LCA than the main Sperrin mountain range. It is in relatively close proximity to

Banagher Forest and forms part of the setting for this amenity landscape but it does not contain any visitor amenity facilities itself.

The SPG's description of Landscape Sensitivity to the Development

4.105 The SPG states that overall sensitivity to wind energy development in the Sperrin Mountains LCA is high because it lies at the heart of the Sperrins and whilst "*the scale and landform of at least parts of the area are in theory well-suited to wind energy development*" there are a number of factors that the SPG notes as making it, in practice, unsuitable, including:

- The sheer visual prominence of the Sperrin Mountains over a wide area of Northern Ireland;
- Its value as an iconic landscape of immense appeal for tourism and recreation;
- Its core landscapes being highly sensitivity to any wind energy development;
- Its strong wild character;
- Its many natural and cultural features which are highly vulnerable to wind energy development.

4.106 The Development is not, however, located within part of the LCA that meets these criteria and the site is therefore deemed to meet the SPG's initial statement of being well-suited to wind energy development for the following reasons:

- It is not visually prominent either as part of the Sperrin Mountain LCA, the Sperrin AONB as a whole or across other parts of Northern Ireland. This is clearly illustrated by the ZTV diagrams and supported by detailed site assessment. The ZTV indicates theoretical blade tip visibility of the Development in approximately 14% of the total area covered by the AONB;
- The site is a small part of the LCA with no public access. Its recreational function is associated only with the privately rented tourist accommodation located adjacent to the site and owned by the landowner of this site. It is provided for visitors to these properties. Access and enjoyment of other tourist and visitor amenities within the LCA would not be affected by the Development and it would have both limited and indirect effects on the physical landscape or visual character of some of these sites. For example, the Development would be partially visible from Altnaheglish Dam which itself represents a significant alteration to a natural landscape in order to harness and use the natural resources provided by the landscape. However, it would not have any effect on the majority of Banagher Forest because it will be screened from view by the steep sided topography of the Glen and the surrounding woodland. The effects of the Development on the setting of cultural heritage sites surrounding the Development are analysed in Chapter 5: Archaeology and

Cultural Heritage, and Banagher Old Church has also been selected for analysis in this LVIA because it is publicly accessible and signposted along the road network in proximity to the Development (Viewpoint 4, from paragraph 4.126 and Figure 4.16);

- The Development is located on the periphery of this LCA rather than within the core area and would have limited effects on the landscape character in the core part of the LCA;
- The site and landscape surrounding the Development does not exhibit the strong wild character elements that are referred to by the SPG, or that are exhibited by the core area;
- The Development would have a negligible effect on the majority of natural and cultural features within this LCA.

The SPG's description of Key Location, Siting, Layout and Design Considerations

4.107 The Development meets the locational criteria of the SPG, specifically:

- The turbines are sited on the side slopes of a low hill where they would be seen either against a backdrop of land or in the context of a wider expanse of higher uplands. This also avoids significant effects on the physical landscape character of skylines within and this LCA and the wider AONB;
- Significant effects on key views within the LCA are avoided. The SPG notes that these include locations from where the mountains and valleys which characterise the LCA can be obtained, and this is most likely to occur from elevated locations within and surrounding this LCA, including from locations along the A6 from where the Development would appear as a small element occupying a peripheral location at the edge of more expansive views which often encompass the whole northern side of the LCA, the Sperrin Foothills, and other upland areas to the north, south and west;
- Adverse effects on parts of the LCA which are described by the SPG as having a wild character are avoided;
- The Development has a small compact and coherent turbine layout which reflects the rounded profile of the low hill on which it is located. It has a secondary and subservient position within the wider range of uplands within the LCA. The complex topography referred to in this section of the SPG relates to the LCA as a whole and the most complex elements are described around the hills at the western rather than to eastern end of the LCA. The Development is located in the latter and would not be visible from the former;
- The SPG notes the presence of a cluster of existing and consented wind farms at Owenreagh Hill at the western end of this LCA and on Bessy Bell

Hill and in County Donegal to the south and west of this LCA at distances of 15 km – 25km. Since the publication of the SPG there have been a number of other wind farms constructed and consented throughout the Study Area. Clusters of wind farms are a commonly occurring characteristic around the peripheries of the Sperrin AONB. All the ranges of hills in the Study Area also contain clusters of existing and consented wind farms and single turbines. Whilst there are sufficient separation distances between these clusters to ensure they are not the dominant characteristic they do form part of baseline landscape character throughout the Study Area. This development is a reflection of both policy and the general advice provided in the SPG that elevated upland landscapes can better accommodate turbines and the broader the upland the greater the capacity.

Other Non-Statutory Landscape Classifications

4.108 A review of other relevant non-statutory landscape classifications has also been carried out as part of this LVIA. These classifications identify landscapes or elements within the landscape that are recognised as being important by virtue of being marketed as attractions or identified in non-statutory documentation in the public realm, but which have no protection in law. These classifications are illustrated on Figure 4.2. Information on them in drawn from a number of websites[7] providing relevant descriptive information which is used in conjunction with Ordnance Survey maps to plot the locations of visitor attractions and including the Ulster Way, National Cycle Network, and scenic drives in the Study Area and to aid the selection of viewpoints (Figure 4.4).

Rights of Way, Cycle Routes, and Scenic Drives

4.109 The Ulster Way is a 1000 km long circular walking route which covers the most scenic parts of Ulster. It is divided into 'Quality Sections', which provide largely off-road way-marked access for walkers in highly scenic areas, and 'Link Sections', which are mainly along roads and are not generally way-marked. A largely 'Quality' section of the Ulster Way tracks along the uplands which sweep in a broad crescent-shaped arc from the summit of Binevenagh at the northern edge of the Study Area, along the series of summits and plateaus to the summit of Benbradagh, which is located approximately 7 km to the north east of the Development. The route then joins the tertiary road network into Dungiven and crosses the A6 road corridor and largely follows the secondary and tertiary road network into the heart of the Sperrins AONB through the Glenelly Valley in the south west of the Study Area. There is an alternative off-road route through Glenshane and Moyladamlaght Forests to the east of the Development and another off-road section through Gortin forest near the south western edge of the Study Area.

[7] http://www.walkni.com, www.cycleni.com, www.sustrans.org.uk

4.110 At its nearest point the Development is located approximately 2.5 km to the west of a 'Link' section of the Ulster Way on the Tamniarin Road which runs along the eastern side of Banagher Forest. There would be no visibility of the Development from much of this road due to the screening effects of the forest. There would also be very limited, if any, visibility of the Development from most other parts of the Ulster Way with the exception of views from the Link section on the descent into Dungiven from Benbradagh and across the A6 road corridor to Glenshane. Overall the Development is not deemed to have a significant effect on the appreciation of views or the physical character of most parts of the landscape through which the Ulster Way passes, particular from Quality sections of the route.

4.111 The National Cycle Network provides cyclists with marked scenic routes across the province. Within this Study Area there are routes linking Binevenagh to the Roe Valley; the Roe Valley over the Loughermore Hills to the Sperrin Foothills, Faughan River Valley, Derry and the banks of the River Foyle in the north western part of the Study Area; around the Glenelly Valley in the central and south western parts of the Sperrin AONB; the farmland around Cookstown to the south east; and a route along the Long Mountain uplands at the eastern edge of the Study Area. Similarly to the Ulster Way there would be limited, if any, visibility of the Development from most other parts of the cycle network and the Development is not deemed to have a significant effect on the appreciation of views or the physical character of most parts of the landscape through which the cycle network passes with the exception of views from around the Loughermore Hills and south-facing slopes of Binevenagh. Views from these routes are represented by Viewpoint 21 which is located on the Loughermore Hills approximately 6.5 km to the north west of the Development (from paragraph 4.182 and Figure 4.32) and also from Viewpoint 20 which is located within the Binevenagh AONB approximately 22 km to the north east (from paragraph 4.177 and Figure 4.31).

4.112 There are several scenic driving routes which are signposted on roads within the Study Area, of which three are in the Sperrin AONB and which are intended to provide visitors with marked routes from which to experience a range of sites of interest, visitor attractions and the scenic qualities of the Sperrins. The East, North and Central Sperrins scenic driving routes were considered in the selection of PVPs. The ZTV and preliminary site surveys indicate very little visibility from the Central or East routes but several Viewpoints have been selected along parts of the East routes. Information on the routes and points of interest can be access via the website www.discovertyroneandsperrins.com.

4.113 There are also a number of scenic drives in the wider Study Area where preliminary assessment revealed little or no visibility of the Development and which were not further considered. These include:

- The Causeway Coastal Route and Inishowen 100 in the northern part of the Study Area where visibility is prevented by the low lying nature of the topography in combination with its distance from the Development combined with intervening vegetation and other land uses;

- The Roe Valley Scenic Drive where the ZTV indicates visibility but where a combination of undulating topography along the road corridors and foreground vegetation, including that within the landscape immediately surrounding Dungiven, combine to filter and screen views. Views of the lower parts of the Sperrin Mountain slopes where the Development is located are particularly well screened. Whilst the Development may become a feature of the landscape character it is likely to appear only intermittently for short lengths of time in between which it will be screened;
- Binevenagh Scenic Drive near the north eastern edge of the Study Area. The ZTV indicates that there is potential visibility from the south-facing slopes of Binevenagh at distance beyond 20 km. Due to its location within an AONB, Viewpoint 20 was selected to represent views (from paragraph 4.177) and a photomontage has been prepared (Figure 4.31).

Baseline Visual Character Assessment and Analysis of Effects

Visual Character of the Study Area

4.114 In broad terms the Study Area is divided by a distinctive crescent-shaped series of uplands which run through the centre of the Study Area from the north east to the south west and which broaden into the extensive bowl-shaped formation of the Sperrin Mountains and outlying hills which combine to form the Sperrin AONB. These uplands encircle and physically enclose the Glenelly Valley which forms the heart of the AONB and also the lowland pastoral landscape within the Roe Valley in the western quarter of the Study Area and floodplain on the southern shores of Lough Foyle and the pastoral landscape that lies between the eastern side of the Binevenagh slopes and Long Mountain which lies just beyond the eastern edge of the Study Area.

4.115 The proposed site is located around the north western to south western side slopes of Teeavan Hill which is the lowest and northern-most hill within a small group of hills which form an outlying upland area on the north western edge of the Sperrin Mountain range where these mountains meet and merge with the Binevenagh and Glenshane uplands. Together they combine to physically contain the southern end of the Roe Valley. Teeavan Hill is visually distinct from the other hills in this group because it is physically separated by the Altnaheglish River and Reservoir which are located at the southern base of the hill. In addition to rising topography which serves to screen the Development from the majority of the Study Area, there are also large areas of coniferous forestry which provide screening. Richly vegetated field boundaries and road corridors in the Roe Valley similarly provide high levels of screening from this lowland pastoral part of the Study Area

4.116 The highest quality views in the Study Area are those which allow viewers to appreciate the expansive nature of the various upland areas as a sequence of interlinked landscapes. Views which are more limited in scope and which are focussed on foreground elements are of less value because of the poor condition and visually detractive nature of many individual landscape character elements. Similarly, in views of the AONB from lowland areas in the northern side of the Study Area it is the sheer extent of these views, rather than individual features that affords them high scenic value. Individual elements of these views are subordinate features and are unlikely to detract from the overall quality of the physical landscape character or visual amenity.

4.117 The side slopes of the Sperrin uplands provide the setting for the majority of views in which the Development would also be visible. However, there are no instances where the heart of the Sperrin AONB, and therefore the key characteristics of the AONB, would be appreciated alongside views of the Development. This is because the Development is located on a much lower hill (329 m AAOD) than the range of hills which enclose the heart of the Sperrins and is physically detached from it. The higher summits of the Sperrin Mountains (which rise to 678 m AOD) are best appreciated from elevated viewpoints around the edge of the AONB boundary (Category C Viewpoints) and in these locations the Development, alongside other individual visual elements become subordinate to the overall expansive nature of these views.

4.118 The outer edges of the Sperrin AONB already provide sites for a number of clusters of existing and consented wind farms and therefore, views of the outer-facing slopes of the Sperrin Mountains and foothills are already characterised by wind farms. The Development reflects this approach to siting wind farms in such locations and visual receptors already experience sequential views from roads within the Study Area that demonstrate this.

The Zone of Theoretical Visibility

4.119 ZTV diagrams have been produced at a radius of 15 km and 30 km from the Development based on the proposed turbine dimensions illustrating visibility for both the maximum blade-tip and hub-height dimensions being considered by the applicant (Figures 4.6 - 4.9). Blade tip visibility illustrates any parts of the Study Area where at least one blade tip would theoretically be visible without taking account of screening provided by contour variations within 10m intervals or land cover elements such as trees and hedgerows. It shows the highest potential levels of theoretical visibility but not necessarily the most realistic because blade tips may be counted even where they protrude only a small amount above a skyline and this type of visibility will change continuously as the turbines rotate. Hub height ZTV diagrams represent a more realistic illustration because they show theoretical visibility of all points of the turbines to the hub/ nacelle, and therefore also include the upper parts of the turbine blades as a minimum. Reverse ZTVs (Figure 4.10) have been produced to clearly illustrate areas where there would be no theoretical blade tip or hub height visibility of the Development. These diagrams are the starting point for the baseline visual assessment and were also used to assist the selection of PVPs. They illustrate the theoretical visibility and non-visibility of the proposed development as a standalone development, unrelated to any other wind farms in the Study Area. They indicate comparatively low levels of theoretical visibility across the Study Area as a whole:

- Within a 15 km radius from the Development, 39.69% the Study Area is likely to have some theoretical blade tip visibility of the proposed development and 36.13% of this visibility would be of 4 - 5 turbine blade tips which reflect the fact that the Development has a simple coherent layout with little variation in turbine heights AOD. Of the total visibility illustrated by this ZTV only 1.7 % represents visibility of only 1 - 2 blade tips meaning that within a 15 km radius theoretical visibility is most likely to comprise of the whole wind farm rather than constantly changing views of it and this is likely to result in it being perceived as a consistent visual element of views (refer to Figure 4.6);
- Within a 15 km radius from the Development overall visibility would reduce to 36.35% if hub height visibility is considered and visibility of 4 - 5 turbines would reduce to 36.35%. The remaining 63.65% of the Study Area would have no view of the Development (refer to Figure 4.7);
- Within a 30 km radius from the Development blade tip visibility would reduce to only 17.96% of the Study Area and only 15.43% would have visibility of 4 - 5 turbine blade tips. Of the total visibility illustrated by this ZTV, 1.22 % represents visibility of only 1 - 2 blade tips and 1.31% visibility of 3 - 4 turbines (refer to Figure 4.8);
- With a 30 km radius from the Development overall visibility would reduce further to 15.39% if hub height visibility and only 13.06% of this would be visibility of 4 - 5 turbines (refer to Figure 4.9).

4.120 The reverse ZTVs (Figure 4.10) clearly illustrate the screening effect of the sequence of uplands which run through the centre of the Study Area and which are higher in elevation than the Development site. The effect of this high ground encircling the site and wider landscape is that there is no theoretical visibility in most of the Sperrin AONB (approximately 86% of the AONB would have no theoretical blade tip visibility of the Development), including much of LCA 29 Sperrin Mountains within which the Development is actually located as well as the majority of the eastern, southern and north western parts of the Study Area. The Reverse blade tip ZTV illustrates that 82.04% of the Study Area would have no view of the Development. The Reverse hub height ZTV illustrates that 84.61% of the Study Area would have no view of the Development. It is noted that this is theoretical visibility and that levels would be further reduced by topographical variations and land cover elements. Detailed site assessment indicates that this is likely to screen many views in low-lying landscapes such as the Roe Valley and the pastoral landscape between Claudy and Feeny in particular. The Development is also likely to be difficult to discern with the naked eye in long distance views such as low level viewpoints along the Roe Valley and the flat floodplain landscape at the base of Binevenagh in the far north of the Study Area and also from elevated viewpoints on the upper slopes of Binevenagh and Slieve Gallion which is located within the Sperrin AONB to the south east.

Table 4.1 - Zone of Theoretical Visibility of the Development

ZTV Diagram	No. of turbines theoretically visible (blade tip)	% of Study Area with visibility	
15 km blade tip ZTV	**1 - 2 turbines visible**	**1.70 %**	
Figure 4.6	**3 - 4 turbines**	**1.86 %**	**Total % of 15 km Study Area where theoretical blade tip visibility would = 39.69 %**
	5 - 6 turbines	**36.13%**	
	0 turbines	**60.31 %**	
15 km hub height ZTV	**1 - 2 turbines visible**	**1.92 %**	
Figure 4.7	**3 - 4 turbines**	**2.36 %**	**Total % of 15 km Study Area where theoretical hub height visibility would = 36.36 %**
	5 - 6 turbines	**32.08 %**	
	0 turbines	**63.64 %**	
30 km blade tip ZTV Figures 4.8	**1 - 2 turbines visible**	**1.22 %**	**Total % of 30 km Study Area where theoretical blade tip visibility would = 17.96 %**
	3 - 4 turbines	**1.31 %**	
	5 - 6 turbines	**15.43 %**	
Reverse blade tip ZTV Figure 4.10	**0 turbines**	**82.04 %**	
30 km hub height ZTV Figures 4.9	**1 - 2 turbines visible**	**1.07 %**	**Total % of 30 km Study Area where theoretical hub height visibility would = 15.39 %**
	3 - 4 turbines	**1.26 %**	
	5 - 6 turbines	**13.06 %**	
Reverse hub height ZTV, Figure 4.10	**0 turbines**	**84.61 %**	

Desk-based selection of Provisional Viewpoint Locations

4.121 The Baseline Assessment identified a number of parts of the Study Area most likely to experience visibility of the Development and contain key receptors due the theoretical levels of visibility indicated by the ZTV diagrams and the potential sensitivity of either the location and / or the visual receptors likely to be present at these locations. These locations guided the selection of PVPs and this initial desk-based selection of PVPs, including the selection criteria, is described in Technical Appendix 4.4 and illustrated on Figure 4.4. Forty three PVP locations were selected and draft wireline diagrams for all these locations were prepared and checked by site visits to confirm the nature of receptors and potential visibility of the Development. These draft wirelines were used as working documents and are not reproduced in this LVIA.

Final Viewpoint Selection

4.122 Following an initial site assessment and the PVP selection process described above 21 Viewpoints have been shortlisted for inclusion in the LVIA. This includes a proportionate number of locations which are intended to be representative of typically occurring views within the Study Area, views experienced by key visual receptors, and also views from specific locations that merit inclusion in the LVIA by virtue of their contribution to the landscape and visual qualities of the Study Area. PVPs were not shortlisted if they were found to provide no actual view of the proposed development. The reasons for this usually arose from differences between theoretical and actual visibility which is explained in Technical Appendix 4.2 (ES Volume 2). Other viewpoints were not shortlisted if a more typical view was demonstrated elsewhere, where no safe stopping place was possible to take a photograph or where the viewpoint location would not be easily accessible to the public.

4.123 A detailed description of the methodology for viewpoint selection is included in Technical Appendix 4.2 starting at paragraph 4.23. A summary analysis of all PVP locations and the rationale regarding shortlisting is provided in Technical Appendix 4.4, Table 4.4.1. The locations of final viewpoints are indicated on all map-based figures which accompany this LVIA chapter (Figures 4.1 - 4.12). Wirelines and photomontages of each viewpoint have also have been presented in Figures 4.13 - 4.33. These are intended to assist in the understanding of, but not to replace, the detailed written descriptions of effects on viewpoints which are contained in the subsequent paragraphs of this chapter. It is important to recognise the limitations of visualisations and this is further described in Technical Appendix 4.2, paragraphs 4.41 - 4.48. They should not be relied upon as the primary means to determine visual effects and it is expected that all locations will be visited in order to be fully understood.

4.124 In the analysis of visual effects cognisance is also taken of the SPPS and PPS 18: BPG. These policy and guidance documents note that whilst wind farms are, by their nature, highly visible and are likely to be relatively prominent at distances of up to 5 km, this does not necessarily preclude them from being acceptable features (refer to paragraphs 4.56 and 4.60). The choice of viewpoints is intended to represent the manner in which the proposed development is experienced when travelling around the Study Area and not just from locations in close proximity where it may be expected to be clearly visible.

4.125 For ease of analysis these shortlisted viewpoints have been categorised as follows so that the different types of views, receptors, and specific areas they represent can be accurately described and understood without unnecessary repetition:

A. Views from rural roads and amenity sites in proximity to the Development;

B. Views from Dungiven and approaches to the town;

C. Elevated views from within the Sperrin AONB;

D. Elevated views from within the Binevenagh AONB;

E. Views overlooking the Roe Valley and the landscape in the north west of the Study Area.

Category A: Views from rural roads and amenity sites in proximity to the Development

Description of Existing and Predicted Views

4.126 Category A includes Viewpoints 1 - 8 which are illustrated in Figures 4.13 – 4.20. They have been selected to represent the range of visual receptors located in proximity to the Development who will experience close range views of the Development and who are likely to include residents of rural properties, farm workers and general road users on the tertiary road network, and visitors to amenity sites, on scenic drives and footpaths. All Category A Viewpoints are located within the Sperrin AONB. Viewpoints 1 and 2 are also both located within the same LCA as the Development (LCA 29 Sperrin Mountains) but they have very different visual elements to them and assist in understanding the location of the Development at the edge of this LCA rather than forming part of the main upland area, often referred to in the NILCA as the “heart” of the Sperrins. Viewpoint 3 is located on the boundary between the Sperrin Foothills and Roe Valley LCAs. The remainder of Category A Viewpoints are located at the southern end of the Roe Valley to the north of the Development which is one of the main areas of theoretical visibility indicated on the ZTV diagrams.

4.127 Viewpoint 1 is located at the Altnaheglish Dam within Banagher Forest and is a destination for walkers along paths through Banagher Glen, a secluded area of ancient woodland which hugs the banks of the Altnaheglish River immediately to the south west of Teeavan Hill. It is the closest Viewpoint to the Development and was selected because few other views were available in this location due to the screening effects of Banagher Forest and the steep sided nature of the Glen and also because it was also the only location specifically mentioned by the Council in early scoping discussions about the selection of Viewpoints. The glen itself is a highly attractive and tranquil area within the Sperrin AONB in close reach of Dungiven and the village of Feeny. Views from within the Glen are completely enclosed by woodland and topography and it is a relatively long walk from the car parking areas around the base of the hill to the dam. Views from the dam, which is located at the top of the glen, are slightly more open and channelled in a north westerly direction by the Teeavan and Altnaheglish Hills, the bases of which converge to form Banagher Glen and the river channel. The area immediately surrounding the dam is utilitarian and relatively unattractive as illustrated by the baseline photograph provided in Figure 4.13. Banagher Forest is the largest piece of commercial forestry in Co. Derry and covers much of Altnaheglish Hill[8]. Forestry tracks provide informal pedestrian access around the hill and in proximity of the summit there are south westward facing views into the heart of the Sperrins including the highest summit at Sawel Mountain. However views towards the Development would be screened by rising ground and forestry on this side of Altnaheglish Hill.

4.128 The foreground landscape at Viewpoint 1 is entirely formed by man-made structures and alterations to the environment for the purpose of harnessing natural resources. The primary attraction is the dam and associated reservoir. Views into the wider landscape are extremely restricted by the channelling effect of the two hills which form the Glen and by the forestry on Altnaheglish Hill which is visible in the left hand side of the view illustrated in Figure 4.13. There is a narrow view towards the uplands located at the north western edge of the Sperrin AONB on which the Slieve Kirk cluster of existing wind farms is located and this cluster of wind farms fill this part of the skyline although they are barely discernible except in clear weather conditions due to their distance from this Viewpoint (over 21 km). Four of the proposed turbines in the Development would be clearly visible at a distance of approximately 0.52 km to the north west of Viewpoint 1 at their nearest point although the turbine bases and any associated tracks would not be screened by foreground topography and forestry. The other two turbines (T3 and T4) would be largely screened from view by intervening forestry on the site and only their blade tips would be visible. Other parts of the view would be contained by the immediate surrounding hills and forestry.

4.129 Viewpoint 2 has been selected to represent views from an elevated part of the North Sperrins Scenic Drive located approximately 2.83 km to the south west of the Development and within the Sperrin AONB. The roadside layby in which the Viewpoint is located previously had a tourist signboard and litter bins but these have been vandalised over the past few year and the layby is now in poor condition with litter and fly tipping. The foreground landscape between the road corridor

[8] http://www.walkni.com/walks/170/banagher-forest/

and the Development comprises improved moorland backed by several areas of coniferous forestry, including some along the Banagher Road corridor (located on the left hand side of the view illustrated in Figure 4.14) and the distinctive narrow bands of forestry on the site itself, some of which will be removed as part of the Development, thus creating a slightly simpler skyline in this section of the view. The edge of Banagher Forest, which appear at the right hand side of the view partially screens Turbine T2, and entirely screens T1. The other four turbines are clearly visible on the open hillside just beyond the edge of Banagher Forest and this point marks one side of a very wide panorama which stretches as a low profiled sequence of uplands visible beyond the heathland in the foreground. This sequence of uplands is one of the most scenic elements of the view from this location. The summit of Benbradagh, which is visible to the left (north) of T4, marks the southern end of the Binevenagh uplands which then stretch northwards to the distinctive summit of Binevenagh, visible in the left half of the view. The Magilligan foreshore area of the Foyle Estuary is perceptible as a flat area between this summit and the more rounded profile of the Loughermore Hills. Between these uplands lies the Roe Valley and beyond the foreshore, in clear weather, there are even longer range views to the Inishowen peninsula in Co. Donegal. Beyond the left hand (western) extent of the view that is illustrated in Figure 4.14 the road corridor becomes more vegetated and pastoral in character as it descends into the Sperrin Foothills landscape surrounding the village of Feeny, which itself is not visible from this location. There are few residential properties located along the lower section of this scenic drive which would not experience views of the Development but which are orientated to take advantage of the highly scenic views into the north west of the province as described above and also towards the main Sperrin Mountain range which begins on the opposite side of the road corridor directly behind this Viewpoint. The scenic drive also continues in a south easterly direction where it passes through an extensive area of commercial forestry located around the south eastern edge of the Sperrin Mountains before descending towards Draperstown. There would be no views of the Development as one travels along the road corridor in this direction due to the screening effects of the higher mountains in this area. Other parts of this scenic drive are represented by Category B Viewpoints 10 and 11 on the A6 and B64 approaches to Dungiven. This circular route is 80 km in length and travels through the landscape in the eastern part of the Study Area and the majority of the drive has no visibility of the Development due to its location on a low lying hill which is screened from this side of the Study Area by the Glenshane, Carntogher and Binevenagh ranges of uplands.

4.130 Viewpoint 3 is located at cluster of properties and a community hall on the B44 near the junction with the B40 scenic drive approximately 4.71 km to the west of the Development and in close proximity to the village of Feeny. It has been selected to represent the types of views that occur in this part of the Study Area where rural settlement tends to be clustered around the road corridors at low density within a predominantly undulating pastoral landscape interspersed with trees, hedgerows and small areas of mature broadleaved woodland. Views tend to be focussed into the foreground landscape because wider views are frequently screened by foreground vegetation. However, the surrounding uplands provide visual containment of these views in the form of a broad low profile of hills visible in all directions, becoming closer and more prominent directly to the south (and to the right hand side of the view illustrated in Figure 4.15) where the Sperrin Mountains appear closer and significantly higher than the Loughermore Hills and peripheries of the Sperrins and its foothills. These latter areas are located to the north west of this Viewpoint and the Development is located on the peripheral uplands at the edge of the main Sperrin Uplands. It is visible but not prominent in the centre section of the view illustrated in Figure 4.15 behind the line of electricity pylons which follow the same line as the B40 North Sperrins Scenic Drive along much of its length.

4.131 Viewpoint 4 has primarily been selected to represent the views of tourists at a site of local historic interest, Banagher Old Church which is located approximately 1.49 km to the north west of the Development. It occupies an elevated position on a mound above the Magheramore Road corridor and from this location there would be clear close range views towards the Development site in one direction but also extensive panoramic views in the opposite direction encompassing the entire northern half of the Study Area and beyond it towards Co. Donegal as well as south westwards towards the heart of the Sperrins (visible in the far right-hand side of the view illustrated in Figure 4.16). The large cluster of existing wind farms at Loughermore would be visible in this direction as well as a number of single turbines located within the lowland farmland. The Development would be visible in a southerly direction and would form a prominent feature located beyond the rounded skyline formed by Teeavan Hill. The bases of all turbines and the upper parts of T1 would be screened by the rising hillside and some areas of forestry on it. Two of the existing strips of forestry would be removed (refer to Figure 4.16) with little effect on the visibility of the turbines although it would slightly simplify the appearance of the summit. The slopes of Teeavan Hill and the foreground landscape surrounding the church are pastoral in character. There is a farmstead located below the church site (to the north) which would have limited and restricted views of the Development due to the prominence of the church mound in the foreground. However, it would experience the wide panoramic views northwards.

4.132 Viewpoint 5 has been selected to represent views from Banagher Road which has an elevated position overlooking Banagher Glen and Forest approximately 1.71 km to the west of the Development. There are rural properties located at several locations along the length of this road, the majority of which are orientated to take advantage of views in this direction. However, the road corridor is frequently contained by high hedgerows and trees which filter or screen views in the direction of the Development. The foreground is characterised by pastoral fields beyond which the steep sided slopes of Banagher Glen are covered by a mix of ancient woodland and commercial forestry, the latter which decreases the quality of the foreground landscape. The site of the Development is visible above the latter and is distinguishable by the narrow bands of forestry which cover parts of the skyline. Some of this will be removed as part of the Development but the majority will remain. The turbines would appear on the skyline. However, the summit of Teeavan Hill would be located beyond this skyline and would not be visible at close range due to the acute angle of view. It is noted that in close range views the Development may often be perceived to be located on the skyline despite being located on a side slope due to the acute angle of view created from viewpoints in close proximity. T3 and T4 would be slightly detached from the other four turbines which would form a more distinct grouping. There would be slightly wider views to the north and south which would become more prominent in views when travelling along the road corridor.

4.133 Viewpoint 6 represents views from a section of Magheramore Road in close proximity to Viewpoint 4 but at a lower elevation so the north-facing panorama that is experienced at Viewpoint 4 is not available at this location. The Development would be visible at close range and from a slightly depressed section of the road corridor where views into the wider landscape would, for a short section of the road, be focussed and in the direction of the Development and dominated by it. There is a property in close proximity to Viewpoint 6 which would experience the same views illustrated in Figure 4.18. There would be no stacking of turbines from Viewpoint 6, as there would be in Viewpoint 4. All turbine bases would be located beyond the summit or, in the case of T4, behind a narrow band of forestry just below the summit. The foreground landscape is of a similar pastoral character and the summit of Teeavan Hill appears as a less pronounced upland area that is detached from the fields around its base which are adjacent to the road corridor. From other sections of the Magheramore Road views would generally encompass a wider area including both the pastoral foreground that is also visible in the foreground of Viewpoint 6, backed by rising upland areas including Teeavan Hill at close range in one direction in most, but not all instances, and also stretching more extensively in a north- north westerly direction as in Viewpoint 4.

4.134 Viewpoints 7 and 8 are both located on the Teeavan Road which is an elevated road corridor which wraps around the lower slopes of Teeavan Hill to the north – north east of the Development. Viewpoint 7 is located approximately 2.2 km from the Development near the junction with Creebarky Road and represents views from the upper section of the road where there are fewer houses and the foreground landscape is in poorer condition. It is largely characterised by rough grazing land and forestry with some large farm buildings such as corrugated barns and broiler houses (the latter located on the opposite side of the road corridor to the direction of view). The Development would be seen in this context. The bases of all turbines would be concealed by the summit of the hill which appears as a broader profile due to the elevated nature of this Viewpoint on the same hill. The turbines would be relatively evenly spaced and in proportion with the overall scale of this landscape. Views in the opposite direction are more scenic and likely to be the main focus. They are framed to the north east by the prominent summit of Benbradagh and stretch extensively to the north and north west. Existing wind farms in the Loughermore cluster of wind farms are clearly visible from Viewpoint 7 and the Rigged Hill and Dunbeg clusters may be perceptible in clear weather conditions. There are a number of residential properties and farmsteads lower down the Creebarky Road which would be orientated to take advantage of these views but would experience no views of the Development.

4.135 Viewpoint 8 is located further westwards along the Teeavan Road at a slightly lower elevation in relation to the Development than Viewpoint 7 and slightly closer (2.08 km). It has been selected to represent views from a section of the road containing a greater number of residential properties and therefore more sensitive receptors. The arrangement of turbines would be similar in appearance to that in Viewpoint 7. From this section of Teeavan Road there are very extensive stretching from the summits of the Sperrin Mountains in the south west (visible to the right hand side of the view illustrated in Figure 4.20) to the hills around Derry and County Donegal, Loughermore, the Roe Valley, Binevenagh and Benbradagh. In front of this highly scenic panorama there are views across a rolling pastoral landscape which is also highly scenic, although the A6 is currently being re-routed though this foreground landscape and the works are clearly visible. Residential properties on this section of Teeavan Road are orientated to face northwards to take advantage of the most scenic area of views. The Development would be located at the periphery of these views and partially screened by roadside vegetation. Some of the forestry on site would be removed to facilitate turbine construction but this is unlikely to be easily perceptible to the casual observer from this Viewpoint.

Sensitivity of Visual Receptors: Ranging from Low to High but predominantly Medium

4.136 Visual receptors at Viewpoint 1 are most likely to comprise of walkers who have reached the location on foot via Banagher Glen but may also include Forestry and Water Service Personnel. All are deemed to occur in relatively low numbers and are deemed to be of Low sensitivity because, although they will be located within an AONB, the nature of their views from the most attractive parts of Banagher Glen will be those within the ancient woodland from where there would be no perception of the Development. It would only become a feature of views in proximity to Altnaheglish Dam where the character of the view is largely restricted to the foreground landscape which is dominated by a large man-made structure designed to harness natural resources in the context of which the Development is not incongruous and may in in fact be regarded as a complimentary land use.

4.137 Visual receptors at Viewpoint 2 will include tourists using the scenic drive, farmers attending to the rough grazing land in proximity to the Viewpoint, general road users including people travelling between Draperstown and Feeny and to forestry sites. Most road users and workers are deemed to be of Low Sensitivity. Receptors using the road as a scenic drive will be of higher sensitivity and may stop at this location specifically to appreciate the view. The degraded nature of the layby and the peripheral location of the Development in the context of a very wide and scenic view will reduce their sensitivity somewhat. Therefore they are deemed to be of Medium sensitivity to the Development.

4.138 Visual receptors at Viewpoints 3, 5, 6 and 7 are likely to comprise primarily of local road users on the tertiary road network, including residents travelling to and from properties located elsewhere along these roads, and also farmers tending land adjacent to the roads. Receptors at Viewpoint 3 are deemed to be of Low sensitivity because their views are likely to be focussed into the foreground landscape with only intermittent and glimpsed views to in the direction of the Development between this foreground which is characterised by settlement and roads between larger areas of settlement. In relation to Viewpoint 4 receptors are deemed to be of Medium sensitivity because they will be present at this location primarily to experience a heritage feature. This is also a small site of local interest and visitors are unlikely to occur in large numbers. Visitors standing on the opposite side of the church site are likely to focus on northward-facing views and views of the Development would be screened but the church building.

4.139 There are several properties located along the Banagher Road in proximity to Viewpoint 5 that may experience similar views to that illustrated by Figure 4.17. However, views from the Banagher Road are frequently contained by high hedgerows and trees which filter or screen views in the direction of the Development and therefore, visual receptors are deemed to be of Medium to Low sensitivity overall.

4.140 Receptors at Viewpoint 6 would experience the Development at close range and from a slightly depressed section of the road corridor where views into the wider landscape would, for a short section of the road, be focussed and in the direction of the Development and dominated by it. There is a property in close proximity to Viewpoint 6 which would experience the same views illustrated in Figure 4.18. From other sections of the Magheramore Road views would generally encompass a wider area including both the pastoral foreground that is also visible in the foreground of Viewpoint 6, backed by rising upland areas including Teeavan Hill at close range in one direction in most, but not all instances, and also stretching more extensively in a north- north westerly direction and encompassing much of this side of the Study Area.

4.141 Receptors at Viewpoint 7 are likely to comprise predominantly of local road users and farmers who are deemed to be of Low sensitivity. Receptors at Viewpoint 8 are deemed to be of High sensitivity because they are likely to comprise primarily of residents travelling to and from properties located on this road.

Magnitude of Visual Effect: Ranging from Low to High but predominantly Medium

4.142 Although the Development would be located at very close range to Viewpoint 1 and would therefore be prominent it is also viewed within an entirely man-made context where wind turbines complement existing purposes and functions of the landscape. Walkers who choose to continue through the commercial forestry towards the summit of Altnaheglish Hill will utilise forest tracks to do so and, whilst within the forestry are unlikely to experience wider ranging views. At the point at which these types of views can be appreciated they will be orientated into the heart of the Sperrin AONB, in the opposite direction and views towards the Development would be restricted by topography. The magnitude of effect on Viewpoint 1 is deemed to be Medium for a short period of time when it would be visible at the dam, reducing to Negligible elsewhere in the Forest and Glen where it is unlikely to be significantly visible.

4.143 From Viewpoint 2 the Development will be visible but located at the periphery of a very wide panorama that incorporates much higher parts of the Sperrin Mountains in the opposite direction of view with a setting provided by long range views in several other directions. The focus of views is initially likely to be in the opposite direction to the Development and the eye will then be drawn to the wider panorama where individual elements, including the Loughermore cluster of existing wind farms, are subordinate. The Magnitude of effect on Viewpoint 2 is deemed to be Medium because the Development would be located at relatively close range but will not impinge upon any elements within the main focus or areas of particular scenic quality. The Magnitude of effects on Viewpoints 4, 7 and 8 are deemed to be Medium for similar reasons. In these Viewpoints the Development would be Prominent at close range but would occupy a peripheral location within an expansive panorama (Viewpoint 8) or would be located in the opposite direction of view to these panoramic views which provide the most scenic elements of the views and which are therefore likely to be the focus of attention (Viewpoints 4 and 7). At Viewpoint 4 there would be one instance of turbine stacking where T5 would appear behind T4 but this would occur in the centre of the turbine group and only from this specific location where receptors are likely to be present for a relatively short period of time with the primary purpose of visiting an historic site. It is not considered to be a significant visual effect of the turbine layout.

4.144 From Viewpoint 3 there are likely to be intermittent and glimpsed views of the Development from open sections of the road corridor but elsewhere, and more commonly, views are likely to be filtered or screened by foreground elements combined with the low profile of Teeavan Hill in comparison with the foreground. The Magnitude of effect from road corridors in and around Viewpoint 3 is Low.

4.145 The Magnitude of effect from Viewpoint 5 is deemed to be High at the specific location reducing to Medium for the Banagher Road corridor which this Viewpoint represents because views from this road corridor are frequently more obscured by roadside vegetation and when travelling in either direction quickly become more open and expansive in nature and less focussed towards the Development. In addition, the presence of a large area of commercial forestry in the foreground is visually detractive.

4.146 The Magnitude of effect from Viewpoint 6 is deemed to be High because, although the Development would be located similarly to Viewpoint 4, the lower elevation of the road corridor at this Viewpoint would limit the extent of the view available and result in views being focussed primarily towards the Development.

4.147 The Magnitude of effects from Viewpoints 7 and 8 are deemed to be Medium because, although the Development would be clearly visible it would be located in an area of the view which at Viewpoint 7 is in relatively poor condition and would not impact upon the main area of scenic value which is the more extensive panoramic view available in the opposite direction to the Development. In Viewpoint 8, it would be peripherally located to far left hand side of a very wide panorama encompassing highly scenic and extensive panoramic views. On the approach to Viewpoint 8 from Magheramore Road the rising gradient of the road and surrounding fields would screen the Development from view and the focus would be on the extensive pastoral landscape framed by uplands to the south west. The Development would become the focus of views for a short period of time if travelling in a southerly along the middle section of Teeavan Road from Viewpoint 8 towards Viewpoint 7. However, when the direction of travel changes to a south easterly direction after the bend in the road, the focus of views from the road corridor becomes more constrained and filtered by roadside hedges and trees. Views of the Development are likely to become glimpsed and would be located to the side of the road corridor rather than in the direction of travel. North easterly views towards Benbradagh also become available from this section of the road corridor and assume a greater focus on the approach to Viewpoint 7 where they form the main element of scenic quality and the primary focus of views.

Significance of Visual Effect: Viewpoints 1 – 4, 7 and 8: Not Significant; Viewpoint 6: Significant

4.148 The overall effects on Viewpoints 1 – 5 and 7 are deemed to be Not Significant because the sensitivity of receptors ranges from Low to Medium and the Magnitude of effects on these Viewpoints also ranges from Low to Medium. From the specific location at Viewpoint 5 the Magnitude of effect is deemed to be High but it reduces to Medium from most other parts of the road corridor which this Viewpoint is also intended to represent and the sensitivity of receptors is deemed to range from Medium to Low. Therefore the effects on Viewpoint 5 are also deemed to be Not Significant. From Viewpoint 8, although receptor sensitivity is High the Development would not be located in the same direction, or impinge upon the primary focus of views which is particularly scenic. Therefore, the Magnitude of effect on Viewpoint 8 is deemed to be Medium and the overall effects are also deemed to be Not Significant.

4.149 Effects on Viewpoint 6 however are deemed to be Significant because views from this location are close range and more constrained in their extent. Therefore, the Development would become the dominant feature of this View. Visual receptors are deemed to range from Medium to High sensitivity and the Magnitude of effect is also deemed to be High. It is noted, however, that Viewpoint 6 represents one short section of the Magheramore Road. Views from either end of the road tend to encompass more expansive views into the wider landscape and therefore, whilst the Development would still be a prominent feature in many of these views because it is located in relatively close proximity, the magnitude of its effect on the overall nature of views is substantially reduced. Views from the section of Magheramore Road directly to the north east of Viewpoint 6 are heavily constrained by roadside trees and hedgerows and the Development would be less visible from this section of the road.

Category B: Views from Dungiven and approaches to the town

Description of Existing View and Predicted Views

4.150 Category B includes Viewpoints 9 - 14 which are illustrated in Figures 4.21 – 4.26 and which have been selected to represent views from Dungiven and the approaches to it, particularly the sequence of views from the A6 which is the main access into the Sperrin AONB from the eastern side of the Province and which connects Belfast to Derry.

4.151 The A6 snakes over the Glenshane Pass then descends steadily into Dungiven before climbing up between the Sperrin Foothills and Loughermore Hills towards Derry. The focus of views from the road changes with the direction of travel and orientation of the road and also by the nature of the road corridor which is frequently in cutting with dense belts of trees and hedgerows on embankments and these often prevent views into the wider landscape. On the eastern side of Dungiven the foreground immediately surrounding the road is dominated by broad rounded uplands with a relatively simple mix of land uses including rough grazing land, turbary and coniferous forestry. The uplands are a dominant feature and are the entire focus of views for approximately 6 km when the A6 first enters the AONB near Maghera. Once the road corridor breaches the highest point at Glenshane Pass the uplands remain dominant but also create narrow channelled views the orientation of which changes as the road corridor changes direction but are broadly focussed into the Sperrin Foothills that form the north-facing edge of the AONB and the pastoral landscape within this part of the Study Area. In the middle section of the A6 road corridor around Dungiven the foreground becomes characterised by settlement and pastoral lowlands also backed by more extensive uplands. To the western side of Dungiven the road corridor becomes elevated once again and characterised by broader and more panoramic views to the south, west and north west including the north-facing side slopes of the Sperrins, the Slieve Kirk and Loughermore ranges of uplands in the western quarter of the Study Area and, in the opposite direction, the Binevenagh uplands.

4.152 There is no point along the A6 road corridor where there are views into the central part of the Sperrin AONB. The side slopes of the uplands which define and contain the heart of the AONB prevent such views but they also provide the setting for the western quarter of the Study Area. There are a number of existing clusters of wind farms located on these uplands and also the Binevenagh and Loughermore uplands which are key visual elements from the A6. Views are channelled towards one or more of these clusters depending on the orientation of the road corridor.

4.153 Viewpoint 9 represents the nature of views from the A6 and residential properties overlooking the road corridor and Dungiven when approaching from the west. It is located approximately 5.32 km to the north west of the Development. Prior to reaching this location receptors will have experienced extensive views of the Sperrin Foothills including the Slieve Kirk cluster of existing wind farms which is located at close range to the A6 on the north western edge of the AONB, followed by views into the Sperrin Foothills where a wind farm at Ballyhanedin has recently been consented, also in very close proximity to the road corridor, and subsequently views of the existing elements of the Loughermore cluster of wind farms at Altahullion and Glenconway which are the largest and one of the longest operating wind farms in the Province, and therefore an established visual element. The road corridor around Viewpoint 9 is partially surrounded by vegetated embankments and hedgerows but there are views south eastwards to the convergence of uplands above Dungiven and towards the low hills around Banagher where the Development would be located. It would appear as a small cluster of turbines above the hedgerow in the foreground.

4.154 Dungiven is located towards the southern end of the Roe Valley where the Binevenagh and Glenshane uplands converge with the Sperrin Mountains. The A6 crosses the River Roe at the western side of the town centre where Viewpoint 10 is located. It is approximately 4.2 km to the north of the Development and has been selected to represent views from within the town including properties located around the A6 and on adjacent tertiary roads around the town centre. Teeavan Hill is the closest and lowest hill in proximity to the town – the summit is approximately 4.5 km from the town centre and is visible beyond a richly vegetated pastoral landscape in the foreground as a broad low profiled hill characterised by strips of coniferous forestry and rough grazing land. It is backed by increasingly higher hills which stretch more extensively to the south, south east and south west. The Development would be clearly visible, i.e. prominent, from this location but the layout would be simple, evenly spaced and visually contained below the summit of Teeavan Hill. It would not impinge upon wider views into the higher parts of the Sperrin Mountains to the south west, or north east. Some forestry on the skyline would be removed to facilitate the Development but this is unlikely to be an easily perceptible alteration when viewed by the casual observer in the context of the wider view. Furthermore, because this forestry is a visually detractive feature its removal will be a minor improvement to the character and appearance of the hill.

4.155 The river wraps around the southern edge of the town which has an elevated position above the river corridor. There is an Environmental Park along the river which is a public amenity space accessible from the town and residential areas on its outskirts which were visited during the viewpoint selection process when views were found to be generally screened by vegetation. Dungiven Castle is positioned to the southern side of the town's main street (A6) and orientated to take advantage of panoramic views across the river corridor to the Sperrins. However, it is not a publicly accessible site and has not been selected as a Viewpoint for this reason. The Development would be visible at a similar distance to that represented by Viewpoint 10 but would appear as a smaller element within a wider panorama including the entire north western edge of the Sperrin foothills as well as the Glenshane uplands to the south east.

4.156 Viewpoint 11 would be located on the B64 road on the outskirts of Dungiven approximately 5 km to the north of the Development which would appear to be of a similar scale and layout to that described in relation to Viewpoint 10. At this location it would also be seen in the context of urban settlement and wider views along the northern edge of the Sperrin uplands are screened by the town. To the left hand side/ north east of this location the summit of Benbradagh is the dominant visual feature. The foreground landscape is defined by the road corridor vegetation, some pastoral fields but primarily urban settlement. The latter comprises a range of vertical built elements including housing, telegraph poles the road corridor and also a number of tall floodlights clustered in the centre of the view. The Development would be viewed within the context of these vertical elements which are already the primary element of views from this location and from approaches into Dungiven from a northerly direction.

4.157 Viewpoints 12- 14 represent the sequential nature of views on eastern approaches to Dungiven along the A6 whilst travelling through the AONB. The road corridor has a strong east-west alignment which channels views in the direction of travel. Therefore views are either close range east-facing views into the barren uplands around Glenshane, or more diverse and extensive west-facing views encompassing the Sperrin foothills, Slieve Kirk and Loughermore uplands with a more pastoral landscape either side of the road corridor and featuring large clusters of existing wind farms (Slieve Kirk and Loughermore clusters) as well as the site of the consented Ballyhanedin wind farm which is to the south side of the A6. When travelling along the A6 road corridor in proximity to Dungiven the Development would be prominent from parts of the road corridor where vegetation does not prevent views into the wider area. However, it would also generally be located to one side of the direction of travel and from most parts of the A6 road corridor it would not be visible. In all instances where it is visible is would appear as a coherent, evenly spaced and small group of turbines that would be of an appropriate scale when seen in the context of wider views.

4.158 Viewpoint 12 represents the location where the road corridor breaches the Glenshane pass and starts to become orientated along the western side of the Sperrin uplands and its foothills. The east-facing side of these uplands characterise views to one side of the road corridor. Rising ground on the southern side of

Benbradagh immediately adjacent to the road corridor constrain views in this direction and they are generally channelled along the river corridor by high sided hills in both directions. The foreground landscape is characterised by the open uplands around Glenshane. Teeavan Hill located in the middle distance to the right hand side/ south west of the foreground is of a similar character, i.e. open grazing / moorland and forestry. It appears from this Viewpoint to be located at the edge of the uplands where they meet the pastoral lowlands and it does not impinge upon either the remoter foreground upland landscape or the more scenic views into the more distant Slieve Kirk uplands that are the end point or focus of views that are channelled along the river corridor by the higher ground on either side. The Loughermore Hills are visible beyond the large area of forestry to the right of centre of the view illustrated in Figure 4.24 and the existing cluster of wind farms at Altahullion/ Glenconway are partially visible in this part of the view. The consented Ballyhanedin wind farm would be visible directly in front of Slieve Kirk.

4.159 From Viewpoint 13 views from the road corridor is lower in elevation and a smaller proportion of Teeavan Hill would be visible beyond a relatively complex pastoral landscape in the foreground. The would be some residential properties located along the road corridor from where similar views may be obtained but properties located on lower ground to the south of the road corridor are likely to experience views only of the foreground landscape. A greater proportion of the turbine bases would be screened by the summit of Teeavan Hill and there would be no alterations to on-site forestry visible from this location. Slieve Kirk and Ballyhanedin would remain as features to the right hands side of the view and Altahullion/ Glenconway would be prominent in the main direction of view, i.e. the western direction of travel.

4.160 The road corridor around Viewpoint 14 is more heavily vegetated and therefore views into the wider landscape are more frequently screened. This location, approximately 4.72 km to the north east of the Development, represents the nature of glimpsed views that may be obtained through gaps in this roadside vegetation. It illustrates that, at lower elevations on the A6 road corridor around Dungiven the pastoral landscape of the foreground occupies a greater proportion of the view and is more dominant. The Development, although forming a prominent new feature, is visually compact and would not occupy a significant proportion of the uplands which form the setting to the foreground landscape.

Sensitivity of Visual Receptors: Low – Medium

4.161 There are no highly sensitive visual receptors in this Category due to their proximity to, or location on the primary and secondary road network and the transitory nature of receptors in the latter group. Travellers on the A6 are deemed to be of Low sensitivity due to their transient nature and location on a primary road. In Viewpoint 11 where receptors would be on a secondary road that forms part of a scenic driving route they are also deemed to be of Low sensitivity because they would be in close proximity to the Dungiven urban area from where views are heavily defined by built structures. There are fewer available views from parts of the secondary road network within the Roe Valley itself due to a higher proportion of roadside and field boundary vegetation which filters and screens views in a southerly direction. Residents of properties located along and around the A6 road corridor are deemed to have reduced sensitivity to human influence due to their proximity to the road corridor and the presence of other long-standing wind farm clusters located in several other parts of the views that would be available from this location. Their sensitivity would be Medium.

Magnitude of Visual Effect: Medium

4.162 The panoramic nature of views that can be obtained from many parts of the road corridors and approaches to Dungiven are the most attractive feature of views from this Category of Viewpoints. These views include the whole range of elements present in this part of the Study Area including distinctly shaped ranges of uplands and summits, foothills and valley landscapes in between. Individual elements of these panoramic views are subordinate to the overall extent of views. They include a number of man-made features such as areas of settlement, farmed land and single turbines, large blocks of coniferous forestry, pylon lines, clusters of wind farms and the road corridors themselves.

4.163 The magnitude of visual effects on Viewpoint 9 is deemed to be Low. Views are more constrained by the landscape immediately surrounding the road corridor than the wider landscape from this location. Where wider views become available in proximity to this Viewpoint the Development would form only a small element of views which are either located to one side of the main direction of travel or it would form a small element in a much wider panorama which would already include a number of man-made structures as described in 4.156. The turbine bases would be concealed by the summit of Teeavan Hill from this location. T1 and T2 would appear to be stacked but this effect would be transitory.

4.164 The Magnitude of effect from Viewpoints 10 and 11 is deemed to be Medium because the Development would be appreciated in the context of both road corridors and urban settlement and therefore already heavily influenced by built structures.

4.165 The Magnitude of effect from the sequence of views along the easterly A6 approach to Dungiven – Viewpoints 12 – 14 – are also deemed to be Medium because the primary focus for the largest number of visual receptors are likely to be orientated in an east-west direction (the direction of travel) and the Development would be located to the south western side of the road corridor and seen as a small element in a much wider context.

Significance of Visual Effect: Not Significant

4.166 The combination of Low – Medium sensitivity and Magnitude result in no significant effects on Viewpoints in this Category.

Category C: Elevated views from within the Sperrin AONB

Description of Existing View and Predicted Views

4.167 Category C includes Viewpoints 15 - 18 which are illustrated in Figures 4.27 – 4.29 and which have been selected to represent views from elevated locations within the Sperrin AONB that are not associated with the A6 road corridor or the lowland landscape in proximity to Dungiven and the Roe Valley.

4.168 Viewpoint 15 is located near the summit of Benbradagh approximately 6.5 km to the north east of the Development. It has been selected because it forms part of the Ulster Way and forms a prominent landmark at the southern end of the Binevenagh range of uplands at the convergence with the Sperrin Mountains and Glenshane Uplands. The upper slopes of Benbradagh in the foreground are characterised by rough grazing fields divided by scrubby trees, stone walls and some gappy hedgerows. Although not in optimum condition, the elevated nature of this landscape means that there are spectacular panoramic views from this location across much of the north west of Northern Ireland and Co. Donegal which affords this location a high degree of scenic quality. This Viewpoint is reached by a very steep winding road with passing places that can be used to gain similar views along all of its length. It is not signposted but is a prominent and well-known location accessible via a steep single track road that starts on the outskirts of Dungiven. Due to its elevation, it is one of the few locations within this Study Area to have clear views of the summits that form the heart of the AONB.

4.169 The town of Dungiven is the largest of these settlements, and is visible in the middle ground. There are also extensive and highly scenic views across the Roe Basin in the middle distance, which comprises high quality pastoral land interspersed with farmsteads and areas of settlements. The backdrop to the Roe Basin is formed by a series of uplands stretching in all directions from the south east to north. They include the Sperrin Mountains directly to the south east, lower hills to the east of the River Foyle, and several ranges of hills in Co. Donegal beyond this. The centre of this view is dominated by the Loughermore Hills, including large clusters of existing wind turbines at Altahullion and Glenconway, and also to the south west around Slieve Kirk. There are also clusters of existing and consented wind farms elsewhere in views from this location including at Rigged Hill, Dunbeg and Carntogher (see cumulative assessment at section 4.189 for more detail).

4.170 Viewpoint 16 is located approximately 10.82 km to the south west of the Development on the hills above Park village. It has been selected because it is located further towards the centre of the AONB between the Sperrin Mountains and Foothills and would represent views from the tertiary road network and detached rural properties. Site analysis revealed few clear views towards the Development from Park itself due to its low lying and position in the landscape and heavy tree cover. The Development would be located beyond and at the base of the edge of some of the higher Sperrin Mountains which form the northern edge of the range. Three of the proposed turbines would be visible against a backdrop of rising land formed by Benbradagh and the Carntogher/ Glenshane uplands and the other three would rise above the skyline but would still appear well below the summits of the Sperrin Mountains in the middle distance. The foreground landscape is also relatively complex in terms of land uses and is itself a prominent feature of the view.

4.171 Viewpoint 17 is located on Slieve Kirk Hill on the north western edge of the AONB within the Sperrin Foothills LCA and approximately 21.13 km from the Development. It has been selected to represent one of the few long range views of the Development from within the Study Area. Viewpoint 18 has been selected for similar reasons. It is located on a hill at the western edge of the main Sperrin Mountain range and AONB boundary approximately 26.77 km from the Development. Both viewpoint locations are in proximity to existing clusters of wind farms although this is not the reason for their inclusion in this LVIA. However, it is reflective of the longstanding approach to the development of wind farms on peripheral upland areas around the edges of the AONB. There are existing and consented wind farms visible across most other areas of the skylines visible from both of these locations, some of which will be dominant features, and some of which will be barely discernible due to their distance from these Viewpoints. The Development would fall within the latter category in both instances and is unlikely to be easily perceptible to the naked eye even in clear weather conditions. In accordance with SNH guidance on visualisations (Technical Appendix 4.2) no photomontages have been produced from these viewpoints due to their distance from the Development and the lack of any significant effects.

Sensitivity of Visual Receptors: High to Low

4.172 Visual receptors in this Category range from High to Low sensitivity. Whilst all are located within the Sperrin AONB, those in and around Viewpoints 17 and 18 will be located at such a distance from the Development, and will experience such extensive views that already include a large number of existing and consented wind farms, that the Development is likely to be an imperceptible as an additional feature. There are no residential properties in proximity to Viewpoint 15. Visual receptors will comprise primarily of tourist visiting the site to appreciate the views and walkers on the Ulster Way. With the exception of farmers tending the rough grazing land surrounding this Viewpoint, who are likely to occur in low numbers, all receptors at Viewpoint 15 are deemed to be of High sensitivity. Receptors are Viewpoint 16 range from High to Medium sensitivity and will include residents in rural properties, users of the tertiary road network, farm and forestry workers.

Magnitude of Visual Effect: Low to Negligible

4.173 The sheer extent of views that are available from the elevated viewpoints in this category are the most scenic elements of these views. Individual components of these views are subordinate. The Development would, in all cases, be discreetly located towards one side of these extensive views or at such a distance that it is unlikely to be discernible to the naked eye. The latter applies to Viewpoints 17 and 18 where the Magnitude of effect is deemed to be Negligible.

4.174 The Development would be located to the far left hand side of the extensive panoramic view available from Viewpoint 15. Although it would be clearly visible it would not be prominent. It would also be set against a backdrop of higher ground and would form a compact and evenly spaced group of turbines with a closer relationship with the lowlands in the middle distance than to the uplands that frame this view. It would occupy a peripheral location in a view that already includes a number of larger clusters of wind farms at varying distances and which are all more prominently located on or near the skyline. The Magnitude of effect is deemed to be Low.

4.175 From Viewpoint 16 the Magnitude of effect is also deemed to be Low because the Development would occupy a relatively discreet position within the view, would be subordinate to the prominent skyline formed by higher summits and also to the prominent foreground landscape. The Development would be partially viewed against a backdrop of rising land located at one end of a broad skyline that stretches for some distance across the centre of the view available from this location.

Significance of Visual Effect: Not Significant

4.176 There would be no significant effects from elevated areas of the Sperrin AONB from the locations represented by Viewpoints in this Category. This is due to the subordinate position that the Development would occupy in relation to the wide panoramic nature of wider views, the fact that some or all of the turbines would often appear below the skyline, the prominent and extensive nature of the foreground and background landscapes where the lower profiled uplands forming the middle distance assuming accordingly less significance, and also the long distance between some of these Viewpoints and the Development which would cause it to be barely perceptible the casual viewer/ visual receptor whether they are deemed to be highly sensitive in principle or not.

Category D: Elevated views from within the Binevenagh AONB

Description of Existing View and Predicted Views

4.177 Category D includes Viewpoints 19 and 20 which are illustrated in Figures 4.30 – 4.31 and which have been selected to represent views from the Binevenagh AONB which is located in the northern part of the Study Area. It forms one end of the long crescent-shaped arc of uplands which define the eastern to south western edges of the Study Area and visually enclose the Roe Valley.

4.178 Viewpoint 19 is located on Keady Mountain approximately 19.04 km to the north east of the Development. It is a distinctive summit which forms part of the broader Binevenagh profile of uplands. There is a quarry which also forms a convenient place to stop and appreciate views across the Roe Valley towards the north to north western parts of the Province. Viewpoint 20 is located on the south-facing side slope of Binevenagh itself. The road forms part of a scenic driving loop which takes in the summit of this mountain and a similarly extensive view as that experienced at Keady when descending into the top/ northern end of the Roe Valley near the town of Limavady. The visual character of both views is very similar to that described for Viewpoint 15 at the summit of Benbradagh. However, due to the increased distance from the Sperrins, and the location of both of these Viewpoints at the top of the arc of uplands, the lowland landscape occupies a much greater proportion of the views. The uplands which frame this view are clearly perceived as an extensive crescent shaped sweep of summits and plateaus but their vertical presence in both viewpoints is reduced by their overall scale and the scale of the lowlands. There are a number of existing and consented wind farms located in several parts of these views but none are more dominant that the overall scale of views. In both cases the Development would be located below the skyline against a backdrop of rising ground and would be difficult to perceive with the naked eye.

Sensitivity of Visual Receptors: Low

4.179 Visual receptors are most likely to comprise of visitors to these locations who will be present in order to appreciate scenic views. There will be smaller numbers of residential receptors in and around Viewpoint 20. The general sensitivity of these receptors is high but, due to their distance and the position of the Development relative to other components of these views their specific sensitivity to this Development would be Low.

Magnitude of Visual Effect: Negligible

4.180 The views from both of these locations are highly attractive despite a highly degraded foreground landscape at Viewpoint 19 (the quarry). The overall scale of these views, the distance to the Development and its discreet position below the skyline means that it would be a difficult feature to discern with the naked eye for most observers. Therefore, the Magnitude of effect is deemed to be Negligible.

Significance of Visual Effect: Not Significant

4.181 Visual receptors are deemed to be of Low sensitivity and the Magnitude of effect in relation to both Viewpoints in this Category is Low, resulting in no significant effects on either Viewpoint.

Category E: Views overlooking the Roe Valley and the landscape in the north west of the Study Area

Description of Existing View and Predicted Views

4.182 Category E includes Viewpoints 21 and 22 which are illustrated in Figures 4.32 – 4.33 and which have been selected to represent views from the lower lying parts of the Study Area within the Roe Valley which would experience views of the Development. Viewpoint 21 is located on the tertiary road network which forms part of the National Cycle Network approximately 6.46 km to the north west of the

Development and only 0.5 km to the north of the A6 road corridor. The latter is largely screened from view by areas of woodland and field boundaries between the pastoral fields in the foreground. The overall scenic quality of the view is high. The view comprises a simple composition of pastoral fields in the foreground backed by a long undulating series of uplands in the middle distance. The existing cluster of wind farms at Slieve Kirk is visible to the far right hand side/ west of this view (beyond the extent of the view illustrated in Figure 4.32). The skyline in this part of the view is free of vertical built structures, although small areas of coniferous forestry are a feature of many of the individual hills in this sequence and there is a single turbine visible within the foreground to the far left hand side of the view. Single turbines are also a relatively common feature of views from the A6 road corridor in proximity to this Viewpoint. The Development would become a prominent new feature on one of the lower hills at a distance of approximately 6.46 km in an area of the view where there are currently no vertical structures. However, it would be sited in accordance with SPG guidelines as a compact and evenly spaced group of turbines that reflect the rounded profile of the underlying hill and which would maintain appropriate separation distances from other wind farms. The hill on which it is located is already characterised by forestry and farming practices and has a character more related to the foreground landscape than of the more remote uplands and higher summits in this sequence of hills which it is less closely related to.

4.183 Viewpoint 22 is located on the outskirts of Drumsurn village approximately 12.03 km to the north of the Development. The village is located at the base of the Binevenagh range of uplands and its setting is strongly defined by this sweep of hills. The Development would be located beyond the base slopes of Benbradagh, the summit of which is a dominant land mark. The broader arc of uplands stretching into the Sperrins is less visible from this part of the Study Area due to the amount of vegetation along field boundaries. This level of screening is typical of that which occurs in many parts of the Roe Valley and which serves to screen views of the Development elsewhere in the valley. The Development itself would be located against a backdrop of higher ground and would be relatively discreet.

Sensitivity of Visual Receptors: Medium

4.184 Visual receptors are Viewpoint 21 are likely to comprise primarily of road users and cyclists on the tertiary road network. They would not be located within a designated landscape and are likely to be present for primary purposes that may be unrelated to the enjoyment of scenery. There are likely to be similar views from residential properties on other parts of the road corridor that may be more elevated and therefore broader in extent. Overall visual receptors at this location are deemed to be of Medium sensitivity.

4.185 Visual receptors are likely to comprise primarily of residents within a small settlement. Their views will largely be constrained by foreground vegetation and by the dominant profile of Benbradagh. Views into the wider landscape, including towards the Development would be more restricted by intervening vegetation and also by distance. Overall visual receptors at this location are also deemed to be of Medium sensitivity

Magnitude of Visual Effect: Medium to Low

4.186 The Development would be prominent from Viewpoint 21 and the surrounding area but it would also form only a small element of a much more expansive view that already includes existing wind farms in other directions. The viewpoint is not located within a designated landscape and therefore the Magnitude of effect is deemed to be Medium. The Magnitude of visual effects on Viewpoint 22 is deemed to be Low due to the distance, the dominant nature of Benbradagh summit at a closer distance to this Viewpoint, and the discreet location of the Development in relation to this feature.

Significance of Visual Effect: Not Signficant

4.187 There would be no significant effects from the two Viewpoints in this Category. The majority of visual receptors are not deemed to be highly sensitive and the presence of the Development would not alter the appreciation of either view to the extent that it would become defined by the Development to a greater extent than other elements of the view. Both Viewpoints are located within a designated landscape and both include views to existing and consented wind farms in other parts of the view. Therefore, the Development would not represent a completely new or incongruous feature.

Table 4.2: Summary of Visual Effects on Viewpoints

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of visual effect	Significance of visual effect
Category A: Views from rural roads and amenity sites in proximity to the Development						
1	**Altnaheglish Dam, Banagher Forest**	**0.52 km to T1**	**Prominent**	**Medium to Low**	**Medium**	**Not Significant**
2	**North Sperrins Scenic Drive, B40 Glenedra Road**	**2.83 km to T6**	**Visible**	**Medium**	**Medium**	**Not Significant**
3	**Fincarn Crossroads at B40 – B44 road junction**	**4.71 km to T4**	**Visible**	**Low**	**Low**	**Not Significant**
4	**Banagher Old Church**	**1.49 km to T4**	**Prominent**	**Medium**	**Medium**	**Not Significant**
5	**Banagher Road**	**1.71 km to T4**	**Prominent**	**Medium to High**	**Medium to High**	**Not Significant**
6	**Magheramore Road near site entrance**	**1.54 km to T4**	**Dominant - Prominent**	**Medium - High**	**High**	**Significant**

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of visual effect	Significance of visual effect
7	Creebarky – Teeavan Road junction	2.20 km to T2	Prominent	Low	Medium	Not Significant
8	Teeavan Road to north east of site	2.08 km to T4	Prominent	High	Medium	Not Significant
Category B: Views from Dungiven and approaches to the town						
9	Killunaght Road, A6 near Dungiven	5.32 km to T4	Visible	Low to Medium	Low	Not Significant
10	Dungiven, Bridge over River Roe	4.20 km to T4	Prominent	Medium - Low	Medium	Not Significant
11	B64 Garvagh Road, Dungiven	5.00 km to T4	Prominent	Low to Medium	Medium	Not Significant
12	A6 at FP McCann Quarry	7.33 km to T1	Prominent	Low	Medium	Not Significant
13	A6 at Corick Road junction	5.72 km to T1	Prominent	Low - Medium	Medium	Not Significant
14	A6 at Cashel Road junction	4.72 km to T1	Prominent	Low - Medium	Medium	Not Significant
Category C: Elevated views from within the Sperrin AONB						
15	Benbradagh Mountain	6.54 km to T2	Visible	High	Low	Not Significant
16	Plantation Road near Park	10.82 km to T6	Visible	High - Medium	Low	Not Significant
17	Slieve Kirk Hill	21.13 km to T4	Not Visible	Low	Negligible	Not Significant
18	Craignagapple near Owenreagh	26.77 km to T6	Not Visible	Low	Negligible	Not Significant
Category D: Elevated views from within the Binevenagh AONB						
19	Keady Mountain	19.04 km to T4	Visible	Medium	Negligible	Not Significant
20	Binevenagh Scenic Drive at Lisnagrib	22.46 km to T4	Visible	Medium	Negligible	Not Significant
Category E: Views overlooking the Roe Valley and the landscape in the north west of the Study Area						
21	Drum Road near Altahullion	6.46 km to T4	Prominent	Medium	Medium	Not Significant
22	Edge of Drumsurn village	12.03 km to T4	Visible	Medium	Low	Not Significant

The Cumulative Baseline and Analysis of Effects

4.188 The Cumulative Baseline refers to all existing, consented and proposed wind farms within the 30 km Study Area. There are a total of 37 wind farms considered to be part of the Cumulative Baseline for this LVIA, of which 19 are existing, 11 are consented and 7 are proposed. It also includes single turbines where they are existing elements within the final viewpoints. Full details of all wind farms included in the Cumulative Baseline are provided in Technical Appendix 4.5.

4.189 In many instances other wind farms in the cumulative baseline are located in visually and / or physically distinct clusters. This often reflects landscapes, ground conditions and wind speeds that are favourable for wind energy development and also a general principle that is implemented by planning authorities to consolidate and group new and established developments together as a means to achieve sustainable development and mitigate potential adverse cumulative effects on scenic landscapes which can result from a sporadic approach to siting new developments. This LVIA has grouped and named clusters of wind farms within the Study Area for ease of reference and because it allows for a better understanding of their interrelationships. These clusters are referred to in Table 4.3 and illustrated in Figure 4.5.

4.190 The Development is not located within a cluster but it is located in accordance with the SPGs guidance on separation distances and other layout recommendations. It is a relatively small wind farm with a coherent layout that is well located away from prominent skylines and summits when viewed in the context of the wider landscape and is detached from the core of the Sperrin AONB. Its cumulative effects on the landscape and visual character of the Study Area are analysed in this section of the LVIA.

Table 4.3: Clusters of Cumulative Wind Farms

Name of Cluster	Included wind farms *(see Technical Appendix 4.5 for full details)*	Total no. of turbines in cluster	Total no. of existing & consented turbines
Binevenagh Cluster	**Croaghan, Dunbeg, Dunbeg Extension, Dunbeg South, Dunmore, Dunmore II**	**46**	**37**
Rigged Hill Cluster	**Craiggore, Rigged Hill, Smulgedon, Upper Ballyrogan**	**32**	**32**
Carntogher Cluster	**Brockaghboy, Brockaghboy Extension, Corlacky Hill, Evishagaran**	**44**	**33**
Loughermore Cluster	**Altahullion I & II, Barr Cregg, Glenconway & Glenconway II, Monnaboy**	**60**	**53**
Slievekirk Cluster	**Carrickatane, Curryfree, Eglish, Slievekirk, Slievekirk Extension**	**37**	**37**
Crockandun	**Brackagh, Creagh, Crockandun**	**12**	**12**

Name of Cluster	Included wind farms *(see Technical Appendix 4.5 for full details)*	Total no. of turbines in cluster	Total no. of existing & consented turbines
Cluster			
Owenreagh Cluster	**Craignagapple, Owenreagh, Owenreagh II**	**25**	**25**
Wind Farms not in a cluster	**Ballyhanedin, Barony, Beltonanean, Beltonanean Extension, Cam Burn, Doraville**	**56**	**15**
	Total no. of turbines in Study Area	**312**	**244**

Cumulative Landscape Effects

4.191 The Study Area comprises of a series of broad and expansive upland ranges of hills which are separated from each other by lowland landscapes which are often pastoral in character and well-vegetated. Clusters of wind farms located on these upland areas are a relatively common landscape characteristic throughout the Study Area (Figure 4.5). The outer edges of the Sperrin AONB already provide sites for a number of wind farms clusters and therefore they are already a landscape character element around various parts of the AONB. The Development reflects this approach and pattern of wind farm development in relation to the AONB. The scale of these uplands and the separation distances between these clusters ensure they are not the dominant characteristic of the Study Area or the AONB. This is in accordance with general advice provided in the SPG that elevated upland landscapes can accommodate larger turbines and the broader the upland the greater the capacity where larger horizons tend to diminish the perception of height.

4.192 The Development is not located in close proximity to any other wind farms and would not significantly decrease separation distances between other clusters of wind farms. Whilst it would introduce wind turbines into a part of the Study Area where there are currently none it would be located within a landscape that is already characterised by other man-made features. It would also reflect the general approach to siting wind farms around the peripheries of the Sperrin AONB where they would have no physical effects on the landscape character of the majority of the AONB but would be perceived as a sequence of separate developments on uplands around its edges. The Development would increase the presence of wind turbines within close range viewpoints but, when viewed in the context of the wider Study Area where clusters of wind farms are a common feature on upland areas the magnitude of effect on landscape character would be Low. The introduction of the Development would result in a minor alteration to the landscape character of a site that is located on the periphery of LCA 29 and the Sperrin AONB and would therefore result in very limited physical effects on the character of this LCA. Therefore it is not deemed to have any significant cumulative landscape effects.

Cumulative Visual Effects

4.193 Existing and consented wind farms form the majority of the cumulative baseline that is considered in this LVIA. There are 19 existing and 11 consented wind farms in the Study Area and these are described as an integral part of the baseline views in the assessment of Viewpoints starting at paragraph 4.122. There are a further 7 proposed wind farms which are unlikely to be visible from most Viewpoint locations and they are therefore afforded less weight in the assessment of cumulative visual effects. A full list of wind farms which have been considered in the cumulative baseline is provided in Technical Appendix 4.5, Table A.5 and has been used in conjunction with the analysis of Cumulative ZTV diagrams and Viewpoints to reach a number of conclusions in relation to cumulative effects.

4.194 Two Cumulative ZTV diagrams have been produced illustrating firstly the combined effect of other existing and consented wind farms within the Study Area and the incremental effect of the Development on this cumulative baseline (Figure 4.11), and secondly the theoretical visibility of other proposed wind farms and the incremental effect of the Development on the level of visibility of proposed wind farms across the Study Area. They are calculated using theoretical blade tip visibility in order to consider the highest possible levels of visibility and cover a radius of 30 km from the centre of the Development unless otherwise stated. Refer to the LVIA methodology in Technical Appendix 4.2 for further details.

4.195 Figure 4.11 shows the cumulative ZTV for the Development in conjunction with all existing and consented wind farms in the Cumulative Baseline. It clearly illustrates the conclusion that has already been made in relation to cumulative landscape effects – that clusters of wind farms are a characteristic feature on uplands in all parts of the Study Area. There are few discernible parts of the Study Area (0.18%) where the proposed development would increase overall theoretical visibility. Existing and consented wind farms are already theoretically visible across 87.31% of the Study Area.

4.196 The ZTV suggests that the areas of additional theoretical visibility will be located at relatively close range to the south east and east of the Development and in two areas indicated to the west at distances of approximately 8km and 15 km either side of the village of Park and at a distance of approximately 10 – 15 km to the north within the Roe Valley. It is noted that vertical structures of this size are often likely to be visible at close range and this is accepted by planning policy. However, when considered in conjunction with the analysis of viewpoint figures and site assessment of the Study Area as a whole, the areas of additional close range visibility to the south east and east will be largely screened by Banagher and Glenshane Forests. Site analysis suggests that views from the two areas to the west near the village of Park and to the north in the Roe Valley will frequently be screened by high levels of roadside and field boundary vegetation. Therefore, it is concluded that the incremental visibility if 0.18% indicated by the ZTV diagram is in fact likely to be far lower, i.e. Negligible.

4.197 There are 30 existing and consented wind farms in the Study Area. Table A.5 in Technical Appendix 4.5 indicates that 7 of them would not be visible either simultaneously or sequentially with the Development because they are outwith the ZTV for this Development. These wind farms include Brockaghboy and its Extension; the 3 wind farms within the Crockandun cluster; Beltonanean and Cam Burn. The cumulative effects of the Development alongside or in addition to the remaining 23 existing and consented wind farms that may be visible from some Viewpoints are not deemed to be Significant for reasons provided in the following paragraphs.

4.198 The Cumulative Baseline includes 37 wind farms which are generally located in closer proximity to each other – there are 7 distinct clusters of wind farms in the Study Area. The Development itself has a very limited ZTV would not increase the size of any of these clusters of the levels of intervisibility between them. This is demonstrated by the percentage figures provided in relation to the two cumulative ZTVs that have been produced (see Table 4.4). The Development would be a compact and discreetly located group of turbines which would maintain good separation distances between all other wind farms in the Study Area and would be located in excess of at least 10 km from most other wind farms in the Study Area.

4.199 The closest wind farm to the Development is the consented Ballyhanedin wind farm which is a standalone development located approximately 6.7 km to the north west of the Development on the southern side of the A6 road corridor within the Sperrin Foothills. Ballyhanedin would be sequentially visible from 11 Viewpoints where visual receptors would either need to turn in an opposite direction or travel for a distance before gaining views. It would be simultaneously visible with the Development from only 8 Viewpoints:

- In Viewpoint 1 at Altnaheglish Dam there would only be visibility of some blade tips to the right hand side of the Slieve Kirk cluster of wind farms in a clearly distinct part of the view. The Development would be a dominant foreground feature but the former wind farms would be relatively indiscernible from this location and only within a very narrow portion of the view;
- In Viewpoints 12, 13, and 14 it would appear in front of the Slieve Kirk cluster of wind farms in transitory views along the A6 road corridor. There would be undeveloped land in between the Development and Ballyhanedin which would increase in depth with the direction of travel in a north westerly direction along this road corridor. In this direction of travel the Development would also become a lesser element of views whilst existing elements of the Slieve Kirk and Loughermore clusters would increase in prominence. All wind farms apparent in these Viewpoints would be seen as sub-ordinate elements to the overall scale of views encompassing the south facing edge of the Sperrins as well as upland ranges to the north and north east;

- In Viewpoint 16 Ballyhanedin would appear at one side of the Viewpoint and the Development would appear at the other at a slightly greater distance from this Viewpoint than Ballyhanedin. This Viewpoint already features views of a number of wind farms and the Development it not deemed to have a Significant effect on the character of the view taking account of both existing and consented wind farms;
- In Viewpoints 19, 20 and 22 both wind farms would be viewed as distant developments and would be clearly separated by undeveloped areas of the landscape. In Viewpoint 22 views of Ballyhanedin would also be screened by foreground vegetation.

4.200 The second closest wind farm to the Development would be the consented Evishagaran wind farm which would be located approximately 8.2 km to the north east. However, in all instances (a total of 8 Viewpoints) where it may be visible in conjunction or in sequence with the Development there would only be partial visibility of some blade tips. This is due to its location on the north eastern facing side of Benbradagh, the summit of which generally screens it from view throughout this Study Area.

4.201 The visual character of the Study Area is defined by expansive upland areas which primarily combine to form a broad and distinctive crescent-shaped arc of summits and plateaus which stretch from the northern edge across the centre to the south west. There are also upland areas in the north western quarter of the Study Area at Loughermore; beyond the eastern edge at Long Mountain; and beyond the north western edge in Co. Donegal. All of these upland areas already feature clusters of wind farms and individual wind farms. There are also single turbines scattered throughout the lowland parts of the Study Area associated with the pastoral farmland which characterises these lowland parts. Notably there are a number of wind farms clustered around the edges of the uplands which contain the Sperrin AONB.

4.202 The Development would not be located within an established cluster but would be well separated from these clusters and would also be located in a manner which reflects the general pattern of locating wind farms on the outward facing edges of the AONB. It would also occupy a relatively discreet position on a low hill surrounded on all sides by higher ground and this is illustrated by the very small extent of its ZTV in relation to the wider Study Area, the Sperrin AONB and the cumulative ZTVs. It would more often be visible in sequential rather than simultaneous cumulative views from close range viewpoints where it is likely to be more prominent and therefore its effect on cumulative views would be of a lesser magnitude. In instances where it appears simultaneously with other wind farms in the Study Area it will generally be viewed with good separation distances and often also from transient viewpoints on busy road corridors such as the A6.

4.203 Figure 4.12 shows the cumulative ZTV for the Development in conjunction other proposed wind farms in the Study Area. It is noted that the inclusion of proposed wind farms is not a requirement of the EIA Regulations 2017. It is included to ensure that a comprehensive analysis of potential cumulative effects has been carried out but proposed wind farms are afforded less weight in the consideration of cumulative effects than existing and consented schemes (refer to Technical Appendix 2, paragraph 4.57). This ZTV clearly illustrates the conclusion that has already been made in relation to cumulative landscape effects – that clusters of wind farms are a characteristic feature on uplands in all parts of the Study Area. There are few discernible parts of the Study Area (2.87%) where the Development would increase overall theoretical visibility. The 7 other proposed wind farms would be theoretically visible across 76.49% of the Study Area. When considered in conjunction with the analysis of viewpoint figures and site assessment the majority of additional theoretical visibility is shown by the ZTV to be located either in lowland parts of the Study Area where views will be screened to a large extent by vegetation along road corridors and in field boundaries, or from elevated locations at a greater distance where the Development may appear as a small element within a much wider panorama and may be hard to perceive with the naked eye. Forestry and rising ground is likely to screen additional views directly to the east of the Development.

4.204 Of the 7 proposed wind farms in the Study Area, four of them would not be visible either simultaneously or sequentially with the Development because they are outwith the ZTV for this Development. These wind farms include Croaghan; Barony, Beltonanean Extension and Doraville. The cumulative effects of the Development alongside or in addition to the remaining three proposed wind farms that may be visible from some Viewpoints are not deemed to be Significant for the following reasons:

- Dunbeg South wind farm is visible within 9 of the 22 Viewpoints but it would usually be viewed either as an integral part of the Binevenagh cluster which is located 20.4 km to the north east of the Development at its nearest point, or there would only be partial visibility of blade tips above the skyline;
- Corlacky Hill wind farm would be located approximately 11.7 km to the north east of the Development. There would be partial blade tip visibility of this wind farm from only 3 of the Viewpoints in this LVIA (Viewpoints 16, 17 and 18) and all of these would be located at some distance from the Development;
- There would be partial visibility of some blade tips in Barr Cregg wind farm from four Viewpoint locations but this is unlikely to be clearly perceived due to the distance of this wind farm from the Viewpoints in question. It would be more clearly visible, although still at some distance, from Viewpoints 17 and 18 which are 21 – 26 km away from the Development.

Table 4.4: The Development's Cumulative Zone of Theoretical Visibility

ZTV Diagram	No. of turbines theoretically visible (blade tip)	% of Study Area with visibility		
Cumulative ZTV: Existing and Consented Wind Farms (30 km radius, blade tip)	**0 turbines visible**	**12.51 %**		
Figures 4.11	**Visibility of other wind farms where there is no visibility of the Development**	**69.53 %**	**Total % of 30 km Study Area where other wind farms are theoretically visible = 87.31 %**	
	Visibility of the Development together with other wind farms	**17.78 %**		**Total % of 30 km Study Area where the Development is theoretically visible = 17.96 %**
	Additional visibility of the Development	**0.18 %**		
Cumulative ZTV: Proposed Wind Farms (30 km radius, blade tip)	**0 turbines visible**	**20.64 %**		
Figures 4.12	**Visibility of other wind farms where there is no visibility of the Development**	**61.40 %**	**Total % of 30 km Study Area where other wind farms are theoretically visible = 76.49 %**	
	Visibility of the Development together with other wind farms	**15.09 %**		**Total % of 30 km Study Area where the Development is theoretically visible = 17.96 %**
	Additional visibility of the Development	**2.87 %**		

4.205 Of the 22 Viewpoints considered to represent typical views of the Development within the Study Area none would experience significant cumulative effect resulting from the Development. In most instances the sensitivity of visual receptors is deemed to range from Low to Medium and the magnitude of cumulative visual effect is deemed to be Negligible or Low. In the Viewpoints where some receptors are deemed to be of High sensitivity (Viewpoints 2, 6, and 16) the magnitude of effect is Low or Negligible. In all cases the Development's location on a low hill in comparison to the uplands across other parts of the Study Area and the varying topography of these uplands restricts intervisibility between the Development and other wind farms.

4.206 Only in relation to Viewpoint 8 is the sensitivity of visual receptors deemed to be High and the Magnitude of effect Medium. In this instance the Development would be located at close range to the Viewpoint in question (2.08 km) and it would become a prominent feature in one part of the view. However, the overall view from in and around this Viewpoint location is expansive in nature. The majority of receptors with the highest sensitivity will have views orientated to take advantage of the most scenic parts of the view rather than in the direction of the Development which occupies a peripheral location. These views include clear visibility of the existing Loughermore cluster of wind farms as well as parts of the Slieve Kirk, Rigged Hill and Binevenagh clusters as well as views of the existing and re-routed A6 road corridors, the extensive pastoral landscape of the Roe Valley, and the uplands surrounding this and stretching beyond the norther western edge of the Study Area (refer to 4.136 for a full description of this Viewpoint). Therefore, whilst the Development would be a Prominent close range feature its peripheral location and geographical extent in relation to the much wider extent of the whole view means it would not cause the overall visual character of the view to become defined by wind turbines rather than by other elements of the existing view the overall effects are deemed to be Not Significant.

Table 4.5: Summary of Cumulative Visual Effects on Viewpoints

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of cumulative visual effect	Significance of cumulative visual effect
Category A: Views from rural roads in proximity to the Development						
1	Altnaheglish Dam, Banagher Forest	0.52 km to T1	Prominent	Medium	Low	Not Significant
2	North Sperrins Scenic Drive, B40 Glenedra Road	2.83 km to T6	Visible	Medium to High	Low	Not Significant
3	Fincarn Crossroads at B40 – B44 road junction	4.71 km to T4	Visible	Low	Negligible	Not Significant
4	Banagher Old Church	1.49 km to T4	Prominent	Medium	Low	Not Significant
5	Banagher Road	1.71 km to T4	Prominent	Medium to Low	Negligible	Not Significant
6	Magheramore Road near site entrance	1.54 km to T4	Dominant - Prominent	Medium - High	Negligible	Not Significant
7	Creebarky – Teeavan Road junction	2.20 km to T2	Prominent	Medium - Low	Low	Not Significant
8	Teeavan Road to north east of site	2.08 km to T4	Prominent	High	Medium	Not Significant
Category B: Views from Dungiven and approaches to the town						
9	Killunaght Road, A6 near Dungiven	5.32 km to T4	Visible	Low to Medium	Low	Not Significant

Viewpoint		Approx. distance to nearest turbine (km)	Visual Prominence	Sensitivity of key visual receptors	Magnitude of cumulative visual effect	Significance of cumulative visual effect
10	Dungiven, Bridge over River Roe	4.20 km to T4	Prominent	Medium - Low	Negligible	Not Significant
11	B64 Garvagh Road, Dungiven	5.00 km to T4	Prominent	Low to Medium	Negligible	Not Significant
12	A6 at FP McCann Quarry	7.33 km to T1	Prominent	Low	Medium	Not Significant
13	A6 at Corick Road junction	5.72 km to T1	Prominent	Low - Medium	Medium	Not Significant
14	A6 at Cashel Road junction	4.72 km to T1	Prominent	Medium	Medium	Not Significant
Category C: Elevated views from within the Sperrin AONB						
15	Benbradagh Mountain	6.54 km to T2	Visible	High	Low	Not Significant
16	Plantation Road near Park	10.82 km to T6	Visible	High - Medium	Low	Not Significant
17	Slieve Kirk Hill	21.13 km to T4	Not Visible	Low	Negligible	Not Significant
18	Craignagapple near Owenreagh	26.77 km to T6	Not Visible	Low	Negligible	Not Significant
Category D: Elevated views from within the Binevenagh AONB						
19	Keady Mountain	19.04 km to T4	Visible	Medium	Negligible	Not Significant
20	Binevenagh Scenic Drive at Lisnagrib	22.46 km to T4	Visible	Medium	Negligible	Not Significant
Category E: Views overlooking the Roe Valley and the landscape in the north west of the Study Area						
21	Drum Road near Altahullion	6.46 km to T4	Prominent	Medium	Low	Not Significant
22	Edge of Drumsurn village	12.03 km to T4	Visible	Medium	Negligible	Not Significant

Information Gaps

4.207 There are no known gaps in the information that has been used in this LVIA.

Future Baseline – The 'No Change' Scenario

4.208 Under the "no change" scenario, were the Development not to be constructed, it is anticipated that the site would be continued to be used in much the same manner as it currently is. However, the existing landscape and visual character of the site and the wider Study Area will continue to be influenced by human activity which is constantly changing the landscape and it is important that the implications of these changes are considered and understood so that the intrinsic qualities of the landscape are retained and enhanced rather than destroyed or compromised. The key trends are identified in the NILCA and are also implied by the existing character of the Study Area:

- There are existing wind farms within and surrounding the Study Area. Based on the number of consented wind farms in the baseline it is likely that more wind farms will be developed within the Study Area and across the Province. Some of these are likely to be intervisible with the Development and they will continue to influence the overall landscape and visual character of the Study Area. It is likely that the current trend of developing cleaner renewable energy sources will continue and become more environmentally acceptable given the predicted effects of climate change and the necessity to tackle these effects;
- Climate change is likely to have the biggest implications on the landscape and its users in the future. Broadly, it is characterised by a general increase in unpredictable weather conditions which will inevitably impact upon all areas of life. River levels are likely to rise and there will be an associated loss of buildings in the flood plain. There will be a loss of habitats associated with the erosion of river banks and lough shores which support unique combinations of plants and animals. Migrant species, in particular birds, may also be affected and warmth-loving species will gradually replace those currently adapted to colder climates. Flooding will become more frequent and cause damage to the interiors and structures of buildings;
- Demographic change is creating the need for a large number of additional dwellings in the countryside which creates pressures on infrastructure. In particular the rural landscape at the edge of existing settlements, such as Dungiven, Limavady, Claudy and Feeny will continue to experience pressure for built development and ribbon development along road corridors such as the A6 and the B-roads that link these settlements together. In the open countryside the presence of derelict buildings signifies a loss of traditional built vernacular and a loss of biodiversity and vegetation associated with a decline in the management of rural field boundaries and farmland;

- Continued expansion of the road network in the study area is likely to occur alongside built development. At present the A6 road corridor is being re-routed to bypass Dungiven and pass closer to the Development. Excavations for this new route are clearly visible in the rural area which is overlooked by the Development and many houses in this area are likely to experience the effects of this new road. Improvements to existing secondary roads are also likely (e.g. straightening, widening and increased signage) will have cumulative negative impacts on local landscape character by eroding local patterns and causing the loss of roadside trees, hedgerows, stonewalls and bridges;
- There is an ongoing trend towards the amalgamation of small farms with the associated loss of traditional buildings and vernacular features, loss of hedgerows and trees to create larger fields. This is having a detrimental impact on the general quality and condition of the rural landscape character. There is also a trend, however, for farmers to diversify into more traditional farming techniques, husbandry of traditional breeds, and the provision of tourist attractions and accommodation. This often has positive landscape impacts. Current forestry grant schemes encourage farmers to plant more broadleaved trees for amenity and wildlife benefits and in the future this should strengthen the character of farmed landscapes. However, converting fields to coniferous plantations or selling it for housing development will continue to be a detrimental force, particularly if wetter weather renders areas of rough grazing land unviable for livestock;
- Commercial forestry on a large scale is detrimental to landscape character as it conceals the intricate pattern of the landscape and often occupies visually prominent positions in upland areas. Peat cutting alters the undulating topography and creates abrupt and artificial changes in level. This activity, particularly as it has become mechanised, also destroys natural vegetation and habitats. Where land becomes too wet to farm forestry is likely to become an attractive alternative. This may provide the opportunity to continue the current shift from coniferous plantations to broadleaved forestry which will in turn have a potentially positive impact on landscape character, visual amenity and ecological function;
- Agriculture is one of Northern Ireland's major industries. Pasture is likely to remain the dominant agricultural land-use but warmer temperatures will also enable spring cereal crops to be grown as well as an increase in the use of pesticides. This has the potential to alter the appearance of agricultural parts of the Study Area in the future.

Mitigation and Enhancement Proposals

Mitigation Proposals

4.209 Mitigation proposals in response to landscape and visual effects include:

- The exterior surfaces of the turbines will be painted in a recessive, non-reflective light grey colour to minimise their visual prominence against the sky in most weather conditions;
- Ancillary facilities, such as the control building, substation and energy storage compounds, have been designed in a manner that is sensitive to the immediate landscape character with regards to location, scale, colour, and choice of materials. These facilities are located within the turbine array and set back from the northern edge of the plateau and immediately bounded to the west by coniferous shelterbelt and a further shelter belt to the south, which will further screen views. Visibility will be limited from out with the site;
- The site entrance is located at an existing access to farm lands on the south side of the Magheramore Road where two stone pillars and walls mark a well-defined farm entrance. Following construction, the site entrance will be reinstated to reduce the extent of hardstanding back to its original pre-construction state. Stone pillars and walls removed to allow access will be reinstated as will stock proof fencing. Any trees and hedgerows removed will be replanted.

Enhancement Proposals

4.210 There are a number of narrow bands of coniferous forestry located on Teeavan Hill which are detrimental to its overall character. Some of these would be removed in order to facilitate the construction and operation of turbines T3 and T4 and this would have a minor but positive effect on the character of Teeavan Hill.

Residual Effects

4.211 Potential landscape and visual effects were addressed through a comprehensive feasibility study and through iterative design development. This resulted in the Development as it is now proposed and therefore potentially significant effects have been avoided prior to the LVIA being carried out as part of the EIA. Beyond this, the proposed mitigation measures will help to minimise the effect of certain aspects of the Development. However, there would be no resulting change in the overall significance of effects. Therefore the residual effects are the same as those already identified.

Overall Significance of Landscape and Visual Effects

4.212 The LVIA process has thoroughly analysed the nature of landscape and visual receptors present within the Study Area including those occurring at close, medium and long range in accordance with best practice guidance on LVIA, wind energy development in Northern Ireland, and emerging Council policies and objectives in relation to the Study Area. Sperrin AONB designation was considered to be the key designation within the Study Area. Landscape and visual receptors within the AONB were also regarded as being of greater sensitivity by virtue of their location in addition to any other characteristics that might otherwise make them sensitive to changes in their views (for example, statically located views from residential properties or scenic attractions). The presence of the other clusters of existing and consented wind farms throughout the Study Area was a key consideration in the assessment of cumulative landscape and visual effects.

4.213 The overall conclusion is that the Development would have no significant landscape effects and a significant visual effect on only one of the 22 Viewpoints which were chosen to represent typical views within the Study Area. In recognition of its location within the Sperrin AONB and the Sperrin Mountains LCA the layout and position of the Development has been designed to minimise its effect on the AONB as a whole and this has been achieved by locating it away from the core area containing the majority of visitor attractions and key landscape features. The proposed site is used primarily for grazing. Adjacent areas are dominated by large coniferous plantations with degraded field boundaries and are suffering from increasing amounts of coniferous forestry, which the NILCA identifies as the most detrimental force of landscape change in this LCA. In relation to the LCA and the wider AONB, Teeavan Hill on which the Development would be located is a low rounded hill that is surrounded on all sides by higher ground and occupies a relatively discreet position within the wider landscape.

4.214 The location of the Development is neither prominent nor highly visible from the majority of the Study Area and most notably from the Sperrin AONB or other parts of the Study Area with good views to the core part of the AONB. This is illustrated by the very small extent of its ZTV in relation to the wider Study Area, the Sperrin AONB and also in relation to the very low levels of additional visibility indicated on the cumulative ZTV diagrams. The Development would have a simple compact layout and where it would be visible from elevated locations from where the best views towards the heart of the AONB may be appreciated, it would generally be viewed against a backdrop of land rather than on the skyline. Where it does appear on the skyline it would either form a minor and subordinate element in much more expansive view or it would be seen at close range where it would be, as is to be expected, a prominent feature but often for relatively short periods of time (for example along the middle section of the Magheramore Road).

4.215 The Development is generally deemed to have No Significant effects on visual character for similar reasons. Of the 22 viewpoints that have been analysed, only one was deemed to experience a significant visual effect resulting from the Development (Viewpoint 6) and none would experience significant cumulative effects. In respect of Viewpoint 6, significant visual effects would occur in relation to a tertiary road in close proximity to the Development where there would be no views into the wider landscape that occur more commonly across the rest of the Study Area. The Development would therefore become the dominant feature in this Viewpoint. However, this level of effect would be limited to the area in immediate proximity to this Viewpoint and would not be experienced from other roads in the area or from the other Viewpoints that have been selected to represent close range views. The Development would appear in views along a relatively short section of the road corridor in and around Viewpoint 6 and would be appreciated largely by road users. From elsewhere along the Magheramore Road views including the Development would either be wider in extent, or restricted by roadside vegetation where the Development would appear less prominent or, in some instance, not visible. All policy documents (the SPPS, PPS 18 and its best practice and supplementary guidance) recognise that wind farms may be prominent elements in close range views but that this does not necessarily equate to unacceptable development.

4.216 The Development is not located within a cluster and would be well separated from clusters of wind farms within the Study Area. It would also be located in a manner which reflects the general pattern of locating wind farms on the outward facing edges of the AONB. It would occupy a relatively discreet position on the side slopes of a low hill which is surrounded on all sides by higher ground. The effect of this location on the visibility of the Development is illustrated by the very small extent of its ZTV in relation to the wider Study Area, the Sperrin AONB and the cumulative ZTVs. It would more often be visible in sequential rather than simultaneous cumulative views from close range viewpoints where it is likely to be more prominent and therefore its effect on cumulative views would be of a lesser magnitude. In instances where it appears simultaneously with other wind farms in the Study Area it will be viewed with good separation distances and often also from transient viewpoints on busy road corridors such as the A6. Wind energy development is already a prominent visual element in all parts of the Study Area and the Development would have a negligible incremental effect on the manner in which wind energy development is perceived generally across the Study Area. Furthermore it reflects the general pattern of the location of wind farms on the outer-facing slopes of the Sperrin AONB where they may be perceived as small, subordinate features within wider views along these extensive upland areas but where they will have little to no visibility from within the majority of the AONB.

4.217 Taking into account that no parts of the Study Area are deemed to experience significant landscape or cumulative effects and only one of the 22 viewpoints assessed as part of the LVIA are deemed to experience significant visual effects, the LVIA concludes that the Development is acceptable in landscape and visual terms.

5

Archaeology & Cultural Heritage

5 Cultural Heritage & Archaeology

Introduction

5.1 This chapter presents an assessment of the effects of the proposed Magheramore Wind Farm, hereinafter referred to as 'the Development', on the historic environment. The objectives of this assessment are to:

- Describe the location, nature and extent of any known heritage assets or areas of archaeological potential which may be affected by the Development;
- Provide an assessment of the importance of these assets;
- Assess the likely scale of any impacts on the historic environment posed by the development;
- Outline suitable mitigation measures to avoid, reduce or offset significant adverse effects; and
- Provide an assessment of any residual effects remaining after mitigation.

5.2 A heritage asset is any element of the archaeological and built heritage which has cultural significance. Both discrete features, and extensive landscapes defined by a specific historic event, process or theme, can be defined as heritage assets; and assets may overlap or be nested within one another.

5.3 Heritage assets may be designated at international level as World Heritage Sites; at regional level as Scheduled Monuments, Monuments in State Care, Listed Buildings, Conservation Areas, or Parks, Gardens and Demesnes of Special Historic Interest (Register and Supplementary); or locally by inclusion in the Northern Ireland Monuments and Buildings Record (NIMBR). The NIMBR comprises information on archaeological sites recorded in the Sites and Monuments Record (SMR), industrial heritage features and defence heritage structures recorded in their respective databases, and historic parks, gardens and demesnes. Other local designations include Areas of Significant Archaeological Interest (ASAIs), Areas of Townscape or Village Character, Local Landscape Policy Areas and other Heritage Designations on Area Plans. The information provided by the above designations is not definitive, however, as many heritage assets are currently unrecorded or may be incompletely or incorrectly identified. The identification of heritage assets is therefore to some extent a matter of professional judgement.

5.4 Some heritage assets may coincide with visual receptors or landscape character areas, which are assessed in Chapter 4 (Landscape and Visual Impact Assessment), and in such cases it is important to recognise the difference in approach between these two topics. Cultural heritage assessment addresses effects on the cultural heritage significance of heritage assets, which may result from, but are not equivalent to, visual impacts. Similarly, an effect on a landscape character area does not equate to an effect on the cultural heritage significance of heritage assets within it.

Policy and Guidance

5.5 The assessment has been undertaken with reference to relevant legislation, policy and guidance relating to Cultural Heritage.

Legislation

5.6 Listed Buildings and Conservation Areas are protected by statute under Sections 85 and 105 of the Planning Act (Northern Ireland) 2011. Under Section 85, it is an offence to carry out “any works for the demolition of a listed building or for its alteration or extension in any manner which would affect its character as a building of special architectural or historic interest” without written consent from the Department (when the Act was passed the ‘Department’ referred to the Department of the Environment (DOENI), but this has since been restructured. The Department for Communities (DfC) now has responsibility for the historic environment). Section 105 of the Act prohibits the demolition of buildings within a Conservation Area without the consent of the appropriate authority.

5.7 Scheduled Monuments are protected under Article 4 of the Historic Monuments and Archaeological Objects (Northern Ireland) Order 1995, which makes it an offence to carry out works directly affecting a Scheduled Monument without Scheduled Monument Consent.

Planning Policy

5.8 The policies of the Department of the Environment for Northern Ireland regarding protection and management of cultural heritage assets are contained in Planning Policy Statement 6 (PPS 6): Planning, Archaeology and the Built Heritage (DOENI, 1999). Revised criteria for the designation of Listed Buildings are contained in an Addendum to PPS6 published in 2011. Planning Policy Statement 18 (PPS18): Renewable Energy (DOENI 2009) sets out the policies of the DOENI for development that generates energy from renewable resources and that requires the submission of a planning application, these policies include material conditions for renewable applications and includes cultural heritage. Additional planning policies relating to areas of Townscape character are provided in an Addendum to PPS 6.

5.9 The policies in PPS 6 make the preservation of the archaeological and built heritage a material consideration in the planning process. This applies specifically to archaeological remains (Policies BH 1 and BH 2), World Heritage Sites (Policy BH 5), Parks, Gardens and Demesnes of Special Historic Interest (Policy BH 6), Listed Buildings (Policies BH 7 – BH 11), and Conservation Areas (Policies BH 12 – BH 14). The setting of an asset covered by any of these designations is also a material consideration.

5.10 The Strategic Planning Policy Statement for Northern Ireland (SPPS), published in 2015 (DOENI, 2015) has a statutory basis under the Planning Act (Northern Ireland) 2011 and outlines DOENI's policy on important planning matters that should be addressed throughout Northern Ireland. The provisions of the SPPS are material to all planning applications and appeals.

5.11 Section 6.3 of SPPS states that the "aim of the SPPS in relation to Archaeology and Built Heritage is to manage change in positive ways so as to safeguard that which society regards as significant whilst facilitating development that will contribute to the ongoing preservation, conservation and enhancement of these assets."

5.12 The SPPS then outlines particular strategic policies to be followed when preparing Local Development Plans (LDPs) and determining planning applications. These policies are outlined in relation to World Heritage Sites; archaeological remains (including Scheduled Monuments, Monuments in State Care and Areas of Significant Archaeological Interest); Listed Buildings; Historic Parks, Gardens and Demesnes; Conservation Areas; Areas of Townscape Character, and non-designated heritage assets. Implementation of the policies outlined in the SPPS is to be undertaken via the LDPs.

5.13 PPS18 'Renewable Energy' covers cultural heritage within Policy RE1 which states "Development that generates energy from renewable resources will be permitted provided the proposal, and any associated buildings and infrastructure, will not result in an unacceptable adverse impact on: …. built heritage interests …"

5.14 The Development lies within an Area of Outstanding Natural Beauty. Regarding archaeology and cultural heritage; Planning Strategy for Rural Northern Ireland Regional Planning Policies (NIDOE, Sept 1993), Policy: DES 4 Area of Outstanding Natural Beauty states;

> *"AONBs are areas not only of high scenic quality but often of wildlife importance and rich in both cultural and architectural heritage. The Department designates them as AONBs in recognition of the national importance of these qualities.*
>
> *The objectives of designation are to:*
>
> *conserve wildlife, historic objects or natural phenomena within it"*

Guidance

5.15 In May 2016, DOENI was restructured, and the Department for Communities (DfC) was created. The Historic Environment Division (HED) of the DfC has responsibility for archaeological and built heritage throughout the region.

5.16 In February 2018, HED published Guidance on Setting and the Historic Environment. This document provides guidance on HED's role in developing advice on potential impacts from development and landscape change upon the settings of heritage assets. It also recommends other international charters and conventions that should be considered as guidance during impact assessment (HED 2018, Appendix B, 14). These include, but are not limited to, the International Council on Monuments and Sites (ICOMOS) 2005 Declaration on the Conservation of the Setting of Heritage

Structures, Sites and Areas (also known as the Xi'an Declaration); the 1992 European Convention on the Protection of the Archaeological Heritage (also known as the Valletta Convention), and the 2011 ICOMOS Guidance on Heritage Impact for Cultural World Heritage Properties.

5.17 HED also recognise the relevance of recent guidance published by Historic Environment Scotland (HES) and Historic England (HE). In 2015, HE published The Setting of Heritage Assets. Historic Environment Good Practice Advice in Planning 3 (HE, 2015) and in 2016 HES published Managing Change in the Historic Environment: Setting (HES, 2016).

5.18 The Services and Standards Framework, published by HED in May 2016, provides additional explanation of the planning process in relation to archaeology and built heritage, with advice on procedures for archaeological evaluation and mitigation.

Consultations

5.19 Issues arising from scoping and other consultation carried out in the course of the cultural heritage assessment are summarised in Table 5.1.

Table 5.1: Consultation

Consultee	Summary Response	Action
HED email response 18.05.18	General comment that the Development is in close proximity to a large number of scheduled monuments and (at that design iteration) immediately adjacent to Banagher old Church and to the south of Dungiven Priory which are State Care monuments and hence particularly sensitive assets. HED also provided a link to the HED document; Guidance on Setting and the Historic Environment, advising that it sets out how HED consider the issue of setting in the context of development proposals and land use change.	This document has considered potential construction and operational on all scheduled monuments in the surrounding area under the heading: **Predicted Effects of the Development**. The HED document Guidance on Setting and the Historic Environment has been referred to throughout this assessment and was used as a guide in the assessment of operational impacts under the heading: **Predicted Operational Impacts**
HED: HM consultation response for the EIA Determination 05.02.19	Requested: 1) A detailed desk-based assessment of potential impacts. Including field inspection of application site. 2) An assessment of potential impacts, including setting impacts on cultural heritage assets in the site boundary and surrounding	A detailed desk-based assessment of the Development area and surrounding area was carried out and forms the bais of the section headed Baseline Conditions. This work included a walkover survey in August 2018 This document has considered potential construction and operational on cultural heritage assets in the Development area and the surrounding area under the

Consultee	Summary Response	Action
	area. With reference to guidance. 3) An archaeological mitigation strategy to identify any previously unrecorded archaeological remains within the development are	heading: **Predicted Effects of the Development**. An approach to mitigation of previously unrecorded archaeological remains is laid out under the heading **Mitigation**

Methodology

The assessment process

5.20 The cultural heritage assessment has been carried out in the following stages:

- Desk-based study leading to the identification of heritage assets potentially affected by the development;
- Definition of baseline conditions, based on results of the desk-based study and visits to assets;
- Assessment of the importance of heritage assets potentially affected by the development;
- Identification of potential impacts on heritage assets, informed by baseline information, site visits, Zone of Theoretical Visibility (ZTV) mapping, wireframes and photomontages;
- Proposal of mitigation measures, to eliminate, reduce or offset adverse effects;
- Assessment of the magnitude of residual effects;
- Assessment of the significance of residual effects, broadly a product of the asset's importance and the magnitude of the impact; and
- Assessment of cumulative effects.

Study Areas

5.21 The Inner Study Area corresponds to the planning application boundary. Within this area, all heritage assets are assessed for construction and operational effects.

5.22 The outer study area extends to 20km from the proposed turbines, which is taken as the maximum extent of potentially significant effects on the settings of heritage assets. Within the outer study area, assets have been included in the assessment based on the level of importance assigned to the asset, so as to ensure that all significant effects are recognised:

- Up to 2km from proposed turbines: Heritage assets of local importance.
- Up to 5km from proposed turbines: Scheduled Monuments, State Care Monuments, Listed Buildings, Conservation Areas, Register Parks, Gardens and Demesnes of Special Historic Interest, and other heritage assets of regional importance.

- Up to 20km from proposed turbines: any asset which is considered exceptionally important, and where long-distance views from or towards the asset are thought to be particularly sensitive, in the opinion of the assessor or consultees.

Data Sources

5.23 The baseline for the Inner Study Area has been informed by a comprehensive desk-based study, based on all readily available documentary sources, following the Chartered Institute for Archaeologists' (CIfA) 'Standard and Guidance for historic environment desk-based assessment'. The following sources of information were referred to:

- Northern Ireland Environment Agency (NIEA): online databases available through the NIEA website, including:
  - Sites and Monuments Record (SMR);
  - Buildings Database;
  - Areas of Significant Archaeological Interest;
  - Scheduled Monument data;
  - Register of Historic Parks, Gardens and Demesnes;
  - Industrial Heritage Record; and
  - Defence Heritage Record.
- Historic maps held by Public Records Office Northern Ireland (PRONI);
- Excavations Bulletin; and
- Other readily available published sources.

5.24 Aerial photographs held by PRONI were not consulted, as the reference maps used to locate sorties have been lost, making it impossible to effectively search the aerial photograph collections.

5.25 A targeted walkover survey of the ISA was carried out on the 8th August 2018 guided by modern mapping and a handheld GPS system. The intention of this walkover was to assess the presence/absence, character, extent and condition of known assets and to identify any previously unrecorded assets.

5.26 Assets in the OSA were visited on 7th and 9th August 2018 in order to establish the potential for impacts upon their setting and to gather data to allow impacts to be assessed.

Definition of baseline conditions

5.27 Heritage assets within both the ISA and OSA which have been previously recorded on the NISMR are labelled with the reference number assigned to them by HED.

Known heritage assets within the Inner Study Area

5.28 Previously unrecorded heritage assets within the Inner Study Area have been assigned an Asset number (prefixed HA for Heritage Asset). A single asset number can refer to a group of related features, which may be recorded separately in the NISMR and other data sources. Assets within the Inner Study Area are shown in Figure 5.1.

Potential for unknown heritage assets within the Inner Study Area

5.29 The likelihood that undiscovered heritage assets may be present within the Inner Study Area is referred to as archaeological potential. Overall levels of potential can be assigned to different landscape zones, following the criteria in Table 5.2, while recognising that the archaeological potential of any zone will relate to particular historical periods and types of evidence. The following factors are considered in assessing archaeological potential:

- The distribution and character of known archaeological remains in the vicinity, based principally on an appraisal of data in the NIMBR;
- The history of archaeological fieldwork and research in the surrounding area, which may give an indication of the reliability and completeness of existing records;
- Environmental factors such as geology, topography and soil quality, which would have influenced land-use in the past and can therefore be used to predict the distribution of archaeological remains;
- Land-use factors affecting the survival of archaeological remains, such as ploughing or commercial forestry planting; and
- Factors affecting the visibility of archaeological remains, which may relate to both environment and land-use, such as soils and geology (which may be more or less conducive to formation of cropmarks), arable cultivation (which has potential to show cropmarks and create surface artefact scatters), vegetation, which can conceal upstanding features, and superficial deposits such as peat and alluvium which can mask archaeological features.

Table 5.2: Archaeological potential

Potential	Definition
High	Undiscovered heritage assets of high or medium importance are likely to be present.
Medium	Undiscovered heritage assets of low importance are likely to be present; and it is possible, though unlikely, that assets of high or medium importance may also be present.
Low	The study area may contain undiscovered heritage assets, but these are unlikely to be numerous and are highly unlikely to include assets of high or medium importance.
Negligible	The study area is highly unlikely to contain undiscovered heritage assets of any level of importance.
Nil	There is no possibility of undiscovered heritage assets existing within the study area.

Heritage Assets in the Outer Study Area

5.30 Assets that meet the initial criteria for assessment are described briefly in paras 5.76 to 5.81 and listed in Tables 5.8 to 5.13 and shown in Figures 5.2 and 5.3. Assets are labelled with the SMR number (for archaeological sites – these include a three-letter prefix denoting the county); the Historic Building number (prefixed HB, for Listed Buildings); the Defence Heritage Number (prefixed DHP); Industrial Heritage Reference number (prefixed IHR); or the name of the asset for other designations.

Identification of potential impacts

5.31 Effects on the historic environment can arise through direct physical impacts, impacts on setting or indirect impacts:

- Direct physical impacts describe those development activities that directly cause damage to the fabric of a heritage asset. Typically, these activities are related to construction works and will only occur within the application site.
- An impact on the setting of a heritage asset occurs when the presence of a development changes the surroundings of a heritage asset in such a way that it affects (positively or negatively) the cultural significance of that asset. Visual impacts are most commonly encountered but other environmental factors such as noise, light or air quality can be relevant in some cases. Impacts may be encountered at all stages in the life cycle of a development from construction to decommissioning but they are only likely to lead to significant effects during the prolonged operational life of the development.
- Indirect impacts describe secondary processes, triggered by the development, that lead to the degradation or preservation of heritage assets. For example, changes to hydrology may affect archaeological preservation; or changes to the setting of a building may affect the viability of its current use and thus lead to dereliction.

5.32 Cultural heritage constraint areas, as shown on Figure 5.1, have been defined to include an appropriate buffer around known heritage assets. Constraint areas can be treated as a 'trigger' for the identification of potential direct impacts: they represent areas within which works may lead to direct impacts of more than negligible significance on known heritage assets.

5.33 Potential impacts on unknown heritage assets are discussed in terms of the risk that a significant effect could occur. The level of risk depends on the level of archaeological potential combined with the nature and scale of disturbance associated with construction activities and may vary between high and negligible for different elements or activities associated with a development, or for the development as a whole.

5.34 Potential impacts on the settings of heritage assets are identified from an initial desk-based appraisal of data from the NIMBR, and consideration of current maps and aerial images available on the internet. Where this initial appraisal has identified the potential for a significant effect, the asset has been visited to define baseline conditions and identify key viewpoints. Visualisations have been prepared to illustrate changes to key views, where potentially significant effects have been identified (Figures 5.5a – 5.20).

Mitigation measures and identification of residual effects

5.35 Proposed mitigation measures are described in paras 5.124 to 5.126. The preferred mitigation option is always to avoid or reduce impacts through design, or through precautionary measures such as fencing off heritage assets during construction works. Impacts which cannot be eliminated in these ways will lead to residual effects.

5.36 Adverse effects may be mitigated by an appropriate level of survey, excavation, recording, analysis and publication of the results, in accordance with a written scheme of investigation, following PPS6 Policy BH4 and the NIEA guidance booklet 'Development and Archaeology'. Archaeological investigation can have a beneficial effect of increasing knowledge and understanding of the asset, thereby enhancing its archaeological and historical interest and offsetting adverse effects.

Impact assessment criteria

Heritage importance, cultural significance and sensitivity

5.37 Cultural heritage impact assessment is concerned with effects on cultural significance, which is a quality that applies to all heritage assets. This use of the word 'significance', referring to the sum of the values we attach to an asset because of its heritage interest, should not be confused with the unrelated usage in EIA where the significance of an effect reflects the weight that should be attached to it in a planning decision.

5.38 The importance of a heritage asset is the overall value assigned to it based on its cultural significance, reflecting its statutory designation or, in the case of undesignated assets, the professional judgement of the assessor (Table 5.3). Assets of international importance, and assets of regional importance in the context of Northern Ireland as a whole, are considered of 'very high' and 'high' importance respectively. Assets of local importance (reflecting the usage in PPS6 Policy BH 2) are assigned a 'medium' level. These include non-scheduled archaeological sites and monuments. Other assets, such as archaeological sites, non-Register 'supplementary' Parks, Gardens and Demesnes, defence heritage structures, and features relating to industrial heritage, may also be of medium importance, if they are judged to meet the criteria for local importance. Any feature which does not merit consideration in planning decisions due to its cultural significance may be said to have negligible heritage importance; in general, such features are not considered as heritage assets and are excluded from the assessment.

Table 5.3: Criteria for Assessing the Importance of Heritage Assets

Importance of the asset	Criteria
Very high	World Heritage Sites and other assets of equal international importance

Importance of the asset	Criteria
High	Scheduled Monuments, Monuments in State Care, Listed Buildings, Conservation Areas, sites included in the Register of Parks, Gardens and Demesnes of Special Historic Interest, and other assets of regional importance
Medium	Non-scheduled entries on the NISMR, and other assets of local importance
Low	Other assets of lesser importance
Negligible	Assets which are very common site types and/or very poorly preserved

5.39 The heritage significance of Listed Buildings derives from their architectural and historic interest. These terms are defined in the Revised Annex C to PPS6, published in 2011:

> *“Architectural interest is understood to encompass a broad spectrum which ranges from style, character and ornamentation to internal plan form and functionality. Also important are examples of particular building types and techniques used in their construction. Where buildings have been changed over time (as many have) it is the consideration of its current architectural interest that is important, rather than what it may have been like in the past.”*

> *“Historic interest is understood to encompass a broad spectrum which ranges from age and rarity, through the amount of historic material left in a building, to its importance as a historic structure, and to the stories, historical events and people associated with the building. It is important that associations are linked in a clear and direct way to the fabric of the building if they are to be regarded as major grounds for listing. Aspects of social, economic and cultural history revealed by the building may also be considered important”.*

5.40 Annex C lists the criteria for architectural interest as: style; proportion; ornamentation; plan form; spatial organisation; structural system; innovatory qualities; alterations; quality and survival of interiors; setting; and group value. The criteria for historic interest are listed as: age; rarity; authenticity; historic importance; authorship; social, cultural or economic importance; and historic associations.

5.41 Factors to be taken into account in assessing the local significance of archaeological sites and monuments are listed in PPS6 paragraph 3.9:

“• appearance: distinctive features in the landscape/townscape or local landmarks;

• quality: well-preserved or extensive buried remains;

• folklore/historical interest: association with a person or event in local tradition or legend;

• group value: one of a number of locally important sites; and

• rarity: a locally rare example.”

5.42 Criteria for deciding whether an archaeological monument is of regional importance (and thus a candidate for Scheduling) are given in PPS6 Annex B, paragraph B11, and comprise: period; rarity; documentation; group value; survival / condition; and diversity.

5.43 The significance of a heritage asset derives both from its physical fabric and from its setting. HED’s 2018 guidance discusses the factors that can contribute to the significance and character of an asset’s setting (HED 2018, Section 2.2, p7). The guidance issued by Historic Scotland (2016, ‘Managing Change in the Historic Environment: Setting‘) and Historic England (2015, ‘The Setting of Heritage Assets: Good Practice Advice in Planning Note 3’) is also considered broadly applicable, and a methodology has been developed based on the general principles set out in these three documents, and taking account of references in PPS6 to the settings of heritage assets (particularly Policy BH 11 and paragraphs 6.28-32 in relation to Listed Buildings). Summaries of factors which can contribute to setting are provided in HED 2018 (Section 2 and Section 3.2), as well as in Historic Scotland 2010 (paragraph 3.1) and in Historic England 2015 (paragraph 21), and are referred to in assessing whether, how and to what degree setting contributes to an asset’s significance. An asset’s physical surroundings, the experience of the asset, and its associations and patterns of use may all contribute to its significance. Characteristics of setting that contribute to an asset’s significance may be localised and limited to its immediate surroundings, or may also include more distant visual relationships, especially where an asset is located at a prominent viewpoint or intended to form a conspicuous landmark.

5.44 The relevance of these factors to the understanding, appreciation and experience of the asset determines how, and to what extent, an asset’s cultural significance derives from its setting. All heritage assets have settings; however, not all assets are equally sensitive to impacts on their settings. In some cases, setting may contribute very little to the asset’s cultural significance, or only certain elements of the setting may be relevant.

Assessment of the magnitude of impacts on cultural significance

5.45 The magnitude of an impact is a measure of the degree to which the significance of a heritage asset will be changed by the development. This definition of magnitude applies to impacts on the setting, as well as impacts on the physical fabric, of an asset. Impacts on the settings of heritage assets are assessed with reference to the stages detailed in guidance issued by HED (Guidance on Setting and the Historic Environment, Chapter 3: Considering Setting, Development and Land-Use Change) and also with regard to factors listed by Historic England (GPA3 ‘Assessment step 3: assessing the effect of the proposed development’, page 11), and Historic Environment Scotland (‘MCHE: Setting’ Stage 3 - evaluate the potential impact of the proposed changes, pages 10-11). It is important to note that the magnitude of an impact resulting from an impact on setting is not a direct measure of the visual prominence, scale, proximity or other attributes of the development itself, or of the extent to which the setting itself is changed; therefore, Landscape and Visual Impact

Assessment criteria for scale/magnitude cannot be applied directly in determining the magnitude of impact on the setting of a heritage asset. It is also necessary to consider whether, and to what extent, the characteristics of the setting which would be affected contribute to the asset's cultural significance.

5.46 Magnitude is assessed as high/medium/low, and adverse/beneficial, or negligible, using the criteria in Table 5.4 as a guide.

5.47 In assessing the effects of a development, it is often necessary to take into account various impacts which affect an asset's significance in different ways, and balance adverse impacts against beneficial impacts. For instance, there may be adverse impacts on an asset's fabric and on its setting, offset by a beneficial impact resulting from archaeological investigation. The residual effect, given in paragraphs 5.234 to 5.235, is an overall measure of how the asset's significance is reduced or enhanced.

Table 5.4: Criteria for Assessing the Magnitude of Impacts on Heritage Assets

Magnitude of Impact	Guideline Criteria
High beneficial	Changes to an asset and/or its setting resulting in considerable enhancement of cultural significance. *Or*: Preservation of an asset and/or its setting where it would otherwise suffer considerable loss of cultural significance in the do-nothing scenario.
Medium beneficial	Changes to an asset and/or its setting resulting in moderate enhancement of cultural significance. *Or*: Preservation of an asset and/or its setting where it would otherwise suffer moderate loss of cultural significance in the do-nothing scenario.
Low beneficial	Changes to an asset and/or its setting resulting in a slight enhancement of cultural significance. *Or*: Preservation of an asset and/or its setting where it would otherwise suffer slight loss of cultural significance in the do-nothing scenario.
Negligible beneficial	Changes to an asset and/or its setting resulting in a very slight enhancement of cultural significance. *Or*: Preservation of an asset and/or its setting where it would otherwise suffer very slight loss of cultural significance in the do-nothing scenario.
No Impact	The asset's cultural significance is not altered.
Negligible adverse	Changes to an asset and/or its setting resulting in a very slight loss of cultural significance.
Low adverse	Changes to an asset and/or its setting resulting in a slight loss of cultural significance.

Magnitude of Impact	Guideline Criteria
Medium adverse	Changes to an asset and/or its setting resulting in a moderate loss of cultural significance.
High adverse	Changes to an asset and/or its setting resulting in a considerable loss of cultural significance.

Assessment of the significance of effects

5.48 The significance of an effect (EIA 'significance') on the cultural significance of a heritage asset, resulting from a direct or indirect physical impact, or an impact on its setting, is assessed by combining the magnitude of the impact and the importance of the heritage asset. The matrix in Table 5.5 provides a guide to decision-making but is not a substitute for professional judgement and interpretation, particularly where the asset importance or impact magnitude levels are not clear or are borderline between categories. EIA significance may be described on a continuous scale from negligible to major; it is also common practice to identify effects as significant or not significant, and in this sense major and moderate effects are regarded as significant in EIA terms, while minor effects are 'not significant'.

Table 5.5: Criteria for Assessing the Significance of Effects on Heritage Assets

Asset importance	Magnitude of impact			
	High	Medium	Low	Negligible
Very high	Major	Major	Major to moderate	Negligible
High	Major	Major to moderate	Moderate to minor	Negligible
Medium	Major to moderate	Moderate to minor	Minor	Negligible
Low	Moderate to minor	Minor	Negligible	Negligible

Assessment of Cumulative Effects

5.49 Cumulative effects can occur when other existing or proposed developments would also be visible in views that are relevant to the setting of a heritage asset. Cumulative effects are considered in cases where an effect of more than negligible significance would occur as a result of the proposed development. Other existing or proposed wind energy developments are included in the cumulative assessment where they also lie within 5km of the asset, or within 20km in cases where an asset's wider landscape setting is judged to be exceptionally sensitive. A cumulative effect is considered to occur where the magnitude of the combined effect of two or more developments is greater than that of the developments considered separately.

Baseline Conditions

Archaeological and historical overview of the Inner Study Area

Geology

5.50 Solid geology within the ISA comprises bands of igneous and sedimentary rocks which form Carnanbane and Teeavan Hills. Overlying the bedrock in the western half of the ISA are glacial fluvial deposits of sand and gravel and diamicton till, in the eastern half peat covers the upper slopes of Teeavan Hill.

Prehistoric Period

5.51 Within 5km of the turbines there are 13 scheduled monuments of prehistoric date and within 2km there are a further 11 undesignated prehistoric assets. These assets include court tombs, a portal tomb, wedge tombs, standing stones, stone circles a possible barrow, an urn burial.

5.52 Court tombs are the earliest type of megalithic burial tomb recorded in Northern Ireland and date from the early Neolithic. They are generally located singly in the landscape, on soils suitable for early agriculture and are often seen as indicators of early settlement (Mitchell & Ryan, 2001, 165). There are two scheduled court tomb within 5km of the turbines (LDY030:028 & LDY030-064). Within 2km there are two sites of possible court tombs (LDY031:029 and LDY030:077) which are recorded as ‘unlocated’ in the SMR. Both tombs are only known from historic documents and can no longer be located, the coordinates and nature of these assets is therefore arbitrary.

5.53 Portal tombs are also of Neolithic date and are closely related to court tombs. Within the study areas the only portal tomb recorded is Magheramore Portal Tomb (LDY030-079) which is located to the north of the Inner Study Area.

5.54 Wedge tombs are a later type of megalithic burial tomb dating to the late Neolithic to Bronze Age. They are also located singly in the landscape and considered as indicators of the settlement patterns of their builders (Mitchell & Ryan, 2001, 195). There are two scheduled wedge tombs within 5km of the turbines (LDY031:003 and LDY031:021). Within 2km there is a possible wedge tomb (LDY030:054) which is recorded as ‘unlocated’ in the SMR. The coordinates and true nature of this tomb is therefore arbitrary.

5.55 Six of the scheduled monuments within 5km of the turbines are single structural stones, three of these stones are recorded as standing stones (LDY025:004, LDY030:013 and LDY030:017) the other three assets are variously recorded as possibly the last trace of a megalithic tomb (LDY024:005 and LDY024:006) and possibly part of a Rath (LDY030:016).

5.56 Within 5km of the turbines are two scheduled stone circles; Templemoyle stone circle (LDY030:045) and Auglish stone circle and alignments (LDY030:021). Stone circles are commonly interpreted as being ritual monuments of Neolithic to Bronze Age date.

5.57 The possible barrow (LDY030:055) and urn burial (LDY030:080) are both undesignated assets recorded as 'unlocated' in the SMR. These assets have been interpreted from historic documents as assets of Bronze Age date, as they cannot now be located on the ground, the coordinates and true nature of these assets is arbitrary.

Medieval Period

5.58 Within 5km of the turbines there are nine scheduled monuments of medieval date and within 2km there are a further three undesignated medieval assets. These include ringforts, souterrains, and religious sites.

5.59 A souterrain is a form of underground chamber, dating from the early medieval period and often found associated with ringforts. Construction methods vary between 'cut and cover' and tunnelling, there is also variation in the walls with stone, timber and clay-lined examples all known across Ireland. Probably primarily used for food storage (due to the cool conditions underground), some examples also functioned as refuges or tunnels, allowing occupants of ringforts to escape beyond the banks in the event of attack (Mitchell & Ryan 2001, 281). The SMR records two undesignated souterrains within 2km of the turbines one of which is unlocated on the ground and only recorded from historic documents.

5.60 The most common site type of this period, within the study area, is the ringfort, which dates to the early medieval period. A ringfort is a form of enclosed and defended farmstead, usually circular or sub-circular in plan (Stout 1997, 15). Otherwise referred to as a rath or cashel depending on the method of construction, these sites are common throughout Ireland; cashels are enclosed by a drystone wall, raths by one or more earthen banks and ditches. Their distribution correlates closely with areas of rich farmland, with most located below the 150m OD contour. The six scheduled ringforts are to the north of the ISA, five are Raths (LDY030:014, LDY030:026, LDY030:027, LDY031:006 and LDY031:007) and one is a cashel (LDY031:008). there is one undesignated rath (LDY030:031) recorded within 2km of the turbines in the ringforts to the north west of the ISA.

5.61 Also of medieval date are the scheduled early Christian sites of Banagher Church, Old Church and St. O'Heany's Tomb (LDY030:029), Dungiven Priory (LDY031:015) and Templemoyle Church (LDY030:030). There are also three undesignated assets, which are holy wells (LDY030:081, LDY030:082, LDY030:083) which are believed to be associated with Banagher Church (LDY030:029).

Post Medieval and Modern Period

5.62 There are 29 Listed Buildings recorded within 5km of the turbines. These comprise six Grade B+, six Grade B1 and 17 Grade B2. The Grade B+ Listed Buildings include four Georgian style houses of mid-18th century to 19th century date, the gothic style Banagher Church (HB02/05/004) with its Georgian style tower and spire and Pellipar House (HB02/06/007 A) which is also of late 18th century date but which was built in the French Chateau style.

5.63 Included in the Grade B1 Listed Buildings is Dungiven Castle which is also a scheduled monument (LDY025:005 and HB02/06/003 A). Dungiven Castle is believed to be built on the site of a late 17th century castle, however, Dungiven Castle dates to the 19th century. The remaining buildings comprise typical examples of rural and semi-rural structures such as bridges, churches, houses, shops and a pump.

5.64 The SMR records one undesignated asset of post medieval date within 2km of the ISA this is a possible Mass Rock (LDY 031:001) which is recorded from first edition Ordnance Survey mapping. The SMR records it as a possible ecclesiastical or penal site. It is now underwater beneath the Altnaheglish Reservoir.

5.65 The Industrial Heritage Record (IHR) within 2km of the turbines contains six bridges, six sites related to Flax Milling and a pipeline. The Defence Heritage Record (DHR) within 2km records one asset; an observation post.

5.66 The most recent asset recorded in the SMR is the scheduled monument Altnaheglish Reservoir Dam (LDY031:500) which was built in the early 20th century. It is a mass concrete structure with a curved dam wall and supplies water to Londonderry and Limavady.

Uncertain date

5.67 The SMR records a further ten undesignated entries as being of 'uncertain' date within 2km of the turbines. These assets have been recorded from OS memoirs and early ordnance survey mapping and cannot be definitively dated from their descriptions or their morphology. They have been recorded as forts, enclosures and a burial ground, and it is possible that these assets date from the medieval period or later.

Known heritage assets within the Inner Study Area

5.68 No cultural heritage assets are recorded within the Inner Study Area.

Potential for undiscovered heritage assets within the Inner Study Area

5.69 The topography of the ISA will have a defining influence on the potential for undiscovered heritage assets. On the steep sloops down to Altnaheglish River the archaeological potential will be low as the slopes are too steep to ever have been suitable for settlement or agriculture.

5.70 The highest potential for previously unrecorded cultural heritage assets will be in the gently sloping areas of the ISA nearest to the scheduled area; Magheramore Court Tomb (LDY030:064) and Portal Tomb (LDY030:079). While there are no upstanding features surrounding these assets, it is possible that discrete associated features survive as subsurface remains in the surrounding area.

5.71 Given that the ISA is largely in an upland environment and that the majority of medieval to modern assets are located in the more fertile valley floors it is considered that there is low potential for previously unrecorded assets of medieval to modern date.

5.72 It is therefore considered that the majority of the site is of low archaeological potential. The exception to this is the north of the ISA next to the scheduled area; Magheramore Court Tomb (LDY030:064) and Portal Tomb (LDY030:079) where there is medium archaeological potential for assets of prehistoric date.

Heritage assets in the Outer Study Area

Scheduled Monuments

5.73 There are 25 Scheduled Monuments within 5km of the turbines (Table 5.6, Figure 5.2). The group comprises seven standing stones, six ring forts (Raths or Cashel), three megalithic tombs (court and wedge tombs) three early Christian sites, two stone circles, the 19th century Dungiven Castle and 20th century Altnaheglish Reservoir Dam. Of these assets Banagher Church (LDY030:029) and Dungiven Priory (LDY031:015) are also Monuments in State Care.

Table 5.6 – Scheduled Monuments in the Outer Study Area

Ref No.	Name	Type
LDY024:005	Derrychrier Standing Stone	Standing stone
LDY024:006	Owenbeg Stones	Standing stone
LDY025:004	Dungiven Standing Stone	Standing stone
LDY025:005	Dungiven Castle	Castle
LDY030:013	Drumcovit Standing Stone	Standing Stone
LDY030:014	Tandragee Fort	Rath
LDY030:016	Gallany Standing Stone	Standing Stone
LDY030:017	Fincairn Standing Stone	Standing Stone
LDY030:021	Aughlish Stone circle and alignments	Stone circle and alignments
LDY030:026	Rallagh Fort	Rath
LDY030:027	Templemoyle Rath	Rath
LDY030:028	Carnanbane	Court Tomb
LDY030:029	Banagher Old Church	Church and stone cross
LDY030:030	Templemoyle Church	Church
LDY 30:045	Templemoyle	Stone circle
LDY030:064 & LDY030:079	Magheramore Court and Portal Tomb	Court tomb
LDY030:089	Tamnyagan Standing Stone	Standing stone

Ref No.	Name	Type
LDY031:003	Cloghnagalla wedge tomb (Boivel)	Wedge tomb
LDY031:006	Tamniaran Rath	Rath
LDY031:007	The Black Fort Rath	Rath
LDY031:008	The White Fort	Cashel and cairn
LDY031:015	Dungiven Priory	Priory
LDY031:021	Carn	Wedge tomb
LDY031:500	Altnaheglish Reservoir	Reservoir

Listed Buildings

5.74 There are 29 listed buildings within 5km of the turbines (Table 5.7, Figure 5.2). Of these six are Grade B+, six are Grade B1 and seventeen are Grade B2. The Grade B+ Listed Buildings include four Georgian style houses of mid-18th century to 19th century date, the gothic style Banagher Church (HB02/05/004) with its Georgian style tower and spire and Pellipar House (HB02/06/007 A) which is also of late 18th century date but which was built in the French Chateau style. A further three 'Record Only' buildings are recorded in the area but as they are not statutorily 'listed' they are not considered further

Table 5.7 - Listed Buildings in the Outer Study Area

Ref No.	Name	Type
HB02/05/003 A	The Old Rectory	B+
HB02/05/004	Banagher Church of Ireland	B+
HB02/05/005 A	Ashpark House	B+
HB02/05/006 A	Knockan House	B+
HB02/05/008 A	Drumcovit House	B+
HB02/06/007 A	Pellipar House, Dungiven	B+
HB02/05/007	Knockan Bridge	B1
HB02/07/022	Tamniarin Bridge, over River Roe, Birren Road, Tamniarin, Dungiven	B1
HB02/05/005 B	714 Glenshane Road, Feeny	B1
HB02/05/012	Aughlish Bridge, Glendra Rd, Auglish, Feeny	B1
HB02/06/003 A	Dungiven Castle	B1
HB02/06/007 B	Outbuildings, Pellipar House, Dungiven	B1

Ref No.	Name	Type
HB02/05/016	Carnanbane Bridge, Carnanbane Road Dungiven Co Londonderry	B2
HB02/05/019	Derrychier Bridge, Derrychier, Dungiven, Co Londonderry	B2
HB02/05/040	Fincarn Bridge, Altimure Road, Fincarn, Feeny, Co. Londonderry	B2
HB02/06/009	Owenbeg Bridge, Foreglen Road, Dungiven	B2
HB02/07/026	31 Birren Road, Dungiven	B2
HB02/05/001 A	Mount Prospect House, 59 Magheramore Road, Dungiven	B2
HB02/05/001 B	Mount Prospect House (Apartments.) 59 Magheramore Road, Dungiven	B2
HB02/05/006 B	Outbuildings, Knockan House, 9 Killunaght Road, Dungiven	B2
HB02/05/010 A	St Joseph's R.C. Church, Glendra Road, Fincairn, Feeny	B2
HB02/05/033	Water pump, 128 Glendra Road, Feeny	B2
HB02/06/001	St Patrick's R.C. Church, Glenshane Rd, Dungiven	B2
HB02/06/002	Church of Ireland Church, Main Street, Dungiven	B2
HB02/06/006 A	7 Lower Main Street, Dungiven	B2
HB02/06/006 B	9 Lower Main Street, Dungiven	B2
HB02/06/006 C	11 Lower Main Street, Dungiven	B2
HB02/06/006 E	15 Lower Main Street, Dungiven	B2
HB02/07/001	Calhame Bridge, over Sruhanadumpan Burn, Tamniarin, Dungiven	B2

Registered Parks and Gardens

5.75 There are two Registered Parks and Gardens within 5km of the turbines (Table 5.8, Figure 5.2 to 5.4). One of which Knockan/ Ash Park (L-045) is included in the main register and the other Pellipar (L-018) which is included as a designated supplementary site.

Table 5.8 - Registered Parks and Gardens in the Outer Study Area

Ref No.	Name
L-045	Knockan/ Ash Park
L-018	Pellipar

Battle Sites

5.76 There is one designated battle site within 5km of the turbines, the Siege of Dungiven (Figure 5.3) which took place in Dungiven in 1650 during the Cromwellian period in Ireland.

Other Designated Heritage Assets

5.77 There are no Conservation Areas within 5km of the turbines, and there are no assets beyond 5km that are considered exceptionally important, or where long-distance views from or towards the asset are thought to be particularly sensitive.

Locally Designated Heritage Assets

5.78 The SMR records a total of 45 undesignated assets within 2km of the turbines. This includes 28 undesignated SMR assets (Table 5.9, Figure 5.4), of these 25 are recorded as being unlocated or having no surface evidence having been recorded from historic documents (OS Memoirs and OS First Edition Maps) but not located on the ground. The unlocated assets includes possible sites of megalithic tombs, enclosures, a cist, an urn and a souterrain. The four located SMR assets include two enclosures, a rath and a souterrain. There are 13 industrial heritage assets (Table 5.10, Figure 5.4) six are related to flax milling, five bridges, the Altnaheglish Reservoir, a pipeline and a filter house. There is one defence heritage asset (Table 5.11, Figure 5.4) an observation post.

Table 5.9- Undesignated SMR assets in the Outer Study Area

SMR No	Name/Description	Period
LDY030:022	Enclosure (O.S. First Edition map, no surface evidence)	Uncertain
LDY030:023	Enclosure (O.S. First Edition map, no surface evidence)	Uncertain
LDY030:031	Caugh Fort. Rath: Caugh Fort	E.christ.
LDY030:032	Enclosure (O.S. First Edition map, no surface evidence)	Uncertain
LDY030:036	Megalithic Tomb (Unlocated)	Prehistoric
LDY030:038	Souterrain	E.christ.
LDY030:054	Cist Burial? (O.S. Memoir Site, Unlocated)	Bronze age
LDY030:055	Barrow (O.S. Memoir Site, Unlocated)	Bronze age
LDY030:056	Enclosure (O.S. Memoir Site, Unlocated)	Uncertain
LDY030:061	Souterrain (O.S. Memoir Site, Unlocated)	E.christ.
LDY030:076	Megalithic Tomb (O.S. Memoir Site, Unlocated)	Prehistoric

SMR No	Name/Description	Period
LDY030:077	Megalithic Tomb (O.S. Memoir Site, Unlocated)	Prehistoric
LDY030:080	Urn Burial (O.S. Memoir Site, Unlocated)	Bronze age
LDY030:081	Slanag. Well: Slanag (O.S. Memoir Site, Unlocated)	Uncertain
LDY030:082	Tubber-Mhuirre. Well: Tubber-Mhuirre (O.S. Memoir Site, Unlocated)	Uncertain
LDY030:083	Holy Well (O.S. Memoir Site, Unlocated)	Uncertain
LDY031:001	Carricknaheglish. Mass Rock? Carricknaheglish (Beneath Altaheglish Reservoir)	Post-med
LDY031:013	Enclosure	Uncertain
LDY031:017	Enclosure	Uncertain
LDY031:027	Possible Megalithic Tomb (O.S. Memoir Site; Unlocated)	Prehistoric
LDY031:028	Megalithic Tomb (O.S. Memoir Site; Unlocated)	Prehistoric
LDY031:029	Possible Court Tomb (O.S. Memoir Site; Unlocated)	Neolithic
LDY031:033	Possible Megalithic Tomb (O.S. Memoir Site, Unlocated)	Prehistoric
LDY031:034	Cist (O.S. Memoir Site, Unlocated)	Prehistoric
LDY030:039	Green Mount, Grien Mount. Vitrified Fort: Grien Mount or Green Mount (Not located possibly removed by quarrying)	Uncertain
LDY031:040	Sceach Mor. Burial Ground/Mound: Sceach Mor (O.S. Memoir Site; Unlocated)	Uncertain
LDY030:062	Natural Feature (O.S. First Edition map, no surface evidence)	Uncertain
LDY030:078	Enclosure (O.S. Memoir Site; Unlocated)	Uncertain

Table 5.10 – Industrial heritage assets in the Outer Study Area

Industrial Heritage No	Type	Townland
IHR01953:000:00	Flax Mill site	Templemoyle / Turmeel
IHR01954:000:00	Flax, Corn & Saw Mill site	Turmeel
IHR01955:000:00	Flax Mill site	Carnanbane

IHR01956:000:00	Bridge	Carnanbane / Templemoyle
IHR01957:000:00	Foot Bridge	Knockan
IHR01958:000:00	Flax Mills - Flax Mill site	Carnanbane
IHR01959:000:00	Bridge	Carnanbane / Templemoyle
IHR01981:000:00	Bridge	Carnanbane / Templemoyle
IHR01982:000:00	Filter House / Settling Ponds	Carnanbane / Templemoyle
IHR01983:000:00	Pipe Line	Carnanbane / Templemoyle
IHR01984:000:00	Bridge	Carnanbane / Templemoyle
IHR02001:000:00	Altnaheglish Reservoir	Teeavan
IHR02009:000:00	Flax Kiln	Teeavan
IHR01953:000:00	Flax Mill site	Templemoyle / Turmeel

Table 5.11 - Defence heritage assets in the Outer Study Area

Defence Heritage No	Type	Townland
DHP278	Observation Post	Teevan

Predicted Effects of the Development

Potential Effects

5.79 Any planned construction works that involve ground disturbance can result in physical impacts on known assets or buried archaeology. Groundworks would include excavations, the construction of turbine bases and hard-standings, access tracks, compounds, substations, laying of grid connection cables and other services. Movement of heavy plant can also result in accidental damage to upstanding archaeological features.

5.80 Wind farms can also result in effects on the settings of historic assets at a distance from the development, by changing views towards or from the historic asset. The settings of assets within the ISA can also be affected in other ways that include noise, alteration of associated features and changes in land-use.

Predicted Construction Effects

5.81 The majority of the ISA is considered to be of low archaeological potential, meaning that it is possible, though unlikely, for direct impacts upon archaeological deposits that may survive as buried remains within the Development footprint.

5.82 The area surrounding the Magheramore Court Tomb (LDY030:064) and Portal Tomb (LDY030:079) is considered to be of medium archaeological potential. No construction work is proposed in this area and therefore no construction impacts are predicted.

Predicted Operational Effects

Assets subject to Operational Effects

5.83 **Magheramore Court Tomb (LDY030-064) and Portal Tomb (LDY030-079) (Photomontage** Figure 5.5 a & b) are jointly designated as a scheduled monument and as such are considered to be assets of high importance.

5.84 This monument is the remains of two prehistoric funerary monuments; they are classified from their morphology as a court tomb and a portal tomb, but they have not been excavated so there is no detailed archaeological record of their structure. Both tombs have been heavily robbed and the OS Memoirs record farmers "*carried off so many cartloads of the best of the stones for door and window lintels, hearthstones, stepping stones, dykes*" (OS Memoirs 1995, 944) from the court tomb. It appears the portal tomb was subject to similar quarrying.

5.85 The tombs are located downslope, and to the north, of the summit of Carnanbane Hill, with the portal tomb located approximately 75m downslope from the court tomb. The hill side is currently used for rough grazing. The cairns have wide panoramic views from the east through the north to the west over the rural agricultural landscape to the plains of Derry, Lough Foyle and the northern mountains of the Sperrins in the distance. The closest prominent hill in this range is Benbradagh Hill to the north-east. The view from the tombs to the south is limited by the rising ground of Carnanbane Hill.

5.86 Court tombs typically comprise an elongated stone cairn with a concave, semi-circular façade of large set stones (or 'megaliths') at one end creating a partially enclosed area or 'court'. A gap at the mid-point of this façade on the long-axis of the cairn allows access to a line of two or more rectangular megalithic chambers. Variants include examples with entirely enclosed 'central' courts and 'double' monuments with two court tombs placed back-to-back (Waddell, 2010, 87-97). Court tombs are the earliest type of megalithic tomb recorded in Ireland dating from the Early Neolithic with radiocarbon dates suggest that the earliest date to 3700 – 3570 cal BC with some seeing reuse into the Early Bronze Age (Schulting et al, 2011, 42).

5.87 The Magheramore court tomb conforms to the basic model; its cairn survives 20m long and up to 8m wide, orientated north-west to south-east with the court at its north-west end. There are two circular depressions in the middle of the cairn which are possibly the remains of two chambers however the highly disturbed nature of this cairn makes it difficult to confidently describe the tomb further.

5.88 Portal tombs are generally considered to be derived from court tombs. They typically comprise a megalithic chamber based on a tripod design with tall upright entrance (portal) stones and a lower backstone, supporting a massive capstone, set with its heavier end above the entrance (Ó Nualláin, 1983, 89). Historically, and colloquially, this style of monument is referred to as a dolmen. Excavated portal tombs have typically produced similar grave goods to court tombs providing them with a similar early Neolithic origin date.

5.89 The Magheramore portal tomb has been heavily disturbed and is therefore difficult to classify, it survives as a small collection of stones 3.7m long and 3.2m wide orientated north-west to south-east with the portal at the north-west end. The morphology of the stones with taller stones at the front and low back and side stones have been used to suggest this is the remains of a portal tomb. It is located downslope from the court tomb and shares both a common long-axis and a north-west orientation for the entrance with the court tomb.

5.90 The cultural significance of these tombs derives primarily from their fabric and its potential to increase our knowledge of funerary practice in the Neolithic. As both tombs possibly date from the Early Neolithic it is difficult to confidently state if one these assets is earlier or if they were contemporary. The relationship between these tombs adds to cultural significance as not only does their fabric contain the potential to increase knowledge of the funerary and ritual practices of the Neolithic, it also has the potential to explain why these assets are sited in proximity, if they were in use at the same time or whether they were used and built subsequently.

5.91 The wider landscape setting appears to have had a bearing on the siting of these tombs. The portal tomb is located approximately 75m downslope from the court tomb and the two tombs appear to have been carefully aligned on a north-west to south-east axis with their entrances being orientated downslope to the north-west.

5.92 The orientation of Neolithic tombs has been widely studied and the potential for important sight-lines to and from a tomb must be examined. In the case of the Magheramore Court Tomb the orientation is north-west – south-east with the entrance to the north-west. This does not conform to the general pattern for court tombs where almost all have been built with their courts facing east of the north-south axis (Ó Nualláin, 1989,105). There is however, a very wide spread of orientations within this 180° arc, suggesting that no specific direction was important for court tombs. At this tomb, there are no obvious distant landmarks on which the entrance is orientated, it appears rather to have been positioned to capture the long-range view over the plains of Derry and beyond. There does not appear to be a strong preference in the orientation of portal tombs. The Magheramore portal tomb has the same alignment as the court tomb with the entrance (portal) to the north-west, but it is not clear whether this reflects an interest in the view over the plains or simply a desire to share a common alignment with a pre-existing monument.

5.93 Located on the side of the hill, these are not summit cairns and there is nothing to suggest that they were sited to be landmarks in distant views towards them. In their current condition, surviving as low mounds of stones, the tombs are no longer either prominent or dominant features in the landscape. These assets cannot be readily identified in the landscape until in their immediate proximity. Indeed, from one cairn it is not immediately clear that there is another tomb close by as the rough vegetation obscures their visibility.

5.94 To a limited extent the views between the cairns add to their cultural significance. The cairns are intervisible and share a common alignment which can be appreciated on site. This adds a degree of value to the view from the court tomb north-west to the portal tomb and, conversely, from the portal tomb south-east to the court tomb. As discussed above, the diminutive remains of these cairns and the surrounding rough vegetation make these views difficult to appreciate but they can still be experienced due to the open moorland character of their immediate surroundings.

5.95 To summarise, the cultural significance of these tombs derives primarily from their fabric and its potential to increase our knowledge of funerary practice in the Neolithic and the relationship between different types of tomb. The additional contribution that setting makes to this significance relates to an appreciation of the relationship between the two monuments, their common alignment and the experience of panoramic long-range views from their entrances to the north-west, suggesting a deliberate orientation of the tombs in this direction.

5.96 The nearest turbine of the Development is Turbine 3 which will be 201m to the south-east of the scheduled area. Turbine 4 will be 227 m to the south-west of scheduled area with the remaining four turbines partially visible over the summit of Carnanbane Hill to the south. The predicted appearance of the wind farm from the Magheramore tombs is illustrated in a photomontage Figure 5.5 a, with a 360^0 view from the court tombs provided in photomontage Figure 5.5 b.

5.97 Turbines 3 and 4 would be dominant features in any views looking south or west from the tombs with the other turbines as prominent features slightly further away. The wind farm would not be visible in the panoramic long-range views from the east through the north to the west from the turbines.

5.98 The Development would be experienced in the immediate landscape setting of the Magheramore Court and Portal Tombs as a dominant feature on the southern horizon and on the hillside to the west of the asset, at least 201m from the asset. The turbines would have no effect on the viewer's ability to appreciate the long-range views from the east through north to west from these tombs and in particular none of the turbines would be in the key view from the entrances of the tombs to the north-west.

5.99 The proximity of the turbines would introduce a degree of visual distraction to the immediate setting of the assets, and particularly in the view from the portal tomb south-east towards the court tomb. This would diminish, but not prevent, the appreciation of the relationship between these Neolithic funerary monuments. The landscape setting of the tombs would remain essentially open and unenclosed, despite the proximity of the closest turbines.

5.100 To the limited extent that the view to the south-east between and across the tombs contributes to the cultural significance of this asset, this change would slightly diminish that positive contribution. It is considered that this would be an adverse impact of low magnitude, resulting in an effect of minor significance on the Magheramore portal and court tombs.

5.101 **Dungiven Castle (HB02/06/003 A)** is a Grade B1 listed building and as such is an asset of high importance. Built in the neo-Gothic style in 1839 on the site of an earlier structure , upon completion the castle was left unoccupied and was fell into dereliction. Although kept as a country house for decades the building was not regularly used, but it has subsequently seen many uses including as a base for American troops during World War II, as a hostel and a hotel. The Castle is currently in use as an Irish language school.

5.102 The castle is located in Dungiven town set back, to the south-west, from the Main Street (A6). Within Dungiven the castle is not a dominant or prominent feature, set behind a carpark and a large agricultural shed. The main façade of the castle is that looking south-west over its gardens to the Roe Valley. As the listing document states "the building has a splendid setting from the south and the River Roe". This view towards Dungiven Castle, from the south on Magheramore Road, is a key view in the setting of this asset as it appears that the Castle has been designed to be viewed from this approach and it becomes the dominate focal point in Dungiven when approached from this road. Equally the castle has also been designed to give panoramic views to the south-east over the rolling agrarian landscape of the Roe Valley to the southern Sperrin Mountains beyond.

5.103 The proposed turbines will be fully visible from Dungiven Castle at a distance of approximately 3.9km to the south. As the main façade of the castle faces south-west these turbines will sit on the eastern edge of the panoramic view towards the southern Sperrin mountains. The turbines will not be in the main view direction and will add another layer to the palimpsest landscape that includes many elements including other wind farms. It is considered that the Development will therefore not detract from the ability to understand appreciate, experience and enjoy Dungiven Castle. However, it will have a slight effect on the elements of Dungiven Castle's setting from which it gains its cultural significance. This will be an impact of negligible magnitude on this asset of high importance resulting in an effect of negligible significance.

5.104 **Aughlish stone circle and alignments (LDY030:021) (Photomontage, Figure 5.6)** is a scheduled monument and as such an asset of high importance. This asset consists of five stone circles, five associated stone alignments and a number of possible small cairns. Excavations on the site have dated it to the Late Neolithic to Early Bronze Age.

5.105 The asset is located at the southern end of the small ridge shaped Caugh Hill, in a field of rough pasture, 250m to the north-east is the Caugh Hill Water Treatment Works. A signpost marks the way to the stones from Rallagh road to the south-west and located in the north-east corner of the field is a Limavady Heritage Trail information board. This information board provides a brief explanation of the site as well as putting forward theories on the probable alignment of the stones. The information board states "the alignment to the northwest is perhaps the most significant pointing southwest towards a physical gap in the surrounding hills".

5.106 The wider landscape setting appears to have had a bearing on the siting of these stones. They have been clearly sited here for the panoramic views the site affords, in particular the expansive views to the Sperrins to the south-west. The majority of the stones stand to a maximum height of 0.35 m and are largely hidden amongst the vegetation, the exception to this is two stones that are approximately 1.5m high within one of the stone circles. It is therefore considered that this asset was not intended to be visible in long views into the site.

5.107 The cultural significance of these stones comes primarily from their fabric and the potential that excavation of the area would have to increase our knowledge of Neolithic to Bronze Age ritual activities. The additional contribution that setting makes to this significance relates to an appreciation of the relationship with the views to the south-west.

5.108 The Development will be located approximately 2.2km to the east of the Aughlish stone circles and alignments. As demonstrated by the photomontage (Figure 5.6), views to two of the turbines will currently be blocked by intervening trees, with the remaining 4 turbines fully visible on the ridge top. These turbines will not appear in the key views to the south-east from this asset, however they will introduce a new element into the wider views from this asset. Due to the very limited extent to which the view to the east contributes to the cultural significance of this asset this change would very slightly diminish that positive contribution. It is considered that this would be an adverse impact of negligible magnitude resulting in an effect of negligible significance on the Aughlish stone circle and alignments.

5.109 **Templemoyle stone circle (LDY030:045)** Wireline Figure 5.11 is a scheduled monument and as such is considered an asset of high importance. This is an incomplete circle approximately 9m in diameter comprising 20 small stones.

5.110 This asset is located at the northern end of the small ridge shaped Caugh Hill. This asset is in an area of heavy gorse cover and at present there are no views into or out from this asset. It is presumed that given the siting of this asset on a level area of ground with the hill sloping to the north, east and west this asset would have had extensive views over the Roe Valley and to Benbradagh Hill in in the distance.

5.111 The cultural significance of this monument derives primarily from the potential of its fabric to inform our knowledge of ritual activity in the Late Neolithic to Early Bronze Age. In its current condition, overgrown with gorse, setting does not contribute to the cultural significance of this asset. The Development will be 1.9km to the west from this asset but the growth of gorse prevents any visibility of the development from the asset or in views towards this asset. It is considered that at present there is no potential for an operational impact on Templemoyle stone circle. In the absence of vegetation, views to and from this asset would be opened up, given the location of the asset it can be presumed that the stone circle was sited for views over the Roe Valley and possibly in contrast to Aughlish stone circle and alignments (LDY030:021) which is sited at the southern end of the same hill. Templemoyle stone circle may be sited for views to the northern Sperrins and in particular Benbradagh Hill. It is therefore considered unlikely that the Development will be located in a key view from this asset and at most will have an impact of negligible magnitude on this asset of high importance giving rise to an effect of negligible significance.

5.112 **Banagher Old Church (LDY030:029)** Photomontage, Figure 5.7 is a scheduled monument and also a Monument in State Care, as such it is an asset of high importance. This mid-12th century church survives extant to roof height. The church sits within a graveyard, which contains many contemporary and later gravestones and crosses as well as a thirteenth-century mortuary house shrine; O'Heany's Tomb (part of the scheduled area). Outside the graveyard to the north-east is a bullaun stone. The longevity of use of the graveyard is indicated by the ground level around both the church and the mortuary tomb. Since being built on the summit of the hill, centuries of use of the graveyard have seen the ground level rise significantly.

5.113 The church is located on a small hillock with extensive views in a wide arc from the hills of the northern Sperrins in the north-east over the Roe Valley through the low agricultural lands to the west to the spire of Banagher Church of Ireland (HB02/06/003 A) in the south-west. These views have been partly blocked by the building of a farm to the immediate west of the church, however the siting of the church for the wide panoramic view can still be readily appreciated. Views from the south-west through east to the north-east are less extensive and are restricted to the rising ground of the surrounding hills. Although located on a hilltop this church is no longer a prominent feature in the surrounding landscape and is only visible from the immediate surrounding land.

5.114 The cultural significance of this asset derives largely from its intrinsic architectural and archaeological value and its potential to increase our knowledge of ecclesiastical practices in the medieval period. As a church the building also derives cultural significance from its function as a recognisable place of worship. The additional contribution that setting makes to this significance relates to an appreciation of the wide views afforded by hilltop location of the church.

5.115 The proposed turbines will be 1.5km to the south-east of the graveyard, visible to hub height on or over the summit of Caranbane Hill, the appearance of the wind farm is illustrated in a photomontage Figure 5.7.

5.116 The Development would be experienced in the wider landscape setting of Banagher Old Church as a prominent but relatively distant feature on the south-east horizon as illustrated in the photomontage (Figure 5.7). It would not appear in the wide panoramic view to the west. At 1.5km, the appearance of the turbines to the rear of the church in views from, and on approach to, the graveyard to the rear of the church will introduce a degree of visual distraction to the immediate setting of the assets. This would slightly diminish but not remove the ability to understand and enjoy the asset.

5.117 To the limited extent that the view to the south-east from the church contributes to the cultural significance of this asset, this change would very slightly diminish that positive contribution. It is considered that this would be an adverse impact of negligible magnitude resulting in an effect of negligible significance on the Banagher Old Church.

Assets subject to Operational Effects

5.118 The remaining assets in the Outer Study Area have been assessed as not being subject to operational effects from the Development. The full assessments for these assets are in Appendix 5.1 Cultural heritage assets not subject to operational impacts.

Predicted Cumulative Effects

5.119 The cumulative effects of the Development with the developments of the other wind farms described in Chapter 4: Landscape and Visual Impact have been considered.

5.120 No cumulative construction effects are predicted for known cultural heritage assets from any combination of developments. Furthermore, due to the nature of previously unrecorded cultural heritage assets likely to be found in this area it is considered that there is no potential for cumulative construction effects on previously unrecorded cultural heritage assets.

5.121 Cumulative operational effects can occur when the Development would be visible in the setting of an asset in combination with other operational, consented or proposed wind energy projects. The assessment of effects uses precisely the same methodology applied in considering the current application alone. All analyses of asset significance and the contribution made by setting remains unchanged. All that is altered is the nature of visual change predicted for the one or more scenarios under consideration.

5.122 Cumulative operational effects are considered in cases where an effect of minor or greater significance has been predicted on the setting of an historic asset as a result of the Development. The purpose of this threshold is to ensure that the assessment remains proportionate and focused on those cases where there is potential for a significant effect (in EIA terms) to arise. Magheramore Court Tomb (LDY030-064) and Portal Tomb (LDY030-079) are the only assets which have been assessed as being potentially subject to an adverse operational effect of minor significance and therefore have the potential for cumulative effects to arise.

5.123 It is considered that the cumulative developments are sufficiently distant from and outwith key views to and from the Magheramore Court Tomb (LDY030-064) and Portal Tomb (LDY030-079) that they will not impact on the cultural significance of these assets. It is therefore considered that there will not be an additional cumulative impact on Magheramore Court Tomb (LDY030-064) and Portal Tomb (LDY030-079) and the operational impact will be of minor significance resulting solely from the proposed Magheramore Wind Farm.

Mitigation

Construction

5.124 Impact significance cannot be meaningfully assessed for unknown assets, as neither the sensitivity of the receptor nor the magnitude of the effect is known. Consequently, only the likelihood of construction impact is considered here.

5.125 The potential for previously unrecorded assets to lie within the construction footprint and vulnerable to being affected by ground works is considered to be low. Any construction effects upon previously unrecorded cultural heritage assets will be mitigated through a programme of archaeological works, to be agreed with the NHED. This programme will allow for features to be recorded appropriately and is likely to comprise;

- Evaluation, by trial trenching, test-pitting and/or geophysical survey, as appropriate, of areas where extensive disturbance will occur (such as compounds and turbine bases), particularly at lower altitudes (below 300m OD); and
- Archaeological monitoring of groundworks where appropriate.

5.126 The excavation and recording of archaeological remains is considered a second best option to their preservation in situ, following PPS6 paragraph 3.16. Construction impacts on currently unknown heritage assets will therefore be avoided by micro-siting where this is possible and proportionate to the significance of the predicted effect on the asset. Where construction impacts are unavoidable, these will be mitigated by licensed excavation and recording of the remains in accordance with PPS6 Policy BH 4 and paragraphs 3.14-19.

Operational

5.127 No significant operational effects are predicted on the setting of cultural heritage assets from the operation of the Development. No mitigation is therefore required.

Cumulative

5.128 No cumulative effects are predicted on cultural heritage assets; therefore no mitigation is required.

Residual Effects

Construction

5.129 Following mitigation there will be no adverse residual construction impacts on cultural heritage assets.

Operation

5.130 There will be no significant operational effects on cultural heritage assets during the operation of the wind farm. The residual effect on the setting of cultural heritage assets will be no greater than minor adverse significance.

Conclusion

5.131 This assessment has considered the potential effects of the Development upon the physical fabric of cultural heritage assets within the Inner Study Area, and potential effects on the settings of assets within the wider landscape.

5.132 No construction impacts on known cultural heritage assets are predicted.

5.133 There remains low potential for the construction phase to have an effect on previously unrecorded cultural heritage assets. A programme of archaeological works to mitigate such effects would be agreed with the HED Archaeologist before the commencement of construction.

5.134 The potential operational effects of the Development on cultural heritage assets has been assessed. Effects on the setting of cultural heritage assets are considered to be of no greater than minor significance.

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6

Ecology

6 Ecology

Introduction

6.1 This chapter constitutes the ecology and nature conservation assessment for the Environmental Impact Assessment of the proposed wind farm at Magheramore, near Dungiven, hereinafter referred to as 'the Development'. This study addresses the potential impacts of the proposal to erect six turbines and to construct associated access tracks and infrastructure on the habitats and species in the study area, as shown in **Figure 6.2:** Habitat survey map.

6.2 Blackstaff Ecology Ltd was commissioned by RES Ltd to undertake an Ecological Impact Assessment (EcIA) for this proposed wind farm. The ecological surveys used to describe the baseline conditions on site and to inform the EcIA were undertaken during the 2018 survey seasons.

6.3 The proposed wind farm will involve construction of six wind turbines (overall height 149.9 m; hub height 94 m; rotor diameter 112 m) and associated ancillary works. Full details can be found in **Chapter 2: The Proposed Project**.

6.4 The chapter is supported by:

- Technical Appendix 6.1: Information to Inform a Habitats Regulations Assessment
- Technical Appendix 6.2: Habitat Survey Report
- Technical Appendix 6.3: Bat Survey Report
- Technical Appendix 6.4: Outline Habitat Management Plan
- Technical Appendix 6.5: Outline Construction Environmental Management Plan

6.5 Figures 6.1 to 6.8 are referenced in the text where relevant.

Statement of Authority

6.6 The vegetation surveys, habitat assessments were carried out by Dr Brian Sutton, with badger, red squirrel, viviparous lizard and bat surveys carried out by Cormac Loughran. Karl Hamilton assisted with the bat transects and Gala Podgornik carried out the marsh fritillary habitat survey. Technical support, including deployment of automated (bat) detectors, GIS figure production (habitat loss/benefit calculations) and UAV (drone) imagery (capture and production) was provided by Philip Leathem.

6.7 The author of this chapter is Cormac Loughran, a Chartered Environmentalist (CEnv), and a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). Cormac has worked professionally as a Consultant Ecologist for over 15 years. He holds an MSc (Distinction) in Environmental Management from the University of Ulster, and has extensive experience in a broad range of flora & fauna surveys. He has undertaken and/or coordinated a wide range of ecological surveys and associated impact assessments for over 20 renewable energy projects. Cormac is also an experienced field naturalist and prior to his consultancy work, he worked as a ranger on a number of important nature reserves. As a result, he also has considerable habitat management experience across a broad range of habitats in including broadleaved woodland, wetland, grassland and wet & dry heathland.

6.8 Dr Brian Sutton was awarded a PhD in Environmental Science by the University of Ulster. Prior to working at Blackstaff Ecology, he worked as a member of the Habitat Survey Team of the Environment and Heritage Service (now NIEA) for 2 years. During this time, he carried out habitat surveys of, principally, designated sites or candidate designated sites across Northern Ireland. In so doing he gained experience of most of the habitat types that are present in the Province. Following this, he worked as a consultant ecologist for AECOM Ltd for 15 years, carrying out habitat and faunal surveys for a wide range of governmental and private clients. Projects undertaken were at a range of scales, from small private developments to major infrastructure projects.

6.9 Gala Podgornik has over six years of experience within the ecology and nature conservation sector and has worked with a range of both terrestrial and marine faunal species through desk studies, laboratory research, wildlife rehabilitation and wildlife surveys. She has experience working on large conservation projects for protected species, funded by the European Union (LIFE 14, INTEREG IVA) and UK bodies (Heritage Lottery Fund, NIEA), through positions with Queen's University Belfast and Ulster Wildlife. Gala is also an experienced and certified trainer in wildlife oil pollution remediation and invasive alien species. For the present proposal Gala assisted with the marsh fritillary habitat, bat activity transects, common lizard and badger surveys which were carried out for the proposal during 2018.

6.10 Karl Hamilton has extensive experience in providing ecological consultancy advice, including habitat monitoring & management advice for a wide range of native flora & fauna. He has extensive experience in surveying, birds, mammals, herpetofauna, (extended) phase 1 and phase 2 (NVC) habitat survey and other protected species surveys. His recent consultancy work includes priority species surveys; extended phase one habitat surveys; National Vegetation Classification surveys; protected species surveys; habitat assessment & management as mitigation for breeding waders, vantage point surveys for raptors and migratory species; walkover surveys including Breeding Bird Surveys and Brown & Shepard surveys; wetland bird surveys (WeBS), and surveys of lowland species-rich meadows.

6.11 Philip Leathem is a UAS (Unmanned Aerial Systems) Operator & GIS Technician who has worked in the environmental sector for the past 3 years. Philip's role as a technician includes the maintenance, monitoring and deployment of a suite of automated bat detector units (SM2 Bat+, SMZC's and Anabat Express') which are used during static (bat) monitoring. In addition to the above role, Philip is also a GIS Technician and had considerable experience in the production of Figures for Environmental Statements. He also has permission to fly from the CAA (Civil Aviation

Authority (BNUC)) for the operation of a fully autonomous professional mapping drone used to capture high-resolution aerial photos, 2D orthomosaics & 3D models).

Legislation & Planning Policy

International Treaties, Conventions & Directives

Bonn Convention of the Conservation of Migratory Species of Wild Animals (June 1979)

6.12 The Convention requires the protection of the endangered migratory species listed and encourages separate international agreements covering particular species. An agreement covering the conservation of bats in Europe came into force in January 1994. It deals with the need to protect bats and their feeding and roosting areas.

Bern Convention on the Conservation of European Wildlife and Natural Habitats (September 1979)

6.13 The Convention carries obligations to conserve wild plants, birds and other animals, with emphasis on endangered and vulnerable species and their habitats. The provisions of the Convention underlie the EC Habitats Directive as well as the UK's wildlife legislation.

UN Biodiversity Convention (The Rio Convention) (June 1992)

6.14 The Convention provides a framework for international action to protect species and habitats. The UK's overall goal under the Convention is to conserve and enhance biological diversity within the UK and to contribute to the conservation of global biodiversity through all appropriate mechanisms.

Convention on Biological Diversity (93/626/EEC) (CBD)

6.15 The Convention requires contracting parties, in accordance with its conditions and capabilities, to develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programmes. It also requires contracting parties to integrate, as far as possible and as appropriate, the conservation and sustainable use of biological diversity into relevant sectorial and cross sectorial plans, programmes and policies.

EC Council Directive on the Conservation of Natural Habitats of Wild Fauna and Flora (92/43/EEC) (The Habitats Directive)

6.16 Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the EU Habitats Directive) is transposed into law in Northern Ireland by the Conservation (Natural Habitats, etc.) Regulations 1995 (as amended), the Habitats Regulations.

6.17 The Habitats Directive covers habitats and non-avian species of fauna of nature conservation importance and in danger of disappearance, for which the European

Commission (EC) has responsibility in view of the proportion of their global range. Habitats are listed and detailed on Annex I of the Directive.

6.18 To conserve these habitats, listed on Annex I of the directive, and species, listed and described on Annex II, a European network of Special Areas of Conservation (SAC) is being established.

6.19 As the Habitats Directive encapsulates a presumption in favour of maintaining Annex I habitats in good conservation status wherever they occur, prior assessment is therefore required to determine whether any areas of habitat within a development site meets the criteria for recognition as Annex I habitat types.

6.20 The Directive also requires appropriate assessment of any plan or project not directly connected with or necessary to the management of a Natura 2000 site, but likely to have significant effects upon a Natura 2000 site, either individually or in combination with other plans or projects.

Annex 1 Habitats

6.21 Northern Atlantic wet heaths (H4010) with *Erica tetralix*, European dry heaths (H4030), Transition mires and quaking bogs (H7140), Alkaline fens (H7230) and Blanket Bog (H7130) are listed in Annex 1 of the EU Habitats Directive and this indicates that they are protected habitats. 'Active' blanket bog is classified as a priority habitat.

6.22 The main aim of the Habitats Directive is to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats listed in Annex 1 at a favourable conservation status, introducing robust protection for those habitats of European importance (i.e. priority habitats, such as 'active' blanket bog).

Domestic Legislation

Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 (as amended)

6.23 The Regulations give effect to requirements relating to the designation of protected sites under the Birds Directive and Habitats Directive. The Regulations provide for the protection and management of European Sites and place obligations on all competent authorities to have regard to the requirements of the Habitats Directive. The Regulations also provide for the protection of species of European importance.

Environment (Northern Ireland) Order 2002

6.24 The Order provides for the designation, management and protection of Areas of Special Scientific Interest (ASSIs). ASSIs may be designated for important geology and land forms as well as for wildlife and habitats. The legislation repeals Part VI of the Nature Conservation and Amenity (Northern Ireland) Order 1985.

Nature Conservation and Amenity Lands (Northern Ireland) Order 1985 (as amended)

6.25 The Order provides for the establishment of National Nature Reserves (NNRs), Nature Reserves (NRs) and Marine Nature Reserves (MNRs). It also provides for the designation and formulation of proposals for National Parks and Areas of Outstanding Natural Beauty (AONBs).

The Wildlife (Northern Ireland) Order 1985 (as amended)

6.26 The Order prohibits the intentional killing, taking or injuring of certain wild birds or wild animals; or the intentional destruction, uprooting or picking of certain wild plants. It also allows for the establishment of Wildlife Refuges (akin to Nature Reserves) for the special protection of certain species of rare plants or animals.

The Environmental Liability (Prevention and Remediation) Regulations (Northern Ireland) 2009

6.27 The Regulations implement Directive 2004/35/EC and require those carrying out certain activities to prevent, limit and remediate significant environmental damage to protected species, natural habitats, ASSIs, surface water, ground water and land. Operators of activities such as discharges to water sources and water impounding are liable for any significant environmental damage, regardless of whether they intended to cause the damage or were negligent.

Wildlife and Natural Environment Act (Northern Ireland) 2011

6.28 The Act makes provision about biodiversity; amends the Wildlife (Northern Ireland) Order 1985 and Part 4 of the Environment (Northern Ireland) Order 2002; abolishes game licences and game dealers' licences; prohibits hare coursing events and amends the Game Preservation Act (Northern Ireland) 1928.

Planning Policy

Regional Development Strategy (RDS) 2035: Building a Better Future

6.29 The Strategy takes account of European and national policies which would have an influence on the future development of Northern Ireland. The Strategic Planning (Northern Ireland) Order 1999 requires Northern Ireland Departments to have regard to the Regional Development Strategy in exercising any functions in relation to development. There are two types of Strategic Guidance: Regional Guidance (RG) and Spatial Framework Guidance (SFG). RG applies to everywhere in the region and is presented under the three sustainable development themes of Economy, Society and Environment.

6.30 RG 9 - RG 12 (Environment) have been adjusted to meet obligations under the Habitats Regulations. Of relevance to the Development is RG 11: Conserve, protect and, where possible, enhance our built heritage and our natural environment. This Strategy Guidance refers to the need to;

6.31 Sustain and enhance biodiversity in line with the objective of the Northern Ireland Biodiversity Strategy to halt the loss of indigenous species and habitats. By protecting existing, or creating new, ecological or wildlife corridors particularly in our cities and towns we can provide valuable help to arrest the decline in biodiversity.

6.32 Identify, establish, protect and manage ecological networks. Ecological networks, including the protection of priority species, are needed to maintain environmental processes and help to conserve and enhance biodiversity. A well-established ecological network, including designated sites, should provide the habitats needed for ecosystems and species populations to survive in an increasingly human dominated landscape. Such networks could also be of amenity value if linked to the green infrastructure provided by walking and cycle routes to heritage and other recreational interest.

Strategic Planning Policy Statement for Northern Ireland (SPPS)

6.33 In addition to reiterating the statement made in PPS18 (below) the SPPS States:

'Active peatland is of particular importance to Northern Ireland for its biodiversity, water and carbon storage qualities.'

and

'Renewable energy reduces our dependence on imported fossil fuels and brings diversity and security of supply to our energy infrastructure. It also helps Northern Ireland achieve its targets for reducing carbon emissions and reduces environmental damage such as that caused by acid rain.'

Planning Policy Statement 18: Policy RE1

6.34 Policy RE1 States:

'The wider environmental, economic and social benefits of all proposals for renewable energy projects are material considerations that will be given significant weight in determining whether planning permission should be granted'.

'Development that generates energy from renewable resources will be permitted provided the proposal, and any associated buildings and infrastructure, will not result in an unacceptable adverse impact on:

(a) public safety, human health, or residential amenity;

(b) visual amenity and landscape character;

(c) biodiversity, nature conservation or built heritage interests;

(d) local natural resources, such as air quality or water quality; and

(e) public access to the countryside.

…..

Where any project is likely to result in unavoidable damage during its installation, operation or decommissioning, the application will need to indicate how this will be minimised and mitigated, including details of any proposed compensatory measures, such as a habitat *management plan or the creation of a new habitat. This matter will need to be agreed before planning permission is granted.*

…..

Any development on active peatland will not be permitted unless there are imperative reasons of overriding public interest.'

Planning Policy Statement 2 - Policy NH5

6.35 Policy NH 5 - Habitats, Species or Features of Natural Heritage Importance, states:

Planning permission will only be granted for a development proposal which is not likely to result in the unacceptable adverse impact on, or damage to known:

- *priority habitats;*
- *priority species;*
- *active peatland;*
- *ancient and long-established woodland;*
- *features of earth science conservation importance;*
- *features of the landscape which are of major importance for wild flora and fauna;*
- *rare or threatened native species;*
- *wetlands (includes river corridors); or*
- *other natural heritage features worthy of protection.*

A development proposal which is likely to result in an unacceptable adverse impact on, or damage to, habitats, species or features may only be permitted where the benefits of the proposed development outweigh the value of the habitat, species or feature. In such cases, appropriate mitigation and/or compensatory measures will be required.

PPS 21 Sustainable Development in the Countryside

6.36 PPS 21 aims to, *"Manage development in the countryside in a manner consistent with achieving the strategic objectives of the Regional Development Strategy for Northern Ireland 2025." Objectives include to "Conserve the landscape and natural resources of the rural area and to protect it from excessive, inappropriate or obtrusive development and from the actual or potential effects of pollution," and to "Promote high standards in the design, siting and landscaping of development in the countryside."*

Northern Ireland Biodiversity Strategy

6.37 A new strategy has just been published by the DoE entitled, Valuing Nature – A Biodiversity Strategy for Northern Ireland to 2020 (01st July 2015). This document describes 20 targets arising from the 2010 Convention on Biological Diversity (CBD) which was held in Noyoga, Japan during October 2010. A key decision at the Convention was the adoption of a new ten-year strategic plan to guide international and national effort to save biodiversity. The strategic plan, or the Aichi Target, adopted by the meeting is the overarching, internationally agreed, framework on biodiversity. The 20 Aichi Targets form the basis for the Implementation Plan for the NI Biodiversity Strategy. The CBD fully adopted the ecosystem services approach that stresses the need to look at maintaining the functionality of ecosystems as key to protecting biodiversity and delivering benefits for humanity.

Sustainable Development Strategy for Northern Ireland

6.38 The Strategy sets out the Government agenda for ensuring that sustainable practice becomes an integral part of development policy in Northern Ireland. The following six principles of the strategy continue to echo those developed from the previous strategy, and are as follows;

- Living within Environmental Limits;
- Ensuring a Strong, Healthy, Just and Equal Society;
- Achieving a Sustainable Economy;
- Promoting Good Governance;
- Using Sound Science Responsibly;
- Promoting Opportunity and Innovation.

6.39 The strategic objective most relevant to this development is: Ensuring reliable, affordable and sustainable energy provision and reducing our carbon footprint.

UK and Northern Ireland Biodiversity and Habitat Action Plans

6.40 The UK Biodiversity Action Plan (UKBAP) and equivalent Northern Ireland Habitat Action Plan, as well the internal NIEA Guidance Document, have been consulted regarding what constitutes 'active' blanket bog.

6.41 The UKBAP indicates that 'active' peatlands include the EU Habitats Directive priority habitat 'active' blanket bog, the definition of 'active' being given as 'still supporting a significant area of vegetation that is normally peat forming'. The UKBAP indicates that the principal vegetation (NVC) types covered and so defined as Blanket bog are M1, M2, M3, M15, M17, M18, M19, M20 and M25, together with their intermediates.

6.42 The Northern Ireland Habitat Action Plan (NIHAP) provides a similar definition of the habitat type, The NI HAP notes the EC Habitats Directive definition of what constitutes 'active' bog, and note the following in respect of relevant NVC types: -

'Within Northern Ireland, blanket bog encompasses a range of plant communities that are similar to those identified in the National Vegetation Classification (NVC) of Great Britain (Rodwell, 1991). NVC descriptions and codes are given to associations of plants that are characteristic of particular environmental and management conditions. Plant communities that are typical of natural blanket bogs include the bog pool communities M1 to M3, M17 Scirpus cespitosus - Eriophorum vaginatum blanket mire, M18 Erica tetralix - Sphagnum papillosum raised and blanket mire and M19 Calluna vulgaris - Eriophorum vaginatum. A number of additional NVC communities are characteristic of the extensive areas of blanket bog which have been subject to some disturbance such as drainage or peat-cutting. These include M15 Scirpus cespitosus - Erica tetralix wet heath, M20 Eriophorum vaginatum blanket and raised mire, M25 Molinia caerulea - Potentilla erecta mire, together with their intermediates. Other wetland plant communities, such as flush M10 Carex dioica - Pinguicula vulgaris mire and poor-fen M6 Carex echinata-Sphagnum recurvum/auriculatum mire, are

often closely associated with blanket bog. For the purposes of this plan, these are treated as an integral part of the blanket bog habitat.'

6.43 The UKBAP, NIHAP and European Commission (2007) Interpretation Manual of European Union Habitats has been utilised in the current report to determine whether peatlands are 'active' and hence require consideration in policy and impact assessment terms.

Guidance on Species/Habitats of Conservation Concern

Red Data Book

6.44 Vascular plant species that are rare and/or threatened on an all-Ireland or European scale have been identified as Red Data Book (RDB) species (Curtis & McGough, 1988).

Northern Ireland Species of Conservation Concern

6.45 NIEA has produced a list of Northern Ireland Priority Species (NIPS) and Species of Conservation Concern (SOCC), which includes Biodiversity Action Plan species, not all of which are Red Data Book species. Rarity is also a criterion for inclusion in the list. NIEA is also in the process of identifying vascular plant species that are of conservation concern as the NI response to the adoption by the UK of the Global Strategy for Plant Conservation (Palmer, 1994). The proposed list will be comprehensive and include species that are near-threatened as well as those protected by the Wildlife Order or listed as NIPS and SOCC. This process of evaluation of the current list of species of conservation concern is on-going.

Local Biodiversity Action Plans (LBAPs)

6.46 Local Authorities have been able to employ Biodiversity Officers, with financial aid from NIEA, since 2004. Their duties include raising awareness of biodiversity issues within local areas, and the development of LBAPs as a means of conserving and enhancing biodiversity at a local scale.

NIEA Internal Guidance Note on Active Peatland

6.47 The Northern Ireland Environment Agency (NIEA) provide internal guidance to their personnel indicating the site conditions, and which NVC types, may indicate that blanket bog is 'active'. In terms of NVC communities, the Guidance states: -

'The list below indicates the NVC classifications that could be active. In these habitats, the full details of quadrats surveyed will be needed to aid identification of active peatland. They should be provided within the environmental statement (ES).

NVC classifications which are likely to be found in active peatland:

- *M1 Sphagnum auriculatum bog pool community*
- *M2 Sphagnum cuspidatum/recurvum bog pool communities*
- *M3 Eriophorum angustifolium bog pool community*
- *M17 Scirpus cespitosus - Eriophorum vaginatum blanket bog*
- *M18 Erica tetralix- Sphagnum papillosum raised and blanket mire*

- *M19 Calluna vulgaris-Eriophorum vaginatum blanket mire*
- *M20 Eriophorum vaginatum blanket mire*
- *M25 Molinia caerulea-Potentilla erecta mire'*

6.48 Other criteria from the Guidance, including site-specific characteristics which could indicate the presence of 'active' peat include:

- *Sphagnum is present*
- *If the surface is spongy underfoot*
- *Deep peat is present (>0.5m)*
- *Intact peat is present or the hydrology is still intact*
- *E. vaginatum/ angustifolium is present in significant quantities with some Sphagnum*
- *The typical range of blanket bog and raised bog species is present as indicated within the interpretation manual*
- *There is a hummock and pool topography*

6.49 Consideration of this Guidance is essential in the design and layout of wind energy projects to ensure compliance with Planning Policy.

Scope of Assessment

Ecological Impact Assessment

6.50 The assessment is based mainly on a study area surrounding the Development and associated infrastructure. Surveys for bats were extended to 200m outside the Planning Application Boundary, as required by NIEA guidance. Sites designated for their nature conservation features within a radius of 2km of the site boundary (**Figure 6.1**) were also considered to assess potential remote effects on valuable ecological site-based receptors.

6.51 The aim of EcIA is therefore to describe and assess potential significant effects upon ecological receptors within the application site and zone of ecological influence within the wider environment as applicable. This is achieved by informed decision making in accordance with published methodologies and after having collected a range of primary survey data across the site of proposed development. Identification and evaluation of likely significance of effects associated with the Development during construction, operation and decommissioning phases is followed by the recommending of appropriate mitigation measures to avoid and/or reduce the predicted adverse effects of the proposed development on the recorded ecological receptors identified as part of the baseline survey.

6.52 The baseline survey, characterisation of the environment and the likely significance of effects of the Development on ornithology, fisheries (aquatic ecology) and the water environment are reported upon in **Chapter 7: Ornithology, Chapter 8: Fisheries** and **Chapter 9: Geology & Water Environment**.

Habitat Regulations Assessment

6.53 A Habitat Regulations Assessment (HRA) is required where a project may give rise to likely significant effects upon a Natura 2000 site. Natura 2000 is a European network of protected sites which includes Special Areas of Conservation (SAC) and Special Protection Areas (SPA). A HRA comprises a 'Test of Likely Significance' and if necessary an 'Appropriate Assessment'.

6.54 The proposed wind farm is hydrologically linked to the River Roe & Tributaries SAC, a Natura 2000 site, via a few nearby minor tributaries of said river.

6.55 The sites have been considered in the Environmental Impact Assessment (EIA) process presented in this Environmental Statement (ES). Relevant environmental information and evidence required for the Competent Authority to undertake a HRA has been compiled in this ES. Information to inform a HRA can be found in **Appendix 6.1**.

Consultation

6.56 Consultation was undertaken with the statutory and non-statutory organisations listed below regarding the proposed scope of the EcIA; the location of any statutory and non-statutory designated nature conservation sites that have the potential to be impacted by the Development; identification of potential ecological receptors; the existence of any ecological records within 2 km of the Preliminary Site Boundary.

- Centre for Environmental Data & Recording (CEDaR);
- DAERA Natural Environment map viewer
- National Biodiversity Network (NBN);
- NIEA – Natural Environment Division;

6.57 CEDaR and NBN provided biological records. NIEA provided a written response.

6.58 NIEA requires the identification of the ecological baseline of the area that will be affected by the scheme and the identification of areas which are likely to be of high conservation value or particularly vulnerable to impact from the proposed scheme. NIEA requires that the EIA should cover both habitats and species of flora and fauna, especially protected species, and that it should cover both the site and its surroundings, in all seasons.

6.59 The developer will be required to consider the potential impact of the scheme on designated sites. Where there is a potential for impacts on a European protected site (SPA, SAC) the developer will be responsible for informing a HRA as mandated by Article 6 of EC Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ("the Habitats Directive").

6.60 The consultation and desk study identified those ecological receptors most likely to be impacted by the proposed wind farm. Ecological receptors identified included; Northern Ireland or European priority habitat and protected species. The ecological surveys and EcIA therefore concentrate on the potential effects of the Development on these ecological receptors.

Assessment Methodology

Baseline Characterisation of the Study Area

6.61 The study methodology includes both desktop and field survey methods in order to assess the potential impact on the local ecological and nature conservation interest. Features of conservation interest and importance were recorded and their locations were one of the key criteria that affect the wind farm layout. The location of the wind farm infrastructure avoids habitats and species of conservation interest where possible, and where this was not possible, mitigation and/or enhancement measures have been incorporated into the design to balance any detrimental impact.

6.62 Habitats were surveyed across the whole Preliminary Site Boundary, hereafter referred to as 'the site', while signs of mobile species were assessed outside the site to determine their point of origin. The study area was thus extended to take account of the potential for species to use the vicinity of the proposed development as part of wider territories or foraging areas. Watercourses within the site, and some tributaries outside the site, were surveyed for signs of otter. Specific study areas for each species are as follows;

- Bats (450m around proposed turbine locations);
- Otter & badger (planning application boundary +50m buffer);
- Red squirrel (coniferous plantation shelterbelts);
- Common lizard & smooth newt (site);
- Marsh fritillary/argent & sable (site);

6.63 Sites designated at international, national and local level for their conservation value within a potential impact zone were considered. The nearest designated sites to the study area were identified, to assess the potential for remote effects of the scheme on valued habitats and species outside the immediate area.

6.64 The Fauna section of the EIA considers information gathered from the following sources:

- Consultations, with statutory and non-statutory stakeholders
- Desk study, including review of published/unpublished sources/literature
- A walkover survey of the entire study area and any other areas likely to be affected
- Specialist surveys, as detailed in paragraph 6.66 below
- Assessment of the data acquired
- Consideration of ecological interests in the scheme design and identification of mitigation to be incorporated into the design
- Impact assessment
- Proposed additional mitigation measures to address any likely significant adverse impacts

6.65 The data collection methodology adopted involves both a desktop search and field survey. The relevant statutory and non-statutory bodies were contacted to obtain ecological data for the study area. CEDaR was approached for records of species of conservation concern in the study area. Detailed surveys were undertaken to establish the baseline conditions for the various habitats and for the species groups that are likely to occur around the proposed scheme. The purpose of an ecological survey is to identify 'valued ecological receptors', those species and habitats that are valued in some way for their ecological function, their contribution to biodiversity or are protected by specific legislation. The following specialist surveys were undertaken:

- Phase 1 & NVC Phase 2 Habitat survey
- Bat (*Chiroptera spp*) survey
- Otter (*Lutra lutra*) habitat assessment
- Badger (*Meles meles*) survey
- Red squirrel (*Sciurus vulgaris*) survey
- Common Lizard (*Zootoca vivipara*) survey
- Smooth Newt (*Lissotriton vulgaris*) habitat assessment
- Marsh Fritillary (*Euphydryas aurinia*) habitat survey
- Argent & Sable (*Rheumaptera hastata*) habitat survey

Habitat Survey Methodology

Phase 1 Habitat Survey

6.66 The Site was visited and habitats of the proposed development site were allocated to the JNCC Phase 1 Habitat (JNCC 2010) derived NIEA habitat classification. Notes were made of the main plant species, and other species that are indicative of the condition and management of the habitat.

6.67 Phase 1 Habitat survey methodology is intended for auditing of habitats and is generally accurate and of wide application. It is noted also that habitat types may frequently merge, grade from one to another, or form complex mosaics.

6.68 Frequently encountered habitat mosaics in Ireland include various mixtures of grassland/pasture types, heathlands and blanket bogs. Mosaics and transitional, modified and degraded habitats can be very difficult to assign to any one Phase 1 Habitat category yet may have very different sensitivities and implications for project planning and assessment.

6.69 The area covered by the Phase 1 Habitat survey is illustrated on **Figure 6.2**. Phase 1 Habitat methodology is not considered to be sufficiently sensitive (for heathlands or (species-rich) grassland) to describe and map them in sufficient detail for this study, and is not sufficiently informative to determine whether blanket bog is active or not. Thus, the Phase 1 Habitat survey results were used to scope and plan a Phase 2 National Vegetation Classification survey.

National Vegetation Classification (NVC) Survey

6.70 NVC survey methodology was commissioned in 1975 by the Nature Conservancy Council (NCC) to provide a comprehensive and systematic catalogue and description of the plant communities of Britain. NVC has now been accepted as a standard, not only by the statutory nature conservation and countryside organisations, but also by forestry, agriculture and water agencies, local authorities, non-governmental organisations, major industries and universities. The NVC is a system of classifying natural plant communities in Britain according to the species they contain and provides a standardised methodology for detailed environmental assessments. The methodology is repeatable and incorporates the use of quadrat sampling within which the types and relative abundance of plant species is recorded. From these results, plant community types can be classified.

6.71 The survey method employed at Magheramore was based on the NVC survey methodology described by Rodwell (Volumes 1 to 5, 1991 to 2000), which provides for the detailed classification and map-based survey of a wide range of plant communities found in Britain. At the time of the Rodwell reports, NVC did not extend to covering Ireland. Despite this, the vegetation communities described in Rodwell's reports are equally applicable to those present in Northern Ireland.

6.72 Plant species were identified and recorded using the keys and nomenclature of Stace (2010) for higher plants and Atherton et al. (2010) for bryophytes (mosses and liverworts).

6.73 The NVC survey was undertaken by a Dr Brian Sutton who is a qualified and experienced ecologist. The study area covered by NVC survey is shown in **Figure 6.2**, although areas of improved/semi-improved grasslands were not subject to a more detailed Phase 2 level survey. The Phase 2 concentrated on areas of residual semi-natural habitats e.g. degraded blanket bog or heathland.

6.74 NVC communities and sub-communities were recorded by taking detailed target notes (TN) of representative samples of vegetation communities. Quadrats were used for sampling. For low growing vegetation, a quadrat size of 4m^2 was used. No woodland or shrub communities were required to be sampled. Plant species abundances were made using percentage cover (as this allows the quadrat data to be more readily analysed using computer software such as MAVIS).

6.75 NVC plant communities and sub-communities were mapped on a 1:10,000 OS map. A hand-held GPS was used to record the location of target notes accurately. A digital camera was used to take representative photographs of each quadrat location for future reference. Analysis of the NVC community and sub-communities that were present were made using the relevant NVC Volumes (Rodwell 1991a to 2000). For the sake of clarity this report uses a combination of common and scientific species names, although the latter are only used by Rodwell (1991a to 2000). The most important references for this work are Rodwell 1991a and 1992).

6.76 NVC surveys (Phase 2 surveys) were carried out during the 2018 survey season, and the quadrat results were compiled to produce a combined JNCC Phase 1/NVC Phase 2 habitat map (**Figure 6.2**). Plant community details were recorded in line with the above methodology in 15 quadrats overall, chosen to represent the range of localised plant communities found and to describe vegetation conditions at important locations in close proximity to Development infrastructure. GPS locations of every quadrat were recorded and the results mapped using geo-referenced OSNI maps (**Figure 6.2**). All quadrat data is provided in **Appendix 6.2**.

6.77 Each NVC community was then assessed to determine its condition and signs of degradation or damage, such as the presence of sheep/cattle grazing, trampling and dunging, artificial drainage, past burning, peat cutting, mowing or any other biotic or abiotic factor likely to cause vegetation communities to be degraded compared to typical NVC communities provided in Rodwell (1991b and 1992).

6.78 NVC survey results were used to identify valuable vegetation communities and provided input into the assessment of active blanket peat within the study area. These were included in a constraints mapping exercise, along with other environmental constraints, to evolve the final layout design and layout of the wind farm. This process is described in **Chapter 3: Design Evolution & Alternatives**.

6.79 Site visits, including NVC survey, were carried out on the 04.09.18 and 07.09.18.

Blanket Bog Condition Assessments

6.80 Peatland habitats within the site were assessed to determine whether there were any areas of 'active' blanket bog present. The criteria used included the following:

- criteria provided in the NIEA Guidance note (2012);
- the presence and condition of NVC communities;
- the eco-hydrological conditions found in each part of the site, particularly the presence and condition of artificial drainage;
- past and present land management practices which have the potential to damage the habitat, including: peat cutting, burning, vegetation topping, sheep grazing, etc.

Mammal Surveys

Bat Surveys

Pre-Survey Visits

6.81 A site visit was undertaken to walk the Site during daylight hours in April 2018, to identify the potential value of habitats and landscape features (buildings, built structures, individual trees and watercourse etc.) potentially used by bats in accordance with Chapter 10 of the BCT Bat Surveys: Good Practice Guidelines (2012). Ordnance Survey mapping and aerial photographs were used to identify potential features prior to the site visit. There were no buildings within 450m of the proposed turbine locations.

6.82 A BRP survey was also completed (01/05/19) for the proposed road widening along the Banagher Road which is required in order to facilitate the delivery of turbines.

Manual Bat Activity Surveys

6.83 Bat surveys were undertaken in accordance with NIEA survey specification for wind farms as requested by NIEA in their EcIA scoping response. Manual bat activity surveys were undertaken (seasonally) during spring, summer and autumn 2018.

6.84 A total of three dusk surveys were completed (see **Figures 6.3 - 6.5**). The location of sample points was determined by suitable habitat features for bats, access, health and safety considerations and turbine locations. Ground conditions (in places) consisted of uneven ground conditions, post & wire stock fencing and drainage ditches, raised banks and deep gullies making some parts of the site difficult to traverse during nocturnal manual transects. Each pre-defined sample point (or listening stop) was surveyed for three minutes to record the level of bat activity near a specific feature within the Site. Bat activity that occurred between sample points was also recorded.

6.85 Bat activity surveys were undertaken when weather conditions were forecast to consist of temperatures >10°C with little or no wind or precipitation when bat activity is known to increase. Meteorological information including temperature, wind speed, cloud cover and precipitation were recorded for each survey session.

6.86 An EM Touch bat detector, or a Batlogger M were used to record bat echolocation calls for later sound analysis using sound analysis software (Kaleidoscope Pro, AnalookW (v4.1) or BatExplorer (v1.11)). For each bat observed, the location was automatically recorded using an (internal) Global Position System module (accurate to within ±3 m). The number of bats, bat species, bat behaviour and the direction of flight of each bat was also recorded where visibility permitted.

6.87 In order to assist analysis of data collected during manual bat activity surveys, bat echolocation calls were converted into a Bat Activity Index (BAI) providing an indicator of the overall bat activity at the site. It should be noted that a bat activity index does not represent the number of bats present at a site but an indication of their abundance and/or activity only. Bat activity levels can therefore be compared between sites, between different parts of a site or between seasons (Hayes et al 2009), to reveal differences in bat activity in areas or at different times. The bat activity index is calculated as the number of bat passes (or other measure of presence) per unit time (e.g. per hour).

Automated Bat Activity Surveys

6.88 Automated passive monitoring was also undertaken during spring (May), summer (July) and autumn (September) 2018 (see **Figure 6.6: Static detector locations**). Several (paired and calibrated) broadband ultrasonic bat detectors (SM2BAT+ and

Anabat Express) were placed to record for a minimum of five days at numerous locations across the site on a seasonal basis, including proposed turbine locations and adjacent habitat features (see **Appendix 6.3** (which contains photographs of each location along with a brief description)). Each static detector was programmed to automatically operate during set time periods to record bat activity between dusk and dawn each night.

6.89 Detectors were placed with the microphone directed at a 90^{o} angle towards the area to be monitored (e.g. the proposed turbine location or the adjacent habitat feature (i.e. fenceline, plantation edge or stream). Whenever possible microphones were placed on a fence post or pole. This helps to prevent recording extraneous noises and places the microphone closer to or within the flight path of the bats; this tends to provide higher quality recordings.

6.90 AnalookW and Kaleidoscope Pro UK was used to undertake analysis of data collected during automated passive monitoring. Bat activity was measured using the number of files containing a bat call or bat call sequence irrespective of length, for a complete night of recording. Passive monitoring enables determination of species composition and temporal activity patterns between different times of year and different times of night at a fixed-point location. Bat activity indices (for all survey types) are provided in the survey results, included in **Appendix 6.3**.

6.91 Photographs were taken during each deployment, to check for disturbance, and as a record of work undertaken. **Appendix 6.3** contains photographs of each location along with dates and a description of the area (i.e. habitat feature or proposed turbine location).

Otter Survey

6.92 An assessment of the potential for otter to be present on the site was undertaken. Any suitable waterbodies which were identified during both the Phase 1 and NVC Phase 2 habitat surveys of the Site were considered for their suitability as otter habitat.

Badger Survey

6.93 A badger survey was undertaken in accordance with the NIEA survey specification (NIEA 2017) to establish the presence of badger setts and/or foraging areas within the site and the surrounding area (within 25 m of the Preliminary Site Boundary). Preliminary badger surveys took place during 2018 over the wider area, prior commencing infrastructure design. The current surveys to inform the final layout were undertaken during December 2018, during which the study area (infrastructure +50m) was searched for the presence of badger setts and badger activity including paths, snuffle holes, latrines, badger hair and bedding material. The location of badger setts, sett entrances and the direction of sett tunnels was recorded and mapped where present.

6.94 In addition, a camera trap was also used along the proposed access lane for a 3-week period during spring 2019.

Red Squirrel Survey

6.95 A red squirrel survey was undertaken in accordance with the NIEA survey specification (NIEA 2017) to establish if there were any red squirrel dreys or activity with the coniferous plantation shelterbelts on site. Surveys took place across a 3-week period during March/April 2019 and included the use of camera traps and suitable attractants in addition to the normal NIEA methodology.

Herpetofauna

Common Lizard Survey

6.96 A common lizard survey was undertaken in accordance with the NIEA survey specification (17 Feb 2017) to establish the presence of common lizard on the site. An initial site visit was undertaken in May 2018 to identify suitable basking habitat and to design a walked transect. Surveys also included the use of artificial refugia, these consisted of 30 X (500 x 500 mm) rubber backed carpet tiles.

6.97 In addition to the NIEA methodology, consideration was also given to the Draft survey protocols for the British herpetofauna. The latter document references (Sewell et al. 2012) who demonstrated that four to five survey visits (depending on species) is usually sufficient to detect 95% of occupied sites, for the commoner British reptile species, providing a combination artificial refugia are used in addition to walked transect searches. The document also recommends that artificial refugia should be laid for a few weeks before surveys begin. The same study suggested that at least 30 refugia should be laid for presence/absence purposes, and that this number applied regardless of the size of site if the artificial refugia were appropriately positioned.

6.98 Transects were walked slowly scanning the ground 3-4 m in front for the presence of basking lizards in suitable habitat. Surveys were undertaken across four visits between April and September 2018. All surveys were undertaken when weather conditions were forecast to consist of temperatures >9°C (and <18°C) with sunshine and little or no wind or precipitation. Surveys were also undertaken early in the day, whenever possible on a day when the preceding night was cool, with little cloud cover. This is when lizards are in greater need of the thermal benefits of basking on artificial refugia and are therefore more easily observed.

Smooth Newt Survey

6.99 An assessment of the potential for smooth newt to be present on the site was undertaken. Any suitable waterbodies/drainage channels which were identified during both the Phase 1 and NVC Phase 2 habitat surveys of the Site were subject to a newt habitat suitability assessment. OSNI aerial photographs were also reviewed, as were bespoke images of the site which were taken from a height of 120m above the ground and which have 5cm resolution per pixel.

Lepidoptera

Marsh Fritillary Survey

6.100 A devil's-bit scabious *Succisa pratensis* survey was undertaken as part of both the JNCC Phase 1 & NVC Phase 2 habitat surveys (2018) in accordance NIEA recommendations to establish the presence/abundance within the site of devil's-bit scabious, which is the larval host plant of the marsh fritillary butterfly. Specific marsh fritillary butterfly habitat surveys were also undertaken.

Argent & Sable Survey

6.101 A bog myrtle *Myrica gale* survey was undertaken as part of the Phase 1 habitat survey (during 2018) in accordance NIEA recommendations (arising out of their consultation response) to establish the presence/abundance within the Site of bog myrtle, which is main food plant of the argent & sable moth.

6.102 The location of bog myrtle (and frequency) was assessed to establish the extent of suitable habitat for the moth. A survey report is unnecessary as patches of the food-plant for this species was not recorded during the NVC surveys. This species has therefore been removed from the assessment.

Ecological Impact Assessment

6.103 The assessment of the impact of a scheme on a species or habitat must consider the conservation value of the species or habitat. This assessment of the potential impact of the Development on the conservation interest of the construction area and associated access routes adopts the Guidelines for Ecological Impact Assessment in the UK (CIEEM 2018).

6.104 The objective of the EIA process, in relation to the natural environment, is to undertake sufficient assessment to identify and quantify any significant impacts on the natural environment likely to arise from turbine construction, operation and eventual decommissioning. Following identification of the final infrastructure layout, the baseline ecological (or biodiversity) conditions in the Site are described, based on information provided by consultees, background sources of information and the results of dedicated surveys carried out for the scheme.

6.105 As a means of achieving this objective, ecological constraints on development of the scheme at international, national, regional and local levels are identified and assessed. This includes the main ecological constraints that should be avoided or that could affect the design of the scheme or delay progress.

Sensitivity Criteria

6.106 Potential significant impacts are assessed according to the ecological value of a site, which is derived from the criteria outlined below. The sensitivity (importance) of a receiving habitat is defined by its position in a hierarchy of site importance and conservation value. This hierarchy extends, highest to lowest, from International, National, Regional, Local, to negligible importance. This range of values is expressed in the protection afforded a site by international and national legislation, and in planning policy at a more local level (**Table 6.1**).

6.107 The biodiversity value of a site, is measured by such factors as:

- animal or plant species, subspecies or varieties that are rare or uncommon, either internationally, nationally or more locally;
- endemic species or locally distinct sub-populations of a species;
- ecosystems and their component parts, which provide the habitats required by the above species, populations and/or assemblages;
- habitat diversity, connectivity and/or synergistic associations (e.g. networks of hedges and areas of species-poor pasture that might provide important feeding habitat for rare species);
- notably large populations of animals or concentrations of animals considered uncommon or threatened in a wider context;
- plant communities (and their associated animals) that are typical of valued natural/semi-natural vegetation types, including examples of naturally species-poor communities;
- species on the edge of their range, particularly where their distribution is changing because of global trends and climate change;
- species-rich assemblages of plants or animals; and
- typical faunal assemblages that are characteristic of homogenous habitats.

6.108 The secondary value of a site can be as part of a corridor or a series of stepping stones that facilitate the migration, dispersal and genetic exchange of wild species, or as a buffer zone that protects a valued site from adverse or beneficial environmental impacts.

Magnitude of Effect

6.109 This relates to the magnitude of the impacts on the features during the construction, operation and decommissioning phases. The magnitude of ecological impacts is assessed by considering the change in the ecology of a site that will arise because of the direct and indirect effects of a development on that ecology. Factors to be considered when considering the magnitude of an impact are outlined in **Table 6.2**. The criteria for determining the magnitude of impact are listed in **Table 6.3**. Both direct and indirect impacts, and the duration of these impacts are examined.

Significance Criteria

6.110 This relates to the significance of impacts on species and habitats of conservation importance, based on their presence as determined by survey. Factors to be considered when assessing the ecological significance of impacts are outlined in **Table 6.4**. Taking the factors in **Table 6.4** into account the significance of an impact may be broadly categorised according to **Table 6.5**.

Table 6.1: Criteria for assessing ecological sensitivity/importance at a geographic scale

Value/Importance	*Criteria*
Internationally important sites (very high conservation value)	World Heritage Sites identified under the Convention for the Protection of World Cultural & Natural Heritage, 1972. Biosphere Reserves identified under the UNESCO Man & Biosphere Programme. Wetlands of International Importance designated as Ramsar Sites under the terms of the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (the Ramsar Convention) formulated at Ramsar, Iran, in 1971. Special Protection Areas (SPAs) designated in accordance with the 1979 European Communities Directive on the Conservation of Wild Birds (79/409/EEC): The Birds Directive. This Directive requires member states to take measures to protect birds, particularly rare or endangered species as listed in Annex I of the Directive, and regularly occurring migratory birds. Special Areas of Conservation (SACs and cSACs) designated in accordance with the 1992 European Commission Habitats Directive 92/43/EEC (1992): The Habitats Directive. This Directive requires member states to establish a network of sites that will make a significant contribution to conserving habitat types and species identified in Annexes I and II. Other sites maintaining habitats and/or species listed under the Birds and/or Habitats Directives (see above). Sites hosting significant populations of species annexed under the Bonn Convention. Sites hosting significant populations annexed under the Bern Convention. Biogenetic Reserves (UNESCO Man and the Biosphere Programme).
Nationally important sites (high conservation value)	Areas of Special Scientific Interest are the principal national designation for sites of nature conservation interest. They are notified under Section 28 of the Environment (NI) Order 2002 and are chosen by virtue of any of their flora, fauna, geological, or physiographic features to represent the best national and regional example of natural habitat, physical landscape features or sites of importance for rare or protected species. National Nature Reserves (NNRs) and Marine Nature Reserves (MNRs) are designated under the Environment Order. Sites maintaining UK Red Data Book species that are listed as being either of unfavourable conservation status in Europe, of uncertain conservation status or of global conservation concern. Sites maintaining species listed in Schedules 1, 5 and 8 of The Wildlife (NI) Order 1985, as amended.
Regionally important sites (medium conservation value)	Sites that reach criteria for Local Nature Reserve but do not meet ASSI selection criteria. Sites of Local Importance for Nature Conservation (SLNCIs) are recognised by Planning Service and are intended to complement the network of nationally and regionally important sites. SLNCIs receive special consideration in relation to local planning issues. Sites supporting viable areas or populations of priority habitats/species identified in the UK Biodiversity Action Plan or smaller areas of such habitat that contribute to the maintenance of such habitat networks and /or species populations.

Value/Importance	*Criteria*
	Sites maintaining habitats or species identified in Regional Biodiversity Action Plans based on national rarity or local distribution. Other sites of significant biodiversity importance (e.g. sites relevant to Local Biodiversity Action Plans).
Local *(lower conservation value)*	Sites not in the above categories but with some biodiversity interest. Examples of lands of lower ecological value include; intensive agricultural lands and coniferous forestry.
Negligible conservation value	Sites with little or no local biodiversity interest.

Table 6.2: Factors to be considered when assessing magnitude of ecological impacts

Parameter	*Description*
Extent	*The area over which an impact occurs.*
Duration	*The period required for a feature to recover or be replaced following an impact. Duration of an activity may have a shorter duration than the impact of the activity.*
Reversibility	*A permanent impact is one from which recovery is unlikely within a reasonable timescale. A temporary impact is reversible either through natural recovery or because of mitigation.*
Timing and frequency	*In some cases, an impact may only occur if it occurs during a critical season or part of a species' life-cycle, and may be avoided by careful scheduling of work activities. Frequency of an activity may also affect the magnitude of its impact by reinforcement of the impact.*

Table 6.3: Criteria for assessing magnitude of ecological impact

Significance	*Description*
Severe adverse	*The development fails to satisfy the subject environmental objective and results in major fundamental deterioration of the environment at national and international levels of importance.* *Proposed development activities will result in a major alteration to the baseline ecological conditions, resulting in fundamental change and major environmental deterioration.* *Large adverse impacts are attributed to any significant adverse impact on habitat and species (or other valued ecological receptors) identified as being of International significance.* *Highly significant impact, warrants refusal of planning permission.*
Major adverse	*The proposal (either on its own or in-combination with other proposals) may adversely affect the site, in terms of coherence of its ecological structure and function, that enables it to sustain the habitat, complex of habitats and/or the population levels of species of interest.*
Moderate adverse	*The site's integrity will not be adversely affected, but the effect on the site is likely to be significant in terms of its ecological objectives. If it cannot be clearly illustrated that the proposal will not have an adverse effect on integrity, then the impact should be assessed as a major adverse.*
Minor adverse	*Neither of the above applies, but some minor adverse impact is evident. (In the case of Natura 2000 sites a further appropriate assessment may be necessary if detailed plans are not yet available).*
Negligible	*Very minor alteration to one or more characteristics, features or elements.*
Neutral	*No observable impact in either direction.*

Table 6.4: Factors to be considered when assessing ecological significance of impacts

Factor	*Defining criteria*
Site integrity	Extent to which site/ecosystem processes will be removed or changed. Effect on the nature, extent, structure and function of component habitats. Effect on the average population size and viability of component species, size and viability of component species.
Conservation status	Habitats: conservation status is determined by the sum of the influences acting on the habitat and its typical species that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species within a given geographical area. Species conservation status is determined by the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within a given geographical area. Conservation status may be evaluated for any defined study area at any defined level of ecological value. The extent of the area used in the assessment will relate to the geographical level at which the feature is considered important.
Probability of expected outcome	Known or likely trends and variations in population size/habitat extent. Likely level of ecological resilience.

Table 6.5: Significance of impacts

Significance	*Description*
Severe adverse	The proposal (either on its own or with other proposals) is likely to adversely affect the integrity of a European or nationally designated site, in terms of coherence of its ecological structure and function, across its whole area, that enables it to sustain the population levels of species of interest, or is likely to adversely affect the numbers, distribution or viability of a species or population of conservation concern. A major change in a site or feature of local importance may also enter this category.
Major adverse	The integrity of a European or nationally designated site will not be adversely affected, but the effect on the site is likely to be significant in terms of its ecological objectives. If, in the light of full information, it cannot be clearly illustrated that the proposal will not have an adverse effect on integrity, then the impact should be assessed as very large adverse.
Moderate adverse	The proposal may adversely affect the integrity of a locally important conservation site, or may have some adverse effect on the numbers, distribution or viability of a species or population of conservation concern.
Minor adverse	None of the above applies, but some minor negative impact is evident. (In the case of Natura 2000 sites a further appropriate assessment may be necessary if detailed plans are not yet available).
Neutral	No observable impact in either direction.
Minor beneficial	The development partly satisfies the subject environmental objective and partly contributes to the environmental context. Proposed development activities will result in minor improvements to baseline ecological conditions and should result in minor environmental gains. Slight beneficial impacts can be attributed to benefits to any valued ecological receptors. Environmental gains which can easily be achieved through standard practices.
Moderate beneficial	The development satisfies the subject environmental objective and contributes to the environmental context. Proposed development activities will result in recognisable improvements to baseline ecological conditions and will result in notable environmental gains. Moderate beneficial impacts can be attributed to benefits to any valued ecological receptors where improvements are expected to be significant. Environmental gains which require detailed design consideration – potentially employed to offset slight/moderate adverse impacts elsewhere.

Significance	*Description*
Major beneficial	The development satisfies the subject environmental objective and results in a major contribution to the environmental context. Proposed development activities will result in quantifiable improvements to baseline ecological conditions and will result in significant environmental gains. Large beneficial impacts are only attributed to substantial benefits to valued ecological receptors identified as being of National or International importance and where such benefits will result in the consolidation and/or expansion of areas of habitats or ensure the security and/or expansion of viable populations of species. Environmental gains which require very detailed design consideration – potentially employed to eliminate and offset potential significant adverse impacts elsewhere.

6.111 Cumulative impacts may also arise. Other projects that have been included in the cumulative impact assessment are:

- Wind farm projects which have received planning consent; and
- Other development projects with valid planning permissions, and for which formal EIA is a requirement or for which non-statutory EIA has been undertaken. Other projects should be included as appropriate, subject to consultation with DOE Planning and other statutory bodies. The cumulative impacts of different projects are assessed against the significance criteria outlined in **Table 6.6**.

Table 6.6: Criteria for assessing the significance of cumulative effects

Significance	*Effects*
Severe	*Effects that the decision-maker must consider as the receptor/resource is irretrievably compromised.*
Major	*Effects that may become key decision-making issue.*
Moderate	*Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performance.*
Minor	*Effects that are locally significant.*
Not Significant	*Effects that are beyond the current forecasting ability or are within the ability of the resource to absorb such change.*

Baseline Conditions

6.112 The site is situated approximately 4km south of Dungiven, Co. Derry, located on the western fringes of Teeavan Hill. The site itself is within the Sperrins Area of Outstanding Natural Beauty (AONB) and the Development, consisting of 6 turbines and associated infrastructure, is hydrologically linked to the River Roe & Tributaries SAC, a statutory designated site of international importance. This SAC, encompasses 87km of watercourses and supports internationally important populations of Atlantic Salmon *Salmo salar*. The number of returning Salmon that enter the River Roe & Tributaries make it one of the most important Salmon rivers in the British Isles. Otters are also a designation feature of the SAC. The River Roe and Tributaries SAC is located approximately 500m to the west and south of the Planning Application Boundary. Most of the field drains which are present on the site ultimately flow through the development site (there is thus a and is hydrological link from the site to the SAC) and enter the River Roe.

6.113 The site topography falls in a westerly direction from Teeavan Hill which lies along the eastern boundary. Elevations fall from approximately 325m AOD in the east of the site to 150m AOD towards the western perimeter along the boundary with the Magheramore road.

6.114 The principal habitat types found on the site are extensive areas of improved & semi-improved grassland, marshy grassland, degraded blanket bog & heath and coniferous plantation forestry shelterbelts. Overall, the habitat of greatest conservation value, the blanket bog, has been avoided. There is also an extensive network of existing site tracks which traverse the area under study.

6.115 The site also abuts to areas of native woodland and plantation forestry and the south boundary lies above the deeply incised valley of the Altnaheglish River which flows through Banagher Glen. There are no watercourses within the site other that a few drainage channels, although a number may have been minor streams that have been channelized over time.

6.116 It is reasonable to assume that in the past, a far greater part of the site was covered by peatland and associated ericoid and moss-dominated communities, but peat cutting, drainage and land reclamation for sheep grazing has resulted in the modified (grassland) habitats which are present today. Most land parcels on the site have been drained, to lower the water-table, and take water off-site as rapidly as possible, to improve the conditions for livestock grazing.

Consultation & Desk Study Results

6.117 A copy of relevant consultee responses is provided in **Appendix 1.2**. The results of the desk study detail designated nature conservation sites and/or ecological records of protected species or species of natural heritage importance within 2km of the Planning Application Boundary.

Plants of additional conservation interest

6.118 Although neither devil's-bit scabious (*Succisa pratensis*) or bog myrtle (*Myrica gale*) are designated species of conservation concern or rarity, they are larvae host plants (LHP) for these two species of invertebrate, both of which are afforded a high priority designation. Devil's-bit scabious is the food plant for the larvae of the EU Annex II protected marsh fritillary (*Euphydryas aurinia*) and is locally scattered in residual areas of blanket bog, heath and marshy grassland mostly outside the Planning Application Boundary.

6.119 Stands of bog myrtle Myrica gale (food plant for the larvae of the argent and sable moth (*Rheumaptera hastate*), a UK priority species) occur extensively on parts of the site. However, these areas (primarily Field 27) are located adjacent to the proposed access track, and will not be impacted upon by the Development.

General site descriptions

6.120 The site has an irregular shape, with the Site Boundary following the boundaries of fields and land holdings. It has longest dimensions of around 2.8km from north to south and 2.2km from west to east, and covers an area of approximately 197ha. Access to the site is along existing farm tracks.

6.121 Much of the site, particularly around its margins, consists of agricultural fields that support species-poor improved and semi-improved grassland, with variable cover of rushes in the wetter fields. Some fields are separated by mature coniferous shelter belts, and a more extensive area of coniferous plantation is present along one field boundary. Fields on lower ground are often separated by hedgerows or discontinuous shrubs, and occasionally mature trees. Hedgerows are invariably species-poor and support species-poor basal vegetation communities.

6.122 The higher ground formerly supported extensive blanket bog and heath communities, as is evidenced by the presence of the degraded and heath habitats that are present in some of the more extensive field units. The peat substrate has been almost universally cut over and has since become fully vegetated. Many fields retain thin peat that now supports marshy grassland and which may be dominated by rush *Juncus* species or purple moor-grass *Molinia caerulea*, or may support patchy acid grassland.

6.123 Grassland habitats have low species diversity and are generally of low botanical interest. Minor streams or active drains are present in parts of the site; their banks generally support vegetation that is similar to that of the adjacent fields, or may be marked by increased rush growth. In the following account TN denotes a target note, the locations of which are to be found in **Appendix 6.2**. The appendix also contains site photographs, quadrat data and a list of plant species found during the survey. Site photographs are also referenced in the relevant Target Notes.

JNCC Phase 1 & NVC Phase 2 Habitat Surveys

6.124 A JNCC (2010) Phase I habitat survey was carried out on 04.09.18 and 07.09.18 to identify the vegetation communities present within the red line boundary of the site. A Phase II study (in the form of 15 quadrats) was carried out in order to provide more detailed descriptions of the various vegetation communities that had the potential to be impacted in the vicinity of the identified potential turbine locations (see **Appendix 6.2**).

6.125 Survey methodologies and habitat classifications followed the JNCC Phase 1 guidelines (2010), the keys and descriptions in the National Vegetation Classification User's Handbook (Rodwell, 2006).

6.126 Six different NVC communities were recorded within the site, in addition to fields of semi-improved grassland. These are listed below:

- M19 *Calluna – E. vaginatum* blanket mire
- M25 *Molinia caerulea – Potentilla erecta* mire
- H12 *Calluna vulgaris – Vaccinium myrtillus* heath

- H21 *Calluna vulgaris – Vaccinium myrtillus – Sphagnum capillifolium* heath

6.127 In some areas no clear NVC type could be ascribed. For example, much of the marshy grassland on site had characteristics of both M23 *Juncus effusus/J. acutiflorus-Galium palustre* rush pasture and M10 *Holcus lanatus-J. effusus* rush pasture.

6.128 Irish Grid References were recorded for all quadrats sampled and boundaries of vegetation communities were confirmed using drone aerial imagery. The results of the habitat survey were compiled to form the habitat map of the site (**Figure 6.2**) and all quadrat data is provided in **Appendix 6.2**.

6.129 Each of the habitats present is described in more detail below.

A1 Plantation woodland

6.130 Dense shelter belts of mainly *Picea sitchensis* have been planted along the boundaries of a number of improved grassland fields. A broader conifer plantation along the southern boundary of Field 20 consists mainly of *Pinus sylvestris*.

A2 Scrub

6.131 Patchy *Ulex europaeus* scrub (Field 48) occurs around the margins of a few fields, or along the banks that mark the location of former field margins (Field 45).

B1 Acid grassland

6.132 Acid grassland is a minor component of habitat mosaics in predominantly bog, heath and marshy grassland habitats (TN10, 37). No species-rich variants of acid grassland have been found and restricted areas of acid grassland are not mapped separately because of the scale of survey required at this stage of the site development.

B4 Improved grassland

6.133 Improved grassland is present on the lower ground along the southern end of the site (Fields 1-7, TN1-TN7, Field 16, TN16), in the central part of the site (Fields 25, 26, TN26, 27) and towards the northern end of the site (Field 30, TN31; Fields 32-33, TN33, 34: Fields 35-43, TN36, 37). Fields 23 and 24 (TN24, TN25) still retain large areas of modified bog and heath, but broad margins of the fields have been improved. A number of fields have been improved, but rush-dominated marshy grassland persists in their wetter parts (Field 11, TN13; Field 18, TN18: Field 20, TN21). These improved grassland habitats are generally dominated by *Lolium perenne* and support a limited grange of common forbs typical of agricultural grassland

B5 Marshy grassland

6.134 Significant areas of the site support marshy grassland, which may be characterised by dominant Molinia on shallow peat, or rush-dominated communities on wetter ground. The most extensive area of Molinia-dominated marshy grassland is present in adjacent Fields 8, 9, 10 and 47 (TN8-12, TN43). This area is likely to have formerly supported heath or blanket bog habitats and there is some evidence of past peat cutting. Other graminids are generally scarce, although more open areas in Field 9 support a limited range of common grasses. Forbs are limited to a small number of common acidophiles, principally *Galium saxatile* and *Potentilla erecta*, with occasional *Viola palustris* and *Epilobium palustre* in wetter locations. Common mosses are frequent, but Sphagnum species are almost exclusively limited to the beds and sides of the drainage network across the fields.

6.135 Marshy grassland characterised by significant *Juncus* cover may occur on wet substrates (Fields 28, TN29; Field 29, Field TN30; Field 48 TN44), where the dominant species is *J. acutiflorus*, or as components in the wetter parts of fields that been improved to varying degrees (e.g. Field 18, TN18; Field 21, TN20; Field 44, TN38), with *J. effusus* the dominant species. Rush -dominated grassland is species-poor, with few forbs and a limited range of common mosses.

B6 Poor semi-improved grassland

6.136 Semi-improved grassland fields are present on the lower ground towards the southern end of the site (Fields 12-15, TN14, 15). Fields 44 and 45 (TN38, TN40) towards the northern end of the site support marshy grassland that grades into species-poor semi-improved grassland, often retaining a rushy component.

C3.1 Tall ruderal

6.137 A stand of *Urtica dioica* adjacent to the access track at the southern end of the site is the only significant area of tall ruderals. Elsewhere isolated stands, mainly of *U. dioica*, are occasionally present in grassland fields but are too restricted to be mapped.

D1/D2 Dry/wet dwarf shrub heath mosaic

6.138 Field 27 (TN28) is a more extensive area of modified mire, with both wet (Q10) and dry (Q11) heath variants present. Of note is an extensive area of Myrica gale-dominated dry heath towards the northern end of the field (Q13).

D2 Wet dwarf shrub heath

6.139 Fields 23 and 24 (TN24, 25) retain a central core of mire habitats, although there has been extensive agricultural improvement around their margins. Wet heath on shallower peat is present towards the southern end of Field 23 (Quadrat Q7) and is likely to occur elsewhere within this area in mosaic with modified bog habitats. Field 29 (TN30) supports patchy wet heath (Q12) in mosaic with scrub and marshy grassland communities.

E1.7 Wet modified bog / E1.8 Dry modified bog

6.140 Field 19 (TN19) supports modified bog vegetation on a generally dry surface (Q2), but extensive areas are dominated by *Molinia caerulea* (Q3). Sphagna are generally absent, but may be locally frequent in damper hollows (Q4). Contiguous parts of Fields 23 (TN24) and 24 (TN25) retain an extensive area of mainly dry bog (Q5, 6) that has been modified by past cutting. Vegetation is often dominated by *Eriophorum vaginatum*, but patches of, particularly, Field 23, have high Sphagnum cover in the wetter parts.

G2 Running water

6.141 Minor streams pass through the site, flowing both towards the north (Field 27) and towards the south (Field 23), but do not support significant vegetation communities. A stream/drain flowing through Field 26 was also of limited interest, supporting *Juncus effusus* and a restricted range of common wetland herbs (TN27).

J1.1 Arable

6.142 Field 31 (TN32) had been re-seeded recently, prior to survey.

J2.1 Intact hedge

6.143 Improved grassland fields towards the northern end of the site generally have intact hedge boundaries. Many of these have been planted in recent years and are dominated by *Crataegus monogyna*, Fields towards the southern end of the site also frequently have intact hedge boundaries, particularly along access routes.

J2.2 Defunct hedge

6.144 Many of the fields towards the southern end of the site retain vestiges of former hedge boundaries as isolated trees, shrubs and patchy *Ulex europaeus* scrub. No species-rich hedgerows were noted.

J2.3 Hedgerow with trees.

6.145 Occasionally, hedgerows support isolated trees or groups of trees. Trees are generally young or young mature, but there are occasional *Fraxinus excelsior* at the northern end of Fields 31 and 32.

Designated Nature Conservation Sites

Internationally Designated Nature Conservation Sites

6.146 The River Roe and Tributaries SAC is located approximately 500m to the west and south of the Planning Application Boundary. Most of the field drains which are present on the site ultimately flow through the development site and enter the River Roe. The boundary of the SAC in relation to the proposed wind farm is illustrated in **Figure 6.1**.

6.147 The primary reason for designation is the presence of the Annex II species Atlantic salmon *Salmo salar*. Other qualifying features present include the Annex I listed habitats 'Old sessile oak woodland with *Ilex* and *Blechnum* in the British Isles' and

'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' and the Annex II species otter *Lutra lutra*. Other Annex II species present include sea lamprey *Petromyzon marinus* and river lamprey *Lampetra fluviatilis*. **Appendix 6.1** describes the qualifying features for the designation of the Natura 2000 site.

6.148 Banagher Glen (which is contiguous with the River Roe & Tributaries SAC) has been designated as a Special Area of Conservation (SAC) because it contains habitat types and/or species which are rare or threatened within a European context. The ASSI citation describes the special interests for which the site was notified in the Northern Ireland context. The interests for which the site was selected as ASSI may differ from the interests selected in a European context.

6.149 The habitats and/or species for which this area has been designated as a SAC are

European priority interest(s):

- *Tilio-Acerion* forests of slopes, screes and ravines

for which the area is considered to support a significant presence.

6.150 These are mixed woodland on base-rich soils associated with rocky slopes in moist shady conditions associated with ravines. Ash *Fraxinus excelsior* tends to dominate but wych elm *Ulmus glabra* and lime *Tilia* species are also usually present. These woodlands are rich in plant species and often have a lush ground flora in which ferns, particularly hart's-tongue *Phyllitis scolopendrium*, are common.

European interest(s):

- Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles

for which this is considered to be one of the best areas in the United Kingdom.

6.151 These western oak woods in the UK include a range of woodland types. They typically have rich assemblages of Atlantic mosses and liverworts, distinctive birds, lichen communities, and ferns such as hard fern *Blechnum spicant*, lemon-scented fern *Oreopteris limbosperma* and various species of male- and buckler-fern *Dryopteris species*. Holly *Ilex aquifolium* is common in the understorey.

Nationally & Locally Designated Nature Conservation Sites

6.152 The River Roe & Tributaries and Banagher Glen are both also designated as ASSI's. While Banagher Glen is also a Nature Reserve. The latter holds some of the last fragments of what were once extensive woods covering much of the north-west. The steep sides of the glens are clothed by mature trees, mostly oak and ash, with an understory of rowan, hazel, hawthorn and holly. Ferns and mosses thrive in damp shady nooks along the river banks.

Biodiversity Action Plan (BAP)

Habitat Action Plan habitats

6.153 NIEA requires reference to be made to any potential impacts of the scheme on habitats that are the subject of Northern Ireland Habitat Action Plans (HAPs). There are significant areas of degraded blanket bog habitat within the site, but these are mostly outside the planning application boundary and thus are only minimally impacted upon.

Blanket bog

6.154 Although modified bog habitats are present in Fields 19, 23 and 24, they are generally in poor condition, reflecting management, including extensive peat cutting. Bog habitats in Field 19 are in particularly bad condition, with poor structure, desiccation of the bog surface and low cover values for Sphagnum species and ericoid shrubs. The areas of degraded bog present on the site are at the lower altitudinal limit of, but are contiguous with, the extensive blanket bog of the northern slopes of the Sperrins. The close association of the surveyed lands with agricultural grasslands and the dense pattern of drains across the degraded bog indicates that the bog hydrology in these areas has been comprehensively disrupted, and further desiccation of the bog surface is likely. Blanket bog habitats on the site are generally variants of NVC communities, often impoverished, reflecting their historical and current agricultural management.

Lowland heathland

6.155 The wet and dry dwarf shrub heath that occurs in Fields 23, 24, 27 and 29 conform to the lowland heathland priority habitat. Dwarf shrub cover in these areas generally exceeds the 25% that is the minimum required by the priority habitat definition and peat depths recorded at quadrat locations are <0.5m. As is frequently the case, heathland habitats are generally in a mosaic with other mire types, acid grassland and marshy grassland with much Molinia. As with surviving blanket bog communities, heathland habitats are often variants of NVC communities.

Hedgerows

6.156 All hedgerows are included within the NI priority habitat. However, the conservation value of hedgerows varies considerably, with long-established and species-rich types being of greatest interest. Neither of these types was found in the survey area, and most hedgerows were dominated by continuous *Crataegus monogyna*.

Lowland dry acid grassland.

6.157 Acid grassland is a minor component of the various habitat mosaics across the site, and no species-rich (>20 or so plant species) variants were found. None of the grassland found on the site can be assigned to the priority habitat.

Purple moor-grass and rush pastures

6.158 *Molinia* is a frequent constituent of bog, heath and marshy grassland communities, and *Juncus* species are important in defining the extent of much of the marshy grassland on the site. However, there are no species-rich variants of these communities, and no examples of the priority habitat were found on the site.

Rivers

6.159 Minor streams that drain parts of the site may be examples of the priority habitat, since they are likely to be within 2.5km of their source, and are therefore within the defining criterion for headwater streams. However, they have been modified to a considerable extent as a result of straightening to facilitate peat exploitation and the development of adjacent agricultural grassland. The short stretches visible on the site do not have a markedly natural aspect and do not support significant vegetation communities.

Species Action Plan species

6.160 Several non-avian species for which NIEA has published Species Action Plans (SAPs) occur or may occur in the study area. SAP species that are known to occur or may occur at the site include; Irish hare, all bat species (the subject of an all-Ireland SAP) and otter. Occurrence of and significance of impact on these species are discussed below.

Existing Ecological Records (NIPS)

6.161 The desk study revealed historical records of 159 species which are listed as Northern Ireland Priority Species (NIPS), BAP or Red/Amber-listed or species of conservation concern (as defined by CEDaR). However, none of these records could reliably be said to have been recorded on the Site. This is due to the close proximity of Banagher Glen ASSI/Nature Reserve from where virtually all the obtained records were attributed.

Bats

6.162 Records were obtained from the Northern Ireland Bat Group (NIBG). A total of 27 records within 10km of the Site were provided by the NIBG. As is typical for such records they are dominated by *pipistrellus* species and are clustered in proximity to human habitation (i.e. within and surrounding the town of Dungiven). Only one of the records were of Leisler's bats *Nyctalus leisleri,* and that was for roost containing five bats. There were also no records for *Nathusius pipistrelle*, although there were 12 records for 'bats' or 'unidentified'. In addition, 7 of the records for of Daubenton's bat, a species which specialises in lakes and waterways.

Mammals

6.163 The desktop study revealed records for NIPS of mammal (hedgehog *Erinaceus europaeus*, badger *Meles meles,* red squirrel *Sciurus vulgaris,* Irish stoat *Mustela erminea hibernicus* and pygmy shrew *Sorex minutus*), all were located in Banagher Glen Nature Reserve/ASSI.

Herpetofauna

6.164 The desk study revealed no historical records of smooth newt *Lissotriton vulgaris* or common lizard *Lacerta vivipara* from within the site or within 2km.

Lepidoptera

6.165 There are no records of marsh fritillary butterfly on the site or within 2 km. Colonies formerly existed in the coastal sand dunes of Magilligan and Ballycarry but these became extinct over 20 years ago and there are still no confirmed colonies in the County.

6.166 There are no records of argent and sable from County Derry since 1875 (CEDaR) and despite searches in parts of the county by volunteers the nearest known site is in West Tyrone (Killeter area).

6.167 Consultation with CEDaR revealed a historical record for both wall *Lasiommata megera* and wood white *Leptidea reali* from Altnaheglish Glen/Banagher Glen Nature Reserve.

Species Baseline

Bats

Pre-survey assessment

6.168 A site visit was undertaken during April 2018 to consider the potential value of habitats and landscape features within 200m of the site (i.e. the study area). The value of each habitat and landscape feature was recorded as ‘low’, ‘medium’ or ‘high’ according to its quality and its potential use by bats for roosting, foraging or commuting in accordance with BCT (2012) guidelines.

6.169 The landscape surrounding the site consists of several features that have potential to provide habitat for bats, notably improved grassland and open moorland of ‘low’ value; coniferous plantation shelterbelts; and occasional hedgerows ‘medium’ value for foraging and commuting.

6.170 The overall foraging potential of the study area is considered ‘low’ in accordance with BCT (2012) as it comprises mostly improved/semi-improved grassland, marshy grassland and degraded blanket bog/heath. However, the site is also connected to the wider landscape by (medium value) linear features that could be used by commuting bats (hedgerows). Habitats and landscape features that may be used by bats are illustrated in **Figure 6.2**.

6.171 The overall potential of the site was of 'low' value taking into consideration the landscape of the general area, the habitats and landscape features identified on the site, the distance to the six turbines and the potential use of the site by bats for roosting, foraging and/or commuting. Therefore, the survey effort which was conducted was for a 'low' value site.

Bat roost potential (BRP) survey

6.172 A number of mature ash *Fraxinus excelsior* and sycamore *Acer pseudoplatanus* are present along either side of the proposed access road. These were subject to a BRP survey on the 13th November 2018. They were all assessed to be low due the absence of significant cracks or loss bark. Any holes that were noted were of insufficient depth to give shelter to a roosting bat. Therefore, no emergence/re-entry surveys were required[1] (as per Table 7.1, BCT 2016).

6.173 A number of trees assessed as 'medium' or 'high' BRP are located further upslope from the initial cluster of mature trees. However, the proposed access track diverts into the adjacent improved grassland field before reaching these trees. Therefore, they are located outside the zone of impact, and emergence/re-entry surveys were deemed to be necessary.

6.174 A single mature beech *Fagus sylvatica* along the route of the proposed road widening along the Banagher Road was also assessed. The BRP of the tree was 'lowl due to the absence of any visible cracks or crevices that could be used by bats. However, as there was a dense covering of ivy *Hedera helix,* all parts of the tree could not be satisfactorily checked.

6.175 As a result of this assessment a review of the evidence for bat use of ivy was undertaken using the Bat Tree Habitat Key (3rd Ed. 2016)[2]. This document reveals that despite numerous radio-tracking studies of bats, no one has reported ivy as a favoured roost feature. There have been numerous other studies of barbastelles as well as Bechstein's bat, Brandt's bat, Daubenton's bat, whiskered bat, Natterer's bat, Leisler's bat, noctule, common pipistrelle, soprano pipistrelle, brown long-eared bat, (not to mention all the bat-group co-ordinated projects), and none of them have recorded bats roosting in ivy. Andrews (2016) concludes that ivy usage must be limited to individuals and low numbers of bats.

Table 6.7: The bat species known from BTHK to make use of ivy as roost sites.

Bat Species	*Roost Status*
Bechsteins *Myotis bechsteinii*	*One study recorded roosts in rot holes, woodpecker holes and in a gap behind thick ivy (Palmer, 2013)*
Barbastelle *Barbastella barbastellus*	*Transitory (Billington 2004, Natural England 2012, BTHK database) & Hibernation (Billington 2004, Natural England 2012)*

[1] No further surveys are required for trees that are assessed to have low roost suitability.

[2] Andrews H *et al.* 2016. *Bat Tree Habitat Key (3rd Edition)*. AEcol, Bridgwater

Common pipistrelle Pipistrellus pipistrellus	*Transitory (BSG Ecology website)*

6.176 Therefore, in a local (Northern Irish) context only common pipistrelle have been recorded using ivy as a roost site, and then only on a transitory basis.

6.177 In addition, surveying trees for bat roosts can be more challenging than surveying buildings because many species that use trees for roosts are known to exhibit roost switching behaviour, including: Daubenton's bat, Natterer's bat, Leisler's bat, common pipistrelle and brown long-eared bat (Harris and Yalden, 2008, Dietz et al., 2011). Some UK examples are as follows: Smith and Racey (2008) observed roost switching in Natterer's bat on average every 3 days; and Waters et al. (1999) observed roost switching in Leisler's bat between every 2 and 10 days.

Plates 1 & 2 - Showing the base & view into the canopy of the beech tree located along the proposed widening off the Banagher Road.

6.178 Additional difficulties inherent in finding tree-roosting bats are as follows: droppings do not persist in trees in the same way as they do in buildings; some tree-roosting bats echolocate very quietly (and sometimes not at all) and are therefore difficult to detect using bat detectors; some tree-roosting bats emerge from their roosts very late and return very early; and emergence surveys are often constrained due to the height of tree roosts above ground level and restricted observation due to foliage or lack of light under the canopy.

6.179 The chances of discovering a roost, even if one is present, are relatively low. However, some of our rarest species are heavily reliant on tree roosts. Due to these limitations and from what is known about the ecology of tree-roosting bats, it is arguable that all trees with bat roosting potential should be considered part of a resource that will be used at one time or another by tree roosting bats in order to determine the extent of impacts. Survey work on individual trees may confirm presence but is unlikely to conclusively confirm absence.

6.180 Therefore, precautionary measures during felling have been recommended.

Manual bat activity surveys

6.181 The bat activity surveys aimed to determine the level of bat activity within the Site. The results provide information on species composition and qualitative information on temporal and spatial bat activity patterns, such as the location of key foraging areas and commuting routes. The full results of bat activity surveys can be found in **Appendix 6.3 - Bat Annex**, while the (4.5km) transect route and associated listening stops are illustrated on **Figures 6.3 - 6.5**.

Table 6.8: Dates, times and weather conditions bat activity surveys (transects)

Date	*Sunset*	*Start / Finish*	*Weather Conditions*		
			Temp	*Wind (mph)*	*Cloud*
29th May 2018	*2150*	*2135 - 2335*	*12°C*	*2-3*	*20%*
9th August 2018	*2113*	*2058 – 2328*	*14°C*	*1-2*	*50%*
6th Sep 2018	*2000*	*1945 – 2215*	*11°C*	*0-1*	*40%*

6.182 A total of 7.5 hours of recording time was saved across the three manual bat activity surveys. During this time, an estimated number of 10 bat passes were recorded across the survey season. A total of three dusk surveys were completed. See **Appendix 6.3 - Bat Annex** for details regarding the estimated number of bats encountered during the manual transect surveys.

6.183 Temporal patterns of bat activity most likely reflect changing weather conditions across the survey season. Bat activity was low during all transect surveys. All surveys were completed during settled periods of weather, which would yield more representative results.

6.184 The results of bat activity surveys confirmed commuting (primarily at dusk) and foraging activity within the site. The results yielded low numbers of bats which would corroborate the initial assessment of Magheramore as a 'low' value site for bats under Chapter 10 of the (2012) BCT guidelines.

6.185 The bat species recorded during activity surveys included Leisler's bat, common pipistrelle, soprano pipistrelle and a single Nathusius pipistrelle. A summary of the bat activity survey results can be found in paragraphs 6.178 to 6.181 below. A visual representation of the spatial variation in bat activity for each survey can be found on **Figures 6.3 - 6.5** (seasonal) Bat Transect Results.

6.186 The spring transect yielded only four bat passes for two species. All three bat passes attributed to *P. pygmaeus* were recorded to the south of T1 over the area of degraded blanket bog. The *P. nathusii* call was recorded in the same area (and at much the same time).

6.187 The summer transect also yielded low numbers, this time with three bat passes recorded. The transect was walked in a clockwise direction (alternating from the spring direction as per BCT guidance). The three bats (all *Nyctalus leisleri*) were recorded at the start/end of the transect close to T4.

6.188 The autumn transect also only yielded three bat passes; two *Pipistrellus pipistrellus and 1 P. pygmaeus.* All passes were in close proximity to a track and were widely scattered across the site.

6.189 The results from the manual activity surveys were; 1.33 bat passes per hour (when translated into a Bat Activity Index (BAI) (for all species combined).

Automated passive monitoring

6.190 Automated passive monitoring was undertaken at the site across spring, summer and autumn during 2018. Monitoring took place at all six turbine locations and a range of 'paired' habitat features (see **Figure 6.6**).

Table 6.9: Automated Monitoring carried out during (spring, summer & autumn) 2018

Location	*Spring*	*Summer*	*Autumn*
T1	*22nd – 27th May*	*07th – 12th June*	*05th – 10th October*
T2 & Feature	*28th May – 02nd June*	*02nd – 7th June*	*05th – 10th October*
T3 & Feature	*28th May – 02nd June*	*04th – 09th July*	*05th – 10th October*
T4		*07th – 12th June*	*05th – 10th October*
T4 Feature	*22nd – 27th May*	*07th – 12th June*	
T5 & Feature	*22nd – 27th May*	*07th – 12th June*	*05th – 10th October*
T6	*28th May – 02nd June*	*07th – 12th June*	*05th – 10th October*

6.191 Across the three seasons (spring, summer & autumn), automated monitoring was carried out for 30 nights (estimated total hours = 1300 hours (based on an average of eight hours recording per night (although night length varies across the survey season)). Bat species recorded during automated passive monitoring included;

common pipistrelle, soprano pipistrelle, pipistrelle spp., Nathusius pipistrelle, Leisler's bat, Myotis species. (*Myotis daubentonii*, *M. nattereri* and *M. mystacinus*) bat are the most difficult species to identify and are therefore collectively referred to as *Myotis* bats (Russ 1999[3] & Russ 2012[4])), as well as a few records for brown long-eared bat.

6.192 **Appendix 6.3** contains Bat Activity Indices (BAI) for the static surveys, broken down by location (see **Figure 6.6**). These indices are based on the total number of ZC files of each species, divided by the total number of survey hours for that location. Most bat activity was recorded along the edge of coniferous forestry plantations or along drains/watercourses, which is unsurprising given the lack of other linear features (i.e. hedgerows) on the site.

6.193 Overall only 1083 bat passes were recorded at the turbine locations across the entire 2018 survey season. The most commonly recorded bat was *N. leisleri,* with 716 bat passes (66%) of all activity at turbine locations (recorded during the automated monitoring sessions). There was 234 bat passes of *P. pipistrellus,* which accounted for 22%; and *P. pygmaeus* accounted for 90 (8%) of bat passes; taken together the pipistrelle species assemblage accounted for 30% of all activity. The other species recorded at the turbine locations were *P. Nathusius, Myotis spp.,* and *Plecotus auritus* with 43 passes for this group combined (4%).

6.194 The BAI (Bat Activity Index) per season at all turbines combined was; 2.8 (bats per hour) during spring, 1.77 during summer and 0.4 during autumn. These figures are considered to be low (1-5) during spring/summer and negligible (<1) during autumn (a detailed breakdown is presented in **Appendix 6.4**).

6.195 However, while bat activity at turbines 1-5 during spring were low; moderate levels of activity were recorded at T1 (during two nights in May). And again, while overall activity levels during summer and autumn were also low (at the proposed turbine locations) (for all species (and at all turbines), there was a single night (at T3) during July (when 51 bat passes were recorded).

6.196 Overall there were 2586 bat passes were recorded at the adjacent habitat features. Again, the most commonly recorded bat was *N. leisleri,* with 1356 bat passes (52%). There was 1043 bat passes of *P. pipistrellus,* which accounted for 40%; and *P. pygmaeus* accounted for 145 (6%) of bat passes; taken together the pipistrelle species assemblage accounted for 46% of all activity. Other species recorded at the habitat features were *P. auritus. Myotis spp.,* and *P. nathusii* (42 passes combined (2%)).

6.197 The BAI (Bat Activity Index) per season at all habitat features combined was; 9.38 (bats per hour) during spring, 6.44 during summer and 0.46 during autumn. These figures are considered to be moderate (5-12) during spring/summer and negligible (<1) during autumn (a detailed breakdown is presented in **Appendix 6.4**)

3 Russ, J. (1999) *The Bats of Britain and Ireland, Echolocation Calls, Sound Analysis and Species Identification*, Alana Ecology Ltd, Shropshire.
4 Russ, J. (2012) British Bat Calls, A Guide to Species Identification, Pelagic Publishing, Exeter.

6.198 This demonstrates that activity was more strongly correlated with habitat features, such as the edges of adjacent coniferous forestry plantations and along watercourses, than at proposed turbine locations.

6.199 Therefore, for all species, activity levels at the proposed turbine locations were significantly lower than at adjacent habitat features (i.e. hedges/watercourses), during most periods.

Other Mammals

Otter Survey

6.200 No suitable habitat for otter occurs within 100m of any infrastructure. Therefore, this species is removed from further assessment.

Badger Survey

6.201 Dedicated badger surveys were undertaken on the 18th July and again on the 13th November 2018. Evidence of badger activity was noted on site in the form of trails snuffle-holes, and a live badger was also sited during one of the manual (bat) transect surveys (see **Figure 6.7**). A camera trap was also positioned at a rabbit warren along the proposed access track between the (14th March to 04th April) in order to ensure that no badgers were using an enlarged rabbit hole in the side of the bank.

Plate 3 - Showing a foraging badger recorded during the spring bat activity transect

6.202 However, no setts were identified during survey and no badger activity recorded during camera trapping. It is considered likely that this is due to the abundance of suitable habitat for the location of setts within the wider surrounding area. Particularly within the woodland of Banagher Glen SAC, as well as numerous smaller copses in the immediate environs outside the survey area.

Red squirrel survey

6.203 A red squirrel survey was undertaken across 4 dates during spring 2019. In addition to this two number camera traps (and associated feeders) were also positioned for a 3-week period between the (14th March to 04th April 2019) within two of the coniferous forestry shelterbelts on site (see **Figure 6.7**).

Table 6.10: Red squirrel survey dates, times and weather conditions

Date	*Start / Finish*	*Weather Conditions*			
		Temp	*Precipitation*	*Wind (mph)*	*Cloud*
21st March 2019	*1000 – 1200*	*7ºC*	*None*	*7*	*75%*
25th March 2019	*1030 – 1230*	*9ºC*	*None*	*5*	*50%*
28th March 2019	*0945 – 1145*	*9ºC*	*None*	*5*	*70%*
04th April 2019	*0915 - 1115*	*12ºC*	*None*	*4*	*20%*

6.204 No red squirrels were recorded; therefore, this species is removed from further assessment.

Herpetofauna Survey Results

Common Lizard

6.205 Lizard *Lacerta vivipara* surveys commenced when thirty (500x500mm) bitumen backed carpet tiles (artificial refugia) were placed across the site (20 on the 27th April and a further 15 on the 4th May 2018). These were left in-situ for a week to allow the lizards to become acclimatised to their presence, with the first survey visit completed during May. This coincides with the NIEA Specific Requirements (in force at the time of survey) for this species, which states that "surveys should be carried out between March and October. With the best time for surveys to be undertaken is generally April-May and in September."

6.206 **Table 6.11** (below) outlines the results of the lizard surveys undertaken between April and September 2018.

Table 6.11: Results of the common/viviparous lizard surveys carried out during 2018

Date/Time	*Weather*	*Results*
29/05/18 *(start 0930, finish 1130hrs)*	*14ºC at start, and 17ºC by end. Fine, dry and warm,*	*3 lizards recorded*
22/06/18 *(start 1800, finish 2000hrs)*	*17ºC, 80% sun with a light breeze*	*No lizards recorded*
28/09/18 *(start 1030, finish 1230hrs)*	*15ºC, 100% sun with a gentle breeze*	*2 lizards recorded*

6.207 A maximum total of 5 adult lizards were recorded using a total of five refugia (see **Figure 6.7**). The results of the common lizard surveys reveal a population score of 2 (good population[5]) (with 5 individuals recorded). It is likely that the habitats immediately to the south of T1 as well Field 27 are suitable habitat for this species. Whereas the habitats surrounding T6 are poorer quality habitat for common lizard (i.e. more overgrazed and with less vegetation cover). Finally, the improved agricultural grassland habitats surrounding T2 – T5 are likely to be unsuitable (due to reseeding and heavy sheep grazing), and therefore lizards are unlikely to be present across the majority of the site.

Smooth newt survey

6.208 There is an absence of suitable breeding habitat for smooth newts present within the study area. This is due to the absence of suitable waterbodies e.g. ponds. Therefore, this species has been removed from further assessment.

Lepidoptera

Marsh fritillary butterfly

6.209 The presence of devil's bit scabious *Succisa pratensis* (the foodplant of the marsh fritillary butterfly *Euphydryas aurinia*) was confirmed within the wider study area. However, over the whole site there were only a few localised patches of *S. pratensis* recorded, each patch was estimated to contain a handful of individual plants. These were overwhelming located outside the immediate zone of impact. In view of the limited extent of suitable habitat and the distance from any known breeding colonies, the site is considered to have negligible potential for breeding marsh fritillaries.

6.210 A common factor in many occupied sites is the presence of low-intensity cattle grazing which creates the preferred sward for the butterfly. The intensive sheep grazing across much of the site has created poor sward conditions and the absence of suitable habitat which is highly unlikely to favour marsh fritillary; therefore, this species has been removed from any further assessment.

Argent & sable

6.211 The presence of bog myrtle *Myrica gale* (the primary foodplant of Argent & Sable *Rheumaptera hastata*) was abundant in a number of locations with the study area (Field 27 & Field 28). However, these extensive patches of foodplant are located outside the immediate zone of impact; therefore, this species has been removed from any further assessment.

[5] Froglife Advice Sheet 10 Reptile Survey, an introduction to planning, conducting and interpreting surveys for snake and lizard conservation

Assessment of Impacts

General

6.212 Having defined the ecological baseline characteristics of the study area, it is necessary to describe the potential resultant scheme-related changes to the baseline and to assess the impact on valued ecological resources (CIEEM 2018)[6]. The process of identifying impacts refers to aspects of ecological structure and function on which a resource feature depends. Examples of aspects of ecological structure and function to consider when predicting impacts include (CIEEM 2018):

- Available resources (Territory: hunting/foraging grounds; shelter and roost sites; breeding sites; corridors for migration and dispersal; stop-over sites);
- Stochastic processes (Flooding, drought, wind blow and storm damage, disease, eutrophication, erosion, deposition and other geomorphological processes, fire and climate change);
- Ecological processes (Population dynamics: population cycles; survival rates and strategies; reproduction rates and strategies; competition; predation; seasonal behaviour; dispersal and genetic exchange; elimination of wastes. Vegetation dynamics: colonisation; succession; competition; and nutrient-cycling);
- Human influences (Animal husbandry, cutting, burning, mowing, draining, irrigation, culling, hunting, excavations, maintenance dredging, earth shaping, ploughing, seeding, planting, cropping, fertilising, pollution and contamination, use of pesticides and herbicides, introduction of exotics, weeds and genetically modified organisms and disturbance from public access and recreation, pets and transport);
- Ecological relationships (Food webs, predator-prey relationships, herbivore-plant relationships, herbivore-carnivore relationships, adaptation and dynamism);
- Ecosystem properties (Fragility and stability, carrying capacity and limiting factors, productivity, community dynamics; connectivity; source/sink; numbers in a population or meta-population, minimum viable populations; sex and age ratios; patchiness and degree of fragmentation);
- Ecological role or function (decomposer, primary producer, herbivore, parasite, predator, keystone species);

6.213 Impacts on ecosystem structure and function are assessed by reference to the following parameters:

- Positive or negative impacts, with international, national and local policies increasingly pressing for projects to deliver positive biodiversity outcomes
- Magnitude, or size of an impact, which in the case of habitat may be coincident with extent

[6] Chartered Institute of Ecology & Environmental Management (CIEEM) (2018) *Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (September 2018)*.

- Extent over which an impact is felt
- Duration of time over which the impact is expected to last prior to recovery or replacement of the resource or feature
- Reversibility, or whether an impact is permanent or temporary
- Timing and frequency of an activity, which may have different impacts depending on, for example, the season during which it is carried out.

6.214 EIA legislation requires the enumeration of significant negative or positive impacts of an activity on ecological features. An ecologically significant impact is here defined as an impact on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a given geographical area (CIEEM 2016). The significance of an impact depends on the importance of a receptor as defined in **Table 6.1** and on the magnitude of the impact on that receptor as defined in **Table 6.2**. Receptor impacts may be averaged against each other to assess the significance of the impact of the scheme on the site's natural environment, but in some cases a single receptor, for example an internationally important species or habitat, may be of sufficiently critical importance that the magnitude of impact on that single receptor defines the significance of the impact on the site. The following narrative assesses the significance of the impact of the Development.

Construction Phase

6.215 Activities that may be associated with construction of the Development and that may generate impacts on the natural environment near the proposed scheme include:

- Disturbance of designation features/sites;
- Disturbance to protected species;
- Construction of hard surfaces for access roads, turbine bases and construction platforms;
- Construction on new ground, leading to habitat and population constriction and/or fragmentation;
- Storage of materials and plant, and construction of site compounds;
- Environmental incidents and accidents (e.g. spillages, noise and emissions;
- Excavation works;
- Removal and redistribution of topsoil and subsoil;
- Provision of temporary access routes;
- Disruption or modification of drainage;
- Vegetation clearance; and
- Implementation of landscape design and habitat management.

6.216 The significance of the potential effects of the proposed scheme on valued ecological receptors during the construction phase has been assessed and outlined in the following sections.

Permanent loss of habitats due to land-take

6.217 The footprint of wind farm infrastructure will involve permanent land-take of approximately 3.13ha, due to the construction of 2.2km of new access track, 2.1km of upgraded access track and approximately 0.9 ha for the construction of substation and control building, 6 crane pads and turbine bases (see **Chapter 2, Proposed Development**). Of a total land take of approximately 3.13ha, approximately 1.02 ha is existing infrastructure upgraded.

6.218 The design of the wind farm layout has evolved in part by taking into account the location of NI Priority Habitats and the NIEA, Natural Heritage, Development Management Team Advice Note – Active Peatland and PPS18.

6.219 The location of all 6 turbines and the route of the access tracks have been chosen to minimise impacts to semi-natural habitats such as blanket bog as much as possible, while at the same time utilising existing on-site tracks insofar as practical during the emplacement of proposed infrastructure.

6.220 There is thus no direct effect on active blanket bog. Two turbines are located on degraded blanket bog/wet heath (which have been heavily influenced by intensive activities for agricultural aimed at improving the area for sheep grazing. This has resulted in a significant reduction in habitat quality in these locations.

6.221 **Table 6.12** lists the NVC communities and habitat condition at each turbine location.

Table 6.12: NVC community and habitat condition at each turbine location

Turbine	*NVC*	*Habitat condition*
T1	M19	Degraded blanket bog immediately adjacent to a coniferous forestry plantation. Area has also been subject to drainage, flailing and cutting for peat in the past.
T2	None	Improved/semi-improved agricultural grassland field
T3	None	Improved/semi-improved agricultural grassland field
T4	None	Improved/semi-improved agricultural grassland field
T5	None	Improved/semi-improved agricultural grassland field
T6	M15	Degraded wet heath adjacent to area of degraded blanket bog.

6.222 Turbine 1 is located in an area of degraded blanket bog immediately adjacent to a coniferous forestry plantation shelterbelt. This area has been subject to drainage, flailing and cutting for peat in the past. The access track leading to the turbine traverse's agricultural grassland and coniferous forestry, both of which are considered to be of 'Lower' conservation value.

6.223 Turbines 2 to 5 are located in large intensively managed agricultural grassland fields. Although there is the requirement to remove a number of coniferous forestry plantation shelterbelts in close proximity to the agricultural fields.

6.224 T6 is located on an area of M15 wet heath which is adjacent to a residual pocket of blanket bog which survives on site, albeit the area is small and its hydrology has been severely compromised with a major drain running through the centre of the area.

6.225 Both construction compounds (upper & lower) and the substation are all located on improved agricultural grassland fields.

6.226 The land take areas of each habitat[7] that will be lost to the development is summarised in **Table 6.13** below.

Table 6.13: Temporary and Long-Term Habitat Loss

Habitat	*Temporary Loss*	*Long Term Loss*	*Total Loss*
Wet heath (M15)	0.15	0.25	0.4
Dry/wet modified bog (M19)	0.15	0.25	0.4
Totals (hectares)	0.3	0.5	0.8

Calculated using a continuous 2.5m buffer around all construction structures and a 7m wide track (5m for running surface and 1m either side for drainage.

6.227 In summary, **Figure 6.2** shows that four of the six turbines, most of the access track, as well as the substation (and both temporary construction compounds) are in areas of improved/semi-improved grassland. The significance of the effect of this impact on a low value habitat is assessed as being negligible to minor and hence is acceptable without further mitigation.

6.228 The loss of approximately 0.8ha of degraded wet heath/modified bog habitat is a permanent and direct effect of medium to high magnitude on a receptor of high value and sensitivity. The loss of 0.8ha of NI priority habitat is assessed to be an adverse effect of **moderate magnitude** on receptors of high value. Since land take (and hence habitat loss) will be long term, this means that the effect is of **moderate adverse significance** and further mitigation is required.

6.229 However, under the "*Biodiversity Net Gain Good practice principles for development*" and to achieve net gain locally to the Development while also contributing towards nature conservation priorities at local, regional and national levels. There will be management implemented to both enhance existing and also create new habitat.

Bats

6.230 Construction activities have the potential to remove foraging habitat or reduce its value, and to disrupt flight-lines. Studies in Britain indicate that most bat activity is near habitat features. Activity declines with distance from features such as treelines and woodland edge and is generally not significant at distances greater than 50m [8]. This decline occurs both when bats are commuting and when foraging, although the decline is greater when animals are commuting. The potential impact of loss of feeding habitats may vary seasonally, with greater impact during the summer, and lower impact during migration.

[7] Excludes habitats of 'Lower' conservation value (improved/semi-improved grassland, coniferous forestry & marshy grassland).

[8] The evidence in Britain is that most activity is in close proximity to habitat features. Activity was shown to decline when measured at fixed intervals up to 50m away from treelines and at varying intervals up to 35m from treelines (Verboom & Spoelstra 1999; Downs & Racey 2006).

6.231 Low numbers of bats were recorded foraging over the proposed turbine locations, while the main bat foraging and commuting routes have all been avoided during the emplacement of infrastructure. Therefore, most bat activity will likely continue as the main areas of better foraging along hedgerows and adjacent heathland, which will remain untouched during construction activities and key commuting routes will therefore be unaffected.

6.232 The other main potential impact on bat populations that may arise due to construction is the loss of roost sites. However, no roosts were identified on the site during survey, and the nearest potential roosting location is >500 m away from the nearest turbine. Therefore, this impact will not arise at the Development. The magnitude of construction activities on bats is likely to be **neutral**, and the significance of the impacts will be **neutral**.

Badger

6.233 Potential conflicts with badgers (arising from construction) include damage to setts, disturbance at setts, and removal of foraging areas and displacement of foraging or breeding animals. Construction works may present additional hazards to badgers, with a potential for entrapment within excavations, accidental injuries on construction plant or materials, diversion from traditional trails by plant and site compounds and exposure to oils and other toxic materials.

6.234 There is also the potential risk of displacement of sensitive animals unaccustomed to high levels of anthropogenic activities. The potential magnitude of impact (without mitigation) on badgers during the construction phase is moderate adverse magnitude and significance.

6.235 However, no badger setts have been identified within the survey area (although they are known to present within the wider environs of the site). As a result of this, the potential impacts are of **minor adverse magnitude** and **minor significance** during construction.

Common Lizard

6.236 Construction of infrastructure will remove habitat for this species and cause disturbance leading to displacement of animals over a limited area of the site. It also has the potential to impact the habitat feature/requirements that lizards need within suitable habitat; this includes areas for basking, foraging, diurnal shelter and hibernation. The recorded use of the site by this species indicates that these impacts have the potential to be of **minor adverse magnitude** and of **minor adverse significance**. Therefore, mitigation is not required, (but is recommended as a precaution).

Operational Phase

6.237 Characteristics of wind farms that may generate impacts on the natural environment in the vicinity of the proposed scheme include:

- Occupation of former semi-natural habitats by turbines and associated infrastructure;
- Occupation of a swept volume of air space by turbine rotors;
- Vehicular use of access routes; and
- Improved access to remote sites.

6.238 Many of the impacts on biological receptors noted for the construction phase are also relevant during the operational phase. However, effective land take is reduced following the construction phase, as temporary site compounds and vehicle and plant running surfaces are returned to their former vegetation cover, and disturbance pressures arising from human presence along the route are significantly reduced.

6.239 Impacts on valued ecological receptors are outlined below.

Habitats

6.240 No adverse effects on vegetation communities and habitats are anticipated during the operation of the Development. Significant positive effects, through habitat restoration and enhancement, i.e. the reinstatement of heathland vegetation and the creation of native woodland, are anticipated through implementation of the oHMP (outline Habitat Management Plan).

Bats

6.241 The main potential impacts on bats during the operational phase arise from collision with rotors and from 'barotrauma', the often-fatal injuries that occur as a result of bats flying through air of rapidly changing atmospheric pressure in the immediate vicinity of a moving blade. The turbines have been located away from the habitat features that many species of bat use as flightlines or as a focus for foraging.

6.242 There is potential for loss of foraging area because bats may avoid a turbine site. Alternatively, there is some evidence that bats may be attracted to turbines (Kunz et al 2007[9]), possibly because insects may congregate in these locations as a response to the heat radiating from the structures (Ahlén 2003[10]). This effect is most likely to occur in calm conditions, or at low wind speeds, when collision risk for bats is likely to be at its highest.

6.243 A further possible operational impact is that ultrasound emissions from turbines may interfere with bats' echolocation capabilities[11]. The literature addressing this effect

[9] Kunz, T.K., Arnett, E.B., Erickson, W.P., Alexander, A.R.H., Johnson, G.D., Larkin, R.P., Strickland, M.D., Thresher, R.W. & Tuttle, M.D. (2007) Ecological impacts of wind energy development on bats: questions, research, needs and hypotheses. – Frontiers in Ecology and the Environment 5: 315-324.R.

[10] Ahlén, I. (2003) Wind turbines and bats – a pilot study. – Report to the Swedish National Energy Administration, Dnr 5210P-2002-00473, P-nr P20272-1.R.

[11] LONG, C.V., LEPPER, P.A. and FLINT, J.A., 2011. Ultrasonic noise emissions from wind turbines: potential effects on bat species. IN: 10th International Congress on Noise as a Public Health Problem (ICBEN2011), 24th-28th July 2011, London. Proceedings of the Institute of Acoustics, 33 (3), pp. 907 - 913

is sparse and it is likely that impacts on Irish bat species is limited (European Commission 2010[12]).

6.244 Seasonal variation in impacts of operational turbines on bats in Ireland is at present not fully understood. Movement of bats over long distances within a limited time period may produce a concentration of animals that are available for collision. Studies have shown that there is a peak in mortality in late summer and autumn during dispersal and migration, and that migrating species are most susceptible (Rodrigues et al 2008[13]). However, it is not known to what extent Irish bats migrate, which species, if any, are involved, whether migration is on a broad or narrow front, and whether there are discernible migration routes. It has been suggested that collisions during migration may be exacerbated because echolocation is not used in order to save energy (Keeley et al 2001[14]).

6.245 Late summer and autumn are also the period during which there may be increased activity associated with finding mates, and differentiating between migration and mating-related causality of mortality at turbines is problematic (Cryan and Barclay 2009[15]). Recent research into Leisler's bat in Ireland (Boston, 2008[16]) showed that this species does not migrate long distances between summer ranges and hibernation sites. Leisler's have been shown to hibernate within Ireland and do not appear to migrate in numbers on a broad front. This is likely to significantly reduce the collision risk for this species in the Irish context. However, in the absence of definitive data for all species, it is not possible to assess the likelihood, and hence the significance, of collision risk during putative migration periods. **Table 6.14** outlines the potential vulnerability of bat populations to onshore wind turbines.

Table 6.14: Level of potential vulnerability of populations of British bat species. (Adapted from Wray et al., 2010) (SNH 2019[17])

Relative abundance	Scotland[18]	Collision risk		
		Low	Medium	High
	Common species			Common Pipistrelle Soprano Pipistrelle
	Rarer species	Brown long eared bat Daubenton's bat Natterer's bat		
	Rarest species	Whiskered bat Brandt's bat		Nathusius' Pipistrelle Noctule bat

[12] European Commission (2010) Guidance on wind energy development in accordance with the EU nature legislation. European Commission, Brussels.

[13] Rodrigues, L., Bach, L., Duborg-Savage, M-J., Goodwin, J. & Harbusch, C. (2008) Guidelines for consideration of bats in wind farm projects. – EUROBATS Conservation Series No. 3, UNEP/EUROBATS Secretariat, Bonn.

[14] Keeley, B., Uogretz, S. & Strickland, D. (2001) Bat ecology and wind turbine considerations. –pp135-141 in Schwartz, S.S. (2001, ed) Proceeding of the National Avian-Wind Power Planning Meeting IV, Carmel, CA, May 16-17, 2000.

[15] Cryan, P.M. and Barclay, R.M.R. (2009) Causes of bat fatalities at wind turbines: hypotheses and predictions. Journal of Mammalogy, 90(6):1330–1340.

[16] Boston (2008) Molecular ecology and conservation genetics of the Leisler's bat (*N. leisleri*) in Ireland. Unpublished PhD Thesis.

[17] Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation (SNH January 2019).

[18] No Northern Ireland specific table is present in the 2019 SNH guidance, therefore the table for Scotland is used here as the species assemblage is closest to what is present in Ireland.

				Leisler's Bat[19]

Yellow = low population vulnerability
Amber = medium population vulnerability
Red = high population vulnerability

6.246 In the absence of mitigation, bats flying along edge habitats would be potentially in close proximity to the rotor swept areas during foraging and commuting activity. This could potentially result in bat fatalities. Therefore, under the precautionary principle (and without mitigation) this project has the potential to have a **moderate adverse** impact magnitude, of **major adverse** significance during the operational phase. As a result, detailed mitigation by design has been developed and implemented.

6.247 All turbines have been positioned to maintain a minimum 57.57m buffer (50m stand-off distance from the tip of the turbine blade to the top of the adjacent habitat feature). This is based on a (blade length of 56m, hub height of 94m and a feature height of 5m).

6.248 The results of bat activity surveys confirmed that most of commuting and foraging was along linear features such as watercourses and edges of adjacent industrial tree monoculture plantations. The infrastructure layout has taken account of bat activity along these features and turbines have been sited to avoid these areas. In addition, it is proposed to clear-fell the existing coniferous shelterbelts for a distance of 100m surrounding all turbines (as shown on Figure 6.2).

6.249 With mitigation, and based on currently available data on all species of (Irish) bat species, the impact magnitude can be reduced to **neutral** significance during the operational phase of the Development.

Badger

6.250 The use of access tracks will be mainly limited to single-vehicle journeys for maintenance and there will be minimal collision risk to badgers. There will be no additional impacts on badgers as a result of the operation of the Development. There is likely to be **neutral** impact on magnitude and significance during the operational phase.

Common Lizard

6.251 The use of access tracks will be mainly limited to single-vehicle journeys for maintenance, and there will be minimal traffic risk to lizards. The additional likely impacts on this species as a result of the operation of the Development will include species specific habitat management and enhancement measures. Overall the successful implementation of these measures during the operational lifetime of the wind farm is likely to be of **minor positive** magnitude and of **beneficial** significance.

[19] According to Bat Conservation Ireland Leisler's bat is a relatively common species in Ireland.

Decommissioning Phase

6.252 Impacts associated with decommissioning a wind farm bear many similarities to those arising during construction. Many of the work processes are similar and plant and vehicle movements are likely to be at a similar scale. It is assumed that decommissioning will require the removal of all above ground structures; the removal of all underground structures to one metre below ground level; and reinstatement of disturbed areas.

Habitats

6.253 Two types of activities have the potential to disrupt and damage vegetation communities and peatland habitats during decommissioning. These are:

- Removal of above-ground infrastructure; and
- Laydown of waste demolition materials or spillages or leaks of fuels from decommissioning plant.

6.254 The types of decommissioning effects are as follows:

- Disruption/damage to peatland vegetation, compaction/rutting of the peat surface and disruption of peat hydrology that supports peatland (especially blanket bog) vegetation
- Contamination of the peat surface and peatland vegetation with demolition waste materials or spilled/leaked fuels.

Species of Conservation Concern

6.255 Impacts on protected mammals and herpetofauna during decommissioning are likely to be of a similar scale and nature to those that occurred during construction and are unlikely to be significant.

6.256 Each of these impacts is described and assessed below and the unmitigated impacts, mitigation measures and residual impacts are summarised in tabular form (**Tables 6.15 & 6.17**).

Table 6.15: Significant Effects upon Valued Ecological Receptors (Prior to Mitigation)

Impact	Nature of Effect	Magnitude	Significance
Construction			
Designated Sites / Watercourses	Statutory: River Roe & Tributaries ASSI/SAC; and Lough Foyle ASSI/SPA There is significant potential for waterborne pollution and increased sediment loading during the construction phase in the absence of mitigation	Moderate	Major adverse
Blanket bog/wet heath	Land take associated with construction of access tracks and turbines and associated infrastructure.	Moderate	Moderate
Bats	Disturbance of European Protected Species during construction activities	Neutral	Neutral

Impact	Nature of Effect	Magnitude	Significance
Badger	Temporary disturbance from construction works possible	Minor	Minor Adverse
Common lizard	Temporary disturbance from construction works and loss of habitat	Minor	Minor Adverse
Operational			
Designated Sites / Watercourses	Statutory: River Roe and Tributaries ASSI/SAC and Lough Foyle ASSI/SPA Water pollution, sediment loading, is extremely unlikely during the operational phase	Neutral	Neutral
Blanket bog/wet heath	Heathland restoration and enhancement to be conducted in accordance with methods defined in the Outline HMP	Neutral	Neutral
Bats	Potential collision of European Protected Species with turbine blades (or barotrauma) during the operational phase	Moderate adverse	Major Adverse
Badger	Operational Effects unlikely	Neutral	Neutral
Common lizard	Loss of habitat for the operational lifetime of the wind farm	Negligible to Neutral	Neutral
Decommissioning			
Designated Sites / Watercourses	Statutory: River Roe & Tributaries ASSI/SAC; and Lough Foyle ASSI/SPA There is significant potential for waterborne pollution and increased sediment loading during the decommissioning phase in the absence of mitigation	Moderate	Major Adverse
Blanket bog/wet heath	Removal of turbines and associated infrastructure will permit reinstatement of impacted areas of this habitat.	Moderate	Moderate Adverse
Bats	Disturbance of European Protected Species during decommissioning activities unlikely	Neutral	Neutral
Badger	Temporary disturbance from decommissioning works possible	Minor	Minor Adverse
Common lizard	Temporary disturbance from decommissioning works probable	Minor	Minor Adverse

Design Evolution & Mitigation

6.257 The purpose of what is broadly classed as mitigation is to maintain the conservation value of a development site as far as is possible, and to exploit opportunities to enhance the site's conservation value wherever possible. This can be achieved by (CIEEM 2018):

- avoiding negative ecological impacts - especially those that could be significant;
- reducing negative impacts that cannot be avoided; and
- compensating for any remaining significant negative ecological impacts.

6.258 The aims of mitigation can be best achieved by choosing locations that allow sites or features of conservation value to be avoided; **Chapter 3: Design Evolution &**

Alternatives provides a full description of the design evolution process which includes details on avoidance measures.

6.259 Avoidance and impact reduction techniques relate to reducing the footprint of the development and any ancillary works as far as is practicable. Measures required to address ecological concerns described in this ES during the construction phase will be implemented by an Ecological Clerk of Works (ECoW) as detailed in the outline Construction Environmental Management Plan (oCEMP) in **Technical Appendix 6.5** and will be incorporated within a Construction & Decommissioning Method Statement (CDMS), which will be submitted to and agreed with the Department at the pre-construction stage. Avoidance and impact reduction measures include:

- No turbine rotors are within 50m from the edge flight-lines such as streams and shelterbelts), which is the minimum stand-off distance from blade tip to the nearest habitat feature likely to be used by bats, (Natural England 2014).
- Consideration will be given to the provenance of fill materials for roads, in terms of the similarity of their physicochemical properties (particularly pH) to the present substrate.
- The contractor will prepare a CDMS prior to construction activities to provide a method statement for working practices that will include measures, among others, to prevent adverse impacts on rivers and other watercourses. Please also refer to the SUDS design Statement in Appendix 9.
- A “no access” buffer will be implemented along sensitive watercourses to prevent damage to banks and to prevent disturbance of riparian habitats, apart from the narrow corridor required during construction.
- Access of all machinery and personnel will be limited to the working area corridor.
- Site compounds and stores have been sited away from any features of conservation interest, including watercourses. Any of these features in close proximity to the works or to compounds will be fenced to prevent damage by plant or stored materials.
- Dust suppression filters and appropriate wetting of running and work surfaces will be used to prevent masking of vegetation outside construction corridors, where appropriate.
- Appropriate speed limits will be imposed to reduce the potential for dust production.
- Excavations left unattended overnight should be ramped in at least one location to allow mammals to avoid becoming trapped.
- It is also recommended that, to minimise the risk of suspended sediment entrainment in surface water run-off, the site drainage system should only be carried out during periods of low rainfall and therefore minimum run-off rates.

6.260 Of particular importance for the maintenance of habitats and associated fauna is the institution of good management practices that prevent the discharge of silt and pollutants into the local drainage system. Containment measures will include:

- Where works near or in watercourses are unavoidable, working practices will include standard methods designed to minimise sedimentation and pollution, and measures will be put in place before the works begin to ensure containment of any released sediments. These may include silt containment booms or sediment barriers, as appropriate. Land stripping will be done in stages to minimise the potential for concentrated, long-lasting pulses of silt to discharge into watercourses. All filtration systems will be monitored frequently, and they will be replaced before they become ineffective.
- Material storage compounds have been located remote from any watercourse. Surface water run-off high in suspended solids should be contained and treated prior to discharge to any watercourse. All storage tanks should be bunded and should be sited remotely from any watercourse. Works should incorporate the relevant Pollution Prevention Guidelines. Additionally, a Pollution Incident Response Plan should be put in place as part of the Construction Management Plan.
- Water should be pumped from turbine bases during construction either to areas of ground capable of absorbing the water or to settlement ponds prior to discharge. Any discharged water must be free of cementitious products.
- All tracks and drains should be maintained and monitored to ensure that surface water flow is directed as designed, and that ponding and blockages are prevented.

6.261 Further details about the proposed SuDS are included in **Technical Appendix 9.1**.

6.262 Avoiding or mitigating impacts arising from construction-initiated alterations of drainage patterns and infiltration regimes is of importance for preventing damage to both aquatic and terrestrial habitats. It must be appreciated that hydrological characteristics of peatland and the habitats that they support are inextricably linked, and that changes in hydrological regime will lead to changes in these habitats. The areas of blanket bog have been avoided by sensitive siting during the design process. The site hydrological regime is considered in detail in **Chapter 9: Geology & the Water Environment** and measures outlined there will be carried out in order to maintain the limited areas of conservation interest on the Site.

6.263 Sympathetic management of the wind farm habitats during the operational phase will provide the greatest opportunity for enhancing the conservation value of the Site, and should be regarded as compensatory mitigation for the permanent land take required for the new turbines and infrastructure.

6.264 The landowner will incorporate compensation and enhancement for lizard into the habitat management plan for the site. This will include the removal of grazing the habitat management area (shown in **Figure 6.8**) for the lifetime of the Development

Habitat Specific Mitigation

6.265 Mitigation measures are required during both the construction and decommissioning phases of the Development. These consist of both generic, standard, good construction working practices and controls described in the CMS, together with site specific and activity specific measures. Only the latter, the specific mitigation measures, are described here.

6.266 Adverse effects during the construction phase that were assessed to be potentially significant and require mitigation are:

- Land take (0.8ha), resulting in loss of degraded wet heath/modified bog which, despite being degraded is still considered to be an NI priority habitat.
- Excavation of turbine bases and cable trenches, potentially severing hydrological routing and causing dewatering of areas of soils.

6.267 The prime mitigation to reduce to an absolute minimum any disturbance or damage to vegetation, over and above the strict controls provided in the CMS, is habitat restoration and enhancement and vigorous supervision by the ECoW of all activities and at all stages of the Development.

6.268 Habitat restoration and enhancement is described in the Outline Habitat Management Plan (OHMP) in **Appendix 6.4** to provide compensation for the loss of small areas of wet heath/degraded blanket bog.

6.269 Quantification of anticipated areas enhanced via habitat management measures indicate that approximately 15ha of NI Priority Habitat will be restored. The overall area enhanced (16.6ha) is a combination of 15.5ha (for restoration of grassland/heath/bog) plus 1.13ha given over to natural regeneration of native woodland. This is approximately 20-times greater than the areas of NI priority habitat (wet heath/degraded blanket bog) which will be lost to the Development through land take for the footprint (0.8ha).

6.270 This is considered to be a significant level of compensation (considering that the majority of infrastructure is situated on agricultural fields of low ecological value and that a significant length (2.1km) of existing track is also being used). In addition, the restored and enhanced habitats will also be protected from drainage, flailing and burning, and reduced grazing throughout the 30-year lifetime of the Development.

6.271 As detailed in the OHMP, the landowner has agreed to cease their currently active land management activities, should the Development be constructed.

General principles for reinstatement of habitats

6.272 Turves of heathland vegetation and associated topsoil from construction activity represent a valuable resource that can be used in the restoration of bare areas. Turves must be cut so that they capture the root systems of mineral soil as this will ensure any viable seeds are present. Turves can be laid in blocks or in a patchwork and over time heathland will develop within gaps and will provide a mosaic of structure.

6.273 During construction the areas of heath/bog at both T1 and T6 will be lifted and stored for reuse using large-scale turfing equipment, using a technique known as "macro-turfing", moving large, thick turves. This method has many advantages over traditional turfing, virtually eliminating problems of frost and drought damage, and because the turves are thick, most burrowing invertebrates and deep-rooted plants survive. At both locations the vegetated turves will be lifted to a depth of approximately 25-40cm, (i.e. total depth of topsoil at each location).

6.274 Under the supervision of an Ecological Clerk of Works the original soil layering will be maintains and the mixing of topsoil and subsoil layers will not be permitted to occur. For peat soils, the acrotelm and catotelm will be handled and stored separately and reinstated with the acrotelmic layer on top. For peat and mineral soils, it is especially important to keep the layer of surface soil and stripped turves of vegetation on the top of the reinstatement, the right way up.

6.275 Turves will not be stacked but placed beside each other. As described above turves will be cut to an appropriate depth to maintain plant root systems and provisions for keeping soil moist must be considered in the event of dry spells of weather where vegetation may succumb to drought or the soil may be susceptible to wind erosion. Maintaining the seed bank and existing vegetation on the surface provides the best possible start for effective restoration.

6.276 Turves will be watered during times of drought or more frequently if deemed necessary by the ECoW in order to protect the health and integrity of newly translocated turves.

Compensation of the loss of NI Priority Habitats

6.277 15.5ha of marshy grassland (likely derived from former heath/bog) will be managed in order to restore this habitat to a more species-rich sward closer to the heath/bog which once prevailed across the wider area.

6.278 The main management techniques that will be employed is the removal of all grazing and the blocking of all drains within the proposed habitat management area. After 5 years the sward will be assessed and compared with the preconstruction baseline for the area. At this point, contingency measures such as the introduction of light cattle (preferable) or light sheep grazing will be considered in order to maintain the momentum towards a more species-rich sward, while slowing down successional forces towards scrub/woodland (should this occur).

Plate 4 - Showing the main area proposed for habitat management

Compensation for hedgerow loss

6.279 The removal of 2.1km of hedgerow required for the widening of the site access track will be compensated for by the planting of 2.1km of new hedging (comprising native species of local provenance) along the exposed side of the upgraded tracks.

6.280 In addition, approximately 1.1ha of native woodland will be created (via natural regeneration) to compensation both the hedgerow loss as well as the removal of approximately 1.77ha of coniferous plantation forestry shelterbelts. This woodland will be contiguous with Banagher Glen SAC. Native woodland of local provenance is also of much greater biodiversity value than coniferous forestry comprising non-native species.

6.281 This technique is considered appropriate due to the fact that there are seed trees immediately adjacent to the proposed regeneration area, and thus provenance is guaranteed. Squirrels and jays are both present in Banagher Glen and both are likely to store seeds for later consumption. The edges of the site are already thick with regenerating trees and woodland cover.

6.282 The current habitats on site consist of a mosaic of sheep grazed semi-improved acid grassland and bracken. In places the bracken forms a partial canopy over a patchwork of woodland plants including bluebell, lesser celandine, wood anemone and bugle with gorse and sycamore also present around the field margins.

Plate 5 - Showing western field which is proposed for natural (woodland) regeneration

Plate 6 - Showing eastern most field which is proposed for natural (woodland) regeneration

Species specific mitigation

Mitigation for bats

6.283 The Project ECoW will carry out a pre-construction BRP survey on any trees to be removed along the route of the access track into the site. This is required to take account to any changes in the status of any trees which may have taken place between the surveys undertaken to inform the EcIA and the commencement of construction.

6.284 Under the precautionary principle, and due to the presence of several species of bat know for open-air foraging (i.e. considered at risk from turbine associated mortality; Leisler's bat (*N. leisleri*) high risk; and Common pipistrelle (*P. pipistrellus*); Soprano pipistrelle (*P. pygmaeus*) medium risk) a Bat Monitoring & Mitigation Plan (BMMP) has been recommended.

6.285 Monitoring, (in the form of bat mortality surveys), will be undertaken for the first 3-years (post-consent (if approved)) and will be reviewed annually to determine whether remedial action is required to mitigate the effects of the Development on bats. In the event that a bat carcass if found, NIEA NED will be immediately contacted in order to discuss/agree the implementation of mitigation measures.

6.286 The BMMP will be agreed with NIEA/The Council and monitoring will be undertaken in years 1, 2 & 3 and will be reviewed after each survey period to determine whether remedial action is required to mitigate the effects of the Development on bats. At the end of year 5, the data will be reviewed to determine whether monitoring should continue.

Frequency of searches and number of turbines to be searched

6.287 It is recommended that systematic searches should be conducted within a 100m x 100m grid centred on the turbine being monitored. Two search periods are recommended, spring (based on the results of the automated monitoring) with a second round during either summer or autumn. Three turbines will be searched during each visit, and these will be selected at random across the year.

6.288 Searches will be conducted at 2 to 4-day intervals (based on National Bats and Wind Turbines study recommendations). Data must be obtained from the turbine operators on whether or not the target turbine was operational on the night preceding the search, with the surveying protocol being adjusted as necessary if the turbines were either non-operational or were not rotating because of a lack of wind.

6.289 To maximise the duration of monitoring during each season, whilst maintaining low carcass removal rates, it is recommended that surveying should be split into blocks as illustrated below. This is the spring schedule, which will be repeated during summer or autumn (and alternated across the three years of the programme).

Table 6.16: Summary of proposed schedule for carcasses searches (spring).

Days 1-10	Days 11-20	Days 21-30	Days 31-40	Days 41-50	Days 51-60
Initial 'sweep' then survey alternate days (d2, d4, d6, d8, d10)	No Survey	Initial 'sweep' then survey alternate days	No survey	Initial 'sweep' then survey alternate days	No survey

Bat Carcass (Mortality) Searches

6.290 Bat carcass searches will be undertaken using a specialist ECoW; and will only take place the morning after optimal conditions for bats have occurred. These are defined as;

- <5m/s ground wind speed,

- >10ºC of temperature (1 hour after dusk),
- no rain, and
- after a warm day of similar settled conditions (i.e. the dusk should have a peak in bat activity in the area).

6.291 Carcass searches will commence one hour after dawn to minimise the potential for carcass removal by predators.

6.292 This approach has been selected to maximise the likelihood of finding bat carcasses, which is essential in enabling predicted bat mortality to be accurately estimated. Bat carcasses will be collected (if found) to enable accurate species identification using DNA where required.

Meteorological Data

6.293 Simultaneous daily collection of meteorological data including wind speed, temperature, and precipitation will be undertaken at the turbine location, alongside bat carcass searches to identify the effect on levels of bat activity at the turbine.

Operational curtailment

6.294 All turbine blades shall be “feathered” when wind speeds are below the “cut-in speed” of the operational turbines. This shall involve pitching the blades to 90 degrees and/or rotating the blades parallel to the wind direction to reduce the blade rotation speeds below two revolutions per minute while idling. This will substantially reduce the risk of bats being struck by idling blades, and will reduce the spatial extent of low-pressure vortices in the wake of the blades (i.e. will substantially reduce the potential for barotrauma to occur).

Remedial measures

6.295 The trigger threshold for remedial measures will be linked to ‘significance’ in line with the CIEEM guidelines for EcIA. Remedial measures will be triggered by an impact predicted to be of significance to bats at the Local level or greater.

6.296 For geographic context, the local level is considered to represent the site boundary plus a 15km radius. A significant effect would be triggered where the level of bat mortality is considered to reduce the ability of the bat population at the Local scale to sustain a viable and stable population, as informed by monitoring.

6.297 The requirement for and design of remedial measures will depend upon the findings and conclusions of monitoring and specific measures will be developed as appropriate to mitigate and significant impact predicted (those considered significant to bat populations at the Local scale or above). Where significant impacts are predicted, potential remedial options may include, but are not limited to, the feathering of individual turbines.

Mitigation for common lizard

6.298 In the case of common lizard, it has been impossible to totally avoid impacts to this species, given the layout constraints. Therefore, the next course of action is to mitigate for any potential impacts.

6.299 The results of the common lizard surveys for the Development were assessed against the Key Reptile Site Survey Assessment Categories (HGBI 1998). This revealed that parts of the Site had a good population (with six individuals recorded). However, given the location of the records, it is also likely that much of the site is sub-optimal habitat for this species. This is likely a consequence of over-grazing and drainage.

6.300 Depending on the commencement of construction on site, the works corridor will be mowed. If possible, this work will be undertaken before the end February (to avoid a conflict with the bird breeding season). If this is not possible, then mowing will take place between August and September, when common lizards are likely to be fully active. Should the latter be required, the corridor will be subjected to an active nest survey by a suitably qualified ornithologist immediately prior to the commencement of mowing operations.

6.301 Clearance of stones, tree stumps, logs, brash, rocks or piles of similar debris will be undertaken carefully and by hand. Although this is only required in a few areas where the proposed site tracks traverse low stone walls. This work will not take place during the hibernation period for common lizard (i.e. mid-October to mid-March).

6.302 Clearance of tall vegetation will be undertaken using a strimmer or brush cutter with all cuttings raked and removed the same day. Cutting will only be undertaken in a phased way which will either include:

- Cutting vegetation to a height of no less than 30mm, clearing no more than one third of the site in anyone day or;
- Cutting vegetation over three consecutive days to a height of no less than 150mm at the first cut, 75mm at the second cut and 30mm at the third cut;

6.303 Following removal of tall vegetation using the methods outlined above, the remaining vegetation will be maintained at a height of 30mm through regular mowing or strimming to discourage common lizards from returning. Ground clearance of any remaining low vegetation (if required) and any ground works will only be undertaken following the works described above.

6.304 As an additional precaution the ECoW will be present from the commencement of clearance/construction with a watching brief to ensure that no common lizards remain within the construction corridor and remain in situ until the area is cleared to ensure no species or habitat conflicts emerge affecting damage to the local lizard population.

6.305 If any common lizards are found during excavation works, all works within the affected area will cease until the ECoW has safely removed them (under licence) from the construction corridor.

6.306 Should it prove necessary during site supervision (i.e. lizards are observed returning to the construction corridor); a protective lizard barrier fence will be installed along both sides of the construction corridor in order to prevent common lizards from entering the works area.

6.307 In total, there is >500 ha (of blanket bog; dry heath and marshy grassland) adjacent to the proposed construction corridor. These areas together provide more than sufficient suitable habitat.

Soft-felling techniques for trees

6.308 All broadleaved trees with any roosting potential (both within the site, and along the Banagher Road) will be subject to a pre-felling inspection (using a MEWP (Mobile Elevated Work Platform) immediately prior to any felling works by the project ECoW. This will involve checking for any bat roost features, and inspecting crevices behind ivy with an endoscope (under licence) where possible. Once re-inspection surveys confirm that no bats are present, the trees will be felled taking reasonable avoidance measures. In particular, the following methodology will be employed:

- The felling work will be undertaken during weather conditions suitable for bats to be active, avoiding the main hibernation period, to minimise the risk of significant disturbance;
- An ECoW with appropriate experience will be present on site to advise on felling methods and what to do in the event bats are encountered;
- Sections of the tree containing features suitable for roosting bats, i.e. thick ivy stems, will be softly lowered to the ground, following which these will be subject to a more detailed inspection by the supervising ecologist to confirm absence of bats;
- After felling, the sections of the tree supporting thick ivy stems will be retained in a suitable location overnight allowing bats to disperse, in the unlikely event that any are present but undetectable.

6.309 In the event that any bats are encountered, all felling works on the tree will immediately cease and the ECoW will advise on how best to proceed. If possible, bats will be left to disperse (or alternatively the bats will be placed in a Schwegler 1FF bat box which will be erected in advance of the works (at both the site access and along the Banagher Road) and the ECoW will carry out a check the following day to ensure that the bats are no longer present. NIEA will be contacted for further advice if appropriate.

Residual Impacts

6.310 Residual effects relating to land management that is designed to provide ecological benefits through the establishment of grazing measures which are appropriate within peatland and associated habitats (See **Appendix 6.4** – Outline Habitat Management Plan) will result in more diverse and ecologically valuable habitat than the present degraded habitats that cover the majority of the site. Continuity of effective, appropriate management should result in the area becoming more biodiverse over time. With improved land management, it is anticipated that in the long term there will be at least a neutral residual impact on fauna of conservation concern. For habitats, a beneficial impact is likely if site management results in more diverse habitats of greater conservation value

6.311 **Table 6.17** provides details of the residual impacts.

Table 6.17: Summary of Residual Impacts after Mitigation and Enhancement

Impact	Ecological Impact Significance without Mitigation	Mitigation & Enhancement	Ecological Impact Significance with Mitigation
Construction			
Designated Sites / Watercourses	Major adverse	Avoidance during infrastructure design and SuDS drainage management (Appendix 9.1). No in-stream works will be required.	Neutral
Wet heath/degraded blanket bog	Moderate	Heathland restoration and enhancement according to the Outline HMP.	Neutral
Temporary disturbance to bats	Neutral	Soft-felling and preconstruction inspection surveys have been recommended. Two Schwegler 1FF bat boxes will also be erected.	Neutral
Temporary disturbance to badgers	Minor	None required, no badger setts found within 25m of the construction area. However, given the foraging records for this species, a pre-construction badger survey will be completed.	Neutral
Temporary disturbance to common lizard	Minor	Implementation of species-specific mitigation to off-set potential significant effects including phased mowing of the vegetation within the construction corridor.	Negligible to Neutral
Operational			
Designated Sites / Watercourses	Major Adverse	Application of the SuDS drainage management and CMS as detailed in Appendix 9.1	Neutral
Wet heath/degraded blanket bog	Moderate	Heathland restoration and enhancement according to the Outline HMP.	Beneficial
Potential collision of bats with turbine blades	Major adverse	The proposed turbine layout was amended to ensure a minimum stand-off distance of 50 m (Natural England TIN051) to all habitat edges (shelterbelts and natural watercourses) which will be maintained through the lifetime of the Development. A Bat Monitoring & Mitigation Plan (BMMP) will be implemented under the Precautionary Principle.	Neutral
Disturbance to badgers	Neutral	None required, no badger setts found within 25m of the construction area.	Neutral
Disturbance to common lizard	Minor	Implementation of species-specific enhancement to off-set potential significant effects includes; Management of <15 hectares of habitat which will also benefit this species.	Beneficial
Decommissioning			
Designated Sites / Watercourses	Major adverse	SuDS and standard Pollution Prevent Guidelines will be adhered to during decommissioning.	Neutral

Impact	Ecological Impact Significance without Mitigation	Mitigation & Enhancement	Ecological Impact Significance with Mitigation
Wet heath/degraded blanket bog	Minor	Heathland restoration and enhancement according to the Outline HMP.	Beneficial
Temporary disturbance to bats	Neutral	No mitigation required	Neutral
Temporary disturbance to badgers	Neutral	No setts were recorded in the area means that disturbance to this species is likely to be minimal.	Neutral
Temporary disturbance to common lizard	Neutral	No mitigation required as no impact during the decommissioning phase is considered likely.	Neutral

Cumulative Impacts

6.312 When considered in the context of the overwhelming dominance of the impact of agricultural land-use change as the primary driver controlling the extent and quality of habitats in Northern Ireland, as well as natural variation (in species populations) over time, it is credible to assume that in only very exceptional circumstances will direct effects in aggregation between wind farm sites have any potential to be cumulatively of concern let alone significant (in EIA terms). It is not unreasonable to assume that any such aggregate effects that may be of significance are likely to be readily apparent to those considering individual applications who can inform consideration of specific detailed measures to avoid unacceptable effects[20].

6.313 The potential for a cumulative impact between proposed and operational wind farms arises principally if species from the same population are using more than one of the sites. The likelihood of this can be assessed through an analysis of the species assemblage and by examining the likely range and territory size of those species.

6.314 The area over which a cumulative impact may be felt should also be considered, and in the present case, wind farms within a radius of 15km have been identified. However, Ballyhanedin and Evishagaran considered to be the only wind farms likely to have the potential to have a significant cumulative effect.

6.315 The following sections assess the potential cumulative impacts, as a result of the Development with other proposed and operational wind farms, where relevant.

Designated sites

6.316 Wind farms have the potential to have an adverse impact on the quality of downstream waters and on the diversity and conservation value of aquatic ecosystems, in this case the River Roe & Tributaries SAC. Flow of peat- and silt-laden

[20] Review of Guidance on the Assessment of Cumulative Impacts of Onshore Windfarms, Phase 1 Report, ENTEC, September 2008

water from a number of wind farms within a restricted catchment has the ability to increase these impacts cumulatively to a level that could reduce fish and invertebrate populations and diversity. Measures to retain surface water on site and to enable infiltration to groundwater at acceptable rates are required at all wind farm sites, as standard best practice. This includes the implementation of detailed mitigation arising from the development of a CMS (Construction Method Statement). Issues of potentially major significance, particularly where salmonid waters are present, are considered to be **not significant** as a result of the routine implementation of these measures.

6.317 Banagher Glen SAC/ASSI and NR is located in close proximity to the application site. However, both are separated from the application site by roads and given that the designation features of the site comprise woodland, there is limited potential for any cumulative impact(s). There is the remote chance of air or water borne pollution during construction reaching these adjacent lands. However, with the successful implementation of the mitigation measures previously outlined (including a detailed CMS, the likelihood of any impact (cumulative or otherwise) is considered to be **not significant**.

Habitats

6.318 In the uplands there is some concern over the potential effects of the access track network required by wind farm developments on the hydrology of peatlands which are important both because they are generated by and support highly valued specialised vegetation, and as natural carbon stores.

6.319 The Development will result in a loss of low and moderate quality habitats, which are of local conservation value. Restricted areas of habitat of higher conservation value have been avoided and their interest maintained. In the case of Magheramore, this additional loss of habitats is considered to be not significant because the degraded wet heath/blanket bog habitat is of local conservation value and is widespread both locally and throughout the region. It is therefore within the ability of the resource to absorb this loss. Those habitats that are of greater value have been avoided and there will be **no significant impact** on them.

Bats

6.320 Overall bat activity recorded at the turbine locations across the entire 2018 survey season was low (negligible during autumn). In contrast, activity levels at the adjacent habitat features were moderate (negligible during autumn). This demonstrates that activity was more strongly correlated with linear features and/or semi-natural habitats, such as along watercourses or over the adjacent heath/bog (with low levels of grazing and corresponding more luxuriant vegetation), than at proposed turbine locations. Therefore, low numbers of bats were recorded foraging at proposed turbine locations, with moderate activity recorded along/over adjacent habitats/features. The main bat foraging and commuting routes have also been avoided during the emplacement of infrastructure.

6.321 Outcomes which must be considered are whether the cumulative impact of wind farm developments will adversely affect the distribution of these species of European conservation concern, and whether there will be population-scale effects on any bat species. The most contentious species issue currently is the extent to which bats may be at risk of collision with turbines. There is potential for bats to forage across more than one wind farm and to be subject to at least the potential of an increased risk of collision. As yet there is no agreement on how best to address it, though specific impacts on bats have been addressed through the incorporation of precautionary stand-offs to habitat features (foraging and commuting areas), as well as the selection of windfarm sites with 'low' levels of bat activity.

6.322 The development therefore has the potential to increase bat mortality resulting from collision and barotrauma, and this impact is likely to be additive to similar impacts arising from the operation of other wind farms, at both local and regional scales. The absence of data relating to bat life cycles and to the intensity and spatial variation of activities during different parts of those life cycles means that there is difficulty in determining the significance of the cumulative impacts on bat species. It is likely that the significance of cumulative impacts will also vary between species, depending on inter alia local and regional abundance of different species, prey preferences, preferred flight height, preferred foraging habitat, degree of attraction to or deflection from turbines, extent of migratory behaviour, swarming characteristics and variability of behaviour in response to varying weather conditions. Bat behaviour and collision risk are likely to be highly site-specific during much of the annual cycle, but more generalised patterns, such as those relating to migration, may be superimposed on these local factors.

6.323 Whilst evidence is beginning to be revealed through a combination of academic research and on-going monitoring at wind farm sites, certainty with regard to cumulative effects is far from clear. This is because the effects of wind farms on bat populations is dependent on a wide variety of factors including; the turbine layout, the species of bats present, existing environmental conditions and the mitigation measures proposed at each wind farm (or individual turbine). Therefore, a clear understanding of the patterns of bat activity at individual wind farms (during the development of EIA's) is essential.

6.324 In the case of the Development a clear understanding of the patterns of bat activity at the site and surrounding area was used to inform the final layout and recommend mitigation, in the form of precautionary stand-off distances to habitat features, and the maintenance of said buffers for the 30-year lifetime of the wind farm).

6.325 The potential cumulative impact of the Development with (the wind farms within 15kms and single turbines (within 5km)) was specifically considered in relation to bats. These included;

- Ballyhanedin (6.7km) north west;

- Evishagaron (8.2km) north east;
- Altahullion I & II – (9.5-10.1km) north west;
- Glenconway I & II (9.5 -11km) north west;
- Corlacky (11.7km) north east;
- Doraville (13.5km) south;
- Mount Prospect single turbine (<1km)

6.326 The stand-off distances of the existing turbines were measured (in addition to the 6 turbines in the Development), in relation to habitat features such as watercourses and plantation edges (areas which are known to have higher levels of bat activity). None of the approved turbines encroached on the Natural England stand-off distance to the edge habitat features. Therefore, if precautionary stand-off distances were applied retrospectively to the windfarms described, the layouts would comply with the guidance (with the implementation of agreed mitigation at the respective sites listed above). The cumulative impact (of the 6 proposed Magheramore turbines) is not considered to alter the existing predicted impacts, therefore the cumulative impact is **not** considered to be **significant**.

Badger

6.327 It is not anticipated that the Development will have a measurable impact on local badger social groups and the wind farm will therefore not contribute to any cumulative impacts that may be detectable from the operation of other wind farms in the local area. The cumulative impact on badgers is considered to be **not significant**.

Herpetofauna

6.328 The limited distribution of these species across much of the site and the habitat improvements specifically designed to favour them, indicate that the Development will not add to any adverse cumulative effects that may arise from wind farm developments generally. The cumulative impact on the site herpetofauna is therefore considered to be **not significant**.

Trans-boundary effects

6.329 Potential trans-boundary effects of the Development on designated sites and on mobile species (i.e. bats) were assessed. The effects are considered to be the same as those described in the relevant sections (i.e. cumulative effects). Trans-boundary effects are therefore not considered to be significant. Potential trans-boundary effects of the Development on Annex 1 migratory bird species are assessed in **Chapter 7 - Ornithology**.

Conclusions

6.330 There is no regular usage of the area by otter, red squirrel, smooth newt, marsh fritillary or argent & sable moth, therefore no impacts to these species is likely. Mitigation for the reptiles found on site (i.e. common lizard) is proposed. This involves the provision of habitat management, as well as drift fencing and mowing/hand clearance during the construction phase. No badger setts found during survey.

6.331 The proposed outline HMP will ensure compensation for areas of NI Priority Habitat lost under the footprint of the Development and should also result in enhancement of the local site ecology.

6.332 The mitigation measures specified in **Table 6.15** will be adhered to, ensuring that any potential impacts to bats will be negligible. In conclusion and based on current knowledge this would appear to be a site posing little risk to bats or bat populations, however a BMMP has been recommended as a precaution.

6.333 Therefore, the potential effects of the Development on ecological receptors have been assessed and it is concluded that with the implementation of appropriate mitigation measures the effects would be reduced to a **minor adverse** or **neutral effect** that would not adversely affect the ecological integrity of the site and the wider area.

6.334 An assessment of cumulative impacts on the habitats and fauna of the area was also undertaken, and it was concluded that this is **not significant impact**.

References

6.335 References have been inserted as footnotes within the body of the document.

Abbreviations

AONB	Area of Outstanding Natural Beauty
ARGUK	Amphibian and Reptile Groups of the UK
ASSI	Area of Special Scientific Interest
BSBI	Botanical Society of the British Isles
CEDaR	Centre for Environmental Data and Recording
CIEEM	Chartered Institute of Ecology and Environmental Management
CNCC	Council for Nature Conservation and the Countryside
EC	European Commission
EcIA	Ecological Impact Assessment
EIA	Environmental Impact Assessment

HRA	Habitat Regulations Assessment
HSI	Habitat Suitability Index
IROPI	Imperative Reasons of Overriding Public Interest
JNCC	Joint Nature Conservation Committee
LHP	Larval Host Plant
MNR	Marine Nature Reserve
NBN	National Biodiversity Network
NIBG	Northern Ireland Bat Group
NIEA	Northern Ireland Environment Agency
NIPS	Northern Ireland Priority Species
NNR	National Nature Reserve
NR	Nature Reserve
PPS	Planning Policy Statement
SAC	Special Area of Conservation
SLNCI	Sites of Local Nature Conservation Importance
SPA	Special Protected Area
UWT	Ulster Wildlife Trust

7

Ornithology

7 Ornithology

Introduction

7.1 This chapter assesses potential effects of Magheramore Wind Farm, hereinafter referred to as 'the Development', on bird communities. The principal objectives of the chapter are:

- To outline the scope of the assessment;
- To describe the methodologies used in completing the assessment;
- To describe the baseline bird communities found within the site and in defined surrounding buffer areas;
- To describe the potential effects on bird communities and assess the significance of these effects;
- To detail any mitigation or compensation measures that may be required and to describe any residual effects remaining after the implementation of these measures.

7.2 The ornithology assessment is supported by:

- Figures 7.1 - 7.11 and Confidential Figure 7.12;
- Appendices 7.1 - 7.16.

7.3 The Figures and Appendices are referenced in the text as necessary and listed in full at the end of the chapter.

Statement of Authority of the Author

7.4 The ornithology assessment has been carried out by David Steele:

- Professional qualifications - B.Sc. (2i Honours), Zoology, University of Aberdeen (1988);
- Professional experience – 30 years working as a professional ornithologist throughout Britain and Ireland, covering a wide range of bird species and methodologies including those particularly relevant to on-shore wind farm work (raptor monitoring, moorland bird surveys and breeding wader surveys). This work has been for a range of organizations including the Royal Society for the Protection of Birds, British Trust for Ornithology, Birdwatch Ireland and Scottish Natural Heritage (Seabirds Team). For the last 16 years working as a freelance consultant and has completed the fieldwork and ornithology assessments for 16 wind farm proposals in Northern Ireland and has also completed training on collision risk modelling.

Legislation and Policy Guidance

Legislation

7.5 The ornithology assessment has been carried out with reference to the following key pieces of legislation:

7.6 The Wildlife (Northern Ireland) Order 1985 (amended) which describes general protection measures for wild birds and in particular Schedule 1 to the Order which details those species (for example raptors) that have special levels of protection;

7.7 Annex 1 of the EC Birds Directive which details those bird species which are of particular conservation concern in Europe and which should be subject to special measures concerning their habitats in order to ensure they maintain a favorable conservation status.

Policy Guidance

7.8 In line with the current policy of the Northern Ireland Environment Agency (NIEA) the assessment has been carried out with reference to the published guidance of Scottish Natural Heritage (SNH) on assessing the effects of on-shore wind farms on bird communities outside designated conservation areas[1].

Scope of Assessment

General Effects of Wind Farms on Birds

7.9 On-shore wind farms can potentially effect birds in two main ways – by displacement of birds around the turbine array (leading to indirect habitat loss) or by creating a risk of collisions with the turbines. Direct habitat loss from wind farms is usually relatively small scale compared to other sorts of developments and in most cases is unlikely to be significant for bird communities[2].

7.10 The ornithology assessment therefore focuses on assessing potential displacement effects and (where relevant) collision risk effects of the Development. The assessment considers the potential effects on the bird communities found within the site and in defined surrounding buffer areas. Where relevant, the assessment also considers the potential cumulative effects resulting from other existing, consented or proposed wind farms in the vicinity of the Development.

Bird Species Requiring Assessment

7.11 All wild birds are subject to a general level of protection through the Wildlife and Countryside Act (Wildlife Order in Northern Ireland) and the EU Birds Directive but

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[1] SNH (2006): Assessing the significance of impacts of on-shore wind farms on birds out-with designated areas (Guidance Note, July 2006)

[2] Percival, S. (2005): Birds and wind farms, what are the real issues? (British Birds 98 / 4)

in line with SNH guidance only some bird species should generally be of concern in relation to wind farms:

- Birds on Annex 1 of the EU Birds Directive;
- Birds on Schedule 1 to the Wildlife and Countryside Act (Wildlife Order in Northern Ireland);
- Regularly occurring migratory species;
- Species listed on the non-statutory lists of birds of conservation concern for the UK and Ireland.

7.12 The SNH guidance recommends that assessment of the effects of a wind farm on birds normally need not consider bird communities that do not come under the above categories. *Additionally, it should be noted SNH are of the view that passerine species (e.g. small moorland birds such as skylarks and meadow pipits) are not significantly impacted by wind farms[3].* However, all bird species (including passerine species) need to be considered in relation to the general levels of statutory protection afforded by the Wildlife (Northern Ireland) Order[4].

Designated Conservation Sites

Banagher Glen ASSI and SAC

7.13 Part of the Banagher Glen Area of Special Scientific Interest (ASSI) and Special Area of Conservation (SAC) is immediately adjacent to the Development boundary and the assessment considers possible effects on the ornithological interest of these sites.

Consultation

7.14 A consultation response in relation to the Development has been received from NIEA (NED)[5]. This included general scoping guidance for environmental impact assessment and in relation to flora and fauna (including birds).

7.15 Northern Ireland Raptor Study Group (NIRSG) responded to a formal request for information on breeding raptors in the vicinity of the proposed Development and also discussed raptor breeding activity in the area on personal communication basis.

Assessment Methodology

Survey Methods

7.16 Field surveys were carried out in line with the current SNH guidance for bird surveys at on-shore wind farms[6]. The different methodologies employed during the field surveys are described below.

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[3] SNH (2014): Recommended bird survey methods to inform impact assessment of onshore wind farms (Guidance Note, May 2014)

[4] NIEA: The Wildlife Law and You in Northern Ireland (Northern Ireland Environment Agency Biodiversity Series Booklet)

[5] DAERA Planning Response Ref. LA01/2918/1019/DETEIA: Intention to submit an Environmental Statement for the proposed Magheramore Wind Farm

Breeding Bird Surveys

7.17 Breeding bird surveys have been completed in four different years as summarized in Table 7.1. These surveys were carried out during the breeding period April to early July. The single visit in 2013 was by way of an initial ornithology scoping visit to the site. This was followed by two consecutive years of breeding bird surveys (2014 and 2015) and then a further year of survey (2018) was completed in order to update the earlier surveys. Further details of the survey visits are provided in Appendix 7.1.

7.18 The surveys were completed using an adapted Moorland Bird Survey (MBS) method (also known as the "Brown and Shepherd" method). This method is suitable for surveying breeding waders (e.g. curlew) and also red grouse. SNH do not generally recommend survey of moorland passerines, however, on sites were breeding waders are absent or present only in small numbers then it is possible to include passerines in the MBS method. The surveys extended over the site and a 500 m buffer around the proposed turbine locations.

Curlews

7.19 In line with the current requirements of NIEA and RSPB the survey area for curlew was extended to include an 800 m buffer around the proposed turbine locations. This additional survey coverage was achieved by two principal methods: (1) by scanning the additional buffer area with binoculars during the standard MBS visits (any areas with access permissions and which were reasonably accessible were also walked through); (2) during the activity assessment surveys by scanning areas of potential curlew habitat from the vantage points and also by listening for calling / singing birds.

Table 7.1 - Summary of Breeding Bird Surveys

Year	Survey Visits Completed	Survey Months / Remarks
2018	4	April to early July
2015	4	April to early July
2014	3	April and May
2013	1	Single scoping visit in mid-June

Winter Bird Surveys

7.20 Surveys for wintering and migrating birds were carried out over the same area as the breeding bird surveys. Two consecutive years of surveys (contemporaneous

[6] SNH (2014 and 2017): Recommended bird survey methods to inform impact assessment of onshore wind farms (Guidance Notes, May 2014 and March 2017)

with the breeding bird surveys) were then followed by a further update year as summarized in Table 7.2. The surveys were completed using the same adapted MBS method as used for the breeding bird surveys. Migratory species (e.g. golden plovers) were also looked for during the early season breeding bird survey visits. Further details of the winter survey visits are provided in Appendix 7.2.

Table 7.2 - Summary of Winter Bird Surveys

Year	Survey Visits Completed	Survey Months / Remarks
October 2018 to February 2019	4	Oct, Nov, Jan, Feb
September 2014 to March 2015	7	Sep, Oct, Nov, Dec, Jan, Feb, Mar
November 2013 to February 2014	4	Nov, Dec, Jan, Feb

Vantage Point Surveys

7.21 An assessment of activity by raptors and other relatively large aerial species (e.g. migrating swans and geese) was completed from three vantage points in 24 consecutive months during the period November 2013 to October 2015. Additional survey (by way of update and using the same three vantage points) was then completed in 12 further consecutive months during March 2018 to February 2019. Vantage point survey effort during both the initial and the update survey periods is summarized in Table 7.3. A more detailed (monthly) summary of survey effort is provided in Appendix 7.3 and details of individual vantage point watches completed during the most recent (update) year are provided in Appendix 7.4.

7.22 Vantage points were selected in line with current SNH guidance, within any constraints imposed by access restrictions. The locations of the vantage points and the associated visibility coverage are shown in Figure 7.1. Areas of overlapping visibility (visible form two or more vantage points) are also shown in the figure.

7.23 In line with SNH guidance, visibility is shown at the lowermost height passed through by the rotor blade tips (which in this case is 38 m above ground level). For the assessment of collision risk, visibility at rotor height is more important than visibility at or near the ground. However, it is important to note that during the vantage point surveys the observer was content with visibility at or near ground level.

7.24 The activity assessment surveys were completed in line with the SNH method statement for vantage point watches[7]. The target species were: (1) all raptor species, but with priority given to the three Annex 1 species (hen harrier, peregrine and merlin); (2) whooper swans and geese (winter and migration periods only).

[7] SNH (2014): Recommended bird survey methods to inform impact assessment of onshore wind farms (Guidance Note, May 2014)

Other species (e.g. golden plovers, gulls, cormorants and grey herons) were recorded as secondary species. At the discretion of the observer, notes were also kept of any significant activity by smaller aerial species (e.g. feeding swallows).

7.25 Vantage point watches were carried out at different times of day and in a range of weather conditions within the constraints imposed by the SNH method statement. Most watches were of three hours duration but some shorter or longer watches (not shorter than one hour or longer than four hours) were also completed.

Roost Surveys

7.26 During the initial survey period a number of vantage point watches were targeted at detecting potential roosting or pre-roosting activity by hen harriers. A smaller number of roost survey watches were also completed during the more recent update survey period. The roost watches were mostly carried out during the winter season. Watches commenced at least 30 minutes before sunset and continued till dusk (typically 30-40 minutes after sunset). A summary of these watches is provided in Appendix 7.5.

Table 7.3 – Summary of Vantage Point Surveys (Hours Completed)

Survey Period	VP1	VP2	VP3
Sep 2018 to Feb 2019 (non-breeding period 3)	36	34	34
Mar 2018 to Aug 2018 (breeding period 3)	34	36	38
Mar 2015 to Aug 2015 (breeding period 2)	36	36	36
Sep 2014 to Feb 2015 (non-breeding period 2)	36	36	36
Mar 2014 to Aug 2014 (breeding period 1)	36	36	36
Nov 2013 to Feb 2014 (non-breeding period 1)	24	24	24

Wider Area Surveys

7.27 Surveys of activity by nesting raptors were carried out in the wider area around the Development. The surveys focused on Annex 1 species (hen harrier, peregrine and merlin) although signs of breeding activity by non-Annex 1 species (buzzard, sparrowhawk and kestrel) were also looked for. In line with current SNH guidance[8] the area of interest of these surveys was limited to a 2 km radius around the proposed turbine locations. Survey effort and areas targeted depended primarily on indications provided by the vantage point surveys in combination with an assessment of potential nesting sites for the relevant species within the area of interest.

7.28 Wider area surveys were completed during the two earlier survey years (2014 and 2015) and repeated (by way of update) during the more recent (2018) survey year.

[8] SNH (2014): Recommended bird survey methods to inform impact assessment of onshore wind farms (Guidance Note, May 2014)

The surveys followed appropriate methodologies for the different target species[9] and the fieldworker for the surveys (David Steele) has significant previous professional knowledge of raptors within the area of interest[10]. During the course of the surveys the fieldworker also had contact with NIRSG fieldworkers who were active in the area - contact was on an informal basis only and was additional to the formal request for Annex 1 species records.

7.29 The surveys were carried out from roads, forestry tracks and other areas with public access within the area of interest. To avoid disturbance, any breeding activity was watched from remote or unobtrusive locations and under no circumstances were nests approached or visited. Further details of the survey activity carried out within the area of interest during the baseline period are provided in Appendix 7.6.

Assessing Significance of Effects

Favourable Conservation Status

7.30 The assessment of the significance of effects on bird communities primarily follows the Favourable Conservation Status (FCS) approach recommended by SNH[11]. This approach considers any potential effects on a given species and any expected reduction in numbers and sets these in the context of the total national or regional population and distribution of the species. This should then enable an evaluation of the test: *will an effect be such as to adversely affect the favourable conservation status of the species concerned (or to prevent a recovering species from achieving favourable conservation status) at the national or regional level.* The conservation status of the bird communities and species considered by the ornithology assessment follows the current non-statutory list of birds of conservation concern published for the island of Ireland[12].

Significance Threshold

7.31 For assessing the significance of bird populations (or any expected losses at the national or regional level) the generally accepted 1% threshold level is used: *if a population (or loss to a population) exceeds 1% of the national or regional population of the species then it should be considered to be significant.*

Confidence in Predictions

7.32 In the assessment of effects, the probability of any given effect occurring (and the probability of any likely effects being significant) are described using the scale

[9] Hardy, J. et al. (2009): Raptors – a Field Guide to Survey and Monitoring (2nd Edition)
[10] Steele, D., Knight, G and Mellon, C: Sperrin Mountains Breeding Bird Survey 1998 (Unpublished Report to RSPB and NIEA, October 1998)

[11] SNH (2006): Assessing the significance of impacts of on-shore wind farms on birds out-with designated areas (Guidance Note, July 2006)
[12] Colhoun, K and Cummins, S (2013): Birds of Conservation Concern in Ireland 2014-2019 (Irish Birds 9: 523-544)

suggested by the Institute of Ecology and Environmental Management (IEEM)[13] – the scale is given in Appendix 7.7.

Local Effects

7.33 In line with the IEEM guidance, where relevant the assessment also considers possible local effects on bird communities. The assessment of the significance of local effects generally follows the same approach as for regional and national effects.

Cumulative Effects

7.34 Where relevant the assessment of the significance of effects also considers possible cumulative effects on bird communities from other existing, consented or proposed wind farm developments (including single turbines) in the vicinity. The assessment of cumulative effects follows the published SNH guidance[14].

Description of Baseline Bird Communities

Breeding Birds

Red Grouse

7.35 Sightings or other signs (e.g. droppings or feathers) of red grouse during the baseline surveys are detailed in Table 7.4 and the locations of the sightings / signs are shown in Figure 7.2. Within the area of interest (the site plus a 500 m turbine buffer) there were three red grouse records during the earlier baseline period and three further records during the more recent update period. All the records were clustered within a relatively small area within the eastern part of the buffer (no grouse were recorded within the site boundary). The average distance of red grouse from the nearest proposed turbine locations (T1 and T2) is 445 m (N=6); the closest distance is 380 m. The records indicate the presence of a single pair of red grouse with a territory that does not impinge on the site and overlaps only marginally with the buffer.

Table 7.4 - Summary of Red Grouse Records

Date	Survey Method	Details
20th Sep 2018	Vantage Point	Calling male
16th May 2018	Vantage Point	Calling male
23rd Apr 2018	MBS	Single bird , disturbed from ground
16th Sep 2015	Vantage Point	Calling male

[13] IEEM (2006): Guidelines for Ecological Impact Assessment in the United Kingdom

[14] SNH (2012): Assessing the cumulative impact of onshore wind energy developments (Scottish Natural Heritage Guidance Note, March 2012)

Date	Survey Method	Details
22nd May 2014	MBS	Calling male
9th Dec 2013	MBS	Fresh droppings found

Curlews

7.36 No curlews have been recorded within the area of interest (the site plus an 800 m turbine buffer) during the baseline period.

Other Breeding Waders

7.37 No other breeding wader species (e.g. snipe and lapwing) have been recorded within the area of interest (the site plus a 500 m turbine buffer) during the baseline period.

Moorland Passerines

7.38 The baseline for moorland passerines and other bird species within the area of interest (the site plus a 500 m turbine buffer) is summarized in Table 7.5 and the locations of these species (breeding pairs / territories or singing males) are shown in Figures 7.3 – 7.6. The baseline presented in the table and the bird locations shown in the figures are for the most recent year of survey (locations for bird species not present in the most recent year are shown for the year in which they were recorded). Locations of skylark territories are also shown for the earlier baseline period. The results for all moorland passerine species from the earlier baseline period are summarized in Appendix 7.8.

7.39 A total of 21 passerine and other species were confirmed or probably breeding within the area of interest. An additional ten species were recorded as transient visitors that were not breeding within the area of interest but visited the area to feed (e.g. swallows, sand martins, starlings and rooks) or on spring migration (wheatears).

7.40 Meadow pipit was the most abundant and widely distributed passerine species. Most other species were present in small numbers only and were distributed very locally within or around the fringes of the area of interest. Several species (e.g. song thrush, chaffinch and nesting hooded crows) were associated primarily with the coniferous shelterbelts that have been planted within the site.

7.41 Three species (crossbill, whitethroat and grasshopper warbler) were present in the earlier baseline period but not during the more recent update year. For various reasons these species may therefore not be regularly occurring within the area of interest. For other species, numbers occurring within the area of interest during the earlier baseline period (Appendix 7.8) are broadly comparable with those found in the recent update year.

Table 7.5 – Baseline for Moorland Passerines

Species	No. of Breeding Pairs / Territories	Remarks
Grey heron	**0**	**Non-breeding transient (max. count one bird)**
Mallard	**0**	**Non-breeding transient (max. count two birds)**
Cuckoo	**2**	**Singing males**
Swallow	**0**	**Non-breeding transient (max. count 20 birds)**
Sand martin	**0**	**Non-breeding transient (max. count 20 birds)**
House martin	**0**	**Non-breeding transient (max. count 30 birds)**
Skylark	**6**	**Singing males**
Meadow pipit	**24**	
Stonechat	**2**	
Wheatear	**0**	**Non-breeding transient (max. count 4 birds)**
Robin	**4+**	**Associated with shelterbelts**
Song thrush	**2**	**Associated with shelterbelts**
Mistle thrush	**1**	**Associated with shelterbelts**
Blackbird	**1+**	**Associated with shelterbelts**
Wren	**6+**	
Coal tit	**2+**	**Associated with shelterbelts**
Grey wagtail	**0**	**Non-breeding transient (max. count one bird)**
Goldcrest	**3+**	**Associated with shelterbelts**
Willow warbler	**11**	
Grasshopper warbler	**1**	**2015 only**
Blackcap	**2**	
Whitethroat	**1**	**2014 only**
Starling	**0**	**Non-breeding transient (max. count 100 birds)**
Chaffinch	**6+**	**Associated with shelterbelts**
Crossbill	**1**	**2014 only**
Linnet	**1**	
Redpoll	**3**	
Hooded crow	**4+**	**Pairs associated with shelterbelts**
Rook	**0**	**Non-breeding transient (max. count 150**

Species	No. of Breeding Pairs / Territories	Remarks
		birds)
Raven	**0**	**Non-breeding transient (max. count 20 birds)**
Reed bunting	**3**	

Winter Birds

7.42 Sightings of all Annex 1 species (e.g. golden plover) and other winter bird sightings considered to be note (e.g. those relating to scarcer species or of significant flocks) within the area of interest (the site plus a 500 m turbine buffer) are given in Table 7.6 and locations for these sightings are shown in Figure 7.11. During the baseline period golden plovers have been recorded only very irregularly and in very small numbers within the area of interest. The maximum flock size recorded (20 birds) would not be significant even at a local level. There was one record of jack snipe during the earlier baseline period but none during the recent update year. A flock of 100 redpolls was observed feeding in birch trees within the buffer area (close to the boundary with Banagher Glen ASSI / SAC) in November 2018. The flock was highly mobile, and it is expected that this species will range very widely in winter within the local and wider surrounding area.

7.43 Details of all other birds recorded during the winter surveys are summarized in Appendix 7.9. A total of 33 bird species were recorded during the winter surveys but all of these species are very widespread in distribution locally and regionally and were recorded within the area of interest in small numbers or on an irregular basis only.

Table 7.6 - Summary of Annex 1 and Other Notable Winter Bird Sightings

Date	Species	Count / Remarks
15th Oct 2018	Golden plover	eight birds (flock)
17th Jan 2014	Golden plover	one bird
2nd Jan 2014	Golden plover	20 birds (flock)
18th Nov 2013	Golden plover	two birds
18th Nov 2013	Jack snipe	one bird
26th Nov 2018	Redpoll	100 birds (flock)
17th Feb	Dipper	single bird

Date	Species	Count / Remarks
2014		

Altnaheglish Reservoir

7.44 The western arm of the Altnaheglish Reservoir falls just outside the area of interest (500 m turbine buffer) however it is visible from the site and during the winter and migration season surveys the opportunity was taken to scan the reservoir for any water-bird species (e.g. ducks, whooper swans, geese or cormorants) that might be present. The results of these counts are summarized in Appendix 7.10. During the baseline period no whooper swans or geese were recorded using the reservoir. Three duck species (mallard, wigeon and teal), cormorants, grey herons and gulls were recorded irregularly and in very small numbers that would not be locally significant.

Vantage Point Surveys

Annex 1 Species

7.45 Activity by Annex 1 species within the area of interest (the site plus a 500 m turbine buffer) during the baseline period is summarized in Table 7.7 and discussed under the relevant species headings below. The respective flight-lines for these species are shown in Figures 7.7 and 7.8. Further details of the individual sightings of Annex 1 raptors are given in Appendix 7.11.

Hen Harrier

7.46 During the baseline period harriers were recorded very infrequently within the area of interest. There were three sightings during the earlier baseline period: an immature male on 11th August 2015, an adult male on 5th November 2014 and a juvenile on 12th September 2014. During the recent (update) baseline period there was just one harrier sighting: of a "ringtail" (a bird in female-type plumage) on 18th February 2019. All sightings (bar the immature male on 11th August) were outside the breeding season for this species and all sightings were of foraging birds (there was no indication of any breeding activity by harriers within the site or 500 m buffer).

Peregrine

7.47 During the baseline period peregrines were recorded infrequently within the area of interest. There were a total of 15 sightings, of which eight were during the earlier baseline period and seven during the recent (update) period. Sightings were in January (1), February (2), March (3), April (1), June (1), July (2), August (1), September (1), October (2) and November (1). Nine sightings were of immature birds (either juveniles or 2nd-calander years) and six sightings of adult birds.

Merlin

7.48 During the baseline period merlins were recorded very infrequently within the area of interest. There were a total of four sightings, two during the earlier baseline period and two during the recent (update) period. Sightings were in July (1), September (1) and November (2). One sighting (in July 2014) was of an adult male and the others were of birds in female-type plumage. All sightings (including the adult male bird in July) were of birds engaged in foraging or related behaviours and there was no indication of any breeding activity by merlins within the site or 500 m buffer.

Whooper Swans

7.49 During the baseline period no whooper swan flight-lines were observed within the area of interest.

Table 7.7 - Summary of Activity by Annex 1 Species

Baseline Period	Sightings			
	Hen Harrier	Peregrine	Merlin	Whooper swan
Sep 2018 to Feb 2019 (non-breeding period 3)	1	2	2	0
Mar 2018 to Aug 2018 (breeding period 3)	0	5	0	0
Mar 2015 to Aug 2015 (breeding period 2)	1	1	0	0
Sep 2014 to Feb 2015 (non-breeding period 2)	2	3	1	0
Mar 2014 to Aug 2014 (breeding period 1)	0	2	1	0
Nov 2013 to Feb 2014 (non-breeding period 1)	0	2	0	0
Totals	4	15	4	0

Non-Annex 1 Species

7.50 Activity by Non-Annex 1 species within the area of interest (the site plus a 500 m turbine buffer) during the recent (update) baseline period is summarized in Table 7.8 and discussed under the relevant species headings below. The respective flight-lines for buzzards and kestrels during the update period are shown in Figures 7.9 and 7.10. Further details of the individual sightings of Non-Annex 1 species during the recent (update) baseline period are given in Appendix 7.12. Activity by Non-Annex 1 species within the area of interest during the earlier baseline period is summarized in Appendix 7.13.

Buzzard

7.51 During the recent (update) baseline period buzzards were recorded regularly within the area of interest. However, activity levels were not especially high, averaging one sighting for every five hours of survey effort during the breeding period (activity was less during the non-breeding period). The flight-lines for this species were widely distributed within the area of interest but with an indication of greater activity over the southern and north-western parts away from the turbine locations. Most sightings were of birds engaged in foraging or related behaviours and there was no indication of any breeding activity by buzzards within the area of interest. Buzzard activity during the earlier baseline period (Appendix 7.13) was broadly comparable to that found during the recent update period.

Honey Buzzard

7.52 A female honey buzzard was observed flying southeast along Banagher Glen at 1400hrs on 27th July 2018 during a watch from VP3. The bird moved quickly through the area and its flight-line impinged only marginally on the area of interest. Honey buzzard is a vagrant to Northern Ireland with just twelve published records up to 2008[15] and a small number of other records since then[16]. There have been no confirmed or suspected breeding records in Northern Ireland and this species is therefore extremely unlikely to be regularly occurring within the area of interest. The sighting was considered to be of low sensitivity and was made public at the time via the Northern Ireland Birdwatchers Association online blog ("NI Birds") and also via Irish Birding.com.

Kestrel

7.53 During the recent (update) baseline period kestrels were recorded only occasionally within the area of interest and sightings were much less frequent than for buzzards. Most sightings were of birds engaged in foraging or related behaviours and there was no indication of any breeding activity by kestrels within the area of interest. Kestrel activity during the earlier baseline period (Appendix 7.13) was broadly comparable to that found during the recent update period.

Sparrowhawk

7.54 During the recent (update) baseline period sparrowhawks were recorded only very occasionally within the area of interest. Most sightings were of birds engaged in foraging or related behaviours however there was one sighting of a bird performing a display flight – the display flight was performed along Banagher Glen and impinged only marginally on the area of interest. The display related to a confirmed nesting attempt located within the wider area (within 2 km) and nesting did not take place within the site or 500 m buffer. Sparrowhawk activity during the

[15] Northern Ireland Birdwatchers Association - Northern Ireland Bird Reports

[16] Irish Birding.com

earlier baseline period (Appendix 7.13) was broadly comparable to that found during the recent update period.

Table 7.8 - Summary of Activity by Non-Annex 1 Species

Baseline Period	Sightings			
	Buzzard	Honey buzzard	Kestrel	Sparrow hawk
Sep 2018 to Feb 2019 (non-breeding period 3)	11	0	4	1
Mar 2018 to Aug 2018 (breeding period 3)	25	1	6	4
Totals	36	1	10	5

Wider Area Surveys

Annex 1 Raptor Species

7.55 Breeding activity by Annex 1 raptors within the wider area (within 2 km radius of the proposed turbine locations) during the baseline period is summarized in Table 7.8. Further details of breeding activity are given in Appendix 7.14 (Confidential) and locations are shown in Figure 7.12 (included in Appendix 7.14). The results of the NIRSG Annex 1 species data request (NIRSG 2018-06) are given in Appendix 7.15. *The results of the data request are confidential other than to the applicant, Planning Causeway Coast & Glens Borough Council or Department of Agriculture, Environment & Rural Affairs*

Hen Harrier

7.56 During the baseline period no hen harrier pairs or confirmed nests were located within the wider area. A single female harrier was recorded on one date in April 2018 at a location approximately 2 km from the nearest proposed turbine location, however the bird was foraging over a wide area and no evidence for breeding was observed (see Confidential Appendix).

Peregrine

7.57 A pair of peregrines was present at a potential nest site within the wider area during one year of the baseline period (2014) however despite follow-up surveys breeding was not confirmed in that year and no birds were present in the next year (2015). In the recent (update) baseline year a single immature (2^{nd}-calander year) peregrine was observed at the same potential nest site, however no adult birds or other signs of breeding were found (see Confidential Appendix). The potential nest site is located approximately 1.5 km from the nearest proposed turbine location, however the observations made during the baseline period would indicate that it is not occupied by nesting peregrines on a regular basis.

Merlin

7.58 During the baseline period no merlin pairs or confirmed nests were located within the wider area. An adult male merlin observed at the eastern boundary of the site in July 2014 during a vantage point survey was a foraging bird and is likely to have been from either of two known long-term merlin nest sites[17] located within 5 km but outside the 2 km wider area of interest.

Table 7.8 - Summary of Annex 1 Raptor Activity in the Wider Area (2 km radius)

Baseline Year	Peregrine		Merlin		Hen harrier	
	Pairs	Confirmed nests	Pairs	Confirmed nests	Pairs	Confirmed nests
2018	0	0	0	0	0	0
2015	0	0	0	0	0	0
2014	1	0	0	0	0	0

Non-Annex 1 Species

7.59 Breeding activity by Non-Annex 1 raptors within the wider area (within 2 km radius) during the baseline period is summarized in Table 7.9. Further details of breeding activity are given in Appendix 7.14 (Confidential Appendix) and locations are shown in Figure 7.12 (included in the Confidential Appendix). Breeding activity is discussed further under the relevant species headings below.

Buzzard

7.60 During the baseline period three buzzard pairs and up to two confirmed nests were located within the wider area. The confirmed nests were at two different sites located 1.6 km (Site 1) and 1.0 km (Site 2) from the nearest proposed turbine locations. Nesting was confirmed at Site 1 in 2015 and again in 2018. Nesting was confirmed at Site 2 in 2014 and 2015 but not in 2018. A third pair (Pair 3) were present within an area approximately 1.5 km from the nearest proposed turbine however breeding was not confirmed at this location during the baseline period.

Kestrel

7.61 During the baseline period no kestrel pairs or confirmed nests were located within the wider area. Kestrels were observed foraging within the site during the vantage point surveys and foraging birds can travel at least 3 - 4 km from the nest site[18]. The flight-lines indicated that a pair of kestrels were possibly breeding somewhere to the south or east of the site, outside the 2 km wider area of interest.

[17] Personal observations and NIRSG personal communications

[18] Personal observations

Sparrowhawk

7.62 A single pair of sparrowhawks was confirmed nesting within the wider area in each of the three baseline years. Although no nests were found, breeding was confirmed (and the general area of nesting indicated) by observations of adult birds carrying prey and sightings of fledged juveniles. In each year the confirmed nesting was in a general area located approximately 1.2 km from the nearest proposed turbine location.

Table 7.9 - Summary of Non-Annex 1 Raptor Activity in the Wider Area (2 km radius)

Baseline Year	Buzzard		Kestrel		Sparrowhawk	
	Pairs	Confirmed nests	Pairs	Confirmed nests	Pairs	Confirmed nests
2018	3	1	0	0	1	1
2015	3	2	0	0	1	1
2014	3	1	0	0	1	1

Assessment of Effects

Breeding Birds

7.63 The potential effects of the proposed Development on breeding birds are described under the headings below. Potential adverse effects and the significance of any likely effects at the regional (Northern Ireland) level are summarized in Table 7.10. The likelihood / probability of an effect occurring or being significant are described using the IEEM probability table (Appendix 7.7).

General Remarks

7.64 Results of research for breeding birds[19] have suggested that the main adverse effects of wind farms for these species are probably due to disturbance displacement during construction and that wind farm operation is unlikely to have a significant effect on local breeding bird populations. The research also suggested that there are potential beneficial effects of wind farm construction on some passerine bird species.

Red Grouse

7.65 The baseline surveys indicated the presence of a single pair of red grouse with a territory that does not impinge on the site and overlaps only marginally with the buffer. All records were clustered within a relatively small area within the eastern part of the buffer and no grouse were recorded within the site boundary.

[19] Pearce-Higgins, J.W. et al. (2012): Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis (Journal of Applied Ecology 49)

7.66 Densities of red grouse have been found to be reduced at wind farms during construction[20] however they had recovered one year after construction, therefore any displacement of birds due to construction would be likely to be temporary. In any case, the recorded distances of red grouse records from the nearest proposed turbines (average 445 m, closest 380 m) means that the birds are unlikely to be displaced to any significant extent. There is no indication that red grouse avoid turbines[21] so birds are extremely unlikely to be displaced during the operational phase of the wind farm.

Moorland Passerines

7.67 Densities of two passerine species (skylark and stonechat) have been found to increase at wind farms during and after construction and there is also an indication of a possible beneficial effect for meadow pipits during construction[22]. It is suggested that vegetation disturbance during the construction of wind farms results in changes to the vegetation that are known to favour these species. The significance of any beneficial effects is likely to be at a local level only however it is significant that no adverse effects have been observed for these species.

7.68 It should also be noted that SNH are of the view that passerine species are generally not adversely affected by wind farms[23] and many of the records of these species within the area of interest are not in the near vicinity of the proposed turbine locations or other infrastructure. All of the moorland passerine species recorded within the area of interest are also occurring in the wider surrounding area and are also widely distributed locally and at a regional level. It is therefore extremely unlikely that there would be any significant displacement effects for moorland passerines.

7.69 The Outline Habitat Management Plan (OHMP) (Technical Appendix 6.4) includes 15.5 ha to be managed under a low-intensity grazing option and 1.13 ha to be set aside for natural woodland regeneration (Figure 6.8). These measures are described in more detail in the OHMP and are likely to provide a significant beneficial effect for several moorland passerine species occurring within the Development site and surrounding buffer area. In particular, the 15.5 ha of low-intensity grazing is likely to provide a significant beneficial effect for meadow pipits, skylarks, reed buntings, grasshopper warblers and stonechats. The natural woodland regeneration area is smaller in extent but nevertheless is likely to be of

[20] Pearce-Higgins, J.W. et al. (2012): Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis (Journal of Applied Ecology 49)

[21] Pearce-Higgins, J.W. et al. (2009): The distribution of breeding birds around upland wind farms (Journal of Applied Ecology 46)

[22] Pearce-Higgins, J.W. et al. (2009): The distribution of breeding birds around upland wind farms (Journal of Applied Ecology 46)

[23] SNH (2006): Assessing the significance of impacts of on-shore wind farms on birds out-with designated areas (Guidance Note, July 2006)

benefit to several locally occurring species that are associated with woodland habitats (e.g. cuckoos, willow warblers and blackcaps).

Table 7.10 - Summary of Potential Effects on Breeding Birds

Species / Species Group	Potential Effect	Likelihood and / or Significance of Effect
Red grouse	Displacement	Extremely unlikely to be significant
Moorland Passerines	Displacement	Extremely unlikely to be significant
Moorland Passerines	Beneficial effect due to improved habitat quality (15.5 ha of low-intensity grazing and 1.13 ha of natural woodland regeneration)	Likely to be a significant beneficial effect within the Development site and surrounding buffer area

Winter Birds

7.70 The potential effects of the proposed Development on winter birds are likely to be similar to those described for breeding birds. Therefore, the main adverse effects for these species are also likely to be due to disturbance displacement during construction and wind farm operation is unlikely to have a significant effect on local populations of these species. In addition, it is also likely that there may be potential beneficial effects of wind farm construction for some wintering and migrating passerine bird species.

7.71 The baseline surveys have indicated that the area of interest is not of significance for any wintering or migrating bird species (including Annex 1 species) therefore it is extremely unlikely that there would be any significant displacement effects in relation to wintering or migrating birds.

Shelterbelt Removal

7.72 The construction of the wind farm will require the removal (or partial removal) of several existing shelterbelts within the Development site. These shelterbelts are of non-native conifer trees and are not used for shelter or roosting by any sensitive bird species. All the bird species recorded using the shelterbelts are also occurring in the wider surrounding area and are widely distributed locally and at a regional level. Therefore, it is not expected that shelterbelt removal will have any significant adverse effects on bird communities.

Annex 1 Raptor Species

7.73 The potential effects of the proposed Development on Annex 1 raptor species are described under the headings below. Potential adverse effects and the significance of any likely effects at the regional (Northern Ireland) level are summarized in Table 7.11. The likelihood / probability of an effect occurring or being significant are described using the IEEM scale.

Hen Harriers

Displacement Effects (Foraging)

7.74 During the baseline period foraging harriers were recorded very infrequently within the area of interest and it is therefore extremely unlikely that any significant displacement effects would occur.

Collision Risk

7.75 During the baseline period there were an insufficient number of harrier sightings to provide robust bird flight data for input to the Collision Risk Model (just one sighting during the twelve month update period) however the low number of sightings within the area of interest and the foraging behaviour of this species (flying mostly within a few metres of the ground) would indicate that a collision is extremely unlikely.

Peregrines

Displacement Effects (Foraging)

7.76 During the baseline period peregrines were recorded infrequently within the area of interest and considering also the foraging behaviour of this species (taking prey from the airspace rather than relying on habitats at ground level) then it is therefore extremely unlikely that any significant displacement effects would occur.

Collision Risk

7.77 During the baseline period there were an insufficient number of peregrine sightings to provide robust bird flight data for input to the Collision Risk Model (total seven sightings during the twelve-month update period) however the low number of sightings within the area of interest and the extremely agile flight behaviour of this species would indicate that a collision is extremely unlikely.

Direct Disturbance (Nest Site)

7.78 The potential nest site is located approximately 1.5 km from the nearest proposed turbine location, however the observations made during the baseline period would indicate that it is not occupied by nesting peregrines on a regular basis. *In the event that the site is occupied by peregrines then the location of the site indicates that direct disturbance due to construction or operation of the wind farm is extremely unlikely.*

Merlins

Displacement Effects (Foraging)

7.79 During the baseline period merlins were recorded very infrequently within the area of interest and it is therefore extremely unlikely that any significant displacement effects would occur.

Table 7.11 - Summary of Potential Effects on Annex 1 Raptors

Species	Potential Effect	Likelihood and / or Significance of Effect
Hen harrier	Displacement	Extremely unlikely to be significant
Hen harrier	Collision risk	Extremely unlikely to occur
Peregrine	Displacement	Extremely unlikely to be significant
Peregrine	Collision risk	Extremely unlikely to occur
Merlin	Displacement	Extremely unlikely to be significant

Non-Annex 1 Raptor Species

7.80 The potential effects of the proposed Development on Non-Annex 1 raptor species are described under the headings below. Potential adverse effects and the significance of any likely effects at the regional (Northern Ireland) level are summarized in Table 7.12. The likelihood / probability of an effect occurring or being significant are described using the IEEM scale.

Buzzards

Displacement Effects (Foraging)

7.81 Flight activity by buzzards has been found to decline by 41% within 500 m of turbine arrays[24]. Assuming displacement does occur then the significance of this effect needs to be assessed in the context of other habitat that is likely to be available to the birds and also in the context of the favourable conservation status[25] and very widespread distribution of this species in Northern Ireland and in the island of Ireland as a whole[26].

7.82 Buzzards forage over a very wide range of habitats including moorland areas, un-intensive upland farmland habitats, woodland and commercial forestry habitats and intensive lowland farming habitats (including arable land and improved grasslands). During the baseline period buzzards were observed foraging in association with all of the above habitats within the wider area around the Development and availability of foraging habitat is unlikely to be a significant constraint for the birds. Placed in this context and considering the relatively small size of the Development (six turbines) then it is extremely unlikely that any foraging displacement would have a significant adverse effect on the distribution and abundance of the local buzzard population or on the regional conservation status of the species.

[24] Pearce-Higgins, J.W. et al. (2009): The distribution of breeding birds around upland wind farms (Journal of Applied Ecology 46)

[25] Colhoun, K and Cummins, S (2013): Birds of Conservation Concern in Ireland 2014-2019 (Irish Birds 9)

[26] Balmer, D. *et al*. (2013): Bird Atlas 2007-2011 (BTO Books)

Collision Risk

7.83 The collision risk assessment for buzzards using the Collision Risk Model is detailed in Appendix 7.16 and indicates an equivalent collision rate of one bird every 3.1 years. The collision rate needs to be assessed in the context of breeding productivity and also the favourable conservation status[27] and very widespread distribution of this species in Northern Ireland and in the island of Ireland as a whole[28].

7.84 The all-Ireland buzzard breeding population has been estimated at 3,312 pairs (of which about half are in Northern Ireland) however the population is still expanding in size and range[29]. Breeding productivity in Northern Ireland has been estimated at an average of 1.95 young fledging per successful pair[30] and a study in the Republic of Ireland recorded an average of 2.61 young fledging per successful pair[31] which is similar to the 2.5 young per successful pair recorded within the wider surrounding area during the baseline surveys completed for the Development (Appendix 7.14). Nesting success for this species also tends to be good, particularly compared to the ground nesting raptor species[32]. Buzzards are also very widespread in the local surrounding area of the Sperrins and Co. Londonderry in both lowland and upland habitats[33]. Placed in this context, then it is extremely unlikely that the predicted rate of collisions would have a significant adverse effect on the distribution and abundance of the local buzzard population or on the regional conservation status of the species.

Direct Disturbance (Nest Sites)

7.85 Disturbance distances for nesting buzzards are likely to be in the region of 500 m[34]. During the baseline period buzzard nests were confirmed at two different sites located 1.6 km (Site 1) and 1.0 km (Site 2) from the nearest proposed turbine locations and at these distances disturbance due to construction or operation of the wind farm is extremely unlikely.

Kestrels

Displacement Effects (Foraging)

7.86 The baseline surveys indicated some foraging activity by kestrels within the area of interest however activity levels were low and the species was not suspected to be

[27] Colhoun, K and Cummins, S (2013): Birds of Conservation Concern in Ireland 2014-2019 (Irish Birds 9)

[28] Balmer, D. *et al*. (2013): Bird Atlas 2007-2011 (BTO Books)

[29] Nagle, T. *et al.* (2014): Habitat and diet of re-colonising common buzzards *Buteo buteo* in County Cork (Irish Birds 10)

[30] Rooney, E and Montgomery, W.I. (2013) Diet diversity of the common buzzard *Buteo buteo* in a vole-less environment (Bird Study 60)

[31] Nagle, T. *et al.* (2014): Habitat and diet of re-colonising common buzzards *Buteo buteo* in County Cork (Irish Birds 10)

[32] Personal observations

[33] Personal observations

[34] Personal observations

nesting in the close vicinity. A relatively low turbine avoidance rate of 95%[35] indicates that kestrels may be less prone to displacement effects than most other raptors – along with the relatively small size of the proposed development (six turbines) and the presence of extensive suitable habitat in the wider surrounding area then it is extremely unlikely that any foraging displacement would have a significant adverse effect on the distribution and abundance of the local kestrel population or on the regional conservation status of the species.

Collision Risk

7.87 During the baseline period there were an insufficient number of kestrel sightings to provide robust bird flight data for input to the Collision Risk Model (total ten sightings during the twelve month update period). A relatively low turbine avoidance rate of 95% indicates that kestrels may be more prone to collisions than most other raptor species however the low activity levels within the area of interest would indicate that the collision rate is also likely to be low. Any potential collisions also need to be considered in the context of the very widespread distribution of this species in Northern Ireland and in the island of Ireland as a whole – although it is an Amber-listed species of conservation concern in Ireland[36], kestrel is nevertheless one of the most widespread and abundant raptor species in Britain and Ireland (present in almost 90% of 10 km squares) and is the most widely distributed raptor species in Ireland[37]. Placed in this context, then it is unlikely that a low rate of collisions would have a significant adverse effect on the distribution and abundance of the local kestrel population or on the regional conservation status of the species.

Table 7.12 – Summary of Potential Effects on Non-Annex 1 Raptors

Species	Potential Effect	Likelihood and / or Significance of Effect
Buzzard	Displacement	Extremely unlikely to be significant
Buzzard	Collision risk	Collision rate of one bird every 3.1 years extremely unlikely to be significant
Buzzard	Direct Disturbance (Nest Sites)	Extremely unlikely to occur
Kestrel	Displacement	Extremely unlikely to be significant
Kestrel	Collision risk	Expected low collision rate extremely unlikely to be significant

[35] SNH (2016): Avoidance rates for the SNH onshore wind farm Collision Risk Model (SNH Guidance Note, October 2016)

[36] Colhoun, K and Cummins, S (2013): Birds of Conservation Concern in Ireland 2014-2019 (Irish Birds 9)

[37] Balmer, D. *et al*. (2013): Bird Atlas 2007-2011 (BTO Books)

Banagher Glen ASSI and SAC

7.88 Part of the Banagher Glen Area of Special Scientific Interest and Special Area of Conservation is immediately adjacent to the Development boundary and the ornithological interest mentioned for these sites lists peregrines, wood warblers and redstarts as occurring in the area[38]. The Development is extremely unlikely to have any significant effect on peregrines. Wood warblers and redstarts are currently rarely reported in Northern Ireland[39]. Redstarts were recorded in the upper part of Banagher Glen adjacent to the Development during surveys in 1998[40] however they were not present in this area during the baseline survey period[41]. Wood warblers were not found by the 1998 surveys and recent incidental observations also did not find this species in the glen[42]. In any case, woodland birds (including wood warblers and redstarts) breeding within Banagher Glen are extremely unlikely to be affected by the Development.

Cumulative Effects

7.89 The consideration of possible cumulative effects of the Development (including for example the bird species requiring assessment and the scope of the assessment) has been completed following SNH guidance[43]. A review of information provided by the applicant and presented elsewhere within the ES has indicated that there are no other relevant wind farm developments in the immediate vicinity of the Development. The closest wind farm (existing or proposed) is Ballyhanedin which is located approximately 6.7 km to the west /northwest. Considering the baseline bird communities that are found within the Development site and surrounding buffer area then this wind farm is therefore located well beyond any likely zone of possible cumulative effects for these bird communities.

Mitigation

7.90 Proposed mitigation measures are summarized in Table 7.13 and would be implemented in full by the developer. Full details of the proposed Ornithological Mitigation Strategy (OMS) would be provided in reports prior to commencement of construction.

[38] DOE (NI): Banagher Glen ASSI Citation Documents

[39] Northern Ireland Birdwatchers Association NI Birds Blog

[40] Steele, D., Knight, G and Mellon, C: Sperrin Mountains Breeding Bird Survey 1998 (Unpublished Report to RSPB and NIEA, October 1998)

[41] Personal observations

[42] Personal observations

[43] SNH (2012): Assessing the cumulative impact of onshore wind energy developments (Scottish Natural Heritage Guidance Note, March 2012)

Table 7.13 – Proposed Mitigation Measures

Proposed Mitigation	Timing	Reason
Ornithological Mitigation Strategy (OMS)	During construction	To allow construction work to take place during the bird breeding season (1st March – 31st August) whilst avoiding any significant adverse effects on breeding birds

Summary and Conclusions

7.91 The potential effects of the Development on birds are summarized in Table 7.14. Direct habitat loss from wind farms is usually relatively small scale compared to other sorts of developments and in most cases is unlikely to be significant for bird communities therefore the ornithology assessment has focused principally on assessing potential displacement effects and (where relevant) collision risk effects of the Development.

7.92 No significant displacement effects have been identified for bird communities. For buzzards collision risk modelling has indicated a collision risk equivalent to one bird every 3.1 years however when assessed in the context of the favourable conservation status, breeding productivity and very widespread distribution of this species then the predicted collision rate is extremely unlikely to be significant. For other raptor species the comparatively low levels of activity recorded and an assessment of other relevant factors indicate that collisions are extremely unlikely to be a significant issue for these species.

7.93 Habitat management measures proposed as part of the Outline Habitat Management Plan are likely to provide significant beneficial effects for several moorland passerine species (including meadow pipits, skylarks, reed buntings, grasshopper warblers and stonechats) occurring within the Development site and surrounding buffer area.

7.94 In conclusion, the Development is extremely unlikely to have any adverse effects on bird communities, including those occurring within the adjacent Banagher Glen ASSI / SAC. For several moorland passerine species, the likely beneficial effects of the proposed habitat management measures indicates a potential overall net beneficial effect of the Development for these species.

Table 7.14 – Summary of Potential Effects of the Development on Bird Communities

Species / Species Group / Feature	Potential Effect	Likelihood and / or Significance of Effect
Red grouse	Displacement	Extremely unlikely to be significant
Moorland Passerines	Displacement	Extremely unlikely to be significant
Moorland Passerines	Beneficial effect due to improved habitat	Likely to be a significant beneficial effect

Species / Species Group / Feature	Potential Effect	Likelihood and / or Significance of Effect
	quality (Outline Habitat Management Plan)	
Winter Birds	Displacement	Extremely unlikely to be significant
Hen harrier	Displacement	Extremely unlikely to be significant
Hen harrier	Collision risk	Extremely unlikely to occur
Peregrine	Displacement	Extremely unlikely to be significant
Peregrine	Collision risk	Extremely unlikely to occur
Merlin	Displacement	Extremely unlikely to be significant
Buzzard	Collision risk	Collision rate of one bird every 3.1 years extremely unlikely to be significant
Buzzard	Direct Disturbance (Nest Sites)	Extremely unlikely to occur
Kestrel	Displacement	Extremely unlikely to be significant
Kestrel	Collision risk	Expected low collision rate extremely unlikely to be significant
Altnaheglish Reservoir (Waterbirds)	None	-
Banagher Glen ASSI / SAC	None	-
Cumulative Effects	None	-

References

References are given in full in the footnotes to the Chapter.

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8

Fisheries

8 Fisheries & Aquatic Ecology

Introduction

8.1 This chapter describes the fisheries interests of the watercourses draining the proposed Magheramore Wind Farm, hereinafter referred to as 'the Development', and considers the potential effects of the construction, operation and decommissioning of the development on these interests. The assessment consists of a desk-based assessment using available published and online information in combination with data and observations collected in the field. The specific objectives of the chapter are to:

- describe the fisheries baseline;
- describe the assessment methodology and significance criteria used in completing the impact assessment;
- describe the potential effects, including direct, indirect and cumulative effects;
- describe the mitigation measures proposed to address likely significant effects;
- assess the residual effects remaining following the implementation of mitigation.

8.2 The assessment has been carried out by Paul Johnston Associates, an independent fisheries consultancy specialising in freshwater fisheries in Ireland. Paul Johnston holds a BSc (Hons) in Zoology and a PhD in Fisheries Ecology; he is also a Fellow of the Institute of Fisheries Management (FIFM) and Chartered Environmentalist (CEnv). Also involved was David Kelly who holds a BSc (Hons) degree in Zoology, and a PhD in Freshwater Ecology; he is a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM), a registered member of the Institute of Fisheries Management (MIFM) and a member of the New Zealand Freshwater Sciences Society.

8.3 The practice has completed a wide range of assignments in the areas of environmental impact assessment, fisheries development and catchment management. This includes fisheries assessments in connection with a series of onshore wind farm developments in Northern Ireland.

8.4 **Volume 3 - Figures 8.1 – 8.6** are referenced in the text where relevant.

Legislation, Policy & Relevant Guidance

Fisheries Administration

8.5 With regard to fisheries administration and legislation, the footprint of the proposed Development lies within the Loughs Agency's geographic area of responsibility.

8.6 Under Section 11 (6) of the Foyle Fisheries Act (Northern Ireland) 1952 and the Foyle Fisheries Act 1952 (Republic of Ireland), the Foyle Fisheries Commission was given the responsibility for "the conservation, protection and improvement of the Fisheries of the Foyle Area generally". Under the North/South Co-Operation (Implementation Bodies) (Northern Ireland) Order 1999 and the British Irish Agreement Act 1999 these functions were extended to include the Carlingford Area, and the Foyle Fisheries Commission transferred its functions to the Loughs Agency.

8.7 The Loughs Agency is an agency of the Foyle, Carlingford and Irish Lights Commission (FCILC), established under the 1998 Agreement between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of Ireland.

Legislation

EU Legislation

8.8 EU and local legislation relevant to fisheries and the water environment in the area of the Development includes the following:

- EC Habitats Directive (92/43/EEC);
- EU Water Framework Directive (2000/60/EC) [incorporating standards from the Fish Directive [Consolidated] (2006/44/EC) – this Directive was repealed in 2013];
- European Eel Regulation (EC) 1100/2007.

Domestic Legislation

- Fisheries (Northern Ireland) Act 1966;
- Foyle Fisheries Act (Northern Ireland) 1952;
- North/South Co-Operation (Implementation Bodies) (Northern Ireland) Order 1999;
- Drainage (Northern Ireland) Order 1973;
- Environment (Northern Ireland) Order 2002;
- Nature Conservation and Amenity Lands (Amendment) (Northern Ireland) Order 1989;
- Water (Northern Ireland) Order 1999;
- Water Environment (Water Framework Directive) (Northern Ireland) Regulations 2003;
- Wildlife (Northern Ireland) Order 1985;
- Wildlife and Natural Environment Act (Northern Ireland) 2011.

Policy

8.9 Policy with regard to Atlantic salmon and European eel in this region is set out in the following:

- River Roe and Tributaries ASSI Citation;
- River Roe and Tributaries SAC Conservation Objectives;
- River Roe Local Management Area Plan;

- Atlantic Salmon Management Strategy for Northern Ireland and the Cross-Border Foyle and Carlingford catchments to meet the objectives of NASCO resolutions and agreements, 2008–2012 (DCAL);
- North Western International River Basin District Eel Management Plan (Northern Regional Fisheries Board/Loughs Agency/DCAL).

Guidance

8.10 Specific guidance relevant the Development includes the following:

- Guidelines for Fisheries Protection during Development Works (Foyle and Carlingford areas); Environmental Guidelines Series – No. 1 (Loughs Agency, 2011);
- Culvert Design and Operation Guide (C689) (CIRIA, 2010);
- Environment Agency Policy Regarding Culverts: Technical Guidance on Culverting Proposals (EA, 1999);
- PPG1: General guide to the prevention of pollution;
- PPG2: Above ground oil storage tanks;
- PPG3: Use and design of oil separators in surface water drainage systems;
- PPG4: Treatment and disposal of sewage where no foul sewer is available;
- PPG5: Works and maintenance in or near water;
- PPG6: Working at construction and demolition sites;
- PPG7: Refuelling facilities;
- PPG8: Safe storage and disposal of used oils;
- PPG13: Vehicle washing and cleaning;
- PPG18: Managing fire water and major spillages;
- PPG21: Pollution incident response planning;
- PPG26: Storage and handling of drums & intermediate bulk containers.

Scope of Assessment

8.11 The fisheries assessment has involved desk study, field work, data processing and analysis and interpretation using professional judgement. The key receptors are the River Roe, the Altnaheglish River, the Owenrigh River and a series of small tributary streams which drain the area within the Site Boundary, hereinafter referred to as ‘the Site’.

8.12 Existing fisheries data and relevant conservation information on the River Roe and Owenrigh River was assimilated and supplemented through a bespoke fisheries survey of the Site covering the principal watercourses draining the area.

8.13 The field study consisted of walkover surveys of the principal watercourses, assessments of physical habitat conditions, measurement of basic chemistry parameters, collection of benthic invertebrate samples for assessment of biological quality, and a fish stock survey by electrofishing.

8.14 The sensitivity of each watercourse with regard to fisheries has been assessed according to a methodology for environmental sensitivity outlined in the Design Manual for Roads and Bridges, specifically with regard to effects on the water environment (DMRB, 2009). Potential effects of the construction, operation and decommissioning phases of the Development were then assessed. This assessment was based primarily on the potential effects on resident fish stocks either directly or upon their habitats.

Consultation

8.15 The principal consultee during the study was the Loughs Agency as the statutory body with authority for fisheries matters in the local waters. Consultee responses are summarised in **Table 8.1**.

8.16 Consultations were also conducted with other sub-consultants on the project, notably in relation to hydrology and drainage issues which are contained within **Chapter 9: Geology and Water Environment** of this ES.

Table 8.1: Consultee Responses

Consultee		Summary of Response	Addressed in Assessment
Loughs Agency		Concern over the proposed location of this farm and its proximity to the Owenrigh/Roe SAC. It is near a public water supply, important salmonid rivers and is on steep ground. Any potential to impact on Altnaheglish Reservoir could impact fish populations in the reservoir, fish in inflowing and outflowing tributaries and on the public water supply.	Assessment of Effects 8.137-8.157; Mitigation 8.158-8.172; Residual Effects 8.173-184 Site Survey: Fisheries Habitat 8.108
DAERA	Environment, Marine & Fisheries Group	States no issues / concerns to raise from an aquaculture / sea fisheries aspect. Reminds the applicant it is an offence under Article 47 of the Fisheries Act (NI) 1966 to cause pollution which is subsequently shown to have a deleterious effect on fish stocks. States works near watercourses to be carried out in line with guidance as described in the PPG 5 (Works In, Near or Liable to Affect Watercourses).	N/A
DAERA	NIEA - Natural Environment Division	The application site is in close proximity to Banagher Glen SAC/ASSI and the River Roe and Tributaries SAC/ASSI. Proposals which may impact on a European site, will require a Habitats Regulations Assessment (HRA).	Assessment of Effects 8.137-8.157; Mitigation 8.158-8.172;

Consultee		Summary of Response	Addressed in Assessment
		Considers the proposal is likely to have significant environmental effects with regard to the Planning (EIA) Regulations (NI) 2015. The application site may contain priority peatland habitat. The topography, geology, soils and water environmental of the site and surrounding area should be described. ES should include the likely significant effects and proposed mitigation measures to offset any significant adverse effects.	Residual Effects 8.173-184
DFI	DfI Rivers	States PPS15 requires flood risk and drainage are assessed in the ES.	

Assessment Methodology

Baseline Characterisation

Study Area

8.17 The study area focussed on the Altnaheglish/ Owenrigh River and tributary streams which drain the area within the site. Field survey work was focussed mainly on the Altnaheglish/ Owenrigh River as the principal receiving watercourse.

8.18 The desk assessment includes an evaluation of fisheries in downstream reaches of the Owenrigh River and the wider catchment of the River Roe **(Volume 3 - Figure 8.1)**.

Desk Study

8.19 A desk study was carried out to assimilate baseline information relating to salmonid fisheries, ecological status (under WFD) and water quality (chemical and biological) for the study area. The following sources were consulted/used:

- Loughs Agency
- Northern Ireland Environment Agency (NIEA) – Water Management Unit (WMU) (Rivers and Lakes Team) www.doeni.gov.uk/niea/water/wfd.htm
- NIEA - Protected Areas www.doeni.gov.uk/niea/protected_areas_home
- Joint Nature Conservation Committee (JNCC) www.jncc/defra.gov.uk

Field Survey

General Approach

8.20 An initial walkover survey was carried out to assess the significance of the streams directly draining the Site. This was followed by more detailed surveys of the Altnaheglish/ Owenrigh River in the reach receiving water from the Site drainage streams.

8.21 The general approach for most aspects of the field survey was based on the *Before-After Control-Impact* Design (BACID) in which there is a need to compare response variables at an impact site over time (before and after construction), with the values of a control site (or multiple control sites) over the same time period. This was applied to streams draining the Site and thus it was intended that control and impact survey sites should be located upstream and downstream of the confluence of the three site drainage streams discharging to the Altnaheglish/ Owenrigh River. This was achievable with two of the three streams, but not with the uppermost stream upstream of which there was no discernible flow in the adjoining main channel due to the lack of any compensation flow from the reservoir 300m upstream. At this location it was therefore not possible to have a control site upstream of the stream confluence; however, an impact site was surveyed immediately downstream of the confluence.

8.22 The surveys at each site comprised assessments of stream quality (water chemistry, physical habitat and aquatic ecology), fisheries habitat and juvenile fish stocks.

Stream Quality

8.23 A series of survey sites was selected on the Altnaheglish/ Owenrigh River in association with the watercourses draining the Site and the survey was carried out in September and November 2018. For each site, baseline water chemistry, physical habitat and aquatic ecology were assessed.

Water Chemistry

8.24 A series of basic water quality parameters were measured at each site using portable meters to provide an outline profile of chemical quality.

8.25 Turbidity was measured using a EUTECH NT-100 turbidimeter which records in Nephelometric Turbidity Units (NTU). pH was measured using a WTW 3110 pH meter, dissolved oxygen with a Hanna Oxy-Check oxygen meter, and conductivity with a Hanna HI86303 conductivity meter; temperature measurements were made with both the pH and oxygen meters.

8.26 Turbidity was used as a proxy indicator of suspended solids as it can be measured quickly in the field. However, there is no universal relationship between turbidity and suspended solids, and accurate computation of suspended solids concentrations from turbidity would require that a calibration exercise be carried out on a site-specific basis.

Physical Habitat

8.27 River physical habitat (substratum type, depth, flow velocity) was assessed based on the fully quantitative method developed by DAERA Inland Fisheries Division and the AgriFood and Biosciences Institute (AFBI). In each site, surveys consisted of a 40m stream reach with 25 sampling points across five equidistant cross-sectional transects except on very narrow (<0.3m width) and overgrown streams where it was difficult to observe the riverbed; on these streams, up to 12 transects (1-3 sampling points per transect) were surveyed in each reach.

8.28 At each sampling point, flow velocity was recorded at 60% depth using a Geopacks flow meter, with water depth measured using the meter's impeller stick; substrate was visually assessed using a bathyscope with the dominant substrate type recorded according to a modified Wentworth Scale (Bain et al. 1985; **Table 8.2**).

Table 8.2: Substrate classification and scoring based on the Wentworth system (from Bain *et al.* 1985)

Substrate type	Size Class (mm)	Score
Sand/silt	<2	1
Gravel	2-16	2
Pebble	17-64	3
Cobble	65-256	4
Boulder	>256	5
Irregular Bedrock	-	6

8.29 The following physical characteristics were measured at each site:

- Stream width and depth at each transect (m)
- Substrate composition (visually estimated as per Bain et al., 1985);
- Percentage of deposited fine sediment (<2mm grain) on the river bed as per Clapcott et al. (2011), with the dominant fine sediment type (sand, silt, clays) determined by running the grain through the observer's fingers.

8.30 The classification system of Bain *et al* (1985) was used to summarise the composition of substrate in a reach based on two indices:

- Coarseness index (CI) – calculated as the mean dominant substrate score
- Heterogeneity (SD) – calculated as the standard deviation of the mean CI.

These indices show how coarse or smooth the substrate of a reach is and if it is comprised of a mixture or is dominated by a particular substrate class **(Table 8.3)**.

Table 8.3: Substrate description inferred from sample data (from Bain *et al.* 1985)

Mean substrate score (CI)	Heterogeneity (SD)	Inferred substrate description
3.2	1.96	Heterogeneous, smooth and rough
5.0	0.00	Homogeneous, coarse
1.25	0.44	Nearly homogeneous, smooth
3.25	0.85	Heterogeneous, intermediate coarseness
5.05	0.69	Heterogeneous, coarse

Aquatic Ecology

8.31 Stream benthic communities are sensitive to a range of environmental conditions, including fine sediment, and have taxa with relatively long lifespans and restricted mobility that allows for the integration of stressor effects over longer timescales than may be indicated by physico-chemical parameters alone (Matthaei et al. 2006; Extence et al. 2011).

8.32 Baseline ecology of the streams within the proposed Development site was assessed by sampling the benthic macroinvertebrate community in September 2018 using a standard three minute kick sample (hand-held 1mm mesh net) followed by a one minute search; this method is recommended by the United Kingdom Technical Advisory Group (UK-TAG) for assessing the condition of the quality element "benthic invertebrates" for WFD reporting (WFD-UKTAG, 2014).

8.33 Samples were collected from riffle/run habitats, fixed in 4% formalin for 1 week, followed by preservation in 70% ethanol prior to sorting and identification.

8.34 In the laboratory, macroinvertebrate samples were spread across a 4 x 5, 20-square grid sorting tray to facilitate identification and to estimate relative abundance. Abundant taxa were counted in a subset of five squares and scaled to whole sample estimates as recommended in Murray-Bligh (2002). Less abundant taxa were counted in all grid squares.

Fisheries Habitat

8.35 An outline assessment of the Owenrigh River and tributary streams draining the Site was carried out in August 2018 and consisted of walkover surveys recording general characteristics to provide an outline assessment for these watercourses. Additional information of fish habitat classification was recorded during the fish stock survey in September 2018.

8.36 The descriptive terminology used in the survey is based on the Life Cycle Unit method (Kennedy, 1984) currently used by DAERA Inland Fisheries and the Loughs Agency (see also DANI advisory leaflet No 1). In summary, habitat type is recorded as:

- Nursery (shallow rock/cobble riffle areas for juvenile fish - fry/parr);
- Holding (deeper pools/runs for adult fish);
- Spawning (shallow gravel areas for fish spawning);
- Unclassified (unsuitable for fish – shallow bedrock areas or heavily modified sections of channel).

Juvenile Fish Stocks

8.37 Monitoring of fish stocks by the Loughs Agency tends not to include sampling sites in the upper reaches of tributaries in most river systems. Therefore, this part of the fisheries assessment considered the principal streams draining the Development site and set out to obtain details on salmonid distribution in areas of the Castle River catchment not covered in routine sampling by the Loughs Agency.

8.38 A juvenile fish stock survey of the Altnaheglish and Owenrigh rivers adjacent to the site and including Stream C was carried out by electrofishing at selected locations in September 2018 (**Volume 3 - Figure 8.5**).

8.39 Electrofishing was carried out according to a semi-quantitative methodology described by Crozier and Kennedy (1994). The procedure involves two operators fishing continuously in an upstream direction for five minutes at each sampling location, using an E-Fish 500W single anode electrofishing backpack (EF-500B-SYS). The system operates on 24V input and delivers a pulsed DC output of 10 to 500W at a variable frequency of 10 to 100Hz. Output voltage and frequency are adjusted according to the electrical conductivity at the survey site.

8.40 All fish were caught using a dip net and retained for general inspection and length measurement before being returned to the water live. Any additional Age 0 salmonids observed but not captured were also recorded. This method is consistent with DAERA and Loughs Agency monitoring procedures.

8.41 The semi-quantitative electrofishing method has been calibrated separately for trout and salmon based on extensive studies in river reaches of known juvenile salmonid density. This has resulted in the development of an abundance classification system (Abundance Index) for salmon with five categories: Absent, Poor, Fair, Good, Excellent (**Table 8.4a**). The Abundance Index for trout has six classifications: Absent, Poor, Poor/Fair, Moderate, Good, Excellent (**Table 8.4b**).

Table 8.4: Semi-quantitative abundance categories for age 0 salmon (a) and trout (b), as developed by Crozier and Kennedy (1994); Kennedy (*unpublished data*)

(a) Salmon

Fry (0+) nos.	Density (No/100m2)	Abundance/ quality category
0	0	Absent
1 – 4	0.1 – 41.0	Poor
5 – 14	41.1 – 69.0	Fair
15 – 24	69.1 – 114.6	Good
25+	114.6+	Excellent

(a) Trout

Fry (0+) nos.	Density (No/100m2)	Abundance/ quality category
0	0	Absent
0 – 1	0.1 – 7.0	Poor
2 – 3	7.1 - 16.5	Fair
4 – 8	17 - 31	Moderate
9 – 17	32 - 59.9	Good
18+	60+	Excellent

Assessment of Effects

8.42 The assessment of effects was derived from methodologies outlined by:

- the Design Manual for Roads and Bridges specifically with regard to Road Drainage and the Water Environment, Volume 11, Section 3, Part 10 HD45/09 (DMRB, 2009);
- Institute of Environmental Management and Assessment guidelines (IEMA, 2004);
- Guidelines for Ecological Impact Assessment in the UK and Ireland (2018).

8.43 The significance of the potential effects of the Development has been classified by professional consideration of the sensitivity of the receptor and the magnitude of the potential effect.

Sensitivity Criteria

8.44 Using the information assembled through the baseline assessment, the Fisheries Significance/Sensitivity of each watercourse was graded according to the generic methodology for environmental sensitivity outlined in the Design Manual for Roads and Bridges (2009). **Table 8.5** details the framework applied in determining the sensitivity and this evaluation was used as the basis for the assessment of effects and the specification of any necessary mitigation requirements with regard to fisheries and the aquatic environment.

Table 8.5: Estimating the Sensitivity/Importance of Receptors (DMRB, 2009)

Sensitivity	Criteria	Typical Examples
Very High	Attribute has a high quality and rarity on a regional or national scale	WFD Class 'High'. Site protected/designated under EC or UK habitat legislation (SAC, ASSI, salmonid water)/Species protected by EC legislation. Watercourse containing salmon and supporting a nationally important fishery or river ecosystem.
High	Attribute has a high quality and rarity on a local scale	WFD Class 'Good'. Species protected under EC or UK habitat legislation. Watercourse containing salmon or trout and supporting a locally important fishery or river ecosystem.
Medium	Attribute has medium quality and rarity on a local scale	WFD Class 'Moderate'. Watercourse containing trout and upstream of locally important fishery or river ecosystem.
Low	Attribute has low quality and rarity on a local scale	WFD Class 'Poor'. Watercourse without salmon or trout but upstream of locally important fishery or river ecosystem.

Sensitivity	Criteria	Typical Examples
Negligible	Attribute has very low quality and rarity on a local scale	WFD Class 'Poor'/unspecified.

Magnitude of Effect

8.45 The magnitude of effect was assessed according to the criteria set out in **Table 8.6** and includes a consideration of the timescale of the effect (short, medium or long term).

Table 8.6: Estimating the Magnitude of Effect on Receptors

Magnitude	Criteria	Type and Scale of Effect
Major	Results in loss of attribute and/or quality and integrity of the attribute	Loss or extensive change to a fishery. Loss or extensive change to a designated Nature Conservation Site. Major alteration to fish population levels in catchment as a whole, through fish mortality, habitat destruction or barrier to migration. Duration: long-term (>5 years).
Moderate	Results in effect on integrity of attribute, or loss of part of attribute	Partial loss in productivity of a fishery. Appreciable alteration to fish population levels in specific sub-catchment or zone. Duration: medium-term (1-5 years).
Minor	Results in some measurable change in attribute's quality or vulnerability	Minor loss in productivity of a fishery. Minor alteration to fish population levels in specific sub-catchment or zone. Duration: short-term (up to 1 year).
Negligible / No impact	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	Unlikely to affect the integrity of the water environment. No measurable alteration to fish population levels.

Significance Criteria

8.46 The correlation of magnitude against the sensitivity of the receptor determines a qualitative expression for the significance of the effect on the basis of a standard matrix shown in **Table 8.7**. The greater the sensitivity or value of a receptor or resource, and the greater the magnitude of the impact, the more significant the effect.

Table 8.7: Estimating the Significance of Potential Effects (DMRB, 2009)

Sensitivity	Magnitude of Effect			
	Major	**Moderate**	**Minor**	**Negligible**
Very High	Very Large	Large/Very Large	Moderate/Large	Neutral
High	Large/Very Large	Moderate/Large	Slight/Moderate	Neutral
Medium	Large	Moderate	Slight	Neutral

Sensitivity	Magnitude of Effect			
	Major	**Moderate**	**Minor**	**Negligible**
Low	Slight/Moderate	Slight	Neutral	Neutral

8.47 The five significance categories with typical effects are shown in **Table 8.8**. Effects evaluated as being Moderate, Large or Very Large are considered to be significant for the purpose of the EIA in line with the EIA Regulations and will require mitigation. Those effects assessed as Slight or Neutral are not considered to be significant in terms of the EIA.

Table 8.8: Descriptors of the Significance of Effect Categories (DMRB, 2009).

Significance category	Descriptors of effects
Very large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Large	These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process.
Moderate	These beneficial or adverse effects may be important, but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.
Slight	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Baseline Conditions

Outline

8.48 This element of the assessment consisted of:

- Desk studies to collate baseline information on fisheries, conservation designations, and ecological status of waterbodies hydrologically connected to the Site; and
- Field surveys focused on the streams draining the Site to assess baseline physical habitat conditions, biological quality, salmonid habitat, and fish distribution. Field survey work was therefore carried out both within the

Site Boundary and in the immediate downstream reaches of the drainage streams connecting to the Castle River and thence to the Roe.

Catchment Status

Designated Sites

8.49 The River Roe and its tributaries including the Owenrigh is designated as an Area of Special Scientific Interest (ASSI) and a Special Area of Conservation (SAC).

Legislative Context

8.50 The EC Habitats Directive (92/43/EEC) requires member states to designate Special Areas of Conservation (SACs) in order to protect habitats and species listed in Annex I and Annex II of the directive. The Habitats Directive was transposed into Northern Ireland legislation by the Conservation (Natural Habitats, etc) (Northern Ireland) Regulations 1995.

8.51 The Environment (Northern Ireland) Order 2002 provides the legislative basis for the protection of important nature conservation sites in Northern Ireland through the declaration of Areas of Special Scientific Interest. ASSIs are the major statutory mechanism for protecting nature conservation sites and generally provide the underpinning protection measure for the designation of European sites.

River Roe and Tributaries ASSI

8.52 The River Roe and Tributaries was declared an Area of Special Scientific Interest (ASSI) in 2007 (ASSI 246), due to the physical features of the river and its associated riverine flora and fauna.

8.53 The ASSI extends over approximately 87 km of watercourse and encompasses the main channel of the River Roe and several significant tributaries including the Owenrigh River which drains the Development site (**Volume 3 - Figure 8.2** – Designated Sites). The ASSI is noted for the physical diversity and naturalness of the banks and channels, especially in the upper reaches. The richness and naturalness of its plant and animal communities are also significant features, in particular the population of Atlantic salmon, which is of international importance.

River Roe and Tributaries SAC

8.54 The River Roe and Tributaries was designated as a Special Area of Conservation (SAC) in 2007 (UK0030360) with Atlantic salmon noted as the Annex II species selected as the primary reason for designation of the site. The Roe SAC was also selected for the following Annex I habitat:

- Water courses of plain to montane levels with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.

8.55 Otter *Lutra lutra*, also listed in Annexe II, was identified as a qualifying feature but not a primary reason for site selection.

8.56 The conservation objectives for this SAC with regard to salmon are:

- Maintain and if possible expand existing population numbers and distribution (preferably through natural recruitment), and improve age structure of population.
- Maintain and if possible enhance the extent and quality of suitable Salmon habitat - particularly the chemical and biological quality of the water and the condition of the river channel and substrate.

8.57 Salmon is included in Annex II as a species of European importance, and other SACs in the Foyle catchment with salmon as the primary selection feature are:

- River Foyle and Tributaries
- River Faughan and Tributaries

EU Water Framework Directive

Local River Catchments

8.58 The Development is located in the Owenrigh River sub-catchment of the River Roe. The Owenrigh River flows in a southerly direction to join with the Roe near Dungiven. The Roe forms one of the major sub-catchments of the Foyle system **(Fig 8.2)**, which is assigned to the North Western International River Basin District (NWIRBD) under the Water Framework Directive.

8.59 The River Roe drains a catchment area of 385 km^2 through a river length of approximately 132 km including tributaries. The river flows in a general northerly direction to discharge into Lough Foyle near Limavady.

8.60 The Roe rises in the Sperrin Mountains and land use in the upper reaches is predominantly rough grazing for sheep with extensive conifer forestry plantation. In the middle reaches the river flows through a deep narrow gorge then emerging onto an alluvial flood plain to form a meandering channel between open grassy embankments.

8.61 The Roe is a top-quality salmon system with excellent quality habitats populated by sustainable stocks of salmon and trout. The river is particularly suited to a flourishing stock of Atlantic salmon and supports a popular recreational fishery. This is borne out in the accumulated data recorded by the Loughs Agency which indicates consistent levels of spawning by salmon and generally favourable densities of juvenile salmon.

Ecological Status

8.62 To achieve the ecological objectives of the Water Framework Directive (WFD), River Basin Management Plans (RBMPs) have been implemented through a series of Local Management Areas (LMAs) during the 2010 to 2015 planning cycle, now extended into the subsequent 2016 to 2021 cycle, and with provision under WFD for a third cycle from 2022 to 2027.

8.63 The Development lies entirely within the Roe LMA, with all of the application area located in the waterbody defined as Owenrigh River (UKGBNI1NW020202010), which is characterised a *Heavily Modified Waterbody* due to the impoundment of the upper

Altnaheglish tributary as Altnaheglish Reservoir (Banagher Dam) and the resultant effects on the hydrology of the catchment.

8.64 Proceeding downstream from the proposed Development there is sequential hydrological connection between the following waterbodies in the Roe LMA (ecological status as assessed in 2014 is noted):

- Owenrigh River (UKGBNI1NW020202010): Moderate Ecological Potential
- River Roe - Limavady (UKGBNI1NW020202018): Good ecological status
- River Roe - Ballycarton (UKGBNI1NW020202024): Good ecological status

8.65 The ecological assessment for these waterbodies in 2015 is summarised in **Table 8.9** which indicates the overall classification and status with regard to each of the principal parameters monitored.

Table 8.9: Classification of individual quality elements contributing to overall WFD status of relevant water bodies in Roe LMA, 2015 (Source: NIEA)

Parameter	Owenrigh River (Ref 2010)	River Roe (Ref 2018)	River Roe (Ref 2024)
Benthic Invertebrates	High	High	High
Macrophytes	High	Good	Good
Phytobenthos	High	Good	Good
Fish	-	Good	Good
Biochemical Oxygen Demand	High	High	High
Temperature	High	High	High
Dissolved oxygen	High	High	High
pH	High	High	High
Soluble Reactive Phosphorus	High	High	Good
Ammonia	Good/High	Good/High	Good/High
Hydrological regime	High	Good	Good
Morphological conditions		Good	Good
Overall Status	**MEP**	**Good**	**Good**

8.66 For the current planning cycle to 2021 NIEA has developed a series of RMBPs for each River Basin District including the North Western RBD. These documents set out the latest assessment of pressures and impacts on the water environment, describe the progress NIEA made towards achieving objectives for 2015, and explain the significant water management issues that still need to be addressed.

EC Fish Directive

8.67 The EC Freshwater Fish Directive (Consolidated) 2006/44/EC (FWFD) set physical and chemical water quality objectives for salmonid waters and cyprinid waters, specifically with regard to dissolved oxygen, ammonia, pH and total zinc.

8.68 The main stem channel of the River Roe (including a section of the Owenrigh River) was designated as “salmonid” under the Surface Waters (Fish Life Classification) Regulations (Northern Ireland) 1997, which implements the EC Freshwater Fish Directive. In 2003 this designation was extended to incorporate several tributaries including the Altnaheglish River.

8.69 The Fish Directive was repealed by the Water Framework Directive at the end of 2013, and the ecological status defined in the WFD sets the same protection to waterbodies designated for fish under the original directive. Areas designated under the Fish Directive have become areas designated for the protection of economically significant aquatic species under WFD and placed on a Register of Protected Areas.

Water Quality Monitoring

8.70 Chemical and biological quality of individual water bodies have been monitored by NIEA Water Management Unit on a monthly basis since 2009 to comply with statutory monitoring for Water Framework Directive reporting. There is a single monitoring station on the Owenrigh River at Carnanbane approximately 2 km downstream of the Development.

Chemical Quality

8.71 Summary results for a selection of chemical quality parameters at the Owenrigh monitoring station are presented in **Table 8.10**. It should be noted that two other significant tributaries merge with the Altnaheglish River upstream of this sampling station.

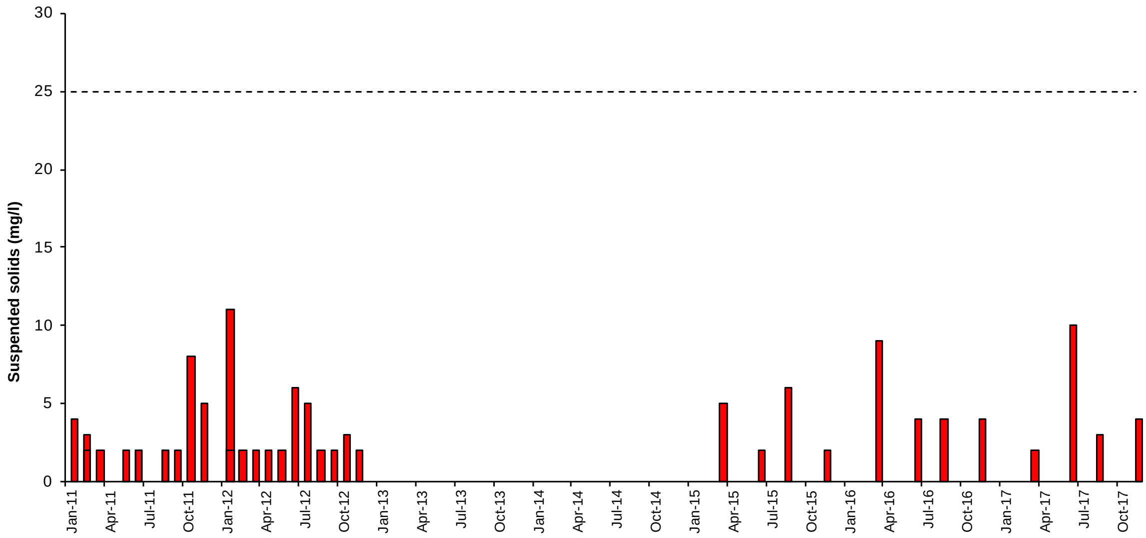
Table 8.10: Selected Chemical Monitoring Data from the Owenrigh River, 2011-17 (Source: NIEA)

Year	Range	pH	Cond (µs/cm)	DO (mg/l)	DO (%)	BOD (mg/l)	NH3 (mg/l)	P-Sol (mg/l)	S.Solids (mg/l)
2011	Min	7.1	62	9.8	84	<1.0	<0.001	<0.01	<2
	Max	8.2	172	12.5	103	2.6	0.001	0.01	8
	Mean	7.6	117	10.9	96	1.4	<0.001	<0.01	3
2012	Min	6.7	62	9.5	93	<1.0	<0.001	<0.01	<2
	Max	7.9	165	12.9	104	2.3	0.001	0.01	11
	Mean	7.5	103	11.3	97	1.4	<0.001	<0.01	3
2015	Min	7.0	65	10.3	95	<2.0	<0.001	<0.01	<2
	Max	7.7	77	11.9	98	2.2	0.001	0.02	6
	Mean	7.4	71	11.2	97	2.1	0.001	0.01	4
2016	**Min**	7.5	75	10.6	96	<2.0	<0.001	<0.01	4
	Max	7.9	162	12.7	105	2.0	0.001	0.01	9
	Mean	7.7	110	11.6	99	2.0	<0.001	<0.01	5
2017	**Min**	6.3	52	10.3	93	<2.0	<0.001	<0.01	<2

Year	Range	pH	Cond (µs/cm)	DO (mg/l)	DO (%)	BOD (mg/l)	NH3 (mg/l)	P-Sol (mg/l)	S.Solids (mg/l)
	Max	7.4	94	11.8	102	2.3	0.001	0.03	10
	Mean	7.0	78	11.3	97	2.1	<0.001	<0.02	5

8.72 Of particular relevance to salmonid fish is suspended sediment as it has significant potential to impact on both directly on the fish and also on their habitat. The variation in suspended solids in the Owenrigh River over a four-year period is illustrated in **Figure 8.1**.

Figure 8.1: Monthly Measurements of Suspended Solids in the Owenrigh River, 2011-17 (Source: NIEA).



8.73 Although data is limited after 2012, the information available indicates that the level of suspended solids was generally less than 5 mg/l with a maximum value of 11 mg/l, and well below the WFD guideline for salmonid fish (25 mg/l) on all sampling occasions. These figures would suggest a low baseline of sediment run-off in the Owenrigh with any rises in suspended solids are likely to be due to spate conditions following periods of heavy or sustained rainfall.

Biological Quality

8.74 Summary results for biological quality monitoring of the Castle River in 2011/12 under the biological monitoring working party (BMWP) system are presented in **Table 8.11** (there has been no biological monitoring carried out at this location since 2012). Indicated are the total number of invertebrate taxa identified (No. taxa) at each site, total bioscore (BMWP bioscore), and average score per taxon (ASPT). In general terms these results reflect a Good standard of biological quality as was indicated in the WFD classifications for this waterbody in 2015 (**Table 8.9**).

Table 8.11: Biological Monitoring of Owenrigh River at Carnanbane, 2011-12 (Source: NIEA)

Date	BMWP score	No. Taxa	ASPT
18/04/2011	101	15	6.73
17/10/2011	112	17	6.59
23/04/2012	132	21	6.29
24/10/2012	105	16	6.56
Mean	113	17	6.54

WFD Fish Monitoring

8.75 Water Framework Directive compliant fish surveys at surveillance stations are required under national and European law. Annex V of the WFD stipulates that rivers should be included within monitoring programmes and that the composition, abundance and age structure of fish fauna should be examined (Council of the European Communities, 2000). Within the Roe catchment there are seven WFD fish monitoring stations which have each been subject to monitoring at least once over the last six years with fish classifications as noted in **Table 8.10** (Niven, 2010; Niven & Scott, 2013; NIEA, *unpublished data*).

Table 8.12: Summary classifications of relevant sites under WFD fish monitoring (Source: Loughs Agency).

Water body	2011	2012	2013	2014	2015
Owenalena River	-	-	-	High	High
River Roe (Limavady)	-	Good	Good	Good	High
Owenbeg River	Good	Good	Good	Good	Good
River Roe (Ballycarton)	Good	Good	Good	Good	Good
River Roe (Corick)	-	-	-	High	High

8.76 The following fish species are recorded as being present in the Roe catchment (Loughs Agency, 2010):

- Atlantic salmon (*Salmo salar*);
- Brown trout and Sea trout (*Salmon trutta*);
- Eel (Anguilla anguilla);
- Three-spined stickleback (*Gasterosteus aculeatus*);
- Minnow (Phoxinus phoxinus);
- Smelt (Osmerus eperlanus)
- River/Brook lamprey (*Lampetra* sp);
- Sea lamprey (Petromyzon marinus).

Significant Freshwater Species

8.77 This section outlines the current status of Annexe II freshwater species and other species of conservation interest in the River Roe catchment.

Atlantic salmon

8.78 The salmon is an anadromous species having both a freshwater stage and a marine stage to its life cycle. The species is listed under Annexe II of the Habitats Directive and was added to the UK Biodiversity Action Plan (BAP) list in 2007 as a priority species for conservation action. More recently the salmon achieved an IUCN threat status of Vulnerable in the Irish Red List No 5 (King *et al*, 2011).

8.79 Adult salmon mature at two to four years of age and spawning generally takes place in November or December notably in the upper reaches of suitable tributaries. The young fish remain in freshwater for one or two years before migrating to sea as smolts during April and May. After a phase of intense feeding and rapid growth in the sea, many salmon will return to freshwater in the following year as one sea-winter fish (grilse), while a proportion may remain at sea for another year to return as two sea-winter fish.

8.80 Northern Ireland's Atlantic salmon management strategy is aligned to the agreement reached by the North Atlantic Salmon Conservation Organisation (NASCO) and its Parties to adopt and apply a precautionary approach to the conservation, management and exploitation of the salmon resource and the environments in which it lives. Northern Ireland, through the UK and EU, is a Party to NASCO.

8.81 Atlantic salmon stocks in general are in serious decline and southern stocks, including some in North America and Europe, are threatened with extinction. As a conservation measure commercial netting for salmon was significantly reduced by the Loughs Agency in 2007 and has been suspended on an annual basis since 2009 due to the River Finn stock falling below its conservation limit.

8.82 Condition Assessments for the River Roe & Tributaries SAC, undertaken as part of Habitats Directive reporting requirements, indicate that the Atlantic salmon population was at *Favourable status* in both 2007 and 2011.

Lamprey

8.83 There are three species of lamprey in Northern Ireland:

- Brook lamprey (*Lampetra planeri*)
- River lamprey (Lampetra fluviatilis)
- Sea lamprey (Petromyzon marinus)

8.84 Sea and River lampreys are parasitic and migrate between the freshwater and marine environments, returning to freshwater to breed. In contrast, Brook lamprey are resident freshwater throughout their life cycle and are non-parasitic. Brook lamprey are widely distributed in Northern Ireland but River and Sea lamprey have a more limited distribution (Goodwin *et al*, 2009).

8.85 All three species are designated under Annex II of the EU Habitats Directive (Directive 92/43/EEC) and there are five large river SACs designated in the Foyle area. None of the three species is listed as a site selection feature of the River Foyle and Tributaries SAC but River/Brook lamprey are known to be present.

8.86 The Loughs Agency carried out a baseline survey in 2013 to record the abundance and distribution of juvenile lamprey in the Roe SAC; it was found that River/Brook lamprey populations were at Favourable conservation status while Sea lamprey populations were Unfavourable (Niven & McCauley, 2013). The assessment also demonstrated the presence of River/Brook lamprey in the Owenrigh tributary.

Eel

8.87 The European eel the stock has been in rapid decline throughout its range since around 1980. This has led to the passing of the European Eel Regulation (EC) 1100/2007 which aims to return the European eel stock to more sustainable levels of adult abundance and juvenile eel recruitment. Member States are required to implement Eel Management Plans in each eel river basin, in this case the North Western International River Basin District.

8.88 The European eel is not listed under Annexe II but has recently been added to the International Union for Conservation of Nature (IUCN) Red List of Threatened Species in the category of Critically Endangered (King *et al*, 2011).

8.89 There is limited data available on the distribution of eel in the River Roe but the catchment status report for 2009 records the occurrence of the species during salmonid electrofishing surveys and indicates a regular distribution throughout the catchment, including the Owenrigh River (Loughs Agency, 2010).

Brown trout

8.90 Brown trout are a priority species for conservation action in Northern Ireland, as required under the Wildlife and Natural Environment Act (Northern Ireland) 2011. The species is widely distributed in the River Roe catchment and a significant proportion of the stock migrates to sea and returns to freshwater to spawn. The Roe is one of the more significant Sea trout rivers in the Foyle system and the species is a popular target for anglers. However, there is little data available on the status of stocks in the Roe or in any Northern Ireland rivers - a major difficulty in assessing stock status is that juvenile trout do not exhibit any specific features which identify them as potential adult Sea trout.

Salmon & Trout Stock Data

8.91 Annual monitoring of salmon (and trout) stocks in the Foyle system is conducted by the Loughs Agency based on:

- Adult salmon runs;
- Salmon spawning;
- Juvenile fish stocks.

The River Roe and the Owenrigh tributary support significant stocks of Atlantic salmon and brown trout.

Adult Salmon Runs and Conservation Limits

8.92 A key factor in assessing the status of salmon stocks is determination of Conservation Limits for individual river systems. The Conservation Limit for Atlantic salmon is defined by NASCO as: *the spawning stock level that produces long term average maximum sustainable yield as derived from the adult to adult stock and recruitment relationship.* In simpler terms the Conservation Limit for a river is the number of spawning salmon required to ensure that salmon are reproducing in sufficient quantities to produce the next generation of fish.

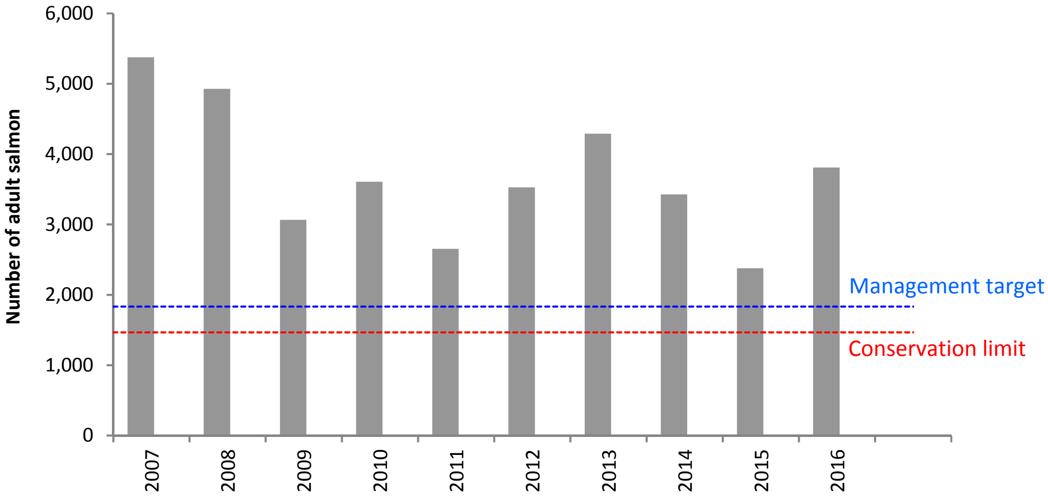
8.93 The Loughs Agency operates a "real time" management regime for the Foyle system which aims to manage salmon fisheries and spawning populations in a sustainable manner. Management targets and spawning targets are set for each river catchment with egg deposition levels are set according to the area and quality grading of each section of nursery habitat. 25% is deducted from the management target allowing for loss of salmon by angling (15%), and poaching and predation (10%). The remaining figure is referred to as the conservation limit/spawning target.

8.94 A management target of 1,833 adult Atlantic salmon has been set for the Roe Catchment, this equates to a conservation limit/spawning target of 1,466 or 2,062,125 eggs.

8.95 Adult salmon runs are now measured by electronic fish counters at six counting stations in the Foyle system; the Roe counter is located downstream of Limavady on a purpose-built crump weir spanning the full width of the river and has been in operation since 2001.

8.96 The numbers of adult fish returning to the river each year since 2007 are shown in **Figure 8.2** along with the conservation limit (CL) and management target (MT) for the river. There is some evidence of a decline in the stock but both CL and MT have been exceeded in each of the last 10 years.

Figure 8.2 Numbers of salmon ascending River Roe fish counter, 2007-16 (Source: Loughs Agency)



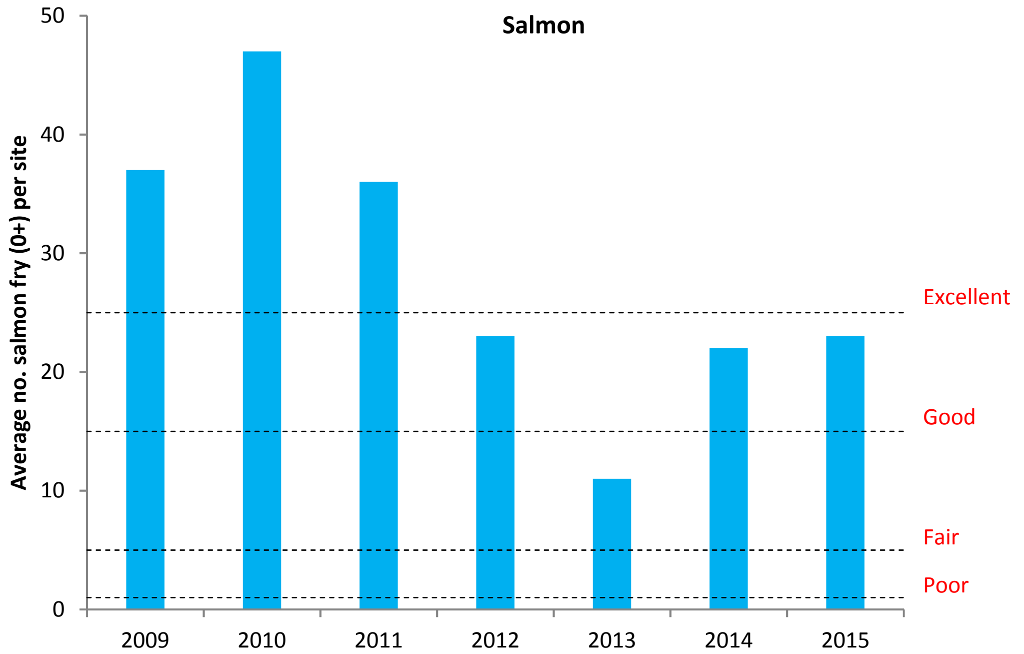
Juvenile Fish Stocks

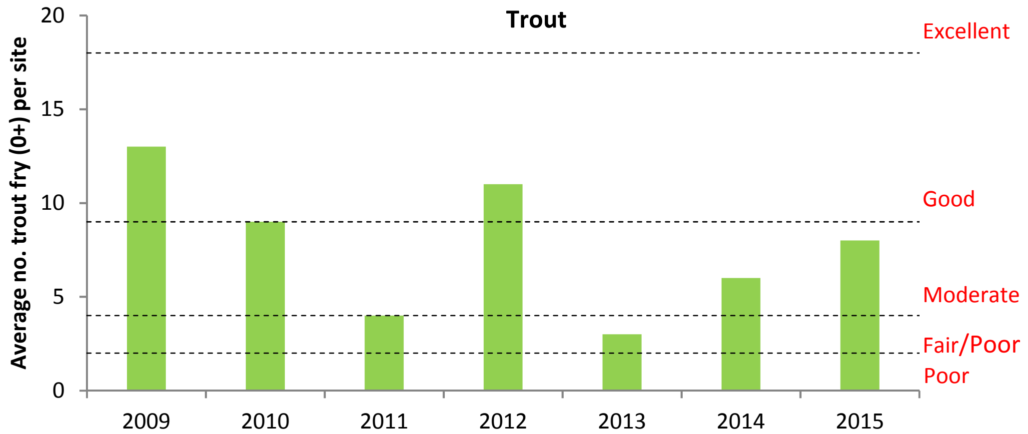
8.97 Fry distribution and abundance are an indication of the distribution and level of spawning by adult fish. Trends in abundance of juvenile salmon and trout are monitored by the Loughs Agency through annual semi-quantitative electrofishing surveys according to a methodology developed by Crozier & Kennedy (1994). Over 450 sites are sampled each year throughout the Foyle area with 60 in the Roe catchment including three on the Owenrigh River.

8.98 The semi-quantitative electrofishing method has been calibrated separately for trout and salmon based on extensive studies in river reaches of known juvenile salmonid density. This has resulted in the development of an abundance classification system (Abundance Index) for salmon with five categories: Absent, Poor, Fair, Good, Excellent (Crozier and Kennedy, 1994). The Abundance Index for trout has six classifications: Absent, Poor, Poor/Fair, Moderate, Good, Excellent (Kennedy, unpublished).

8.99 **Figure 8.3** shows the average catch of salmon and trout fry at survey sites on the Roe over the most recent seven-year period with abundance categories indicated. Salmon fry are generally more abundant than trout and there is some evidence of a decline in both stocks during this period, consistent with the apparent decline in adult fish runs. However average salmon fry abundance remains in the Good category while trout abundance is Moderate.

Figure 8.3 Salmon and trout fry Abundance Indices based on mean fry numbers at electrofishing sites on the Roe, 2009-15 (Source: Loughs Agency)





8.100 The average numbers of trout and salmon detected at Loughs Agency monitoring sites on the Owenrigh River which are hydrologically connected to the Site are indicated in Table 8.11. The location of these sites is shown along with average Fry Abundance Indices for salmon and trout in **Figs 8.3 and 8.4**.

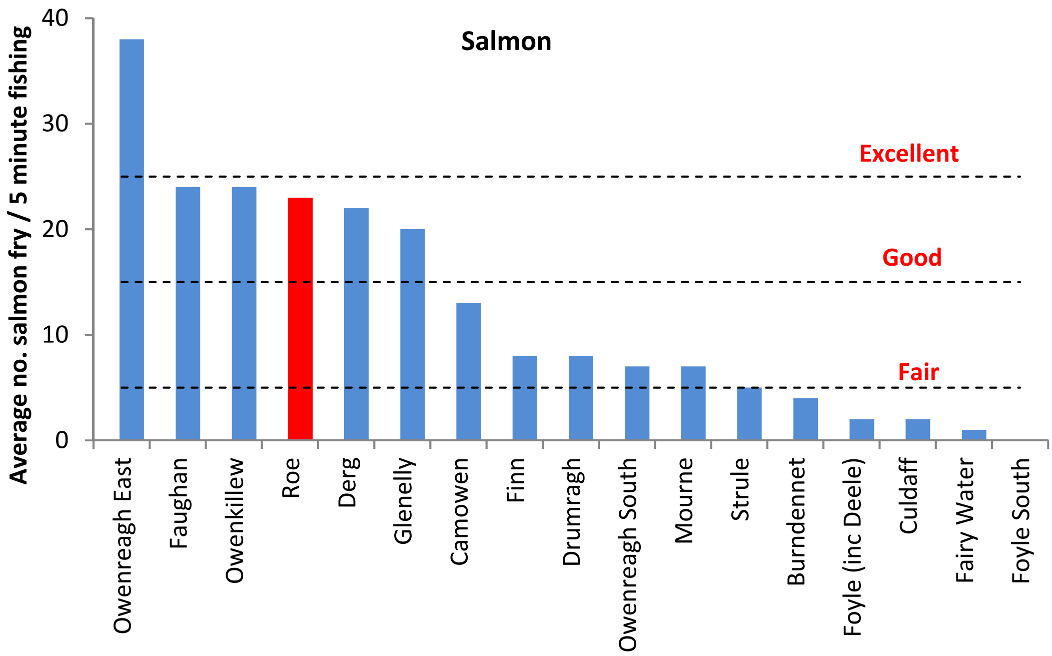
Table 8.11: Average fry abundance indices at survey sites on the Owenrigh River, 2012-15; listed upstream to downstream (Source: Loughs Agency)

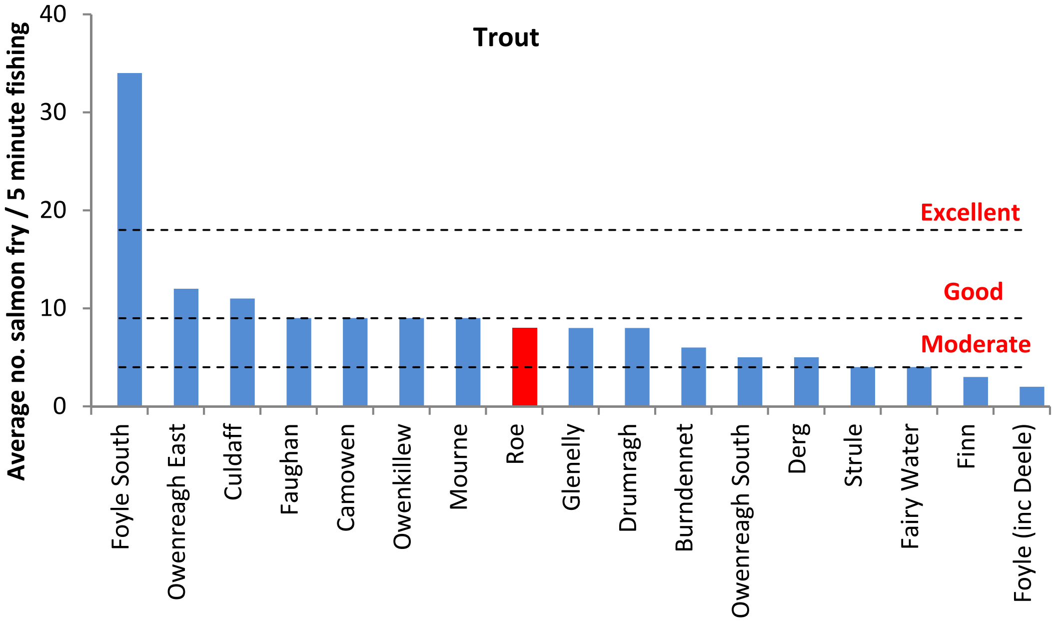
Site ID	Grid ref		Average 5 min catch		Fry abundance index	
	Easting	Northing	Salmon	Trout	Salmon	Trout
17_010	268267	408004	46	3	Excellent	Poor/Fair
17_009	266955	406753	38	4	Excellent	Moderate
17_089	267042	405065	31	4	Excellent	Moderate

8.101 This data demonstrates that there is a significant level of salmon spawning in the Owenrigh River directly downstream from the Site (within 1-2km of boundary), with Excellent fry densities indicated at all three survey sites in the reach extending downstream to connect with the Roe – this is indicative of widespread spawning in this reach. Trout fry were present at a lower average density with Poor/Fair to Moderate abundance at these indicating a lower level of spawning.

8.102 Fry densities in the Roe for 2015 are compared with those from other leading catchments in the Foyle system in Figure 8.4. This illustrates that for both salmon and trout the Roe is one of the more productive rivers in the region.

Figure 8.4: Salmon and trout fry index based on mean fry numbers in 17 principal catchments of the Foyle, 2015 (Source: Loughs Agency)





Angling

8.103 The Roe is one of the leading angling waters in the Foyle system providing a popular rod fishery for both the local population and visitors to the area. Fishing rights on the freshwater reaches of the main channel and tributaries are owned by The Honourable Irish Society while the tidal section is owned by the Loughs Agency.

8.104 Angling is controlled and administered by the Roe Angling Ltd which leases the fishing rights on both the freshwater and tidal sections.

8.105 Details of angling activity and catches of salmon and sea trout are shown in **Table 8.12**. As these returns are based on incomplete licence/logbook returns, a raising factor is applied in line with Loughs Agency methodology which is based on an analysis by Small (1991). Adjustment of the catch returns for 2009-15 would suggest an average annual catch of 379 salmon which would indicate a very productive fishery. Voluntary catch and release is now practised widely on the Foyle system reaching 58% in 2012.

Table 8.12: Salmon angling catches for the Roe indicating adjustment according to annual rate of licence/logbook returns, 2009-15 (Source: Loughs Agency)

Catch statistics	2009	2010	2011	2012	2013	2014	2015	Average
% licence/logbook return	44%	56%	46%	16%	10%	15%	38%	32%
Raising factor	1.38	1.24	1.35	2.58	3.70	2.70	1.49	2.06
Reported salmon catch	197	500	398	379	11	34	78	228
Adjusted salmon catch	273	619	538	976	41	92	116	379

Habitat Improvement Works

8.106 Roe Angling Ltd has invested significant funds and labour in conducting fisheries enhancement works on various tributaries, notably the Owenbeg River, to upgrade spawning and nursery habitats. Grant funding has been obtained from ARC North West (NI Rural Development Programme), NGO Challenge Fund (NIEA) and the Lough Agency.

8.107 The Loughs Agency has also carried out a series of habitat improvement measures in tributaries such as the Bovevagh River and the Wood Burn. The works were designed to improve in-channel flow and to introduce sequences of spawning, nursery and holding water.

Site Survey: Fisheries Habitat

Overview

8.108 The Development is located entirely within the River Roe catchment and specifically within the Owenrigh River sub-catchment. The application area drains via a series of small drainage channels and un-named streams flowing into the Altnaheglish and Owenrigh rivers; it is not hydrologically connected to Altnaheglish Reservoir. Site drainage is described in further detail in Ch 9 Geology & Hydrogeology.

8.109 The fish habitat survey consisted of a walkover assessment of the three main drainage streams A, B and C (as shown on **Volume 3 - Figures 8.3-8.6**), accessible reaches of the Altnaheglish River downstream of the dam and the Owenrigh River downstream to Carnanbane Bridge.

General Description / Observations

Stream A

8.110 This watercourse drains the south-eastern part of the Site incorporating T1, T2 and T5 and flows in a south-easterly direction to join with the Altnaheglish River 300m downstream of Banagher Dam. At the Site boundary it has a gravel bed but is essentially an overgrown drainage ditch with a steep bed slope and little if any discernible flow of water **(Plate 8.1)**. Adjacent to the Altnaheglish River Stream A has a gravel/cobble bed **(Plate 8.2)** but is of no fisheries value in terms of usable salmonid habitat due mainly to its diminutive size and lack of flow.

Plate 8.1: Stream A at Site boundary

Plate 8.2: Stream A at Altnaheglish River

Stream B

8.111 Stream B drains the area including T3, T4 and T6 – it is enclosed in a culvert throughout its course within the site boundary, only emerging at the western boundary approximately 300m from the Owenrigh **(Plate 8.3)**. Over the next 200m the channel follows a steep gradient through a densely wooded reach, then emerging in the river valley approximately 100m from the Owenrigh. In this lower reach the stream is 1m in width with reasonable quality substrate materials and could have some potential in terms of salmonid spawning and nursery habitat; however, the flow of water is poor and only 10m from the Owenrigh an access channel has been constructed across the channel forming a barrier for fish movements from the main river **(Plate 8.4)**. Stream B is therefore of little fisheries value.

Plate 8.3: Stream B at Site boundary

Plate 8.4: Stream B at Owenrigh River

Stream C

8.112 Stream C is also known as the Carnanbane Stream and it drains the northern extension of the Site which includes the proposed access route from Magheramore Road. At the Site boundary it is 1-1½m wide with good quality substrate materials of mixed grades **(Plate 8.5)**. The habitat characteristics would suggest that fish should be present in this reach, but the electrofishing survey indicated otherwise.

8.113 Downstream of the Site boundary, Stream C proceeds in a northerly direction for approximately 800m before joining with the Owenrigh River. Good quality habitat conditions prevail throughout with an increasing proportion of boulder material and sand deposits towards the confluence **(Plate 8.6)**. The lower reach was not electrofished but almost certainly contains trout and possibly salmon.

Plate 8.5: Stream C at Site boundary

Plate 8.6: Stream C at Owenrigh River

Altnaheglish River

8.114 The headwaters of the Altnaheglish River have been impounded as a reservoir for public water supply and known locally as Banagher Dam – the river now issues from the dam and flows in a westerly direction through Banagher Glen lying to the south of the Site. During the survey period (Jul-Oct) there was no compensation flow from the dam and any water contained in the channel was practically static **(Plate 8.7)**.

8.115 Over the next 300m the flow gradually increases due to seepage and minor inputs from the surrounding land and is potentially more habitable for fish. Downstream of the input from Stream A the channel ranges from 1½-4m in width with long, shallow riffle/ runs but remaining generally slow-flowing **(Plate 8.8)**. A single trout was detected in this reach indicating that it is very sparsely populated, most likely due to the limited flow.

Plate 8.7: Altnaheglish Dam outfall

Plate 8.8: Altnaheglish R at Stream A

8.116 Proceeding down through Banagher Glen over the subsequent 2 km the channel increases in flow and width exceeding 6m at some points. There is a sequence of riffles and glides with occasional deeper pools providing the full range of habitat requirements for trout **(Plate 8.9)**; the reach upstream of Alt Bridge was found to be well populated with trout and would also be suitable for salmon.

8.117 The Altnaheglish joins with the Glenedra Water after 2.5 km, and then swings north to merge with the Cushcapal Water to form the Owenrigh River after a further 0.7 km. There is likely to be some salmon spawning in the lower reach of the Altnaheglish as monitoring by the Loughs Agency indicates Excellent abundance of salmon fry at the uppermost monitoring site on the Owenrigh just 250m downstream.

Plate 8.9: Altnaheglish R at Alt Bridge

Owenrigh River

8.118 The initial reach of the Owenrigh is 6-8m wide and is heavily shaded by overhanging tree growth from both banks (Plate 8.10). The substrate materials of boulder, cobble, gravel and sand are ideally suited for salmonid spawning and the juvenile stages of the life cycle; this is borne out by the consistent *Excellent* abundance revealed through annual surveys by the Loughs Agency (Fig 8.3).

8.119 Proceeding downstream (north) the river emerges on to a flood plain and appears to have been previously re-sectioned and re-aligned to alleviate flooding and improve land drainage. Although more uniform in character, the channel retains good fish habitat features and the Loughs Agency data demonstrates the presence salmon fry at *Excellent* abundance throughout thereby indicating the importance of the overall reach as a salmon spawning and nursery area (Plate 8.11).

8.120 After a course of approximately 6 km the Owenrigh merges with the River Roe approximately 1.5 km upstream (north) of Dungiven.

Plate 8.10: Owenrigh R d/s Cushcapal W

Plate 8.11: Owenrigh R at Stream C

Site Survey: Stream Quality

8.121 Seven sites were surveyed in the watercourses draining the development area (Sites 1-7; **Volume 3- Figure 8.5**) as follows:

- Site 1 - the uppermost site on the Altnaheglish River, 350m downstream of the Altnaheglish dam outfall and immediately downstream of Stream A.
- Site 2 – 1,750m further downstream on the Altnaheglish River but upstream of its confluence with the Glenedra Water/ Crooked Burn.
- Sites 3 and 4 - on the Owenrigh River were respectively upstream and downstream of the confluence of a Stream B draining the development area; these sites were selected as control (site 3) and impact (site 4) reaches for assessing potential effects.
- Sites 5 and 6 - on the Owenrigh River were respectively upstream (control) and downstream (impact) of the confluence of the Carnanbane Stream (Stream C), which drains the northern area of the Site.
- Site 7 – on Stream C at its intersection with the site boundary; to assess potential impacts the stream.

8.122 It was not possible to sample Streams A and B effectively. Stream A essentially consisted of an overgrown drainage ditch with indeterminate stream features and little if any discernible flow of water. Stream B was found to be enclosed within a culvert throughout most of its course within the site boundary and intermittently downstream of the Site.

Chemical Water Quality: Basic Parameters

8.123 All streams had satisfactory dissolved oxygen levels with lower conductivity recorded in sites 2-6 (Table 8.16). Although the joint highest conductivity was recorded in the uppermost (site 1), this is possibly explained by the location directly downstream from Atlnaheglish Dam, where a small flow of water was observed, and the low likelihood of any gains from low conductivity groundwater. In contrast, further downstream at site 2 on the same river, groundwater recharge potential would be higher and could explain the sites much lower conductivity. Turbidity was low at all stream sites and, as a proxy indicator, is consistent with suspended sediment concentrations well below the 25 mg/L upper threshold specified for salmonids in the Water Framework Directive.

Table 8.13: Water chemistry parameters measured at five survey sites, Sept/Nov 2018.

Site	River/ stream location	Diss. Oxygen (mg/l; % sat)	Conductivity (µS/cm)	Turbidity (NTU)
1	Altnaheglish R (0.35 km below dam)	10.2 (89%)	145	2.75
2	Altnaheglish R (2.1 km below dam)	11.1 (97%)	111	1.25
3	Owenrigh R (Stream B control)	10.6 (96%)	103	2.25
4	Owenrigh R (Stream B impact)	10.6 (96%)	103	2.25
5	Owenrigh R (Stream C control)	12.1 (96%)	96	N/A
6	Owenrigh R (Stream C impact)	12.0 (96%)	105	N/A
7	Stream C (at site boundary)	11.5 (94%)	145	N/A

8.124 It should be noted that spot measurements of physico-chemical parameters provide only a snap-shot of stream water quality; consensus on overall quality should consider consider additional indicators such as those provided by stream macroinvertebrate communities (see below).

Physical Habitat Quality

8.125 Both sites on the Altnaheglish River (sites 1 and 2) were very shallow with low flows most likely linked to their location downstream of the dam where compensation flows were negligible. Both sites were characterised by complex substrate mainly comprising cobbles and boulders. Although fine sediment exceeded the 20% cover threshold above which salmonid and benthic biodiversity can be compromised (Clapcott et al. 2011), this was due mainly to high levels of deposited humic material that reflected erosion of the surrounding moorland and the low flow character of this stream. Sites 3-6 in the Owenrigh River were wider and had deeper water with higher flows and negligible fine sediment, all reflecting their location further downstream, where flow is augmented by the Cushcapal and Glenedra Waters. Stream C (site 7 - Carnanbane Stream), was a much narrower and shallow channel but had moderate flow and a low level of fine sediment cover. The substrate coarseness index at all sites was moderate to coarse, comprised of a mixture of grains (sites 2, 3, 4, and 7) or largely of boulder and cobble (sites 1, 5 and 6; Table 8.14).

Table 8.14: Stream habitat quality at each site from baseline surveys, Sept/Nov 2018.

Site	River/ stream	Sediment cover (%) & type	Mean width (m)	Mean water depth (m)	Mean flow velocity (ms-1)	Coarse-ness index (CI)	Substrate hetero-geneity (SD)	Inferred substrate
1	Altnaheglish R	39.11; humic material	2.2	0.09	0.08	4.1	0.51	Almost homo-geneous, coarse
2	Altnaheglish R	28; humic material	4.1	0.1	0.1	3.8	0.75	Mixture; inter-mediate coarseness
3	Owenrigh R	1.6; sand	6.95	0.17	0.2	4.16	1.0	Mixture; coarse
4	Owenrigh R	1.9; sand	7.2	0.17	0.22	3.7	0.94	Mixture; inter-mediate coarseness
5	Owenrigh R	2.6; sand	8.9	0.18	0.26	3.8	0.47	Almost homo-geneous; inter-mediate coarseness
6	Owenrigh R	0.8; sand	8.4	0.18	0.29	4.1	0.64	Almost homo-geneous, coarse
7	Stream C	6; sand/ silt	1.3	0.1	0.17	3.8	1.1	Mixture; inter-mediate coarseness

Aquatic Ecology

8.126 Recorded habitat characteristics for the seven survey sites are shown in Table 8.15. Based on the benthic invertebrate indicator element, and the “one out, all out” philosophy, four sites (1, 3, 4 and 6) were indicated as having GOOD WFD-based ecological quality with the remaining sites (2, 5 and 7) classed at HIGH ecological quality. It should be noted that for sites 1 and 2 on the Altnaheglish River, site 5 on the Owenrigh River, and site 7 on Stream C (Carnanbane Stream), quality classifications were the same whether using the predicted number of taxa (N-TAXA) or ASPT metric, reinforcing the robustness of these data.

Table 8.15: WFD-based ecological quality classes at each site derived from benthic invertebrate baseline surveys, Sept/Nov 2018.

Site	River/ stream	BMWP WHPT score	Number of taxa	N-TAXA WFD-based invert. class	WHPT ASPT	ASPT WFD-based invert. class
1	Altnaheglish R	79.2	14	Good	5.65	Good
2	Altnaheglish R	135.9	20	High	6.7	High
3	Owenrigh R	89.2	14	Good	6.3	High
4	Owenrigh R	105.7	15	Good	7.04	High
5	Owenrigh R	140.4	18	High	7.8	High
6	Owenrigh R	95.4	15	Good	6.3	High
7	Stream C	168.3	25	High	6.7	High

8.127 For sites 3, 4 and 6 the quality class derived from the observed ASPT metric was indicated as HIGH as compared to GOOD based on N-TAXA, but this reflects the very high ASPT values recorded at these sites.

8.128 The metrics and quality classes derived for sites 3 and 4 on the Owenrigh River establish that baseline conditions upstream and downstream of Stream B are similar with no apparent effect of the inflowing stream. However, the metrics and quality classes for sites 5 and 6 on the Owenrigh upstream and downstream of Stream C indicate that there are slight differences in quality (HIGH versus GOOD) and this appears driven by the lower number of invertebrate taxa at site 6 downstream of the confluence. It is unlikely that Stream C is influencing this difference because the biological quality class in the stream was HIGH. However, Stream C was sampled approximately 1 km upstream of the Owenrigh at the Site Boundary on Magheramore Road – there may be some deterioration in stream quality downstream of the road crossing which is having a minor effect on the Owenrigh.

8.129 Overall, the classes for each site suggest GOOD to HIGH water quality and good physical habitat, with most streams supporting sensitive invertebrate communities.

Site Survey: Juvenile Fish Stocks

8.130 Four sites were surveyed on 6 September 2018 in the watercourses draining the development area and corresponding Stream Quality survey sites 1, 2, 4 and 7 (Sites 1-7; **- Volume 3 - Figure 8.5**). Trout were found to present at three sites on the Altnaheglish and Owenrigh while salmon were limited to the Owenrigh.

Population Age Structure

8.131 The age structures of the salmon and trout stocks in the Altnaheglish/ Owenrigh River site were verified by constructing separate length frequency distributions for each species (**Charts 8.5 and 8.6**).

Figure 8.5: Length frequency distribution of trout caught in the Altnaheglish/ Owenrigh River.

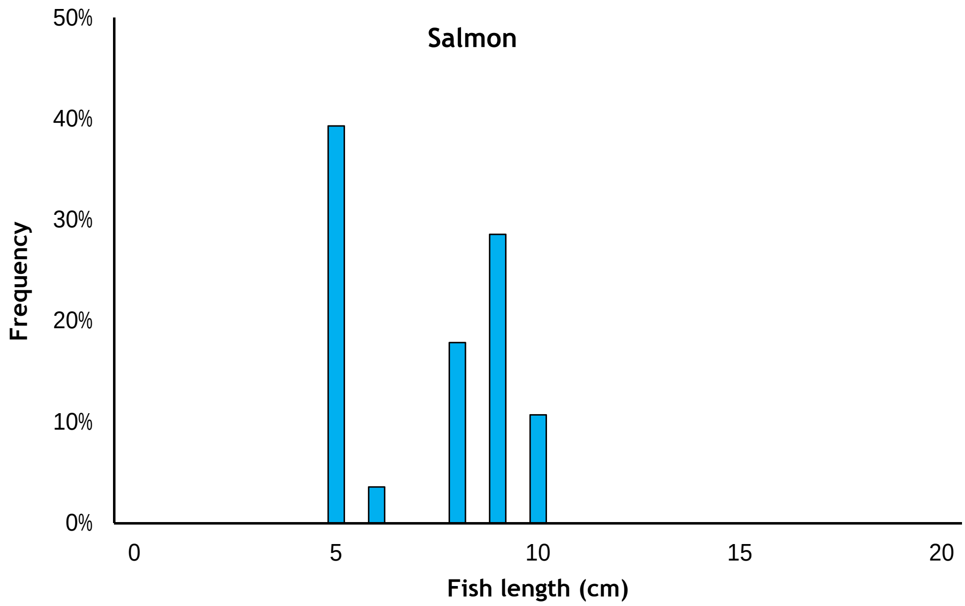
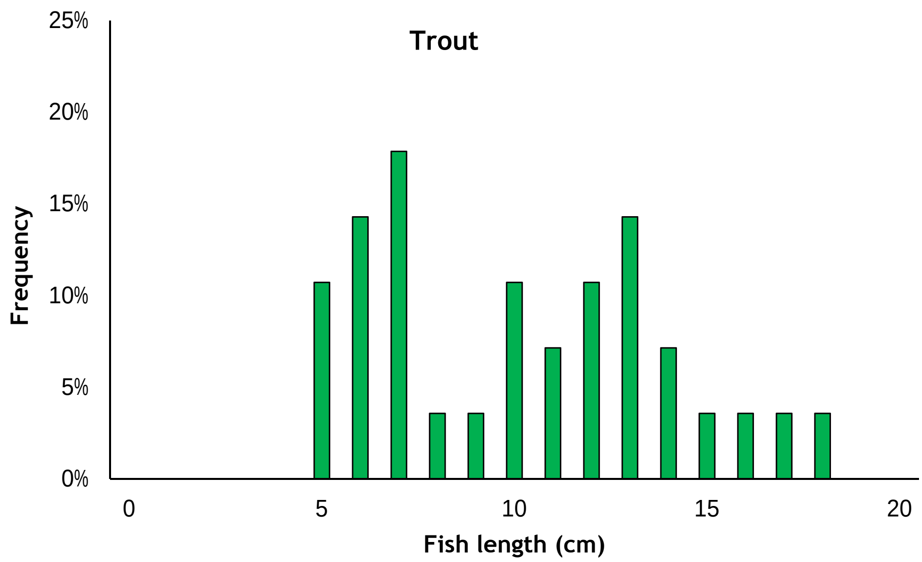


Figure 8.6: Length frequency distribution of salmon caught in the Altnaheglish/ Owenrigh River.



8.132 The salmon length frequency shows a clear separation of Age 0 fry (5-6 cm) from Age 1 fish (8-10 cm). The trout length frequency is less distinct but does indicate a bimodal distribution separating Age 0 fry (5-8 cm) from 'older fish' (9-18 cm), made up mostly of Age 1 with the largest fish (16-18 cm) likely to be Age 2.

Fish Distribution & Abundance

8.133 The results of the semi-quantitative survey are shown in **Table 8.15** with the numbers of trout and salmon at each site separated into age groups based on observed fish length as outlined above.

Table 8.15: Summary results of electrofishing survey indicating numbers of age 0 and older trout and salmon caught; fry abundance indices also indicated.

Site	Stream	Trout (Age)			Salmon (Age)		Fry abundance index	
		(0)	(1)	(2)	(0)	(1)	Trout	Salmon
1	Altnaheglish	0	0	1	0	0	Absent	Absent
2	Altnaheglish	12	6	1	0	0	Good	Absent
3	Owenrigh	Not surveyed					-	-
4	Owenrigh	4	12	1	16	20	Moderate	Good
5	Owenrigh	Not surveyed					-	-
6	Owenrigh	Not surveyed					-	-
7	Stream C	0	0	0	0	0	Absent	Absent

8.134 Juvenile trout in the range Age 0 to Age 2 were observed to be distributed throughout the adjacent and downstream reaches of the Altnaheglish/ Owenrigh River but were absent from adjoining Stream C. The other principal drainage streams A and B were adjudged to be unsuitable for habitation by fish. Applying the abundance indices outlined in **Table 8.4** show trout fry (Age 0) densities ranging from *Absent* to *Moderate*, and salmon fry (Age 0) densities *Absent* to *Good*.

8.135 These findings tie in with the Loughs Agency survey results which consistently indicate *Excellent* salmon abundance and *Poor* to *Moderate* trout abundance in the equivalent reach of the Owenrigh. The ES survey demonstrates that the upstream distribution of salmon is limited to some point between sites 2 and 3, while trout distribution extends significantly further upstream and is limited by lack of a consistent compensation flow from the dam.

8.136 None of the three site drainage streams A, B and C contains a significant stock of fish although the lower reach of Stream C is likely to be inhabited by trout immediately upstream of its confluence with the Owenrigh River.

Assessment of Effects

8.137 Potential effects were assessed for construction, operational and decommissioning phases of the Development. Construction impacts cover the discharge of suspended solids, release of other pollutants and interruption of fish passage. Post-construction (operational) impacts include habitat loss at watercourse crossings, obstruction of fish passage and surface water run-off.

8.138 Impact assessments are primarily based on their effect on salmonids either directly or upon their habitats. However, these assessments would be equally relevant to eels and lamprey if present in these waters.

Fisheries Significance / Sensitivity

8.139 Using the information assembled through the baseline assessment, the Fisheries Significance/Sensitivity for the main watercourses draining the area within the Site Boundary and downstream of this area are shown respectively in **Table 8.16**. A watercourse was deemed to have a High/ Very High sensitivity if its WFD class was at least Good and/or Annex II species were present (e.g. salmon, lamprey).

Table 8.16: Sensitivity of receiving watercourses within Site Boundary and downstream to River Roe main channel.

River/Stream	Key Species	WFD class	ASSI/SAC	Sensitivity
Stream A	No fish present within Site Boundary and unlikely in downstream reaches.	MEP	-	Negligible
Stream B	No fish present within Site Boundary and unlikely in downstream reaches.	MEP	-	Negligible
Stream C	No fish present within Site Boundary. Brown trout & Atlantic salmon likely adjacent to Owenrigh River.	MEP	-	Negligible (High: d/s reach)
Altnaheglish	Receiving watercourse located downstream of application area; Brown trout present & European eel likely. Annexe II species: Atlantic salmon also likely in lower reach.	MEP	-	High
Owenrigh	Receiving watercourse located downstream of application area; Annexe II species: Atlantic salmon, River/Brook/Sea lamprey. Brown trout & European eel also present.	MEP	ASSI/SAC	Very High
Roe	Receiving watercourse located downstream of application area; Annexe II species: Atlantic salmon, River/Brook/Sea lamprey. Brown trout & European eel also present.	Good	ASSI/SAC	Very High

8.140 Streams A, B and C **(Volume 3 - Figures 8.3-8.6)** were assessed as generally of Negligible sensitivity because they were of low habitat quality (at least within the Site Boundary) and were not populated by any significant fish species. However, the downstream section of Stream C adjacent to the Owenrigh was assessed as of High sensitivity due to good quality habitat and the likely presence of juvenile trout and salmon. The downstream main channel rivers Altnaheglish, Owenrigh and Roe were of High/Very High sensitivity due to the presence of Atlantic salmon and, in the case of the latter two, their designated status as SACs.

Construction Phase

8.141 The potential for impacts on fisheries and aquatic habitats during the construction phase is mainly associated with ground disturbance and the entrainment of sediments in surface water drainage. There is also a potential impact from the accidental spillage of other hazardous substances (oil and fuel) used in the construction process.

Sediment Run-off

8.142 The release of fine sediment (grain size <2mm) is potentially a major cause of environmental impacts and is associated with clearly defined negative impacts (Newcombe and Jensen, 1996; Turley et al. 2014). Sensitive fish species such as brown trout and Atlantic salmon are highly vulnerable to suspended and deposited sediment in spawning and nursery habitats (Kemp et al. 2011). In spawning gravels, incubating salmonid eggs require good water circulation to provide oxygen and remove waste products. As deposited fine sediment content increases, gravels become embedded, resulting in restricted water circulation and reduced egg and alevin survival (Cowx and Welcome, 1998). After emergence, juvenile salmonids (fry) disperse downstream to suitable nursery rearing habitat generally within 100m (Kennedy, 1984), often in faster flowing riffles/ runs, where they establish feeding territories and compete for food.

8.143 Suspended sediment can lower water clarity leading to reduce prey capture efficiency and may affect respiration rates by clogging of gills (Kemp et al. 2011). Deposited sediment can reduce habitat complexity and quality by in-filling of substrate, thus reducing territory size leading to increased aggression and ultimately lower carrying capacity. Deposited fine sediment can also indirectly affect growth and survival of juvenile salmonids by reducing the quality of habitat for preferred invertebrate prey species (Suttle et al., 1994).

8.144 Although adult salmonids are prone to gill-clogging and visual impairment at high levels of suspended sediment, they are much less reliant on substrate complexity, tending to occupy deeper pools, particularly during the spawning season. Adult salmonids are also more mobile than sessile eggs or juvenile stages, and thus more capable of avoiding adverse local conditions (Kemp et al. 2011).

8.145 Freshwater benthic macroinvertebrates are also an important component of river ecosystems, acting both as sentinels of general water and habitat quality, and as an important food resource for higher trophic levels such as fish and birds. Pulses of fine sediment can cause behavioural drift, whereas excessive fine sediment can reduce the quality of physical habitat by smothering and blocking of interstitial spaces and water flow (Allan, 1999). As fine sediment infiltration increases, invertebrate abundance and community diversity is reduced, resulting in the replacement of sensitive taxa (mayfly, stonefly and caddis) by more tolerant types (worms, midge larvae, molluscs; Matthaei et al. 2006; Kemp et al. 2011).

8.146 Sediment release and entrainment can also increase the risk of nutrient addition and alterations in channel morphology and hydrology (Levesque and Dube, 2007; Kelly, 2015). For example, excavated bank material or soils associated with the construction process could increase inputs of sediment bound phosphorus, which could negatively affect aquatic biota by causing excessive algal and macrophyte growth, and depressed oxygen levels.

8.147 Fine sediment is partly managed by the water quality objectives and standards of the EC Freshwater Fish Directive 2006/44/EC (FWFD), where a mean total suspended solids (TSS) concentration of 25 mg/L is specified for salmonid waters. While Article 6 of the Water Framework Directive has now repealed the FWFD, new standards that provide the same level of protection have been proposed (UKTAG, 2010). However, there is no national environmental standard or guideline for deposited fine sediment in the UK. Fine sediment cover above a threshold of 20% bed cover, based on recommendations in New Zealand by Clapcott et al. (2011), and published research (e.g. O'Connor & Andrew,1998; Kemp et al. 2011), provides a general indication of increasing risk for both invertebrates and salmonids.

8.148 The discharge of suspended solids during construction of the wind farm at Magheramore could result from:

- Excavations associated with construction of access tracks and turbine foundations
- Excavations associated with watercourse crossings
- Surface peat disturbance and subsequent erosion of the underlying soils
- Stockpiling of soils and excavated materials
- Run-off from access roads
- Landslide resulting from slippage of access roads or excavated materials.

8.149 The proposed site is hydrologically connected to watercourses of significant fisheries interest via on-site and off-site watercourses which are potential routes for suspended solids run-off. The Owenrigh and the Roe are of particular significance due to their SAC status and stocks of Annexe II listed Atlantic salmon.

Release of other pollutants

8.150 As the Site drains into the Altnaheglish and Owenrigh rivers which connect to River Roe, there is some potential for spillage or release of diesel, oil or other polluting substances to reach these key waters with consequences for resident fish together with invertebrate organisms, including key Annexe II listed species.

8.151 During construction, with high usage of plant fuel and oil, there is an increased risk of accidental spillage and discharge to the any of the drainage streams and thence to the Altnaheglish/ Owenrigh River. Similarly, the application of ready-mix concrete in construction processes carries some risk of inadvertent discharge with the potential to impact on resident fish and invertebrate organisms in these watercourses.

Operational Phase

8.152 The potential for any impacts will be significantly reduced during the operational phase with the construction process complete, site infrastructure in place, and a reduced requirement for any hazardous materials on-site. Potential impacts at Magheramore are essentially limited to surface water run-off.

Surface Water Run-off

8.153 Surface water run-off from an increased area of hard surface in the form of access tracks and hardstanding areas (crane hardstanding areas; onsite substation / control building compound) could lead to sediment-laden run-off to the receiving watercourses with potential effects on fish and other forms of aquatic life as outlined above.

8.154 Wash-out of areas of excavated peat during or following periods of heavy rainfall could also result in run-off of sediment to the receiving watercourses with potential increases in sediment load.

Decommissioning Phase

8.155 Decommissioning of the Development would have potential effects on fish stocks and aquatic habitats in the Altnaheglish and Owenrigh rivers. These impacts will be similar to those predicted for the construction phase but will ultimately depend on the level of reinstatement required.

8.156 In this case the decommissioning process will involve the removal of all above ground structures, removal of underground structures to one metre below ground level, and reinstatement of disturbed areas; access tracks are likely to remain for farm use. However, it is unlikely that any of the structures at or near to the main watercourses will be removed or modified in any way.

8.157 The effects of decommissioning on fish habitats and fish stocks are therefore likely to be similar to those of construction, although of lower magnitude.

Mitigation

Construction Phase

Sediment Run-off

8.158 Mitigation measures to control sediment run-off are described in detail in Chapter 9 (Geology & Water Environment) and summarised as follows:

Buffer Zones

8.159 During the construction phase it is important that works should be avoided within the area of sensitive watercourses, with the preservation of intact vegetated buffer zones between development infrastructure and stream channels. To this end, buffer zones of 50m minimum width are specified in Chapter 9 for significant watercourses (catchment area within site >0.25 km^2). This is in line with NIEA guidance and will apply to Stream C, the key watercourse in terms of fisheries sensitivity.

8.160 Turbine bases, access roads and associated infrastructure will be located out with buffer zones, with the exception of two watercourse crossings - Stream C and a tributary; however, both of these coincide with existing track crossings and as such will not cause any new significant morphological change. There are seven crossings of minor watercourses (catchment area within site <0.25 km^2), and the majority of these comprise existing track-side drains.

8.161 The application of buffer zones will minimise the risk of sediment run-off from site construction works to on-site watercourses and more sensitive downstream reaches in the Altnaheglish and Owenrigh rivers.

Construction Methods & Timing of Works

8.162 The Loughs Agency has produced Guidelines for Fisheries Protection during Development Works (2011) which identifies the likely impact of construction and development work on fisheries habitat and outlines practical measures for the avoidance and mitigation of damage.

8.163 The Development will require watercourse crossings on Stream C, and a series of minor drainage features including dry or partially dry agricultural ditches, ephemeral drains etc. There will also be a drainage diversion at T6. All of these crossings and the diversion are relatively minor and will be completed using standard culvert structures which may be installed without any seasonal restriction.

8.164 All works at stream crossings will adhere to the measures outlined in the Good Practice Guidance notes PPG5: Works In, Near or Liable to Affect Watercourses (Environment Agency, 2014). It is also recommended that to minimise the risk of suspended sediment entrainment in surface water run-off, the site drainage system should only be constructed during periods of low rainfall and therefore low run-off rates.

Surface Water Management

8.165 The potential for pollution of watercourses by silt-laden runoff is addressed in detail in Chapter 9: Geology & Water Environment. A surface water management plan will be developed using the principles of Sustainable Drainage, based on the on-site retention of flows and use of buffers and other silt removal techniques. An established Sustainable Drainage System (SuDS) design which will be used to control drainage and silt management.

8.166 The surface water management plan outlined in Chapter 9 will include a series of measures minimise modification and disruption of the existing hydrology. This approach will include a system for the drainage of the temporary works during the construction phase, with use of swales, check dams and settlement ponds to provide a surface water management system that will prevent any adverse effects on the ecology of the principal receiving watercourses during the construction phase of the project.

Water Quality Monitoring

8.167 Chapter 9 also proposes the implementation of a water quality monitoring programme to examine the effects of the infrastructure construction works on surface water quality. It is recommended that the monitoring programme be continued through the operation and decommissioning phases of the Development.

Release of other pollutants

Site Management

8.168 All precautions will be taken to avoid spillages of diesel, oil or other polluting substances during the construction phase. This will be achieved through good site practices as described in the Good Practice Guidance notes proposed by EA/SEPA/NIEA (Environment Agency, 2014), including:

- PPG1: General Guide to the Prevention of Water Pollution;
- PPG5: Works In, Near or Liable to Affect Watercourses;
- PPG10: Working at Construction and Demolition Sites.

8.169 A Pollution Prevention Plan will be included as part of the Construction & Decommissioning Method Statement (CDMS) for the Development, to be agreed with the local planning authority at the pre-construction stage. This will incorporate a contingency plan setting out the procedure to be followed in the event of a significant spillage occurring.

Surface Water Management

8.170 The proposed surface water management plan and associated SuDS system will also facilitate the interception of diesel, oil or other polluting substances during the construction phase.

Operational Phase

Surface Water Run-off

8.171 As outlined in Chapter 9, site drainage will use the principles of SuDS, with installations to incorporate a “treatment train” of two to three stages of pollutant removal to all surface water runoff during the operational phase, as with the construction and decommissioning phases. Additional measures to prevent the release of suspended solids will include:

- Preservation of natural run-off patterns;
- Reduction of flow rates from access tracks through use of attenuating check-dams;
- Use of shallow ponds to aid settlement;
- Linear track drainage swales with regular outflow points throughout the SuDS system to limit the potential for large flows at single outflow points;
- Avoidance of peat storage within denoted watercourse buffer zones or in areas of overland water flow.

Decommissioning Phase

8.172 Mitigation measures during decommissioning will be the same as during the construction phase with regard to addressing the potential for run-off of suspended solids and other polluting substances. However, the level of mitigation will be determined by the level of reinstatement required.

Residual Effects

8.173 The potential effects of the Development on fish stocks and their habitats in the Altnaheglish, Owenrigh and Roe rivers are measured against proposed mitigation measures, as a means of assessing the residual effects of the project. Of particular importance in this context are the impacts on the Annex II listed Atlantic salmon as the primary feature of the River Roe & Tributaries ASSI/SAC.

8.174 The magnitude of the potential effects and their residual significance were assessed according to the procedure outlined in the Methodology section of this chapter. It is the residual effects associated with the Development that most accurately reflect the overall predicted effects on fisheries and the aquatic environment during the construction, operational and decommissioning phases.

Construction Phase

8.175 Mitigation measures employed through the surface water management plan outlined in Chapter 9 based on SuDS technology to control drainage and silt management on the Development site will remove the potential for direct damage to fish or siltation of spawning and nursery habitats. These measures in association with the Pollution Prevention Plan will also minimise the risk for release of other construction related polluting substances into the river network.

8.176 As there are no streams of any fisheries significance within the Site, there will be no effects on fish migrations or spawning activity.

8.177 The magnitude and significance of potential effects during the construction phase before mitigation are summarised for each watercourse in **Table 8.17** along with the predicted residual effects after mitigation.

8.178 Without mitigation the effects during the construction phase are predicted to be at worst of ***Major Magnitude*** and of ***Very Large Significance***, depending on specific effects and the sensitivity of individual watercourses e.g. sediment run-off to the Owenrigh River as a significant salmon spawning and nursery river. However, with mitigation the effects are reduced to ***Neutral***.

Operational Phase

8.179 As there are no streams of any fisheries significance within the Site there will be no loss of salmonid habitat or reduced productivity.

8.180 Although there will be an increase in the area of hard surface due to the Development, the surface water management plan / drainage design features for the control and attenuation of storm water run-off will protect receiving watercourses from excessive inputs of sediment.

8.181 The magnitude and significance of potential effects during the operational phase before mitigation are summarised for each watercourse in **Table 8.18** along with the predicted residual effects after mitigation.

8.182 Without mitigation the effects during the operational phase are predicted to be at worst of ***Major Magnitude*** and of ***Very Large Significance***, depending on specific effects and the sensitivity of individual watercourses. However, with mitigation the effects are reduced to ***Neutral***.

Decommissioning Phase

8.183 The magnitude and significance of potential effects during the decommissioning phase before mitigation are summarised for each watercourse in **Table 8.19** along with the predicted residual effects after mitigation.

8.184 Without mitigation the effects during the decommissioning phase are predicted to be at worst of ***Major Magnitude*** and of ***Very Large Significance***, depending on specific effects and the sensitivity of individual watercourses. Mitigation measures will ensure that the effects remain as ***Neutral***.

Table 8.17: Construction Phase - Magnitude and Significance of Effects without Mitigation, and Residual Effects after Mitigation.

River/ Stream	Designation	Key Species	Sensitivity	Potential Effect	Magnitude of Effect	Sig. without Mitigation	Residual Effect after Mitigation
Stream C	None	No fish present within Site Boundary. Brown trout & Atlantic salmon likely to be present adjacent to Owenrigh River.	Negligible (High in d/s reach)	Sediment run-off	No impact (Minor in d/s reach)	Neutral (Slight/ Moderate in d/s reach)	Neutral
				Release of other pollutants	No impact (Minor in d/s reach)	Neutral (Slight/ Moderate in d/s reach)	Neutral
Altnaheglish River	None	Brown trout present & European eel likely. Annexe II species: Atlantic salmon also likely in lower reach.	High	Sediment run-off	Moderate	Large	Neutral
				Release of other pollutants	Moderate	Large	Neutral
Owenrigh River	ASSI / SAC	Annex II species: Atlantic salmon, River/Brook/Sea lamprey. Brown trout & European eel also present.	Very High	Sediment run-off	Major	Very Large	Neutral
				Release of other pollutants	Major	Very Large	Neutral
River Roe	ASSI / SAC	Annex II species: Atlantic salmon, River/Brook/Sea lamprey. Brown trout & European	Very High	Sediment run-off	Moderate	Large/ Very Large adverse	Neutral
				Release of other pollutants	Moderate	Large/ Very Large adverse	Neutral

River/ Stream	Designation	Key Species	Sensitivity	Potential Effect	Magnitude of Effect	Sig. without Mitigation	Residual Effect after Mitigation
		eel also present.					

Table 8.18: Operational Phase – Magnitude and Significance of Potential Effects without Mitigation, and Residual Effects after Mitigation.

River/ Stream	Designation	Key Species	Sensitivity	Potential Effect	Magnitude of Effect	Sig. without Mitigation	Residual Effect after Mitigation
Stream C	None	No fish present within Site Boundary. Brown trout & Atlantic salmon likely to be present adjacent to Owenrigh River.	Negligible (High in d/s reach)	Sediment run-off	No impact (Minor in d/s reach)	Neutral (Slight/ Moderate in d/s reach)	Neutral
Altnaheglish River	None	Brown trout present & European eel likely. Annexe II species: Atlantic salmon also likely in lower reach.	High	Sediment run-off	Moderate	Large	Neutral
Owenrigh River	ASSI / SAC	Annex II species: Atlantic salmon, River/Brook /Sea lamprey. Brown trout & European eel also present.	Very High	Sediment run-off	Major	Very Large	Neutral
River Roe	ASSI / SAC	Annex II species: Atlantic salmon, River/Brook	Very High	Sediment run-off	Moderate	Large/ Very Large adverse	Neutral

River/ Stream	Designation	Key Species	Sensitivity	Potential Effect	Magnitude of Effect	Sig. without Mitigation	Residual Effect after Mitigation
		/Sea lamprey. Brown trout & European eel also present.					

Table 8.19: Decommissioning - Magnitude and Significance of Effects without Mitigation, and Residual Effects after Mitigation.

River/ Stream	Designation	Key Species	Sensitivity	Potential Effect	Magnitude of Effect	Significance without Mitigation	Residual Effect after Mitigation
Stream C	None	No fish present within Site Boundary. Brown trout & Atlantic salmon likely to be present adjacent to Owenrigh River.	Negligible (High in d/s reach)	Sediment run-off	No impact (Minor in d/s reach)	Neutral (Slight/ Moderate in d/s reach)	Neutral
				Release of other pollutants	No impact (Minor in d/s reach)	Neutral (Slight/ Moderate in d/s reach)	Neutral
Altnaheglish River	None	Brown trout present & European eel likely. Annexe II species: Atlantic salmon also likely in lower reach.	High	Sediment run-off	Moderate	Large	Neutral
				Release of other pollutants	Moderate	Large	Neutral
Owenrigh River	ASSI / SAC	Annex II species: Atlantic salmon, River/Brook/Sea lamprey. Brown trout & European eel also present.	Very High	Sediment run-off	Major	Very Large	Neutral
				Release of other pollutants	Major	Very Large	Neutral
River Roe	ASSI / SAC	Annex II species: Atlantic salmon, River/Brook/Sea lamprey. Brown trout & European eel also present.	Very High	Sediment run-off	Moderate	Large/Very Large adverse	Neutral
				Release of other pollutants	Moderate	Large/Very Large adverse	Neutral

Cumulative Effects

Additional Developments

8.185 This section considers other wind farm developments within a 20 km radius which have either been constructed or are at different stages of the planning process in Northern Ireland. Along with the proposed development, these developments/proposals could give rise to the potential for cumulative effects on local rivers.

8.186 With regard to fisheries and the aquatic environment, the potential for cumulative effects is only relevant when proposed or existing developments are either hydrologically connected or which drain to the same receiving environment. It is therefore more important to consider additional developments in the context of river catchments, both locally and on a wider river basin scale.

8.187 Within a 20 km radius of the Development a total of 12 additional wind farm developments have been identified which are wholly or partly located within River Roe catchment and might therefore be considered to have the potential for cumulative impacts on the river and the integrity of the SAC **(Table 8.20)**. However, none of these sites are located within the immediate Owenrigh River waterbody removing the potential for any cumulative effects in the immediate sub-catchment.

Table 8.20: Additional wind farm developments/proposals within a 20 km radius of the Development indicating their location by WFD waterbody within the River Roe LMA.

Wind Farm	Planning Reference	WFD waterbody	No. of Turbines	Status
Rigged Hill	B/1993/0377/F	Castle River	10	Operational
Smulgedon	B/2009/0070/F		7	Consented
Craiggore	B/2012/0268/F		10	Consented
Altahullion I	B/2000/0118/F	Bovevagh River	20	Operational
Altahullion II	B/2004/0795/F		9	Operational
Altahullion III	B/2007/0006/F		12	Operational
Glenconway	B/2011/0272/F		8	Operational
Dunbeg	B/2007/0560/F	Curly River	14	Operational
Dunmore	B/2007/0563/F		7	Operational
Dunmore II	B/2013/0241/F		8	Consented
Dunbeg Ext	LA01/2016/0061/F		3	Consented
Dunbeg South	LA01/2018/0200/F		9	In Planning
Ballyhanedin	A/2014/0630/F	Owenbeg River	8	Consented

8.188 Whilst there has been one noted problem relating to sediment run-off at Bin Mountain Wind Farm in the Fairy Water catchment, there does not appear to have been any problems relating to other sites in Northern Ireland or specifically to the eight sites currently operational in the Roe catchment.

8.189 The five consented sites (Ballyhanedin, Smulgedon, Dunmore II, Dunbeg Ext & Craiggore) along with two proposed developments (Dunbeg South & Magheramore) will involve civil engineering works including land excavation and possibly including in-river works, each with the potential for similar effects on the aquatic environment including fisheries. As such there is the potential for the run-off of sediments to local watercourses with resultant damage to aquatic fauna and habitats.

8.190 Aside from wind farm developments the only other significant construction project within the River Roe catchment is the A6 Dungiven to Drumahoe road scheme which involves the construction of 25.5 kilometres of dual carriageway with numerous watercourse crossings including both the Owenrigh and the main channel River Roe. Works commenced in April 2018 and the scheme is scheduled for completion by Spring 2022.

8.191 The greatest risk to fisheries and the aquatic environment is during the construction phase of these projects when the civil engineering works are carried out. It follows that it is vital for the highest standards to be maintained with regard to site preparation, temporary works and site drainage issues, and that full mitigation measures must be applied to remove any potential for this type of incident.

Assessment

8.192 There is no evidence that existing wind farm developments in the area have had any adverse impact on River Roe catchment which in turn could have affected the integrity of the River Roe & Tributaries ASSI/SAC.

8.193 However, there are a range of activities that currently have an influence on conservation and management of the SAC, primarily in relation to water quality e.g. point-source pollution from urban and industrial sources; point-source pollution from development including proposed wind farm developments; and diffuse pollution from commercial forestry in the upper catchment and farming in the lower catchment. There is potential for these impacts to act in combination to produce cumulative impacts on water dependant qualifying features, affecting their conservation status, and the overall integrity of the SAC.

8.194 The likelihood of significant cumulative impacts on the aquatic environment is increased if two or more wind farms are to be constructed or decommissioned at the same time. Craiggore, Dunbeg Extension and Smulgedon have been consented for some time and therefore construction is likely to proceed in advance of the Development. The likelihood of simultaneous construction with the Development further reduces the potential for any cumulative effects.

8.195 Similarly, the A6 road scheme is scheduled for completion in spring 2022 and it is unlikely that the Development will proceed within that period - there is therefore a low likelihood of any resultant cumulative effects.

8.196 Implementation of the mitigation measures as described will ensure that the Development will not contribute to any cumulative impact on the SAC, in particular on Atlantic salmon as the primary feature of the site.

Summary

8.197 This chapter outlines the potential effects of the Development on the fish stocks and fish habitats of the receiving watercourses in the River Roe catchment. It provides relevant baseline information on fisheries enabling the potential effects to be identified and evaluated.

8.198 It has been determined that potential impacts are primarily related to the sediment run-off to the receiving watercourses with related effects on fish stocks and their habitats. Without mitigation it is considered that these impacts have the potential to be of Major Magnitude and of Very Large Significance depending of the sensitivity of individual watercourses.

8.199 A series of specific mitigation measures have been designed to avoid adverse effects on fisheries with regard to both construction and operational phases of the project.

8.200 Hydrology and site drainage issues have been considered in detail in Chapter 9 which outlines a surface water management system and drainage (SuDS) designed to control drainage and silt management on the Site.

8.201 It is concluded that, provided the mitigation measures are implemented as specified, construction and operation of the proposed development will have a neutral impact on the fish stocks and aquatic biology of the Altnaheglish/ Owenrigh River and the wider River Roe catchment. It follows that the development will have no effect on the Atlantic salmon as the primary feature of the River Roe and Tributaries ASSI/SAC.

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9

Geology & Water Environment

9 Geology and Water Environment

Introduction

Terms of Reference

9.1 This chapter considers the likely significant effects on the receiving hydrological, geological and hydrogeological environments; associated with the construction, operation and decommissioning of the proposed windfarm at Magheramore, Co. L'Derry, hereinafter referred to as 'the Development'.

9.2 The impacts caused by the construction and operation phases of the development are assessed, and mitigation measures are provided where required.

9.3 The assessment also identifies where hydrological features may constrain the layout of the Development.

Supplementary Assessments

9.4 This Chapter is supported by:

- Technical Appendix 9.1: Water Framework Directive Assessment;
- Technical Appendix 9.2: Flood Risk & Drainage Assessment
- Technical Appendix 9.3: Geotechnical Assessment including Peat Slide Risk Assessment
- Technical Appendix 9.4: Consultation Records
- Figures 9.1 to 9.4

9.5 Reference should be made to **Chapter 2: Development** for information regarding detailed construction proposals.

9.6 Changes to the hydrological / hydrogeological regime may create resultant effects on ecology within the hydrological dependent ecosystems. Therefore, this chapter is further supported by;

- Chapter 6: Ecology;
- Chapter 8: Fisheries & Aquatic Ecology Assessment;

Statement of Authority

9.7 The assessment has been carried out by McCloy Consulting Ltd.; an independent environmental consultancy specialising in the water environment, with specialist knowledge of hydrological and hydrogeological assessments.

9.8 The key staff members involved in this project are as follows:

- Caítríona Downey BSc (Hons)– Graduate Environmental Consultant experienced in undertaking hydrology and hydrogeology assessments, water quality monitoring projects and flood risk and drainage assessments.

- Kyle Somerville BEng (Hons) CEng MIEI – Associate and Chartered Senior Engineer specialising in the fields of flood risk assessment, flood modelling, drainage and surface water management design.

Scope of Assessment

9.9 This report will assess the effects of the Development on hydrology and surface water quality, hydrogeology and groundwater quality, and geological features. The assessment covers the construction, operational, maintenance and decommissioning phases of the development.

9.10 This assessment identifies the hydrological constraints within the application boundary; herein referred to as "the site" and assesses the potential effects of the following;

9.11 The report identifies and assesses the potential effects on the following:

- Existing natural and artificial drainage patterns;
- Water quality of surface water and groundwater;
- Surface water dependent ecosystems;
- Usage of surface water and groundwater including abstractions;
- Groundwater - surface water interactions;
- Aquifer systems and their vulnerability;
- Superficial and bedrock geology at the site;
- Structural geology of the area and its environs;

9.12 In order to quantifiably assess the preceding, this report:

- Outlines relevant policy relating to the water environment;
- Summarises consultations provided in response to scoping requests;
- Provides baseline information and identifies sensitive receptors;
- Identifies potential likely effects, including potential likely cumulative effects;
- Assesses the significance of any adverse effects and resulting impacts based on the magnitude of the impact and the sensitivity of the receptors;
- Discusses management of design evolution and details mitigation measures;
- Provides a residual impact assessment;
- Discusses the cumulative effects of the development in conjunction with other proposed and existing developments in the vicinity.

Legislation and Planning Policy

9.13 Relevant Environmental planning legislation and policy and industry best-practice guidance relevant to an assessment of hydrogeology and the water environment are summarised in **Table 9.1** and the following sections.

Relevant European and National Planning Policy

Table 9.1: Relevant European and National Planning Policy

Legislation	
EU	EU Water Framework Directive (2000/60/EC)
	Groundwater Daughter Directive to the Water Framework Directive (2006/118/EC)
	Priority Substance Daughter Directive to the Water Framework Directive (2008/105/EC)
	Environmental Liability Directive (2004/35/EC)
	Dangerous Substances Directive (2006/11/EC)
UK	UK Environmental Standards and Conditions Phase 1 and Phase 2 (UK TAG 2008)
NI	Control of Pollution (Oil Storage) (Amendment) Regulations (NI) 2011
	Drainage (Environmental Impact Assessment) Regulations (NI) 2006
	Environmental Liability (Prevention and Remediation) (Amendment) Regulations (NI) 2009
	Groundwater Regulations (NI) 2009 / Groundwater (Amendment) Regulations (NI) 2014
	Nature Conservation and Amenity Lands (NI) Order 1985
	Private Water Supply Regulations (NI) 2009 / Private Water Supply (Amendment) Regulations (NI) 2010
	Surface Waters (Dangerous Substances) (Classifications) Regulations (NI) 1998
	The Drainage (NI) Order 1973 / The Drainage (Amendment) (NI) Order 2005
	The Environment (NI) Order 2002
	The Fisheries (NI) Act 1966
	Water Act (Northern Ireland) 1972 / The Water (NI) Order 1999
	Water Supply (Water Quality) Regulations (NI) 2007 / (Amendment) Regulations (NI) 2010
	Water Environment (Water Framework Directive) Regulations (NI) 2003
	Water Framework Directive (Priority Substances and Classification) (Amendment) Regulations (NI) 2012
	Water Framework Directive (Classification, Priority Substances and Shellfish Regulations (NI) 2015
	Sustainable Development Strategy, “Everyone's Involved" (2010)

Regional and Local Planning Policy

9.14 The Site has been reviewed in relation to local planning policy specific to geology and the water environment. A detailed planning policy and legislation review is included within **Chapter 1: Introduction and Planning Policy**.

Northern Area Plan 2016

9.15 The Site lies within Causeway Coast & Glens BC; the current area plan is Northern Area Plan 2016. The plan contains limited information regarding planning policy related to water environments; other that reference to habitation regulations.

9.16 A Habitats Regulation Assessment on the Northern Area Plan provides details of a screening assessment undertaken on SPA and SAC sites within the Council area which may be affected by the Northern Area Plan. The scale of importance of summarised in the below table.

Table 9.2: Designations Summary

Scale of Importance	Designation Type	Designated By
INTERNATIONAL Nature Conservation Importance	Ramsar Sites	Convention on Wetlands of International Importance1975
	Special Protection Areas Special Areas of Conservation	European Commission Directive on the Conservation of Wild Birds (79/409/EEC) The Conservation (Natural Habitats, etc.) Regulations (NI) 1995
NATIONAL Nature Conservation Importance	Nature Reserves, National Nature Reserves, Marine Nature Reserves Areas of Special Scientific Interest	Nature Conservation and Amenity Lands (NI) Order 1985
LOCAL Nature Conservation Importance	Sites of Local Nature Conservation Importance and Earth Science Interests / Assets	Northern Ireland Council Area Plans

PPS15 – Revised Planning and Flood Risk

9.17 Revised PPS15 sets out planning policies to "minimise flood risk to people, property and the environment", emphasising sustainable development and the conservation of biodiversity. The policy refers to the use of Sustainable Drainage Systems (SuDS) to minimise effects on the receiving water environment.

9.18 The policy notes that development proposals facilitating sustainable drainage would be considered favourably by the planning authority; as such a sustainable drainage approach should be adopted by the Development.

Guidance on Conservation of Geological Features - Earth Science Conservation Review

9.19 The Earth Science Conservation Review (ESCR) is the means whereby areas of geological interest in Northern Ireland are assessed to determine their importance to science and hence to earth science conservation.

9.20 The objective of the ESCR is to define systematically all earth science localities (geological and/or geomorphologic) in Northern Ireland. The overall aim of the process is to encourage conservation of such areas to protect them from potential threats such as landfill, changes to natural systems and coastal defence work.

Industry Guidelines

9.21 The Pollution Prevention Guidelines (PPGs), published by the Northern Ireland Environment Agency (NIEA) in conjunction with the Environment Agency for England and Wales, and the Scottish Environment Protection Agency (SEPA) are currently being replaced by updated Guidance for Pollution Prevention (GPPs). Guidance notes relevant to the Development include:

- NIEA Guidance for Pollution Prevention (GPPs):
    - GPP 2: Above ground oil storage tanks;
    - GPP 4 Treatment and disposal of Wastewater where there is no connection to the public foul sewer;
    - GPP 5: Works and Maintenance in or near Water;
    - GPP 8: Safe Storage and Disposal of Used Oils;
    - GPP 20: Dewatering Underground Ducts and Chambers;
    - GPP 21: Pollution Incident Response Planning;
    - GPP 22: Dealing with Spills;
- GPP 26 Safe Storage – Drums and Intermediate Bulk Containers
- In the absence of revised specific guidance, works shall similarly consider the lapsed NIEA Pollution Prevention Guidance Notes (PPGs):
    - PPG 1: Understanding Your Environmental Responsibilities – Good Environmental Practice;
    - PPG 3 Use and Design of Oil Separators in Surface Water Drainage Systems
    - PPG 6: Working at Construction and Demolition Sites;
    - PPG 7: The Safe Operation of Refuelling Facilities;
    - PPG 18: Managing Fire Water and Major Spillages;
    - PPG 20 Dewatering Underground Ducts and Chambers

9.22 Other relevant industry guidance includes:

- BS6031: 2009 Code of Practice for Earthworks;
- BS 5930 2015: Code of Practice for Site Investigations;

- CIRIA C523 - Sustainable Urban Drainage Systems; Best Practice Manual (2001);
- CIRIA C532 - Control of Water Pollution from Construction Sites (2001);
- CIRIA C692 - Environmental Good Practice on-Site (2010);
- CIRIA C609 - Sustainable Drainage Systems: hydraulic/structural/water quality (2004);
- CIRIA C753- The SuDS Manual (2015);
- CIRIA C689- Culvert Design and Operation Guide (2010);
- DEFRA Construction Code of Practice for Sustainable Use of Soils on Construction Sites (2009);
- DOE / NIEA - Water Feature Surveys: A Guide to EIA and Planning Considerations (2015);
- DOE / NIEA - Water Feature Surveys: Wind Farms and Groundwater Impacts (2015).

Scope of Assessment

9.23 This report assesses the effects of the Development on hydrology and surface water quality, hydrogeology and groundwater quality, and geological features. The assessment covers construction, operation, maintenance and decommissioning phases.

9.24 The report identifies and assesses the potential effects on the following:

- Existing natural and artificial drainage patterns
- Runoff rates and volumes
- Flooding and impediments to flows
- Surface water dependent ecosystems including hydrological units of peat bog
- Hydrogeological patterns
- Water quality of surface water and groundwater
- Usage of surface water and groundwater including abstractions
- Aquifer systems and their vulnerability
- Existing solid geology and superficial geology
- Structural geology of the area and its environs.

9.25 In order to quantifiably assess the preceding, this report:

- Outlines relevant policy relating to the water and geological environment;
- Summarises and responds to consultations provided in response to scoping requests to inform particular requirements of the assessment;
- Provides baseline information and identifies sensitive receptors;
- Identifies potential likely effects, including potential likely cumulative effects;

- Assesses the significance of any adverse effects and resulting impacts based on the magnitude of the impact and the sensitivity of the receptors;
- Discusses management of design evolution and detailed mitigation measures;
- Provides a residual impact assessment;
- Discusses cumulative effects of the Development in conjunction with other proposed and existing developments in the vicinity.

Consultation

9.26 Formal consultation to form opinion and requirements with regards to the hydrological and geological environments was sought from local and regional organisations by RES as summarised within. Consultation took the form of a proposed scope of this assessment and a request for any amendment or additional requirements sought by the consultee.

9.27 A summary of the specific requests made by the various consultees is included in the following table. Site specific input provided is included in the following baseline assessment. Consultee responses are included in **Appendix 9.4**.

Table 9.3: Consultee Summary

Consultee		Summary of Response	Addressed in Assessment
DAERA	NIEA Land and Groundwater Team	Wind turbine foundations have the potential to impact on the groundwater environment; e.g. groundwater flow paths, aquifers or secondary receptors (including private water supplies). Groundwater receptors should be identified through a Water Feature Survey, the risk of potential impact assessed, and, mitigation measures should be identified where required.	9.83 to 9.98
	Environment, Marine & Fisheries Group Marine & Fisheries Division	States no issues / concerns to raise from an aquaculture / sea fisheries aspect. Reminds the applicant it is an offence under Article 47 of the Fisheries Act (NI) 1966 to cause pollution which is subsequently shown to have a deleterious effect on fish stocks. States works near watercourses to be carried out in line with guidance as described in the PPG 5 (Works In, Near or Liable to Affect Watercourses).	9.132 to 9.140

Consultee		**Summary of Response**	**Addressed in Assessment**
	NIEA - Natural Environment Division	The application site is in proximity to Banagher Glen SAC/ASSI and the River Roe and Tributaries SAC/ASSI. Proposals which may impact on a European site, will require a Habitats Regulations Assessment (HRA). Considers the proposal is likely to have significant environmental effects with regard to the Planning (EIA) Regulations (NI) 2015. The application site may contain priority peatland habitat. The topography, geology, soils and water environmental of the site and surrounding area should be described. ES should include the likely significant effects and proposed mitigation measures to offset any significant adverse effects.	The NIEA NED comments relate to the Ecology Chapter (Chapter 6). The Ecology chapter is inter-related with the Water and Geology chapter is crossed referenced where appropriate.
Department for Infrastructure	Rivers Planning Advisory Unit	States PPS15 requires flood risk and drainage are assessed in the ES. **FLD 1** – a small portion of the site lies within the 1 in 100 yr fluvial flood plain. **FLD 2** – the site is traversed by various undesignated watercourses, to which a 5m maintenance strip should be applied. Clear access and egress should be provided at all times and be protected from impediments (including tree planting, hedges, permanent fencing and sheds), land raising or future unapproved development. **FLD 3** – the applicant should refer to para. D17 and D18 and PPS15. The drainage assessment should acquire evidence from the relevant authority that the proposed storm water run-off from the site can be safely discharged. Under the terms of Schedule 6 of the Drainage (NI) Order 1973 the applicant must submit to DfI Rivers for its consent for any proposal to carry out works which might affect a watercourse.	9.126 to 9.131, 9.191 to 9.196, and 9.218
Causeway Coast and Glens Borough Council	Shared Environmental Service	The proposed site is hydrologically connected to the River Roe and Tributaries and falls slightly within the Banagher Glen SAC.	9.141 to 9.151
Northern Ireland Water	Infrastructure Planning	The Development is located in close proximity to Altnaheglish Impounding Reservoir and Caugh Hill Water Treatment Works. NI Water confirmed the site area is downstream of Altnaheglish Dam and outside of the catchment area. NI Water acknowledge a raw water main in proximity to the site.	9.130

9.28 Additional pre-application consultation and data gathering to form opinion and requirements with regards to the hydrological and geological environments was sought from local and regional stakeholder organisations, including organisations who would be anticipated to be consulted by the planning authority in relation to the planning application. The consultation is intended to pre-empt any pre-application or in-application consultation that would be undertaken on notification or submission of the planning application and EIA. The informal consultation excludes NIEA:NED whose concerns are addressed separately in **Chapter 6 Ecology**.

9.29 A summary of the specific data provided by and information / concerns raised by the various stakeholders is included in the following table. Site specific input provided is included in the following baseline assessment. Stakeholder responses are included in **Technical Appendix 9.4**.

Table 9.4: Additional Consultation Summary

Consultees		Summary of Response	Addressed in Assessment
Causeway Coast and Glens Borough Council	Environmental Health	Provided a list council held private water supplies within 2km radius of the proposed windfarm site. Details of 19 no. wells and springs were provided located on Magheramore Rd, Teevan Rd and Banagher Rd. The response states some of the supplies may not be in use but are on private land.	9.93 to 9.98
Department of DAERA	Fisheries Inspectorate	DAERA Sea Fisheries Inspectorate have an aquaculture site downstream from the Development which was damaged by floods in 2017 but may be operational in the future and it is important that this site is kept in mind for any future developments upstream.	9.133 to 9.138
NIEA	Drinking Water Inspectorate	Holds information on private water supplies with the Inspectorate under The Private Water Supplies Regulations (Northern Ireland) 2017. There are no private drinking water supplies registered with the Inspectorate within 5km of the outlined site.	9.93
	Water Management Unit – Pollution Prevention Team	Pollution Prevention Team provided general information in relation to pollution prevention. Recommends all necessary source control and mitigation measures to prevent pollution of the water environment during construction, operational or maintenance phase of a project are identified and employed. Highly recommends the relevant PPGs and GPPs are identified and their precepts adhered to, in particular PPG5 and PPG6. Recommends the NIEA Pollution Prevent Team be consulted about any work, to be conducted in or near a waterway, or liable to affect any waterway, to agree a Method Statement with contractors (8	9.230 to 9.257

Consultees		Summary of Response	Addressed in Assessment
		weeks) prior to the commencement of any works. Risks to the water environment, potential pollution pathways, best practices principles and mitigation measures to minimise risks should be identified, incorporated in contractors' Method Statements and be in place prior to the commencement of any works. Provided examples of mitigation measures; Construction phase site drainage plans should be considered at an early, to ensure site water is minimised (e.g. utilising cut off channels) collected, channelled and treated prior to discharge. Water should be collected in cut of drains and check dams and channelled to settlement features (built and maintained according to industry bet practice) for treatment of suspended solids prior to discharge. Phased stripping and minimisation of exposed land to control suspended solid generation should be considered. Use of settlement systems for settlement of suspended solids from site drainage. These should be built and maintained according to industry best practice. Any works in a waterway must be conducted 'in the dry' e.g. behind coffer dams, use of over pumping, the use of temporary diversions etc. The NIEA Pollution Prevention Team do not permit machinery to enter any waterway at any time. NIEA must be consulted prior to commencement of any such works to ensure appropriate mitigation measures are in place. The Pollution Prevention Team work with contractors to ensure minimal disturbance and generation of suspended solids during the placement and removal of cofferdams/diversions etc. The NIEA do not encourage in stream settlement as a primary mitigation measure, the contractor must strive to ensure the generation of suspended solids is prevented/ minimised in the first instance. The use of downstream settlement measures is considered a secondary line of protection. Management and maintenance of mitigation measures to ensure effective functioning. Prevent pollution by fuel/oil, from leaking machinery, there must be regular inspections of machinery working near any waterway. Safe refuelling, handling and storage practices for earth stockpiles and secondary containment for chemicals, oil, fuels etc. Compliance with the requirements of Control of Pollution (Oil Storage) Regulations (NI) 2010.	

Consultees		Summary of Response	Addressed in Assessment
		Emergency spill procedures should be addressed Highlights requirements of the Control of Pollution (Oil Storage) Regulations, the primary requirement being secondary containment must be provided for oil stored in above ground containers over 200L with 110% capacity.	
	Water Management Unit	Conducted a search of the groundwater monitoring database and found there are no groundwater abstraction points within the search area. Provided water quality data and River Waterbody Class (2015) for waterbodies within 5km the development.	9.93 to 9.98 and 9.114
Department of Infrastructure	Rivers Asset Management Unit	Confirmed there are no watercourses within or bounding the site which are designated within the terms of the Drainage (NI) Order 1973. Stated there may be undesignated rivers about which DfI Rivers is unaware. Provided 1 no. record of downstream flooding adjacent to 11 Carnanbane Rd dated 31st August 2005. Advised if during the development of the site a watercourse is uncovered which was not previously evident the DfI Coleraine office should be contacted immediately Advised details of any temporary or permanent proposal that may impact on the drainage function of any watercourse within the site, now or in the future, must be submitted in advance of any development to the DfI Coleraine office. Development e.g. release of stormwater to a watercourse, culverting, bridging, diverting, building adjacent to / over a watercourse requires written consent from the department.	9.99 to 9.103
Department for Economy	Geological Survey of Northern Ireland (GSNI)	Undertook a search of the Groundwater Data Repository and karst feature datasets and stated GSNI holds no records of any boreholes, springs or shallow wells recorded within 1km of the site. There are no karst features within 1km of the site and no would be expected based on the geology.	9.62, Table 9.11, 9.83 to 9.98

9.30 Loughs Agency was not consulted but is acknowledged as the authority in relation to inland fisheries within the affected catchment. Loughs Agency opinion in relation to development such as that proposed, and measures required to be incorporated to protect water quality and fisheries, is well established.

9.31 Northern Ireland Water (NI Water) were also contacted. NI Water confirmed abstractions located to the north of the Site are no longer in use. There are abstractions within 5km however they are upstream or considered in their opinion to be within a different catchment.

9.32 A copy of consultee responses is included in **Technical Appendix 9.4**.

Assessment Methodology

Baseline Characterisation

9.33 This qualitative assessment has been undertaken based on experienced professional judgement and assessment of compliance with statutory and industry guidance, including site visits for verification.

Study Area

9.34 Potential effects were considered within the study area defined as: the area within the Preliminary Boundary (within which the planning application boundary lies) hereafter referred to as the Site; and the wider geological and hydrogeological setting of the area.

9.35 The hydrological study area includes surface water catchments draining the area within the Site and the downstream river reaches affected by this area as defined by the relevant River Basin Management Plans, Local Management Areas (LMAs) and Catchment Stakeholder Groups.

9.36 The hydrogeological and geological study area extends to the underlying aquifer catchments and extents of the geological units.

Additional Areas Considered

9.37 Consideration has been given to potential likely significant effects in respect of the proposed turbine delivery route and access route. Details of the work comprising junction widening, passing bays and general road widening, and potential effects on the geology and water environment are summarised within **Chapter 11: Transport & Traffic**.

9.38 A potential grid connection route is described within **Technical Appendix 2.1: Assessment of Potential Grid Connection**. Although the grid route is not part of the Development consideration has been given to potential likely significant effects.

Desk Study

9.39 The desktop study involved collation and assessment of the relevant information from the following sources:

- Ordnance Survey raster and vector mapping in addition to aerial photography to assess land use and environs and to identify water features and watercourse catchments
- Local authority and regulatory body consultation responses
- NIEA river quality data and natural heritage data
- DfI Rivers Flood Maps NI
- NIEA Drinking Water Inspectorate and Water Management Unit data
- Review of CEH Flood Estimation Handbook (Version 3) for details of river catchment data

- Review of DCAL Inland Fisheries information
- Review of detailed site topographic survey
- The Geology of Northern Ireland – Our Natural Foundation, GSNI, Mitchell (2004)
- GSNI Geoindex (1:10,000 bedrock and superficial geology maps)
- GSNI Geoindex (aquifers and aquifer vulnerability)
- GSNI Georecords database.
- General Soil Type Map of Northern Ireland at 1:250 000 scale
- NIEA Groundwater quality data and abstractions / discharges database
- NIEA Drinking Water Inspectorate and Water Management Unit data
- NIEA river quality data and natural heritage data
- Rivers Agency Flood Maps NI.

Determination of Sensitivity, Magnitude, Likelihood and Significance

9.40 This assessment determines the nature, scale and significance of the effects of the Development on the baseline (current) scenario in accordance with a methodology stated within The Institute of Environmental Management and Assessment guidance[1].

9.41 The potential impact significance is defined by the combination of the sensitivity of the receptor and the magnitude of the effect. Following this an overall impact significance is determined by considering the potential impact significance and the likelihood of the effect occurring.

Sensitivity Criteria

9.42 The scale and sensitivity of the receiving environment (receptor) has been categorised on a scale of "Very High" to "Low". The sensitivity criteria used for this assessment are presented in **Table 9.5** and are based on:

- Vulnerability of a receptor to a particular pressure (degree of environmental response to any particular effect); and
- The importance or 'value' of the receptor e.g. an area of international importance should be considered more sensitive to effect than a local area of little or no conservation value.

Table 9.5: Evaluation of Hydrological / Hydrogeological Receptor Sensitivity Criteria

Scale / Sensitivity of the Environment (Receptor)		
International and / or Very High	Attribute has a very high quality / rarity at an international scale.	Important on a European or global level, e.g. Ramsar Sites, SAC, SPA and Habitats Directive Sites with dependence on the water environment.

1 Institute of Environmental Management and Assessment (2004) Guidelines for Environmental Impact Assessment.

Scale / Sensitivity of the Environment (Receptor)		
National and / or High	Attribute has a high quality and rarity at a national scale.	Important in Northern Ireland, e.g. ASSI or National Nature Reserve (NNR) with respect to the hydrological environment. WFD classification of 'High' with the watercourse providing a nationally important resource or supporting river ecosystem. Public water supplies and highly productive aquifers or local water supplies, including private water supplies where there is no alternative to private supplies. Principal aquifer providing a nationally important resource. Source Protection Zone 2 (Outer Source Protection Zone).
Regional and / or Medium	Attribute has a medium quality and rarity at a regional scale.	Important in the context of the region, e.g. catchment scale issues, main river within the catchment, local Nature Reserves or Sites of Local Importance for Nature Conservation (SLNCI). WFD classification of 'Good' with the watercourse providing an important resource or supporting river ecosystem or upstream of a designated fishery. Active floodplain area. Designated fishery, catchment regionally important for fisheries. Domestic private water supplies, located within vicinity of mains water supply or private water supplies used only for agricultural purposes and not drinking water. Groundwater dependent terrestrial ecosystems in hydraulic continuity with the Site. Principal aquifer providing a regionally important resource e.g. industrial use with limited connection to surface water. Source Protection Zone 3 (catchment of groundwater source).
Local and / or Low	Attribute has a low quality and rarity at a local scale.	WFD classification of 'Moderate' or less with the watercourse providing a locally important resource or supporting river ecosystem. Domestic private water supplies, located within vicinity of mains water supply or private water supplies used only for agricultural purposes and not drinking water. Groundwater dependent terrestrial ecosystems in hydraulic continuity with the Site. Aquifer providing a locally important resource e.g. For agricultural or small-domestic supplies.

Magnitude of Effect

9.43 The magnitude of change / effect is influenced by the timing, scale, size and duration of the hazardous effect; magnitude has been categorised on a scale of “High” to “Low”; defined in **Table 9.6**.

Table 9.6: Evaluation of Magnitude of Effect Criteria

Magnitude of Effect / Description		Definition of Criteria	
High	Fundamental change resulting in loss of an attribute and /or the quality and integrity of conditions.	Water Quality	Potential high risk of pollution to surface water changing water quality status.
		Water Supply	Loss of local water supply or change in quality with respect to drinking water standards (DWS).
		Groundwater	Significant change in groundwater levels, flow regime, groundwater quality or extensive change to an aquifer.
		Surface Water Dependent Ecosystem	Loss of or extensive change to a surface water dependent ecosystem or fishery.
Medium	Detectable change to conditions resulting in non-fundamental temporary or permanent consequential changes.	Water Quality	Potential medium risk of pollution to surface water, changing water quality status.
		Water Supply	Temporary loss of local water supply or minor change in quality of supply with respect to drinking water standards.
		Groundwater	Measurable change in groundwater levels, groundwater flow regime, groundwater quality or identifiable change to an aquifer.
		Surface Water Dependent Ecosystem	Partial loss or change to a surface water dependent ecosystem or fishery.
Low	Results in minor effect on attribute of insufficient magnitude to affect the use or integrity.	Water Quality	Minor deterioration in water quality unlikely to affect the most sensitive receptor or insignificant change in water quality conditions not exceeding those expected due to naturally occurring fluctuations.
		Water Supply	No change in pressure or flow to local water supply or minor change in quality of supply with respect to drinking water standards.
		Groundwater	Minor alteration to one or more characteristics, features or elements or no observable effect
		Surface Water Dependent Ecosystem	Any measurable change in groundwater levels does not affect groundwater flow regime, groundwater quality with regards to DWS or result in any change to an aquifer.

Impact Significance Criteria

9.44 The magnitude of effect and receptor sensitivity are combined to evaluate and qualify if an impact is of high, moderate, low or negligible significance as outlined in **Table 9.7.**

Table 9.7: Evaluation of Potential Effect Significance

Scale / Sensitivity of the Environment (Receptor)	Magnitude of Effect		
	Low	Medium	High
International / Very High	Moderate	High	High
National / High	Moderate	Moderate	High
Regional / Medium	Low	Moderate	Moderate
Local / Low	Negligible	Low	Low

Likelihood of Occurrence Criteria

9.45 The likelihood of the potential effects occurring is assessed based on historical data, quantitative analysis and professional judgement based on relevant experience as shown in **Table 9.8**.

Table 9.8: Evaluation of Likelihood of Occurrence

Likelihood of occurrence	Criteria
Certain	Likely consequential effect in medium term and inevitable in long term (within the life of the development).
Likely	Possible consequential effect in the medium term and likely but not inevitable in the long term.
Unlikely	Unlikely that any consequential effect would arise within the lifetime of the development.
Rare	It is unlikely that any consequence would ever arise.

Determination of Overall Impact Significance

9.46 Potential Impact Significance (**Table 9.7)** and Likelihood of Occurrence (**Table 9.8**) are combined to determine an Overall Impact Significance as shown in the matrix in **Table 9.9**.

Table 9.9: Evaluation of Overall Significance

Potential Significance	Likelihood of Occurrence			
	Rarely	Unlikely	Likely	Certain
High	Minor	Moderate	Major	Major
Moderate	Minor	Minor	Moderate	Major
Low	Not Significant	Minor	Minor	Moderate
Negligible	Not Significant	Not Significant	Minor	Moderate

Site Characteristics & Baseline Conditions

Site Description

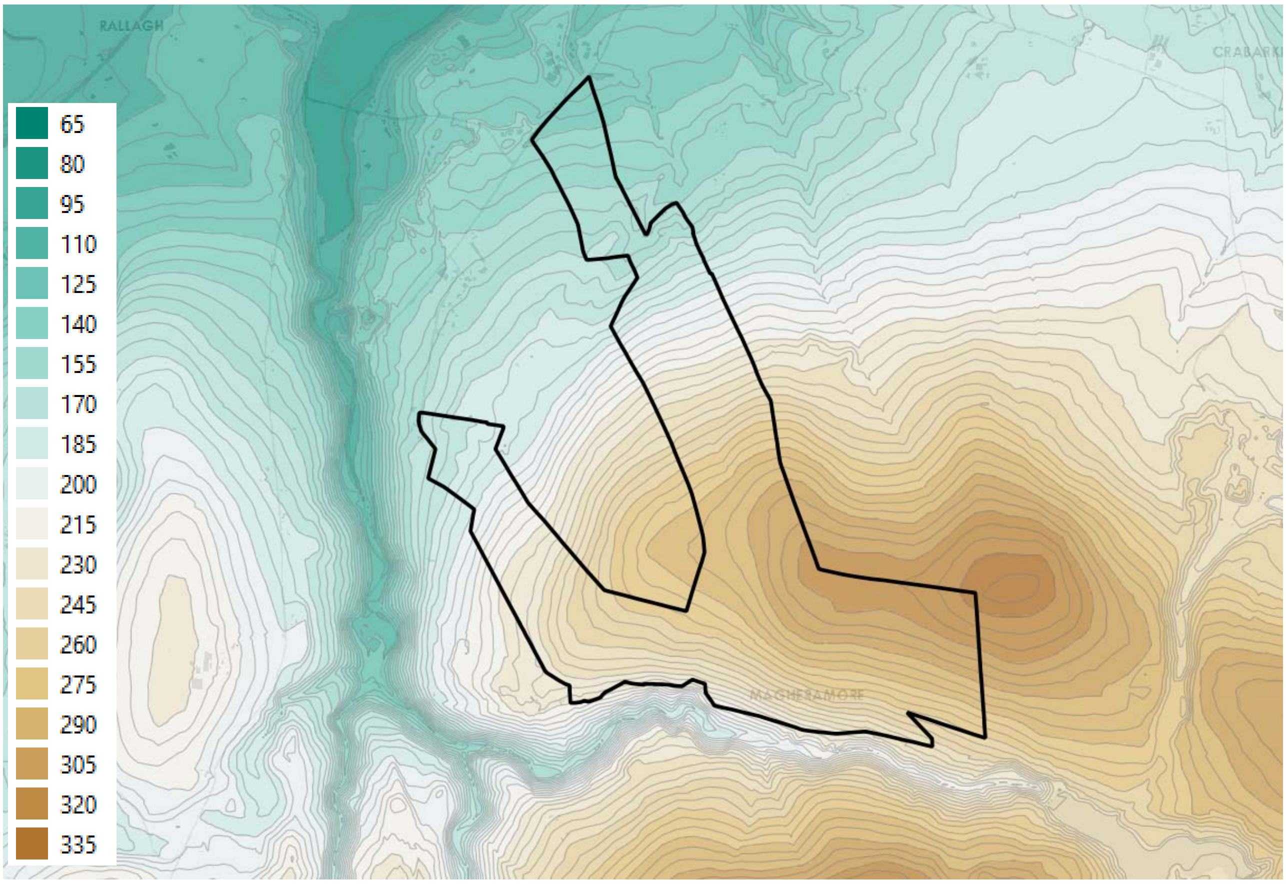
9.47 The Development is located approximately 3 km to the south of Dungiven. The Site area considered within this assessment occupies an area of approximately 1.5 km^2.

Topography

9.48 The Site lies on the northern and southern flank of Teeavan Hill, with wind turbines sited on the western ridge of the Hill.

9.49 Ground levels within the Site range from approximately 325 m to 110m at the northern extent. Surface slopes within the site range from approximately 1 to 47%, with an average (mean) slope of approximately 13%.

Plate 9-1: Topography



Land Cover

9.50 Land cover / use predominately comprises agricultural grazing land of varying quality and improvement, and pockets of forestry in the south-eastern area.

9.51 Access to the site is available via 2 farm tracks; one a farm track located off the Magheramore Rd and one at the end of the Magheramore Road.

Meteorological Data Summary

9.52 The Standard Percentage Runoff (SPR) is a parameter used in runoff and flood estimation, which represents the percentage of total rainfall likely to contribute to direct runoff and storm flow. Review of the site in relation to Hydrology of Soil Types (HOST) class mapping indicates a SPR of approximately 48 - 60 %. For context, SPR values in the UK range from 2% (sand or chalk with slow response / low runoff) to a maximum of 60% (peat bog with rapid response / high runoff).

9.53 Rainfall data from the Banagher Caugh Hill climate station2 records an annual average rainfall total of 1350.3 mm during the 1981 – 2010 climatic period. Based on the Meteorological Office banding of annual average rainfall (1981 – 2010), rainfall in the

[2] Met Office, Banagher Caugh Hill Climate. Available at https://www.metoffice.gov.uk/public/weather/climate/gcg01rx82 Accessed 02/07/2018

vicinity of the site is within the fourth highest of nine bands (1250 – 1500 mm) and is typical for northern and western regions in Northern Ireland.

Geology

Agricultural Land Classification

9.54 DAERA published a classification index for Agricultural Land Classification (ALC) in 1997 based on a document "Agricultural Land Classification of England and Wales" published by the Ministry of Agriculture and Fisheries and Food (now Department for Environment, Food and Rural Affairs)[3] in 1988. The index classifies agricultural land into five grades based on climate, topography, soil, slope and altitude characteristics; with Grade 1 excellent quality and Grade 5 very poor quality.

9.55 Using the guidance from the ALC of England and Wales, along with available site information including site walkover observations and gradients the land the most suitable land classification for the site ranges from Grade 3b – 'moderate quality agricultural land' for the majority of the site and Grade 4 – 'poor quality agricultural land', in the south western area of the site.

9.56 The loss or partial loss of agricultural function on the site is therefore not significant and does not inform constraints to development.

Soil Conditions

9.57 A review of the UK Soil Observatory interactive map viewer indicates a varied soil type coverage on the site.

9.58 The central and eastern area of the site is characterised by 'Histosols' comprising peaty soils with a deep surface layer of organic material. Histosols are generally poorly draining due to high clay content and high organic content.

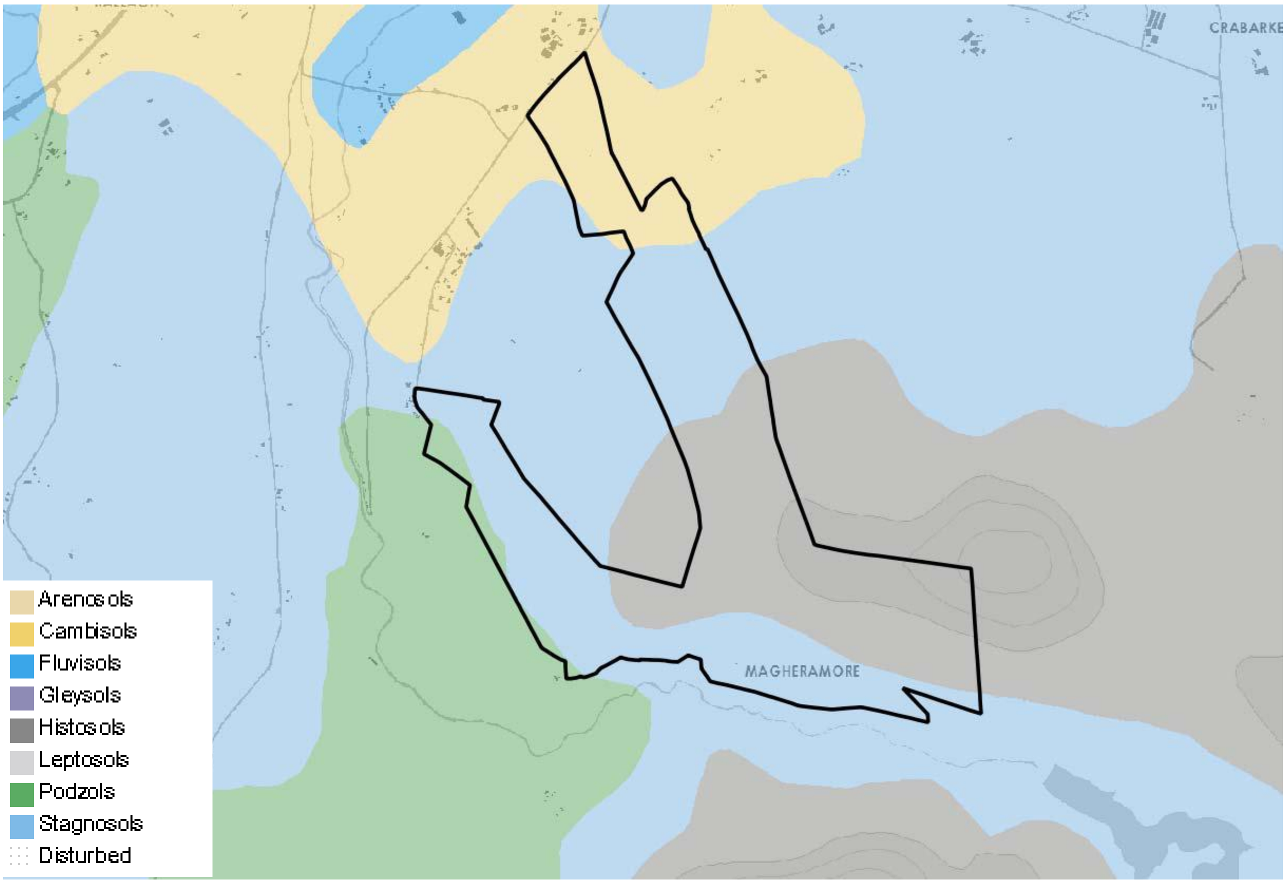
9.59 Where peaty soils where observed on site peat had be subjected to cutting. A number of manmade ditches were observed on the site.

9.60 The western area of the site comprises of 'Stagnosols'; which are usually developed on unconsolidated materials, such as, glacial till and alluvial deposits due to stagnating water and poor drainage. For use of agricultural purposes, this soil type requires drainage channels, however, in areas with low permeability subsoil engineered drainage channels are often insufficient. In summary, they comprise very poorly draining clay soils.

9.61 Soils characteristic of Stagnosols were observed in the western portion of site; agricultural grazing and manmade drainage channels present at field boundaries.

3 Ministry of Agriculture, Fisheries and Food: Agricultural Land Classification of England and Wales (1988) http://publications.naturalengland.org.uk/file/5526580165083136

Plate 9-2: Soils



Superficial Deposits

9.62 The site has been reviewed in relation to the 1:10,000 mapping available from the GSNI GeoIndex WMS layers. The majority of the Site is mapped as diamicton till. There are widespread areas of the peat in the south and east of the site.

9.63 In the western / north west of the Site there is an isolated deposit of glaciofluvial material comprising gravels and boulders observed within a watercourse.

Peat

9.64 The central eastern area is mapped as peat, an area of approximately 0.24 km^2 and there are pockets of peat in the central and western areas of the site; equating to a total peat coverage on the site of approximately 0.39 km^2.

9.65 Consultation with the Minerals Branch at GSNI informed that consideration should be given to a peat slide risk assessment being undertaken. A Phase 1 Geotechnical Study including Peat Slide Risk Assessment has been commissioned from a 3rd party by the applicant

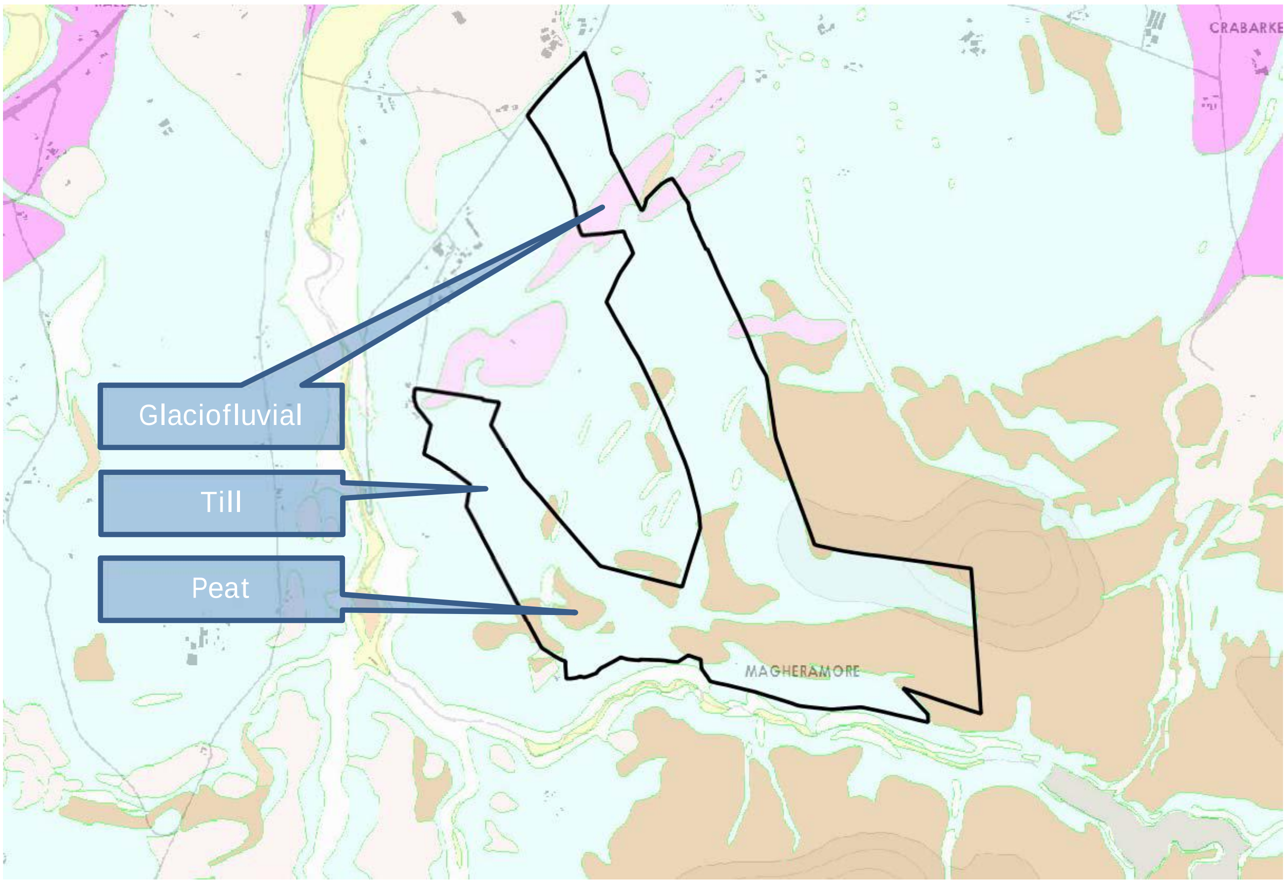
9.66 The findings of that assessment conclude that the majority of the site exhibits a peat depth of under 0.5m, which is generally considered to have a negligible peat slide potential. Peat depth in areas where development is proposed has been determined by the assessment to vary to a maximum depth of 1.3m. Peat in many of these areas is noted to have appeared to have been historically treated resulting in an increased shear strength further reducing the risk. Typically, this may have comprised artificial drainage and mixing ploughing with topsoil materials and is likely to have taken place historically as part of the local farming practice.

9.67 During the survey no previous instability was observed, nor are there any peatland features such as peat hags or peat pipes that could increase the risk of instability.

9.68 The Geotechnical Assessment including peat slide risk assessment concludes that there is no risk at the site and thereafter that no further action is required save for site investigations typically undertaken as part of detailed construction design.

9.69 The Phase 1 Geotechnical Study including Peat Slide Risk Assessment is included in **Appendix 9.3**.

Plate 9-3: Superficial Deposits



Bedrock Geology

9.70 The bedrock geology of the site has been reviewed in relation to the 1:10,000 mapping available from the GSNI GeoIndex WMS layers. The majority of the site is underlain by the Dart Formation comprising metamorphic psammite. The north of the site is underlain by the Barony Glen Formation comprising sandstone.

9.71 A number of igneous intrusions are present within the Dart Formation comprising meta gabbro and are orientated in a northeast-southwest direction.

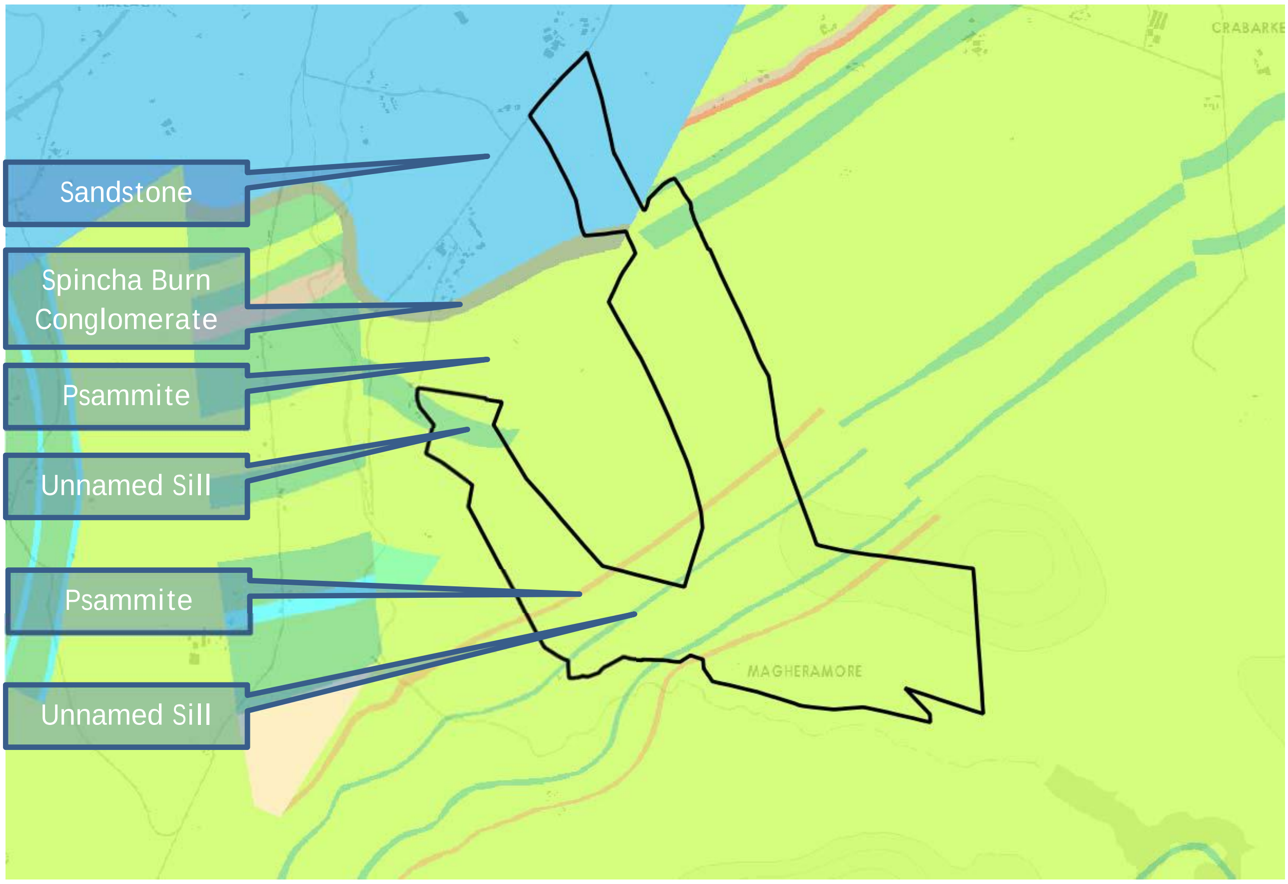
Exposed Bedrock

9.72 The 1:10,000 superficial mapping indicates there are minor areas of exposed bedrock in the central and western area of the site. Exposed bedrock was not observed during the site walkover.

Faults

9.73 Two faults are inferred to transect the site. One in a northeast-southwest orientation traversing the north of the site, and one in a northwest-southeast orientation trans versing the northwest of the site. The mapped faults are inferred regional scale geological faults and are not considered a geohazard for a development of this scale.

Plate 9-4: Solid Geology



Radon

9.74 The UK interactive radon map[4], based on the Indicative Atlas of Radon in Northern Ireland[5], indicates the entire site area is situated on an area of elevated radon potential, where 10 – 30 % of homes are above the action level.

4Public Health England (2015) UK Maps of Radon. Available at http://www.ukradon.org/information/ukmaps. Accessed 02/07/2018

[5] Public Health England (2015) Radon in Northern Ireland: Indicative Atlas. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/453711/PHE-CRCE-017__maps_with_place_names_.pdf. Accessed 02/07/2018

Landfills and Licenced Waste Facilities

9.75 A review of the opensource NIEA authorised landfill sites dataset does not identify any features within the vicinity of the Development.

9.76 A review of waste site licenses and exemptions within a 2 km radius of the site indicated Carnanbane Sand Pit, 1.3 km north of the application site boundary, holds several exemption registered permits under the European Waste Catalogue. Waste materials at this site include; mixtures of concrete, bricks, tiles and ceramic, bituminous mixtures, soil and stones and track basalt. The identified site does not have any linkage to the site and is not a constraint to development.

9.77 An information request made to the DAERA Environmental Crime Department confirmed the department is not aware of any unlicensed landfills within 1 km of the site.

Active Quarries

9.78 Consultation of the GSNI GeoIndex (records from 2000) lists three active quarries within 1 km of the site boundary, the details of which are summarised in below table. The Development is not constrained by and would not affect operations at those locations.

9.79 There are no mapped mine shafts or adits within the boundary or within 1 km of the site.

Table 9.10: Active Quarries within 1 km of Site

Name	Quarry ID	Commodity	Distance and Direction from Site
Carnabane	18920	Sand & Gravel	500 m north
Bannagher 62	19015	Sand & Gravel and Clay & Shale	700 m south west
Murnies	19044	Sand & Gravel	1 km east / north east

Mineral Occurrences

9.80 Information available on the GSNI GeoIndex shows there is one mineral occurrence within 1 km of the site boundary. Baryte is mapped in a stream section, 350 m north east of the most northerly part of the site, on the Teevan Rd. The comments describe irregular veins of baryte, 6 m wide, traversing the schistose and gneissic rock in the northern part of the townland. The occurrence is not a constraint to development.

Mineral Prospecting Licences March (2015)

9.81 Consultation of the GSNI GeoIndex showed the site is within a mineral prospecting licence zone. GSNI Mineral Branch informed that the licence is issued for all minerals vested in the Department, the licence holder confirmed there is no known economic mineralisation in the area but the location has not been fully evaluated.

9.82 There are no recorded abandoned mine workings within the site boundary.

Summary of Geohazards

Table 9.11: Summary of Identified Geohazards

Geohazard Type	Applicable to the Development?	Rationale / Potential Constraint	Consider Further?
Extractions	Yes	There are 3 no. active quarries within 1 km of the application, however, they are considered a sufficient distance from proposed deep excavations for turbine locations and the nature of the extraction (i.e. open cast)is not of a type .that would cause tunnels / shafts / adits that would be of consideration in design of infrastructure at the site. GSNI confirmed there is no known economic mineralisation in the area to constraint development at this time.	No
Land Slip	Yes	There is no previous evidence (held by GSNI) of mass movement within the site boundary.	No
Peat	Yes	A Phase 1 Geotechnical Assessment including Peat Slide Risk Assessment has been undertaken and has concluded that the risk is not significant and no further action is required.	No
Running Sands	Yes	Deep excavations required for turbine foundations are not proposed in areas of sand and gravel deposits.	No
Compressible Ground	Yes	Peat is present within the area of proposed built development and a peat slide risk assessment should be considered prior to development.	No
Landfill	No	There is no evidence (current or historic) of landfill(s) present within the site boundary.	No
Karst Features	No	The detailed 1:10,000 series mapping indicates the entirety of the site is underlain by the Dart Formation, therefore, it is assumed there are no karst features present within the application site boundary or vicinity of the site. No karst or pseudokarstic features were noted during the site walkover.	No
Radon	Yes	The site is within an area of elevated radon potential. Consideration of radon protection measures should be given for manned buildings proposed as part of the development.	No

Hydrogeology

Aquifer Classifications

9.83 A review of the online data available on GSNI GeoIndex indicates the bedrock aquifer underlying the site is classified as Bl(f), indicating it has limited productivity[6] and flow is controlled by fracture and fissure networks within the rock with no intergranular flow.

[6] Geological Survey Northern Ireland (2005) WFD Aquifer Classification Scheme for Northern Ireland. Available from https://www.daera-

9.84 The GSNI Groundwater Vulnerability Map indicates that groundwater at the site has a classification ranging from 4a to 5, on a vulnerability scale of 1 (very low) to 5 (very high). The majority if the site is classed as 4a with classifications of 4e and 5 in the north and northwest parts of the site. The vulnerability mapping is informed by the 1:250:000 scale geological mapping indicates the areas classed as 4e and 5 are underlain by permeable sand and gravel deposits, or absent superficial deposits, respectively. However, the more detailed 1:10,000 scale mapping show that these areas are in fact underlain by low permeability till which will downgrade the vulnerability of the groundwater within the underlying bedrock aquifer.

9.85 The groundwater body underlying the site is mapped as the Claudy Groundwater Body and has an overall status of “Good”. The overall status relates to both the quantitative and chemical (water quality) characteristics of the groundwater body.

9.86 A review of the GSNI Geoindex viewer indicates there is a potential superficial aquifer underlying the site associated with the sand and gravel deposits mapped at the 1:250:000 scale. However, a review of the more detailed 1:10:000 mapping indicates the area is predominantly underlain by Glacial Till and as such there is no significant potential superficial aquifer underlying the site. This position is supported by the NIEA River Basin Viewer which indicates there are no superficial aquifers underlying the site.

Groundwater Recharge

9.87 Recharge will be direct where bedrock is at or close to surface. A proportion of recharge through overlying till deposits may also occur especially where these are thin. Recharge is expected to be reduced where thicker tills and/or peat overlie bedrock.

9.88 Average rainfall is 1199 mm/a. The long-term average recharge rates are approximately 324 mm/a (for Bf(l) aquifers the actual recharge rate is likely to be limited and assumed to be 100 mm/a.

Groundwater Flow

9.89 Groundwater flow is controlled by fractures within the bedrock. Flow paths are generally considered to be short (tens to hundreds of metres) with flow mainly following topography. The dominant flow zone will be in the upper weathered zone (top 10 - 30m). In the sandy superficial deposits, flow will be intergranular with potentially shorter flow paths to surface water discharge areas.

9.90 Groundwater flow within the bedrock is expected to be mainly shallow and discharging locally to surface waters especially in upland areas. Within the river valleys some limited discharge from bedrock to the sand/gravel aquifers is likely to occur with eventual discharge from these deposits to the rivers. Gauging stations on the downstream end of the Faughan and Burndennet have baseflow indices around 0.5 reflecting the importance of the down gradient sand and gravel deposits as large groundwater stores.

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ni.gov.uk/sites/default/files/publications/doe/WFD%20Aquifer%20classification%20for%20Northern%20Ireland%20by%20GSNI%202004.PDF

Springs

9.91 A review of the OSNI historical maps available from PRONI[7] and the Historical Map Viewer[8] indicated there are no historical springs within the site boundary and immediate vicinity, beyond those indicated on OSNI mapping or observed during site visits. GSNI do not hold records of any springs within 1 km of the site boundary.

Boreholes

9.92 GSNI do not hold records of any boreholes within 1 km of the site boundary.

Groundwater Abstractions

9.93 In order to identify potential groundwater users, data was sought from a number of sources, as follows:

- NIEA Water Management Unit provided information in relation to licensed non-domestic groundwater-derived abstractions.
- NIEA Drinking Water Inspectorate confirmed there are no private drinking water supplies registered with the Inspectorate within 5 km of the site under the Private Water Supplies Regulations (Northern Ireland) 2017. A copy of this correspondence is included in **Appendix 9.4**.
- Causeway Coast and Glens Borough Council was contacted with respect to information on private water supplies which supply single dwellings. In their consultation response received 16th October 2018, the Council supplied a list of private water supplies identified within a 2 km radius of the application site. The response is included in **Appendix 9.4**.
- Mapping, including detailed Ordnance Survey mapping and historical mapping available through the Public Records Office (PRONI) was reviewed in order to identify present or historic mapped wells that may imply a current groundwater usage.

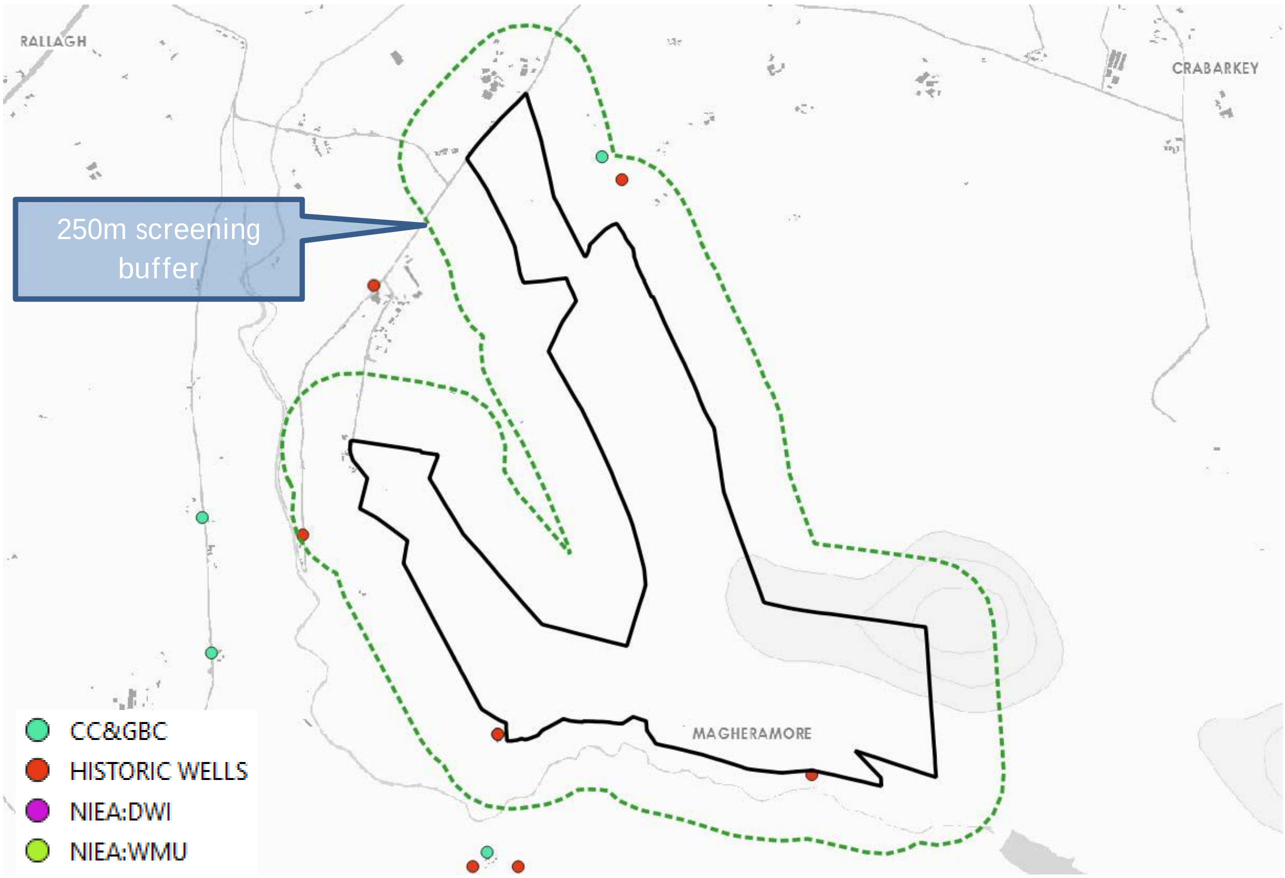
9.94 Known and potential abstractions have been collated. NIEA guidance recommends applying 250 m buffer zone for a water feature used for drinking water (public or private). The collated abstraction locations have been screened within a 250m buffer from the Site extents, as shown on the following **Plate 9-5**.

9.95 Three no. historic wells and one no. abstraction known to Causeway Coast and Glens B.C. lie within an area with potential to be affected by development of the site. Presence of these receptors informs sensitivity of the groundwater body and the subsequent assessment of effects and design of avoidance / mitigation.

[7] PRONI Historical Maps. Available from https://apps.spatialni.gov.uk/EduSocial/PRONIApplication/index.html

[8] Department for Communities Historical Environment Map Viewer. Available from https://dfcgis.maps.arcgis.com/apps/webappviewer/index.html?id=6887ca0873b446e39d2f82c80c8a9337

Plate 9-5: Groundwater Abstraction Screening



9.96 In addition to identification of potential abstractions from records, the various consultees indicated that they do not hold a definitive database of individual properties served by a private water supply. In order to ensure a robust assessment, screening has been undertaken to identify properties potentially served by local, unrecorded water abstractions within the vicinity of the Development based on property and occupancy information determined by the applicant.

9.97 To a ensure a conservative assessment a 500 m screening radius (i.e. 2 x NIEA Guidance) has been applied to the Site. Screened properties are shown on the following **Plate 9-6** and scheduled in **Table 9.12**.

Plate 9-6: Property Screening

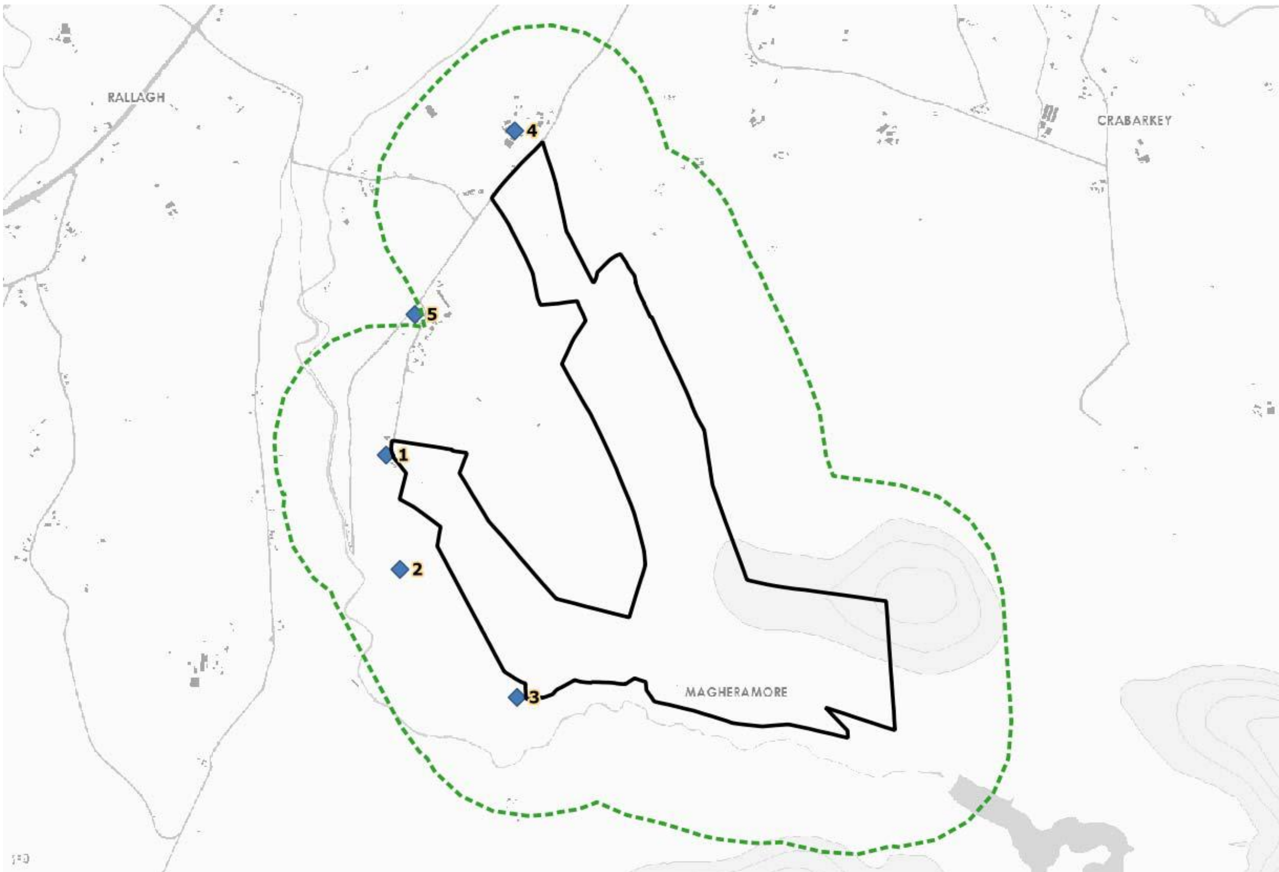


Table 9.12: Summary of Dwellings with Potential Private Drinking Water Abstractions

Feature ID	Description	Significance and Rationale
1	Residential property (Farm house), agriculture shed	NI Water main present.
2	Uninhabited property	NI Water main present.
3	Uninhabited outhouse	Uninhabited building, no drinking water requirements.
4	Farm buildings	NI Water main present.
5	Residential property	>100m from nearest turbine.

9.98 The screening exercise confirms no additional properties likely to rely on a private water supply abstraction within an area with potential to be affected by the Development.

Catchment Hydrology

Surface Water Bodies

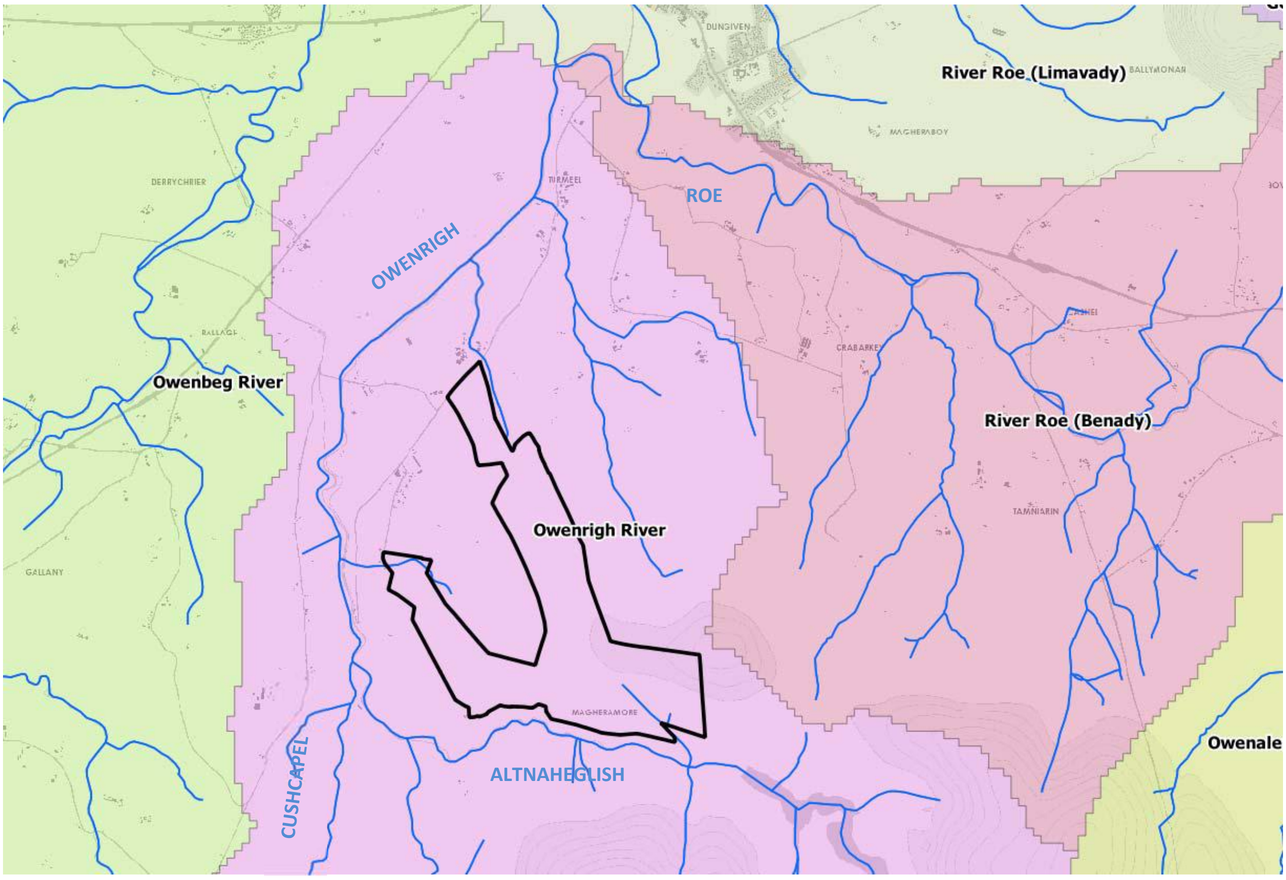
9.99 DfI Rivers map of Designations approved by the Drainage Council (NI) indicate there are no designated watercourses within the site boundary. All watercourses within the application area are subject to riparian ownership and maintenance only.

9.100 Site reconnaissance observations indicate that the current hydrology of the site consists of a number of natural source watercourses and streams and artificially modified drainage ditches and peat drains. The nature of the Site, which primarily occupies the ridge crest of a hill, means that there are no significant waterbodies on the upper site where development of wind turbines is proposed.

9.101 NIEA River Water Body dataset boundaries show that the site is entirely contained within the Owenrigh River water body (UKGBNI1NW020202010). Desktop catchment analysis, terrain models, and ground truthing, verified that all water features on the site, eventually, discharge to the Owenrigh River.

9.102 The southern flank of Teeavan Hill falls to the Altnaheglish River. The Altnaheglish merges with the Cuschapel Water west of the site to form the Owenrigh River. Other smaller tributaries rise on the northern and western flank of Teeavan which flow west or north and west to discharge to the Owenrigh. The Owenrigh discharges to the River Roe approximately 2 km north of the site.

Plate 9-7: Watersheds and NIEA Waterbodies



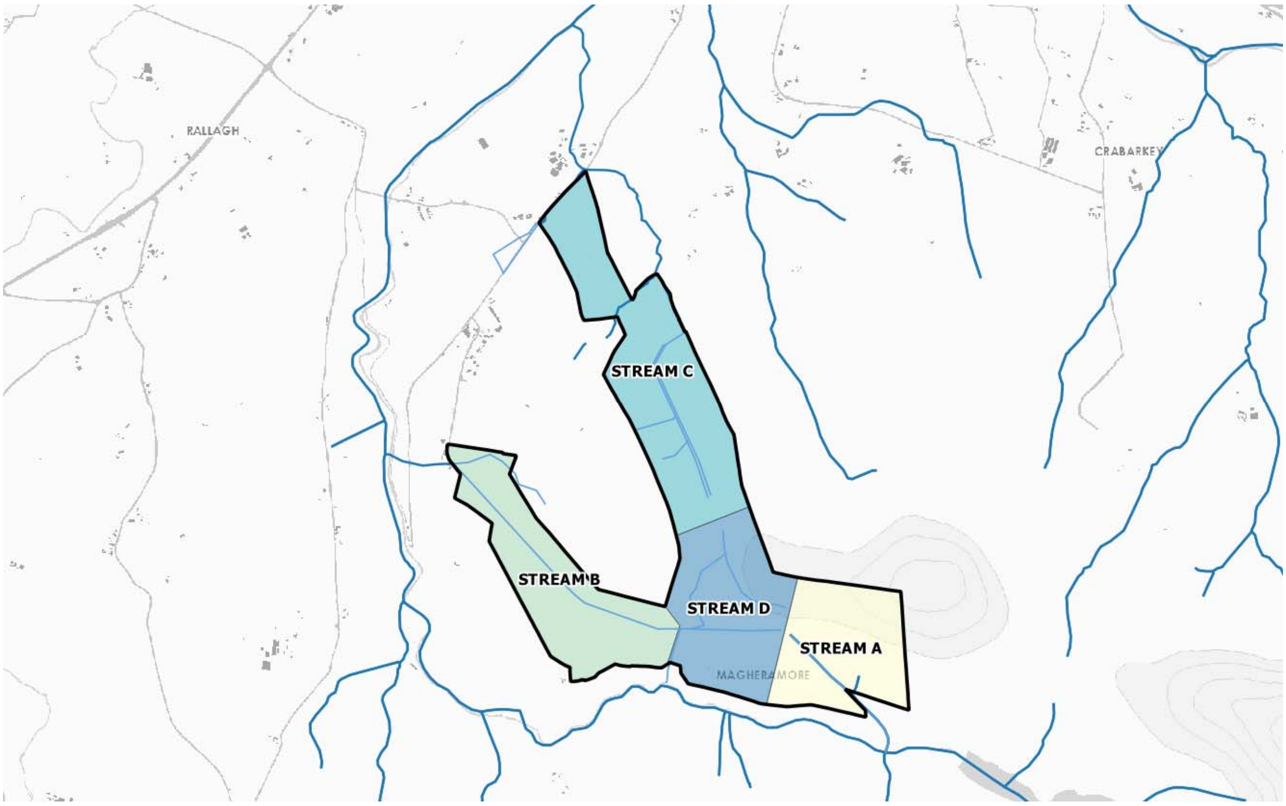
9.103 Internal site drainage on elevated parts of the site comprises headwaters of minor drains, peat drainage, and artificial trackside drains. More significant watercourses are sited at lower elevations within the north of the Site. Detailed site hydrology identified following a number of walkovers, tracing surveys, and desktop analysis of flow routes and catchments based on height data is shown on **Figure 9.1: Site Hydrology**.

9.104 The area of lands within the Site comprises approximately 4% of the hydrological catchment of the Owenrigh.

Watersheds

9.105 For purposes of differentiation of effects and consistency with associated assessments (and in particularly Chapter 8 – Fisheries), hydrology of the site can be split into 3 sub-catchments which discharge to the Altnaheglish / Owenrigh rivers by 3 tributary streams. Those sub-catchments and main internal streams are shown on the following **Plate 9-8**.

Plate 9-8: Internal Catchments



Stream A

9.106 Drainage within Stream A catchment is characterised by cut peat and forestry drainage. The catchment drains by a tributary channel to join with the Altnaheglish River 300m downstream of Banagher Dam. Within the site the most significant channel is characterised as an overgrown drainage ditch with a steep bed slope and little if any discernible flow of water.

Stream B

9.107 Drainage within Stream B catchment is characterised by an artificial drainage ditch adjacent to an existing access track.

Stream C

9.108 Drainage within Stream C catchment is characterised on the elevated (southern) areas of the catchment by ephemeral channels adjacent to an existing access track, with field boundary drainage. In the north of the site, in areas where a sustained baseflow is maintained, a stream understood to be known locally as Carnanbane Stream flows within a well-defined valley floor flows west to east across the site characterised by a natural gravel / cobble substrate. A second stream that is culverted over almost its entire length within the site exists at the northern boundary of the Site where it meets Magheramore Road, and discharges to the Carnabane Stream north-east of the Site.

Stream D

9.109 Drainage within Catchment C is characterised by artificial ditches adjacent to existing access tracks, with a partially modified cut peat drain flowing from approximately north to south. The most significant downstream channel is diverted away from existing track drainage and flows south towards the Altnaheglish in a channel characterised as an overgrown field drain with cobbles and boulders.

Surface Water Quality

9.110 The following section is intended to provide a qualitative appraisal of existing surface water quality in those waterbodies whose catchment the Development lies within.

9.111 Following the publication of the Water Framework Directive (Classification, Priority Substances and Shellfish Waters) Regulations (Northern Ireland) 2015 waterbodies are given a classification based on annual average / percentile results from several individual monitoring stations.

9.112 The WFD classification is a combination of chemical, biological and hydromorphological elements; whereby, the overall status is the lowest of the combined constituents.

9.113 The entirely of the site and affecting watercourse are located within the Owenrigh River waterbody, which has an area of 45.9 km^2. This waterbody is hydrological linked to the River Roe (Limavady) and River Roe (Ballycarton) river waterbodies. The status of the receiving river waterbodies is summarised in the table below.

Table 9.13: River Water Body Status

River Waterbody	2009 Status	2015 Status	2021 Target	2027 Target
Owenrigh UKGBNI1NW020202010	Moderate Ecological Potential	Moderate Ecological Potential	Good Ecological Potential	Good Ecological Potential
River Roe (Limavady) UKGBNI1NW020202018	-	Good	Good	Good
River Roe (Ballycarton) UKGBNI1NW020202024	-	Good	Good	Good

9.114 NIEA Water Management Unit were consulted for surface water quality monitoring station sites and data (from 2009 onwards) within a 5 km radius of the site. The below table provides a summary of the downstream monitoring sites, where there is potential for water quality to be altered as a result of the Development. The complete consultation response, including raw chemical and biological data, is included in **Appendix 9.4**. Each of the above is contained within the Roe Local Management Area and designated as Salmonid under the Freshwater Fish Directive.

Table 9.14: NIEA WMU Water Quality Classification

River Water Body ID	Location	Sitecode	Monitoring Station	Overall NI Site Class 2015	River Waterbody Class 2015
GBNI1NW020202010	Owenrigh River	F10179	Owenrigh River at Carnanbane	High	Moderate Ecological Potential
GBNI1NW020202015	River Roe (Benady)	F11208	Roe River at Turmeel Bridge	High	Good
GBNI1NW020202018	River Roe (Limavady)	F10171	Roe River at Limavady	Good	Good
GBNI1NW020202018	River Roe (Limavady)	F10172	Roe River at Dog Leap	Good	Good
GBNI1NW020202023	Owenbeg River	F10178	Owenbeg River at Dungiven	Good	Good

Project Specific Water Quality Assessment

9.115 In addition to a review of water quality data held by statutory bodies, independent water quality monitoring has been undertaken as part of this assessment to provide baseline water quality standards of water features within the application boundary prior to any development.

9.116 Sampling was carried out on the 11th July 2018. The sampling was conducted during a drought period in Northern Ireland and as a result a number of the onsite ephemeral water features were dry or contained a very low flow and volume. On the morning preceding sampling and during sampling the prevailing weather conditions were heavy rain and mizzle. This resulted in visibly elevated turbidity and suspended solids in streams following the prolonged period of dry, sunny weather.

9.117 Extreme low flow channel conditions at the time of sampling were not conducive to obtaining biological kick samples; water features were dry and lacking 'riffle' areas.

9.118 The baseline assessment collected and assessed five representative water samples from watercourses draining the site for a range of physio-chemical parameters. Monitoring locations are shown on **Figure 9.4**.

9.119 Water quality results were assessed for compliance against key parameter limits outlined in the Water Framework Directive (2000/60/EC), transposed in Northern Ireland through the Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017, and the Directive 2013/39/EU is transposed through the Water Framework Directive (Classification, Priority Substances and Shellfish Waters) Regulations (Northern Ireland) 2015. In terms of the key indicators of water quality and / or pre-existing pollutants, chemical results obtained showed:

- pH results were within the naturally excepted range and classified 'Good', based on WFD standards for this parameter;
- Dissolved oxygen levels are classified as 'High' under the WFD;
- Orthophosphate levels were below the LOD at all sample locations;
- TSS and Turbidity concentrations are considered to be significantly elevated above the excepted natural ranges on the site, this assumption is based on previous experience of environmental monitoring of similar upland sites and consideration of the prevailing weather conditions at the time of sampling. However, the results indicate that these parameters may be naturally elevated at certain times on site resulting from heavy runoff over peaty soils;
- BOD results signified 'High' water quality in all locations based on WFD classifications;
- Alkalinity concentrations and topography characteristics classed the site as 'upland and low alkalinity';
- Ammoniacal Nitrogen concentrations ranged from 'Good' to 'Moderate'.

9.120 Water quality for watercourses draining the Site is generally consistent with the WFD status of Good and Moderate for the downstream waterbody outlined previously. Therefore, preservation of the baseline water quality results within the upper reaches would be important at a local level to preserve the downstream NIEA classifications.

Surface Water Abstractions

9.121 In order to allow assessment of potential for the Development to affect surface water abstractions in the catchment at and up to 5km downstream of the site, an initial screening review of NIEA WMU datasets confirms no active abstractions hydrologically within that screening radius downstream of the site.

Northern Ireland Water Infrastructure

9.122 Caugh Hill Water Treatment Works is located approximately 1 km south east of the application site boundary, the works takes water from the Glenedra River which is not hydrologically connected to the site.

9.123 A review of NI Water Intakes in the area indicates the presence of 2 no. Intakes within the vicinity of the site. Glenedra Intake (W1000017452) is 2 km to the south of the application site boundary, desk study catchment analysis has established that there is no hydrologic connection to the site.

9.124 Altnaheglish No.1 (W1000017397) is located 330 m to the south east of the site boundary. The intake is a Lough Intake from the Altnaheglish reservoir and is upstream of the Development site. NI Water Site observations and surface hydrology analysis have determined there is no current hydrological connection to the Altanheglish river upstream of the intake location. NI Water correspondence confirmed the site is outside of the catchment for Altnaheglish Dam.

9.125 No raw or treated water infrastructure is sited within the Site.

Flood Risk

9.126 The Development was assessed in relation to Flood Maps (NI) and similar DfI Rivers datasets, which provide an indication of predicted flood extents for a 1% Annual Equivalent Probability (AEP) fluvial flood and 0.5% AEP Surface Water Flood, and for reservoir inundation. The site has also been reviewed in light of DfI River consultation (Ref: IN1-18-8869).

Historical Flood Extents

9.127 Flood Maps (NI) indicates no recorded incidents of historic flooding in the vicinity of the site.

Fluvial Flooding

9.128 The Site is unaffected by indicative predicted 1 % AEP fluvial (river) flood extents. It is noted that this is contrary to the advice offered by DfI Rivers in consultation, which is assumed to refer to flooding on lands proximal to the site.

Pluvial Flooding

9.129 Surface water flooding is predicted by the indicative 0.5 % AEP surface water flood extent mapping, coinciding with minor watercourses in the north of the Site. Surface water flooding would not constrain development but would inform design of the infrastructure with a view to ensuring that surface water flow paths are maintained, and a suitable standard of protection if afforded to any development adjacent to areas predicted to be affected by flooding.

Reservoir Flooding

9.130 The risk of reservoir flooding was assessed using Reservoir Flood Mapping for Emergency Planning[9], which shows the indicative area that may flood from an uncontrolled release of water from all possible dam failure scenarios. The Site is unaffected by any inundation area, including from Altnaheglish Reservoir.

Summary

9.131 Flood extents are shown on **Figure 9.1: Site Hydrology**. Mitigation of flood risk is described in subsequent sections and is addressed in detailed in **Appendix 9.2 – Flood Risk & Drainage Assessment** in the format normally requested by DfI Rivers in consultation.

Eco-Hydrology & Water Dependent Habitats / Species

9.132 Consideration has been given to local surface water and groundwater dependent ecosystems and habitats dependent on or prone to change due to variation in surface water and groundwater patterns on the Site within **Chapter 6: Ecology**. No further consideration is given to those aspects within this chapter.

Fisheries

9.133 Detailed consideration has been given to fisheries on and downstream the Site within **Chapter 8: Fisheries and Aquatic Ecology**.

9.134 That assessment, utilising the same watercourse / catchment referencing terminology adopted by this chapter, has determined that:

- No fish are present within the site boundary in Streams A, B, C, or D. Fish are unlikely to be present in offsite downstream reaches in all reaches other than C.
- Brown trout and Atlantic Salmon are likely to be present in downstream reaches of Stream C adjacent to the Owenreagh River.

9.135 The Altnaheglish River downstream of the site has Brown trout present & European eel are likely. Atlantic salmon are also likely in lower reaches.

9.136 The Owenrigh River downstream of the site has Atlantic salmon, River/Brook/Sea lamprey, Brown trout & European eel also present.

9.137 The downstream River Roe has Atlantic salmon, River/Brook/Sea lamprey, Brown trout & European eel also present.

Aquaculture

9.138 DAERA Fisheries Inspectorate has indicated an aquaculture site that in its opinion is downstream of the Development. The site is understood to be located near Ballyarton Road at Claudy and was damaged by floods in 2017, it may resume operation in the future.

[9] DfI Rivers (2017) Reservoir Flood Mapping for Emergency Planning. Available at http://riversagency.maps.arcgis.com/apps/webappviewer/index.html?id=006872dcdd7b43b89d352e0b93190e67. Accessed 03/07/2018

For avoidance of doubt the Site is not hydrologically connected to the River Faughan at Claudy and as such there is no potential for the Development to affect the aquaculture site.

Water Framework Directive - Fisheries Classification

9.139 The Altnaheglish and Owenrigh Rivers, and the River Roe were given status under the now revoked Directive 2006/44/EC 'on the quality of fresh waters needing protection or improvement in order to support fish life'; more commonly known as the Freshwater Fish Directive.

9.140 NIEA Water Management Unit data, on the NIEA River Basin Planning Mapviewer[10] designates the three rivers as protected areas containing economically significant species.

Designated Sites

9.141 Designated sites such as; Special Protected Areas (SPA), Special Areas of Conservation (SAC), Areas of Special Scientific Interest (ASSI), Ramsar sites and similarly designated environmental receptors have been identified as part of this assessment. Sites were identified based on information available on the NIEA Natural Environment Map Viewer and Join Nature Conservation Committee[11] website.

9.142 Designated sites were identified based on datasets available from NIEA at the time of the assessment and the datasets were screened to identify:

- Hydrological sites with sensitivities to the water environment that are connected to the Site, i.e. sites which lie in the upstream catchment of or are on downstream streamlines of the watercourses draining the Site;
- Terrestrial sites of geological importance on or immediately adjacent to the Site.

9.143 Only sites meeting these criteria as discussed further in this assessment. Terrestrial sites with ground or surface water dependent habitats are not included within this assessment; those sites are considered in **Chapter 6: Ecology.** Terrestrial sites with water-related reliance for birds are not considered further within this assessment and are considered in **Chapter 7: Ornithology**.

Table 9.15: Initial Screening of Designated Sites

Name	Designation	Reason for designation and qualifying features relevant to this assessment	Distance from Site at Nearest Point (km)
Banagher Glen	SAC (UK0030083) & ASSI (ASSI064)	Geological and physiographical importance due to the valley structure and exposure of Upper Dalradian rocks.	Immediately adjacent

10 NIEA River Basin Viewer. Available at https://appsd.daera-ni.gov.uk/RiverBasinViewer/

11 Joint Nature Conversation Committee (2016) Protected Sites. Available at: http://jncc.defra.gov.uk/page-4 . Accessed 03/07/2018

Name	Designation	Reason for designation and qualifying features relevant to this assessment	Distance from Site at Nearest Point (km)
River Roe and Tributaries	SAC (UK0030360) & ASSI (ASSI246)	Selected for N2K status due to presence of Annex II species (Atlantic Salmon)	Immediately adjacent
Lough Foyle / Lough Foyle Ramsar Site	SPA (UK9020031) Ramsar (UK12014)	Wetland of national importance.	c. 37 km downstream

Banagher Glen SAC and ASSI

9.144 The feature objective requirements of Banagher Glen in relation to the Dalradian bedrock include the ability to maintain the extent of the site, maintain the extent of the feature; and maintain the access to the feature including retaining the potential to expose the full geological series as required.

9.145 While adjacent to the designated site, no part of the proposal has potential to directly affect the morphology of the designated quality and as such potential for any effect is discounted from further consideration.

River Roe and Tributaries SAC and ASSI

9.146 All onsite water features ultimately drain to the Altnaheglish and Owenrigh Rivers which are included within the designation. While the designated footprint extends adjacent to the Site, this includes terrestrial aspects which are not relevant to this assessment. The site is approximately 300 m upstream of the designated watercourse at its nearest point.

9.147 Maintenance of water quality is key to the preservation of the main reason for the designation (i.e. habitat for Atlantic Salmon and brown trout), and as such any significant development work within the catchment could have a potentially adverse effect.

9.148 Management of pollution including silt is a particular objective set out in the management principles for the ASSI[12].

Lough Foyle / Lough Foyle SPA and Ramsar Site

9.149 The River Roe discharges to Lough Foyle approximately 37 km downstream of the site boundary. Deterioration of water quality is highlighted in conservation guidance[13] as a threat to inter-tidal and open water habitat quality.

9.150 Whilst the site is hydrologically connected to the River Roe, the minor contributing catchment of the site to receiving watercourses which feed the designated site, combined with the considerable distance between the Site and receptor, mean any

[12] River Roe & Tributaries SAC Conservation Objectives (2017) https://www.daera-ni.gov.uk/sites/default/files/publications/doe/Conservation%20Objectives%20%282017%29.%20%20River%20Roe%20%26%20Tributaries%20SAC.%20%20Version%203....pdf [Accessed 06/10/2017]

[13] NIEA (2015) Lough Foyle SPA UK9020031 Conservation Objectives. Available from https://www.daera-ni.gov.uk/sites/default/files/publications/doe/lough-foyle-spa-conservation-objectives-2015.pdf

potential effects to water supply / quality as a result of construction or operation of the Development would cause no effect at the designated site and as such this receptor is discounted from further consideration.

Baseline Summary and Receptor Sensitivities

9.151 The baseline assessment identified the receptors which have the potential to demonstrate a sensitivity to the Development; the receptors and their scale / sensitivity value are summarised in **Table 9.16**. Sensitivity is based on the baseline assessment and determined in accordance with the rationale previously described in **Table 9.5**.

Table 9.16: Receptor Sensitivity

Type	Receptor	Scale / Sensitivity	Rational
Geological	Soils / Drift Deposits	Local / Low	Site with little geological value or of widespread local abundance. Loss of the land on the Site would not be considered significant in the context of the region.
Hydrological	On-Site watercourse – Carnanbane Stream	Local / Low	Better quality watercourse within Stream C catchment, known as Carnanbane Stream and noted as Stream C within the Fisheries Assessment. The fisheries assessment has confirmed the watercourse to be insignificant in terms of fisheries There are no other significant pressures on or users of the watercourse. No fluvial flooding is predicted, although surface water flooding is predicted coinciding with watercourse channels.
	On Site Minor Drainage	Local / Low	All other on-site watercourses are generally characterised by vegetated overgrown field drains / cut peat drainage / trackside drainage and have low fisheries and other ecological potential, and have no other use of significant value.
	Altnaheglish River	High	Brown trout present & European eel likely. Annexe II species: Atlantic salmon also likely in lower reach.
	Owenrigh River & River Roe and Tributaries	International and / or Very High	The Owenrigh receives all runoff from the site; and are included within the River Roe and Tributaries SAC designation due to its importance to Atlantic salmon and other fish species.
Hydro-Geological	Private Water Supply	Local / Low	Domestic private water supplies and potential water supplies have been identified within a screening distance from the Site.
	Bedrock Groundwater / Aquifers	Local / Low	Aquifer with limited productivity and no significant abstractions. Potential for discrete local supply sources WFD Status of "Good"
	Shallow Groundwater / potential superficial Aquifers	Local / Low	No substantial superficial aquifers present at the site.

Type	Receptor	Scale / Sensitivity	Rational
Terrestrial	The Development	Local / Low	Proposed infrastructure prone to damage including potential for water damage of electrical infrastructure in a flood event; potential for structural damage of access infrastructure in the event of hydraulic incapacity.
	Buildings	Local / Low	The Site is shown to be within the radon affected area. Any buildings located within this area would be subject to inclusion of protection measures.

Predicted Environmental Effects

Preamble

9.152 This section outlines and describes the potential likely effects of the Development on hydrological patterns and water quality on the site, and in the downstream environment, that have the potential to arise in the absence of mitigation. The following phases of the Development are considered;

- Windfarm construction;
- Windfarm operation and maintenance;
- Wind farm decommissioning

9.153 During each phase some of the activities undertaken have the potential to modify hydrological regimes and affect water quality on the site and the downstream environment. Due to the nature of the site and work undertaken, the hazards and associated effects will be similar for each phase; with an increased likelihood during the construction phase.

Components Contributing to Predicted Environmental Effects

Activities Associated with Construction, Operation and Decommissioning

9.154 During construction, the Development comprises construction of infrastructure which would be likely to cause change to local hydrology and water quality, comprising earthworks, plant movements with associated use of lubricants and fuel oils, spoil handling and placement of aggregates and cementitious materials, and dewatering associated with construction of temporary compounds, turbine foundations, building foundations, access tracks, and cable trenches.

9.155 The operational phase of the Development (the designed operating life estimated to be 30 years) would cause runoff from access tracks, turbine bases and hard standings via drainage features, would require onsite welfare facilities with associated waste, and potentially necessitate storage and use of oils, fuels and lubricants on-site, each with the potential to cause adverse effects on the environment without adequate avoidance, design, or mitigation measures.

9.156 Activities associated with the decommissioning phase at the end of the operating design life are generally as per those for the construction phase i.e. earthworks, plant movements with associated use of lubricants and fuel oils, spoil handling and placement of aggregates and cementitious materials, and dewatering associated with removal of turbines, buildings, hard standing areas and buried structures followed by reinstatement and restoration of ground cover.

Likely Significant Effects

9.157 The likely effects of the Development on the surface and ground water environment prior to any avoidance, careful design, or additional mitigation are summarised in the following sections.

Changes in Runoff and Flow Patterns

9.158 New temporary and permanent impermeable surfaces, as well as temporary compaction of soils due to construction phase plant and site traffic movements, may cause increased rate and volume of surface water runoff due to the reduced permeable area on the Site through which rainfall can infiltrate. Impermeable surfaces will cause an increased "flashy" response to rainfall events, with increased water velocities in new and existing drainage features. As a consequence, the effect would be likely to cause temporary or permanent increases in surface water runoff rates and volumes, leading to increased flood risk and increased effects of erosion and scour in downstream watercourses. Similarly, loss of permeable areas is likely to cause reduced potential for groundwater recharge affecting aquifers.

9.159 Significant excavations, in particular linear works such as access tracks, drainage ditches and cable trenches, are likely to act as barriers to runoff resulting in ponding, or development of preferential flow routes, diverting surface water away from its current route. Consequently, temporarily or permanently redirected surface water flows may starve areas where water currently flows, or cause flooding of areas where water currently does not flow.

9.160 Works to existing surface watercourses (such as installation of culverts or bridges) have the potential to cause an obstruction to flows and may alter conveyance capacities, potentially causing temporary or permanent restrictions in watercourse channels, affecting upstream water levels and increasing flood risk.

Changes to Water Quality

Sediment / Suspended Pollution

9.161 Temporary activities required to construct windfarm infrastructure would require excavations, ground disturbance (due to excavations and plant and vehicle movements), stripping and excavation of peat and soils, and temporary spoil deposition. Exposed soils have potential to release fine sediments in surface water runoff or where excavations come in contact with surface watercourses.

9.162 Construction of hardstanding areas and access tracks would require importing, handling and placement of aggregate; which would have the potential to release fine sediments into surface water runoff. The proximity of such works to surface watercourse will increase the risk of pollution to the wider water environment.

9.163 Temporary surface water or shallow groundwater gathering in significant excavations has the potential to be significantly polluted due to contact with excavated surfaces and aggregates. Discharge of intercepted contaminated groundwater during passive or active dewatering has the potential to pollute the wider water environment if not disposed of correctly.

9.164 Silt and suspended sediments and debris entering watercourses would have the potential to adversely modify stream morphologies, smother habitats and harm aquatic flora and fauna.

Chemical Pollution of Surface Water and Groundwater

9.165 Temporary storage and use onsite use of chemicals, fuels and oils associated with construction activities, and use of wet concrete and other cementitious material, may result in potentially harmful substances entering the water environment. Possible pathways to hydrological receptors may include; accidental spillages, improper transport and refuelling, or inappropriate storage and disposal procedures, by gradual leakage or single failure of storage tanks or refuelling mechanisms. Temporary presence of alum-based flocculants (used to remove suspended solids from surface water) has the potential to enter surface waters if unregulated.

9.166 During the operational phase of the Development, the permanent presence of oils and lubricants associated with turbine maintenance has a similar potential to enter and pollution the water environment.

9.167 Wastewater effluent from temporary construction phase welfare facilities and permanent substation building welfare facilities has the potential to enter surface water or shallow groundwater.

9.168 As a consequence, chemical pollutants from construction activities, storage of materials, or from coliforms from wastewater entering watercourses have the potential to adversely affect water quality, with associated effects to potable supplies, fish and aquatic ecology.

Design Evolution: Constraints and Avoidance Measures

9.169 The magnitude and significance of those effects determined as being likely to be a consequence of the Development can be substantially reduced or eliminated through a proactive design approach to avoid identified baseline receptors, with particular emphasis in relation to fishery habitats.

9.170 This section identifies the avoidance measures imposed and outlines the resulting magnitude and significance of residual effects. Additional mitigation is then specified to further reduce or eliminate remaining residual effects.

9.171 Detail of the design evolution highlighting considerations made with regards to hydrology and water quality management is presented in **Chapter 3: Design Evolution & Alternatives**.

9.172 The Development layout has evolved so that the design avoids conflict with the water and geology environment, as demonstrated in the following sections.

Water Features

9.173 As a precautionary measure and in accordance with the guidance previously advocated by NIEA Natural Environment Division, buffer (exclusion) zones to valuable water features are adopted as constraints to built development, and for incorporation as a construction buffer in relation to permissible land uses in proximity to watercourses.

9.174 Impact avoidance and design of mitigation have been developed in accordance with legislation and best practice guidance outlined in **Table 9.1** and paragraphs **9.21** and **9.22**, respectively. Mitigation for all water features aims to preserve existing water quality ratings as a minimum.

9.175 Establishment of intact vegetated buffer zones between infrastructure and water features allows:

- Protection of water quality by filtering runoff within riparian vegetation before it enters the watercourse;
- Space for natural fluvial processes such as channel shape and planform adjustment which help restore and maintain the natural dynamic balance of river systems and associated habitats;
- Establishment of vegetation to stabilise banks and reduce soil erosion;
- Access for the maintenance and inspection of watercourses and for dealing with any residual risk of pollution incidents; and
- Habitat for plants and animals to form part of a habitat network.

9.176 The sensitivity of the water feature and the associated degree of protection it is therefore afforded, is primarily dependent on;

- Environmental designations on the water feature or downstream environment;
- Fisheries or ecological potential in the water feature or in the downstream environment;
- Water feature morphology (natural substrate or artificial channel, soil/ground type);
- Water feature size, capacity to convey water and hydrological potential (flows) – proportionate to the size of the catchment drained by the water feature;
- Nature and topography of the surrounding land, i.e. wet, poorly drained soils and steep slopes (>10°) would require greater protection;
- Sensitivity of the water feature to particular types of pollution, i.e. silts / nutrient enrichment / chemical pollution.

9.177 The rationale adopted in relation to water feature buffers is informed by NIEA Natural Environment Division guidance, which has typically in response to similar development advised no infill, disturbance, construction activity or storage of materials within 50 m of natural watercourses. NIEA has indicated that justification for buffer zones applied is the responsibility on the Applicant, while any rationale for reducing the scale of the buffer zone must be demonstrated requiring the submission of detailed information using a number of additional factors e.g. soil typology, topography, size of watercourse and climatic conditions.

9.178 NIEA, in Practice Guide to EIA and Planning Considerations, outlines buffer zones for water features as per the below table;

Table 9.17: NIEA Buffer Zones for Water Features

Width of Watercourse	Width of Buffer Strip
Surface Watercourse	10 m (minimum detailed in GGP 5)
Water Feature (surface watercourse, spring, well, borehole used for Drinking Water – public or private)	250 m
Water Feature (surface watercourse, spring, well, borehole not used for water supply – but could provide preferential flow pathway)	50 m
Designated Wetland	250 m

9.179 Additional Further planning and policy guidance from adopted elsewhere in the UK has also been considered for the purposes of the Development. SEPA and Scottish Natural Heritage (SNH) endorse guidance provided in Scottish Planning Advice as per **Table 9.18**. Additional qualification notes that wet, poorly drained soils and steep slopes (>10°) will require a larger buffer strip.

Table 9.18: SEPA/SNH Buffer Guidance

Width of Watercourse	Width of Buffer Strip
Ditches	3 m
Less than 1 m	6
1 – 5 m	6 – 12 m
5 – 15 m	12 – 20 m
15 m+	20 m+

9.180 Additional industry guidance relevant and similar in nature to the construction and operational activities for the Development has been reviewed and taken into account:

- Guidance for Pollution Prevention (GPPs): GGP5-Works and Maintenance in or near water;
- Pollution Prevention Guidance (PPGs);
- Best practice in relation to forestry works (in particular on upland and peat sites) recommends riparian buffer reflecting stream size, with buffers from 5 –20 m;
- Best practice in management of sediments and runoff from exposed ground in relation to agriculture recommends buffers of up to 10 m in order to protect surface waters from pollution by suspended solids, and nutrient enrichment by organic/inorganic fertilisers.

9.181 All water features considered significant for the purposes of the Development are shown on **Figure 9.1** and drainage drawings within **Appendix 9.1: Water Framework Directive Assessment.**

9.182 Significance has been determined following a desktop studies and verified by site walkovers, with all streamlines subject to catchment and flow analysis by GIS -flow-raster accumulation analysis.

Significant watercourses

9.183 Significant watercourses identified and requiring application of a buffer to the proposed turbines and infrastructure are largely as per OS close scale vector mapping and were subject to ground truthing on Site.

9.184 A 50 m buffer has been applied to the significant watercourses identified in the baseline assessment, i.e. significant where catchment within Site is >0.25 km^2.

9.185 "Significant" watercourses are limited to the main channel and a main tributary of the Carnanbane Stream, i.e. Stream C, within the north of the Site.

9.186 Examples of the significant watercourses on the site are shown on the following **Plate 9-9**.

Plate 9-9: Significant Watercourse Examples

Location	**Main Site Access**
Grid Ref.	**268067 406241**
Photo Ref.	**IMG_20190111_104256.jpg**
	

Minor Watercourses

9.1 Minor watercourses were given buffers of 10 m based on SEPA and SNH guidance and represent tributary channels on the site where the catchment area was less than 0.25 km^2. Specific to the Magheramore site, the watercourses are generally track-side drainage or larger vegetated field drains, differentiated from other drainage in that they were observed to maintain a baseflow or during dry conditions and so require a degree of protection for reasons of their hydrological connectivity to more significant downstream receptors.

9.187 Minor watercourses will either be protected on their present alignment, or where works or diversions are required then this shall be as enabling work adhering to strict procedures for working in or near water (described later in this assessment) with the proposed alignment then protected from the development.

9.188 Examples of minor watercourses on the site are shown on the following **Plate 9-10**.

Plate 9-10: Minor Watercourse Examples

Location	**Existing track drainage tributary to Stream C**	**Cut peat hag south of proposed WTG 6**
Grid Ref.	**268181 405939**	**268397 404769**
Photo Ref.	**IMG_20181026_110740.jpg**	**IMG_20180613_113818.jpg**
		

Other Drainage Features

9.189 All other minor drainage features (mapped or otherwise) comprising; dry or partially dry agricultural ditches, ephemeral drains, dry track drainage, grips, peat cuttings or other drainage features are considered insignificant in the context of site hydrology and habitat potential.

9.190 Such features would be managed during and following construction by means of diversion and/or temporary blocking (with prior settlement features upstream of and outwith the drainage channel), using filtration check dams or similar, in order to prevent residual indirect potential pollution downstream caused by connectivity to downstream waterways.

Adopted Watercourse Buffers

9.191 The significance of watercourses is shown on **Figure 9.1: Site Hydrology.** Conservative minimum hydrological buffer zones are adopted and implemented as shown in **Table 9.19**. The buffer widths adopted exceed those recommended in industry guidance; the allowance provided gives due consideration to the nature of peat soil conditions on the Site, antecedent weather, moisture and base flow and a significantly increased factor of safety in all instances given the significance of fishery interests within downstream catchments.

Table 9.19: Minimum Adopted Hydrological Buffer Zones

Water Features	Minimum Width of Buffer Strip
Significant Watercourses (catchment >0.25 km^2)	50 m
Minor Watercourses (catchment <0.25 km^2)	10 m
Other Drainage Features	Managed on-site by diversion / temporary blocking in accordance with GGPs and PPGs.

9.192 New infrastructure is designed to lie outwith the 50m hydrological buffer zones for significant watercourses in all instances. This includes those elements of the works associated with significant earthworks and greatest potential for spillage or leakage of chemical pollutants, i.e.:

- All turbine bases, crane pads and associated working areas;
- Temporary and permanent spoil storage areas;
- Enabling works compound, substation and construction compound, fuel and chemical storage areas and any other platforms;
- Spoil movements and earthworks (placement of donor turves and contour ploughing) associated with proposed habitat enhancement and ecological mitigation.

9.193 With regards to minor watercourses, new infrastructure is similarly designed to lie outwith the 10m hydrological buffer based on either the present watercourse alignment, or a diverted alignment where the diversion is installed as enabling works. Diversions of minor watercourses are proposed only where the affected existing channel is an artificial feature (peat drain or track drainage).

9.194 The layout has deliberately sought to re-use existing agricultural tracks as much as possible in order to minimise the introduction of new impermeable areas. As such, upgraded tracks are proposed in areas within 10m hydrological buffers associated with minor watercourses that are in effect existing trackside drainage.

9.195 Careful consideration has been given to the routing of access tracks in order to avoid / limit crossing of watercourses.

9.196 Temporary track infrastructure (such as temporary widening and turning heads) that may encroach into buffers shall be managed through the use of additional surface water management measures, discussed in **paragraphs 9.240** through **9.243**.

Abstractions

9.197 The proposed infrastructure layout within the Site is such that no development (tracks, turbines or other significant infrastructure) is sited within 250m of any known or potential potable water abstraction identified in the previous screening assessment. No further constraint is required.

Floodplains

9.198 The baseline screening of the site did not identify any fluvial 1 % AEP flood extents within the Site and as such no constraint is required in relation to avoidance of floodplains.

9.199 Pluvial flood extends noted along watercourses on-site (shown on **Figure 9.1: Site Hydrology**) do not extend beyond the extent of the hydrological buffers established in **paragraph 9.191** and therefore do not further constrain development.

9.200 Infrastructure is designed to ensure that conveyance of surface water flooding is not impeded by means of providing drainage culverts / under track crossings where necessary. Crossings of significant watercourse (Stream C) coincide with existing track crossings and as such will not cause any new significant morphological change that would affect flooding on site or elsewhere.

9.201 Electrical infrastructure that would be susceptible to damage by floodwater is designed such that it does not have potential to be affected by surface water flooding.

9.202 Areas of isolated surface water flooding generally coincide with source areas of on-site water features or isolated low-points. Site drainage and culverts shall allow passage of local surface flooding as considered within **Appendix 9.1: Water Framework Directive Assessment**, **Appendix 9.2 Flood Risk & Drainage Assessment**, and accompanying drainage management drawings.

Designed Measures

9.203 Normal design measures associated with development of the type proposed are not considered "mitigation" in EIA terms, but are important in their effect of controlling or reducing the potential effect of the proposal on the receiving environment. Such measures are outlined in the following sections.

Site Drainage Management and SuDS Design

9.204 The Development will adopt a surface water management plan / site drainage design using the principles of Sustainable Drainage, promoting the principles of onsite retention of flows and use of buffers and other silt removal techniques. All drainage related mitigation measures proposed will be encompassed by a robust and proven Sustainable Drainage System (SuDS) design which will be used to control drainage and silt management on the site.

9.205 Onsite drainage design will minimise modification and disruption of the existing natural hydrology by:

- Maintaining existing overland flow routes and channels. Existing natural flow paths lateral to access roads will be maintained through the use of piped crossings under road alignments at natural depressions and at regular intermediate intervals. The spacing of cross drains will be specified at detailed design stage;
- Avoiding transporting rainfall runoff in long linear drainage swales by providing regular channel "breakouts", whereby water is encouraged to flow overland, thus maintaining existing natural hydrological patterns;
- Reducing surface water flow rates and volumes by attenuating runoff from tracks and hard standings "at source" by providing check-dams in swales, whereby the flow velocity and rate of discharge is artificially reduced to mimic natural properties;
- Providing settlement ponds at turbine hard standing areas and other main surface water discharge locations, where runoff from significant new impermeable areas is treated and attenuated before being released overland;
- All swales, crossings and other hydraulic features will be engineered to ensure that dimensions are suitable to convey predicted flows and so prevent build-up of surface water and / or flooding.

9.206 Drainage design will reduce chemical, silt and other suspended pollutant transport by providing a "treatment train" of two to three stages of pollutant removal to all surface water runoff, nominally by:

- Ensuring that drainage swales are designed to convey flows at a low velocity by using a wide, flat bottomed drain;
- Providing settlement and filtration features in all linear drainage swales (check dams, filtration dams) to reduce flow velocity and encourage settlement;
- Encouraging appropriate vegetation growth in the base of all linear drainage to provide additional filtration to flows;
- Providing settlement ponds at turbine hard standing areas and other key discharge locations in order to provide treatment to contaminated runoff prior to discharge;
- Discharging surface water runoff over undisturbed vegetated ground, hence allowing any remaining silts and other pollutants to drop out of flows before entering the watercourse (having the effect of polishing the runoff);
- Preventing the discharge of surface water runoff flows directly to existing watercourses or drainage. All discharges shall seek to be via SuDS and buffer

zones which will act as a filter strip, allowing deposition of suspended solids and other pollutants;

- Providing settlement features in water channels downstream of areas of peat infilling and ditch blocking area proposed as part of habitat management and enhancement planning.

9.207 Consideration specific to the proposed infrastructure elements are documented in the detailed site-specific drainage management / SuDS design – see **Appendix 9.1: Water Framework Directive Assessment** and accompanying drainage drawings.

Drainage at Upgraded Tracks

9.208 The infrastructure design has sought to upgrade existing agricultural tracks and as such comes into contact with existing track drainage which are locally significant in terms of drainage function.

9.209 Where a single trackside drain exists then widening shall be offset to the other side, to preserve the existing drain intact.

9.210 Where existing track drainage is located on both sides of the existing track then track widening shall be offset consistently to one side (typically the downgradient side) in order that the upgradient drain is left intact as a clean water cut-off from the works. The disrupted / redundant drain where widening is proposed shall be diverted into a new drain offset from the track widening. The new drain will be installed as enabling works prior to main earthworks, to ensure that track widening is undertaken in dry conditions. The new drain shall be designed to ensure an equivalent or greater dimension and hydraulic capacity to that which it replaces.

9.211 In all instances, additional mitigation measures shall be deployed and will include measures including: placement of temporary silt barriers (e.g. check dams) within retained and replacement drains, and silt fencing barriers erected between the widened track and drains. Additional mitigation is discussed further in **paragraphs 9.240** through **9.243**.

Works to drains at WTG 5 and 6

9.212 Minor watercourses, characteristic of cut peat drainage and existing track drainage, are proposed to be diverted to permit siting of turbine bases and infrastructure at Wind Turbine Generator (WTG) 5 and 6. The drains shall be diverted as enabling works prior to undertaking main civil earthworks and the diverted channels are designed to ensure hydrological buffer zones complying with the measures stated previously in **paragraph 9.191** (i.e. 10 m). The new diverted drain shall be designed to ensure an equivalent or greater dimension and hydraulic capacity to that which it replaces.

9.213 Mitigation in relation to the works to divert the drains (i.e. work in or adjacent to water) is discussed further in **paragraphs 9.238** and **9.239**.

Watercourse Crossings

9.214 As noted previously, the number of watercourse and drainage crossings has been minimised through the principle of avoidance at the layout design stage, and a number of culverts have been sited to coincide with existing culverts which will be upgraded. Proposals submitted in conjunction with this assessment indicate:

- Two crossings of a significant watercourse (Stream C and tributary), both at locations where an existing culverted track exists.
- Five crossings of minor watercourses, the majority of which comprise existing track-side drains.

9.215 Culverts will be designed to accommodate track crossings and minimise length of affected channel in order to comply with Revised PPS15 policy FLD4.

9.216 Hydraulic design of crossings will be undertaken as per the guidance and requirements provided in CIRIA C689 "Culvert Design and Operation Guide" (or other standard as may be required by DfI Rivers in post-consent consultation), with primary parameters likely to include:

- Width of the culvert will be greater than the width of the active drainage channel;
- Alignment of the culvert will suit the alignment of the drainage channel, i.e. preserve the existing direction of flow;
- The slope of the culvert will not exceed the slope of the bed of the existing drainage channel.
- Detailed design of crossings will assume a hydraulic capacity requirement of 1% Annual Equivalent Probability flow as a conservative measure. Detailed hydraulic design of culverts and similar structures post permission is normal and accepted practice for wind farms in Northern Ireland.
- Fisheries shall be protected by adopting the guidance stated in Guidelines for Fisheries Protection during Development Works as published by Loughs Agency.

9.217 Culvert form will be informed by the site-specific fisheries assessment (**Chapter 8: Fisheries**). That assessment has determined that fish passage is not a consideration at any proposed watercourse crossing location, and as such culverts shall be of a closed conduit type. Typical design drawings for closed culverts have been provided as part of the planning application and are included as part of the Drainage Management Drawings within **Appendix 9.1: Water Framework Directive Assessment.**

9.218 Consultation and approval will be sought from all relevant parties as required by the DAERA Surface Waters Alteration Handbook (November 2017), including and DfI Rivers in particular, at the pre-construction detailed design stage for all works in and affecting watercourses and drains, as per the requirements of Schedule 6 of the Drainage (Northern Ireland) Order 1973 and subsequent amendments. Given that all proposed culverts are of a conventional type and in a number of instances coincide with and replace existing culverts, it is anticipated that Rivers approvals for culvert works can be deferred post-determination of the planning application. Further consideration is given in Flood Risk Assessment included at **Appendix 9.2**.

Radon

9.219 The site is within an area of elevated radon potential, where 10 – 30 % buildings are above the action level. Radon protection measures are advised to be implemented for the permanent sub-station and control building.

Effect of the Development

9.220 Magnitude and likelihood of the potential environmental effects have been determined based on criteria outlined within **paragraphs 9.40** to **9.46** taking into account the effect of avoidance measures and normal designed-in measures proposed and described in preceding sections.

9.221 The associated impact significance of these effects on the receptors affected (following the implementation of avoidance and design measures proposed) has been determined in accordance with the rationale described previously and the results are presented in summary **Table 9.20**.

Table 9.20: Potential Magnitude and Significance of Impacts to Receptors – Including effect of Avoidance & Design

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
Soils / Drift Deposits (Local / Low)	Ground Movement / Instability	Low	Negligible	Unlikely	Not Significant	The Quantitative Risk Assessment within the Peat Slide Risk Assessment has concluded that peat slide risk is not significant.
On Site Minor Drainage (Local / Low)	Changes in runoff and flow patterns	Low	Negligible	Unlikely	Not Significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt “soft” rural SuDS features to ensure response to rainfall is not exacerbated. Design of crossings of minor watercourses at nine locations within channels on-site when adopting best practice design standards as stated result in no significant localised effect in terms of restricted capacity that would cause any change to flood risk.
	Silt / suspended solid pollution of surface waters	Medium	Low	Likely	Minor	Temporary short-term construction activities within watercourses would be likely to cause a significant but temporary fundamental change in water quality in watercourses on the site.
	Chemical pollution of surface waters	Medium	Low	Likely	Minor	Spillage of oils, chemicals, or cementitious material associated with temporary construction and arising due to improper site management would be likely to cause a fundamental but temporary change in water quality in watercourses on the site.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
On Site Watercourse – Carnanbane Stream (Local / Low)	Changes in runoff and flow patterns	Low	Negligible	Unlikely	Not Significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt "soft" rural SuDS features to ensure response to rainfall is not exacerbated. The watercourse crossing of the Carnanbane is sited at an existing culvert location and as such potential for there to be an adverse change in natural stream morphology is discounted.
	Silt / suspended solid pollution of surface waters	Medium	Low	Likely	Minor	Temporary short-term construction activities within the watercourse (to construct the culvert) would be likely to cause a significant but temporary fundamental change in water quality in watercourses on the site.
	Chemical pollution of surface waters	Medium	Low	Likely	Minor	Spillage of oils, chemicals, or cementitious material associated with temporary construction and arising due to improper site management would be likely to cause a fundamental but temporary change in water quality in watercourses on the site.
Altnahelglish River (National / High)	Changes in runoff and flow patterns	Low	Moderate	Unlikely	Minor	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt "soft" rural SuDS features to ensure response to rainfall is not exacerbated. The drainage strategy adopted ensures that natural catchments are mirrored and ensures that water is not lost from the catchment that would result in a loss of available water for abstraction.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
	Silt / suspended solid pollution of surface waters	Medium	Moderate	Likely	Moderate	Riparian buffer zones, avoidance, and control of reduced quality runoff from the temporary and permanent works would cause runoff from the site to have no effect exceeding normal seasonal or pre-existing fluctuations. Temporary short-term construction activities within upstream watercourses would be likely to cause a detectable but temporary change in water quality in the immediate downstream environment.
	Chemical pollution of surface waters	High	High	Likely	Major	Spillage of oils, chemicals, or cementitious material associated with temporary construction, particularly at works adjacent to or within watercourses, and arising due to improper site management would be likely to cause a fundamental but temporary change in water quality in the downstream environment.
Owenrigh River & River Roe and Tributaries (International / Very High)	Changes in runoff and flow patterns	Negligible	Low	Rarely	Not significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt "soft" rural SuDS features to ensure response to rainfall is not exacerbated. The site as a proportion of the waterbody catchment is not significant.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
	Silt / suspended solid pollution of surface waters	Medium	High	Likely	Major	Riparian buffer zones, avoidance, and control of reduced quality runoff from the temporary and permanent works would cause runoff from the site to have no effect exceeding normal seasonal or pre-existing fluctuations. Temporary short-term construction activities within upstream watercourses would be likely to cause a detectable but temporary change in water quality in the immediate downstream environment. The site as a proportion of the waterbody catchment is not significant and as such the effect of dilution would be significant in reducing the effect.
	Chemical pollution of the watercourse	High	High	Likely	Major	Spillage of oils, chemicals, or cementitious material associated with temporary construction, particularly at works adjacent to or within watercourses, and arising due to improper site management would be likely to cause a fundamental but temporary change in water quality in the downstream environment. The site as a proportion of the waterbody catchment is not significant and as such the effect of dilution would be significant in reducing the effect.
Bedrock Groundwater / Aquifers (Local / Low)	Alteration of Groundwater	Low	Negligible	Unlikely	Not Significant	No significant excavations within the bedrock are expected as groundwater within the bedrock is sufficiently deep as to not be affected by the proposed wind farm. Significant dewatering with the potential for affecting groundwater levels is not anticipated.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
	Chemical pollution of groundwater	Low	Negligible	Likely	Minor	Bedrock is expected to be shallow in several areas, with limited thickness of Superficial Deposits however depth to groundwater is anticipated to be significant and dominated by fracture flow.
Private water supplies	Disruption to quantity or quality of supply	Negligible	Negligible	Unlikely	Not Significant	No infrastructure is proposed within 250m of any known or potential abstraction location and as such no supply would be affected.
Tracks, turbines and associated buildings. (Local / Low)	Risk to occupants and infrastructure due to identified potential risk of flooding.	Low	Negligible	Unlikely	Not Significant	The development has been designed to avoid areas potentially susceptible to pluvial ponding.
	Risk to occupants due to presence of Radon	Low	Negligible	Unlikely	Not Significant	Proposed buildings will be designed to incorporate appropriate radon / gas protection measures.

Additional Mitigation Measures – Construction Phase

9.222 Additional mitigating measures, over and above the avoidance and buffer zones previously detailed, are intended to reduce or prevent the residual significant hazards which may not be fully mitigated by the design evolution and avoidance.

Water Quality Monitoring

9.223 A water quality monitoring program will be implemented to monitor effects on the surface water quality regime during the infrastructure construction, operational and decommissioning phases of the Development, in order to;

- Demonstrate that the mitigation measures and surface water management is performing as designed;
- Provide validation that the in-place mitigation measures are not having an adverse effect upon the environment;
- Indicate the need for additional mitigation measures to prevent, reduce or remove any effects on the water environment, such as additional temporary settlement or filtration structures or short-term flocculant dosing to suit observed site conditions.

9.224 The monitoring would be informed by existing water quality baseline data presented in **paragraphs 9.115** through **9.120** of this assessment and baseline monitoring rounds undertaken prior to the commencement of the construction phase.

9.225 It is intended that the water monitoring extent, duration and frequency will be agreed with the Department of Infrastructure or the relevant regulating body (nominally NIEA WMU) post consent and will nominally consist of physicochemical and biological monitoring. The extent, duration and frequency of the monitoring will be proportionate to the level of activity during each phase of the development and the associated perceived risks.

Pollution Prevention

Pollution Prevention Plan

9.226 An Outline Construction Environmental Management Plan (oCEMP) (**Appendix 6.5**) provides information on good practice pollution prevention measures that shall be implemented at the Site. It is intended that the oCEMP be used by the Applicant as a guide when developing more detailed site-specific plans.

9.227 A detailed Pollution Prevention Plan (PPP) will be implemented and monitored by the site manager as part of a full Construction & Decommissioning Method Statement (CDMS) for the project, to be submitted post-consent following detailed site investigations and agreed with the local planning authority. Although this will be of particular importance during construction, it will apply to potentially polluting activities during all phases of the Development.

9.228 The detailed PPP will be produced following consultation and agreement with NIEA, and all appropriate personnel working on the Site will be trained in its use. As a minimum, the PPP will comply with Guidance for Pollution Prevention (GPP) and Pollution Prevention Guidelines (in particular GPP 21: Pollution Incident Response Planning) and best practice as advocated by CIRIA. The PPP will identify site-specific measures and incorporate a Pollution Incident Plan, which will include emergency contact details, details of spill kits on the Site and instructions on actions in case of spillage / emergency.

9.229 Measures to be incorporated within the PPP are identified in the following sections.

Pollution Prevention Measures

9.230 During all phases the site manager will ensure that mitigation measures as identified within this assessment are fully implemented and that activities are carried out in such a manner as to prevent or reduce effects. The following construction and decommissioning phase-specific measures will be implemented. The following sections should be read in conjunction with the construction management information provided within **Chapter 2: Proposed Development**.

9.231 To ensure best practice on site and to help avoid pollution release to watercourses and groundwater, the following NIEA Guidance for Pollution Prevention (GPP) and Pollution Prevention Guidance (PPGs) will be adhered to:

- GPP2 Above Ground Oil Storage Tanks
- GPP 4 Treatment and disposal of Wastewater where there is no connection to the public foul sewer
- GPP 5 Works and Maintenance in or near Water
- GPP 8 Safe Storage and Disposal of Used Oils
- GPP 20 Dewatering Underground Ducts and Chambers
- GPP 21 Pollution Incident Response Planning
- GPP 22 Dealing with Spills
- GPP 26 Safe Storage of Drums and Intermediate Bulk Containers.
- PPG 1 Understanding Your Environmental Responsibilities - Good Environmental Practices
- PPG 3 Use and Design of Oil Separators in Surface Water Drainage Systems
- PPG 6 Working at Construction and Demolition Sites
- PPG 7 Safe Storage – The Safe Operation of Refuelling Facilities

9.232 Key requirement for control of chemical pollution risk are identified in the above guidance and will include the following:

Storage

9.233 All equipment, materials and chemicals on the Site will be stored away from any watercourse (i.e. outwith previously stated buffer zones). Chemical, fuel and oil stores will be sited on impervious bases in accordance with GPP2 and within a secured bund of 110% of the storage capacity, within the temporary storage compound

Vehicles and Refuelling

9.234 Standing machinery will have drip trays placed underneath to prevent oil and fuel leaks causing pollution. Refuelling of vehicles and machinery will be carried out on an impermeable surface in designated areas, well away from any watercourse or drainage ditches (i.e. outwith previously stated buffer zones) and will adhere to best practice as detailed in PPG 7.

Maintenance

9.235 Onsite maintenance to construction plant will be avoided in all practicable instances, unless vehicles have broken down necessitating maintenance at the point of breakdown. Suitable measures in accordance with a Pollution Prevention Plan (PPP) will be put in place prior to commencement of maintenance in this instance.

Cement and concrete batching

9.236 Preference shall be given to construction techniques that do not require use of cementitious materials where suitable practicable alternatives exist. When concrete / cement is used, concrete batching will not be permitted on site. Wet concrete operations will not be carried out within watercourses or adjacent to watercourses. Measures to prevent discharge of alkaline wastewaters or contaminated storm water to watercourses will be outlined in a detailed PPP for the Site to be approved by NIEA before commencement of works. Wastewater spillage will be minimised by using settling tanks and recycling water.

Mess and welfare facilities

9.237 Mess and welfare facilities will be required during construction and decommissioning and will be located at the construction compound. Foul effluent disposal shall be via chemical facilities with periodic tankered removal by a licensed waste haulier for licensed offsite disposal (i.e. there shall be no emission on site).

Construction Best Practice

Construction in the vicinity of Watercourses

9.238 The following procedures apply to the general construction activities either within the watercourses or in defined watercourse buffer zones:

- Due consideration will be given to the prevailing ground and weather conditions when programming the execution of the works in order to ensure that in-channel works are undertaken during periods of predicted low flow and low rainfall in order to minimise contact with water.

- Ensure that roadside drains do not discharge directly into watercourses, but rather through a riparian buffer area of intact vegetation as denoted on design drawings.

Construction of Watercourse Crossings

9.239 Construction of watercourse crossings will be programmed to coincide with periods of predicted low flow in the affected channel (determined by rainfall and would generally coincide with summer months) and adhere to working period restrictions imposed. Construction will be strictly as per the design for each identified watercourse crossing and will fully implement all SuDS and additional mitigating measures proposed at the detailed design stage. For purposes of outline design, the proposed mitigation will include:

- Installation of silt fences parallel to the watercourse channel in the vicinity of the proposed crossing;
- Installation of small cut-off drains to prevent natural surface runoff entering area of construction activity;
- Installation of filtration or other silt entraining features within the watercourse channel immediately downstream of the works location;
- Use of over pumping where deemed appropriate.

Temporary SuDS

9.240 Temporary drainage and silt management features (SuDS) will be constructed prior to earthworks (including preliminary or enabling works) proceeding to construct any linear works (tracks / hardstanding areas / cable routes), turbine bases, and other infrastructure. Drainage will be provided to temporary works and reinstated to suit the final footprint of the completed development.

9.241 Temporary drainage measures in particular will be employed in enabling works to facilitate widening of existing tracks and diversion of minor watercourses where specifically proposed.

9.242 Temporary measures may include:

- Temporary silt fences erected in areas where risk of pollution to watercourses has been identified e.g. watercourse crossing locations and areas where tracks or other infrastructure lie within watercourse buffer zones.
- Placing temporary filtration silt fences within drainage channels where siltation is observed.
- Installing temporary constructed settlement features such as sumps or settlement ponds / lagoons where required.
- Upslope cut-off drainage channels approximately parallel to the proposed track alignment installed in advance of any excavated cuttings for the track or turbine hardstanding areas.

- Watercourses, drains, natural flow paths and cut-off drain outlet locations should be identified and charted, in order to ensure that piped crossings can be installed in advance of or adjacent to the track construction.
- Settlement ponds should be constructed in advance of commencing excavations for foundations and at any other locations identified as required at detailed design stage.
- Trackside drainage swales should be installed in parallel with track construction. Note that this may require that drainage swales are reformed on an ongoing basis as temporary track alignments are modified to their eventual finished design level.

9.243 Suitable prevention measures should be in place at all times to prevent the conveyance of silts to receiving watercourses.

Electrical Cable Laying

9.244 Due consideration will be given to the prevailing ground conditions and season when programming the execution of cable trench excavations in order to ensure works are undertaken during periods with low rainfall and elevated shallow groundwater levels in order to reduce the likelihood of runoff entering the excavations.

9.245 Excavation of cable trenches will be carried out over short distances, with frequent backfilling of trenches to minimise opportunity for the ingress of water into open trenches, temporary silt traps will be provided in longer trench runs and on steeper slopes and spoil will be stored in line with a spoil management plan, which will be produced as part of the CDMS at the pre-construction stage.

Excavations and Spoil Management

9.246 Soil and subsoil excavation and movement will be undertaken in accordance with best practice guidelines such as Good Practice Guide for Handling Soils (MAFF, 2000) in order to minimise potential for silt laden runoff from spoil and excavations. Areas of stockpiled spoil including stored peat:

- will not be permitted within previously identified watercourse buffer zones; and
- will not be permitted to obstruct the flow of overland surface water with specific drainage to spoil mounds to be provided.

9.247 Material produced from excavations on the Site will be reused where reasonably practicable in the reinstatement of the site. Excavated materials will be separated into rock material, subsoil, reusable peat and vegetated sod material and will be stored in the designated temporary stockpile zones, under the supervision of a geotechnical expert. These materials will be reused where possible to re-grade slopes, and to re-vegetate and stabilise the sides of access tracks and hard standing areas.

9.248 Spoil drainage will be designed on a bespoke basis for spoil storage areas to allow controlled dewatering and prevent washout of suspended solids to the receiving water environment. As part of the detailed CDMS a spoil management strategy will be developed by the appointed competent contractor for the development. Outline designs for drainage arrangements for temporary spoil areas are shown on the Drainage Management Drawings within **Appendix 9.1: Water Framework Directive Assessment.**

Ditch Blocking and Earthworks for Habitat Enhancement

9.249 It is proposed that very localised ditch blocking be carried out for the purposes of habitat enhancement. Specific methods will depend upon conditions at any given location. A number of techniques for maintaining the water levels in the drains associated with the flushes may be used and would typically comprise the installation of a barrier (e.g. (piled) corrugated sheets or drop board sluice or installation of pipe dams, in conjunction with backfilling with site-won material). Methods will comply with best practice guidance. The effect of impeded drainage would be limited to lands under control of the Applicant and are not likely to have offsite hydrological effects.

9.250 Habitat management will also include reduced grazing and an allowance for woodland to naturally regenerate.

Dewatering of Excavations

9.251 The majority of the turbine base foundations will be on bedrock or other hard strata above bedrock (to be confirmed by detailed site investigation prior to detailed design); therefore, deep excavations within bedrock and the associated bedrock aquifer are not anticipated and dewatering below the bedrock aquifer groundwater table is therefore not anticipated.

9.252 Shallow groundwater (e.g. in areas of glacial sand and gravel) or rainfall runoff collected in excavations will be discharged via settlement ponds or filter strips prior to entry to the receiving water environment.

9.253 Any settlement lagoons or filter strips associated with dewatering will be regularly inspected, particularly after periods of heavy rainfall and prior to periods of forecast heavy rainfall. Maintenance (to clear blockages or remove silt) will be carried out in periods of dry weather where practicable. Maintenance requirements are further considered in **Appendix 9.1: Water Framework Directive Assessment.**

Dust Management

9.254 Loose track material generated during the use of access tracks and the construction compound will be prevented from reaching watercourses by maintenance to surface water drainage systems installed at aggregate based hard standing areas. In dry weather dust suppression methods such as by dust suppression bowser will be employed.

Borrow Pits

9.255 For the avoidance of doubt, no borrow pits are proposed at the site, therefore associated pollution risks associated with rock extraction activities are not a consideration.

Maintenance of Pollution Prevention Measures

9.256 All SuDS and additional pollution prevention measures installed will be subject to a regular maintenance regime for the life of the construction phase in order to maintain functionality of all features. This will comprise:

- Unblocking of drains;
- Maintenance of access road and other hard standing surfaces;
- Replacement of filtration features;
- Removal of silt build-up from settlement and filtration features.

Mitigating Measures - Operational Phase

9.257 Mitigation of the effects of the wind farm development will comprise the following:

- Ensure best practice is adhered to on the Site and avoid pollution release to watercourses by incorporating NIEA Pollution Prevention Guidance notes into management policy.
- In the event that permanent welfare facilities are installed as part of control building / substation facilities, foul effluent will be disposed of through the use of sealed cesspools or chemical facilities with periodic tankered removal by a licensed waste haulier for licensed offsite disposal (i.e. there shall be no emission on the site).
- Cyclical maintenance of permanent SuDS drainage features installed during the construction phase, including unblocking of drains, maintenance of access road and other hard standing surfaces, and removal of silt build-up from settlement features. An outline maintenance programme is included in **Appendix 9.1: Water Framework Directive Assessment.**

Mitigating Measures and Residual Effects

9.258 The following table details the assessed impact magnitude, likelihood and associated significance as a function of the matrix stated previously of all receptors identified as previously having an unmitigated impact significance greater than ‘not significant’.

Table 9.21: Mitigated Effects

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
Soils / Drift Deposits (Local / Low)	Ground Movement / Instability	Low	Negligible	Unlikely	Not Significant	The Quantitative Risk Assessment within the Peat Slide Risk Assessment has concluded that peat slide risk is not significant.
On Site Minor Drainage (Local / Low)	Changes in runoff and flow patterns	Low	Negligible	Unlikely	Not Significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt “soft” rural SuDS features to ensure response to rainfall is not exacerbated. Design of crossings of minor watercourses at nine locations within channels on-site when adopting best practice design standards as stated result in no significant localised effect in terms of restricted capacity that would cause any change to flood risk.
	Silt / suspended solid pollution of surface waters	Medium	Low	Rare	Not Significant	Surface water management and pollution control and in particular to work in and adjacent to watercourses, is likely to result in no permanent change and no significant temporary change in conditions exceeding natural or pre-existing conditions.
	Chemical pollution of surface waters	Medium	Low	Rare	Not Significant	Pollution prevention measures proposed to control chemical pollution at all phases is likely to result in no permanent or temporary change in conditions exceeding natural or pre-existing conditions. Robust water quality monitoring will permit a rapid response to any residual risk.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
On Site Watercourse – Carnanbane Stream (Local / Low)	Changes in runoff and flow patterns	Low	Negligible	Unlikely	Not Significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt "soft" rural SuDS features to ensure response to rainfall is not exacerbated. The watercourse crossing of the Carnanbane is sited at an existing culvert location and as such potential for there to be an adverse change in natural stream morphology is discounted.
	Silt / suspended solid pollution of surface waters	Medium	Low	Rare	Not Significant	Surface water management and pollution control and in particular to work in and adjacent to watercourses, is likely to result in no permanent change and no significant temporary change in conditions exceeding natural or pre-existing conditions.
	Chemical pollution of surface waters	Medium	Low	Rare	Not Significant	Pollution prevention measures proposed to control chemical pollution at all phases is likely to result in no permanent or temporary change in conditions exceeding natural or pre-existing conditions. Robust water quality monitoring will permit a rapid response to any residual risk.
Altnahelglish River (National / High)	Changes in runoff and flow patterns	Low	Moderate	Unlikely	Minor	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt "soft" rural SuDS features to ensure response to rainfall is not exacerbated. The drainage strategy adopted ensures that natural catchments are mirrored and ensures that water is not lost from the catchment that would result in a loss of available water for abstraction.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
	Silt / suspended solid pollution of surface waters	Medium	Moderate	Rare	Minor	Riparian buffer zones, avoidance, and control of reduced quality runoff from the temporary and permanent works would cause runoff from the site to have no effect exceeding normal seasonal or pre-existing fluctuations. Surface water management and pollution control in particular to work in and adjacent to watercourses, is likely to result in no permanent change and no significant temporary change in conditions exceeding natural or pre-existing conditions.
	Chemical pollution of surface waters	High	High	Rare	Minor	Pollution prevention measures proposed to control chemical pollution at all phases is likely to result in no permanent or temporary change in conditions exceeding natural or pre-existing conditions. Robust water quality monitoring will permit a rapid response to any residual risk.
Owenrigh River & River Roe and Tributaries (International / Very High)	Changes in runoff and flow patterns	Negligible	Low	Rarely	Not significant	Increased runoff from impermeable infrastructure is to be attenuated to a greenfield equivalent rate and will adopt “soft” rural SuDS features to ensure response to rainfall is not exacerbated. The site as a proportion of the waterbody catchment is not significant.

Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
	Silt / suspended solid pollution of surface waters	Medium	High	Rare	Minor	Riparian buffer zones, avoidance, and control of reduced quality runoff from the temporary and permanent works would cause runoff from the site to have no effect exceeding normal seasonal or pre-existing fluctuations. The site as a proportion of the waterbody catchment is not significant and as such the effect of dilution would be significant in reducing the effect. Surface water management and pollution control in particular to work in and adjacent to watercourses, is likely to result in no permanent change and no significant temporary change in conditions exceeding natural or pre-existing conditions.
	Chemical pollution of the watercourse	High	High	Rare	Minor	The site as a proportion of the waterbody catchment is not significant and as such the effect of dilution would be significant in reducing the effect. Pollution prevention measures proposed to control chemical pollution at all phases is likely to result in no permanent or temporary change in conditions exceeding natural or pre-existing conditions. Robust water quality monitoring will permit a rapid response to any residual risk.
Bedrock Groundwater / Aquifers (Local / Low)	Alteration of Groundwater	Low	Negligible	Unlikely	Not Significant	No significant excavations within the bedrock are expected as groundwater within the bedrock is sufficiently deep as to not be affected by the proposed wind farm. Significant dewatering with the potential for affecting groundwater levels is not anticipated.

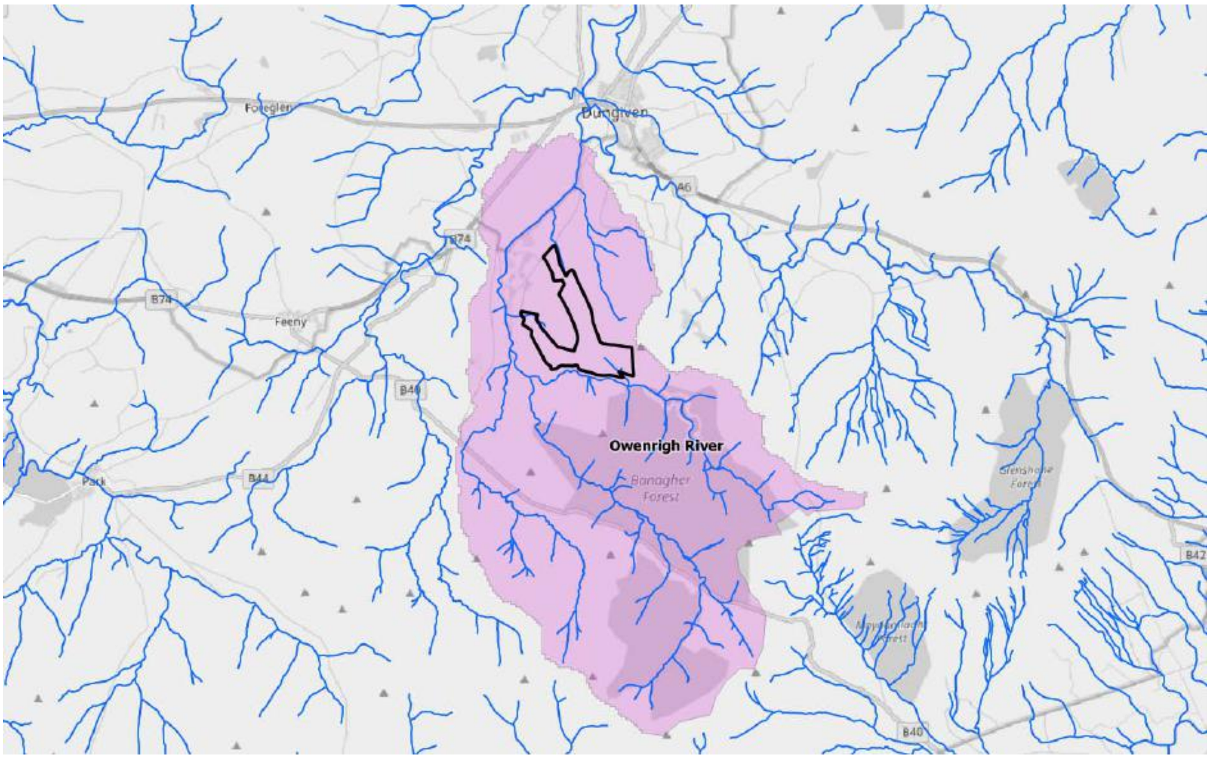
Receptor and Sensitivity	Effect and Magnitude		Potential Effect Significance	Likelihood	Overall Effect Significance	Rationale
	Chemical pollution of groundwater	Low	Negligible	Unlikely	Not Significant	Pollution prevention measures proposed to control chemical pollution at all phases is likely to result in no permanent or temporary change in conditions exceeding natural or pre-existing conditions.
Private water supplies	Disruption to quantity or quality of supply	Negligible	Negligible	Unlikely	Not Significant	No infrastructure is proposed within 250m of any known or potential abstraction location and as such no supply would be affected.
Tracks, turbines and associated buildings. (Local / Low)	Risk to occupants and infrastructure due to identified potential risk of flooding.	Low	Negligible	Unlikely	Not Significant	The development has been designed to avoid areas potentially susceptible to pluvial ponding.
	Risk to occupants due to presence of Radon	Low	Negligible	Unlikely	Not Significant	Proposed buildings will be designed to incorporate appropriate radon / gas protection measures.

Cumulative Effects

9.259 An assessment has been undertaken of the cumulative effect on geology and the water environment of the Development in conjunction with other known wind farms and other significant developments in planning, construction or operation at the time of the application.

9.260 The assessment aims to determine potential for cumulative impact within the hydrological, hydrogeological and geological setting of the site caused by an accumulation of similar developments. The hydrological and hydrogeological setting of the site for the purposes of the assessment is the downstream Owenrigh River as identified on the NIEA Water Framework Directive interactive catchment mapping website and shown on the following **Plate 9-11**.

Plate 9-11: Hydrological Setting



9.261 No other significant wind farm development is planned or operational within that setting and as such potential for cumulative effect is discounted.

9.262 If considering a wider setting, then as no likely significant residual water environment or geological effects are predicted arising from the Development, there is no potential significant cumulative effect to water or the geological environment in conjunction with any other pre-existing or Development.

Summary and Conclusions

9.263 This assessment identifies the potential geological, hydrological, and hydrogeological impacts, including surface and groundwater quality of the Development. It summarises the relevant legislation and guidance and provides appropriate baseline information, enabling the potential effects to be identified.

9.264 Aspects of the design, construction and operation of the Development that may potentially impact on the receiving geological and water environment have been identified and the pathways for impacts assessed. It has been determined that without mitigation the Development would be likely to cause adverse impacts of moderate significance primarily driven by the sensitivity of fisheries interests on and shortly downstream of the Site. As such, informed by the baseline assessment and pathways identified, mitigation integrated as part of outline design and proposed during construction phase includes:

- Avoidance of water features based on baseline constraints mapping;
- Design of site elements to minimise impact on the geological and water environment;
- Implementation of a comprehensive surface water management plan comprising the use of SuDS (drainage) and silt management in order to prevent pathways for pollution;
- Construction phase pollution prevention procedures in accordance with NIEA requirements and guidance.

9.265 Monitoring of the effect of the Development on the water environment and fisheries habitat will be provided by the Applicant through physicochemical and biological water quality monitoring. Implementation of the mitigation proposed eliminates or reduces the potential significance to all receptors to “not significant”.

9.266 There is no likelihood of significant cumulative impacts over and above any pre-existing effect caused by existing or consented wind development.

10

Noise

10 Acoustic Assessment

Introduction

10.1 This report contains an assessment of the acoustic impact of the proposed Magheramore Wind Farm, hereafter referred to as "the Development". The report assesses wind farm operational noise and construction noise at the nearest residential properties.

Statement of Authority

10.2 This assessment has been undertaken by RES, with at least one in-house Member of the Institute of Acoustics involved in its production. RES has undertaken acoustic impact assessments in every single one of its UK wind farm development applications since 2000. RES has also carried out noise assessments and reported to several local planning authorities on operational wind energy projects, including taking measurements on newly constructed wind farms to ensure compliance with planning conditions.

10.3 Additionally, RES has been project co-ordinator for several Joule[1] projects, leading European research into wind turbine noise, was involved in producing the guideline 'The Assessment and Rating of Noise from Wind Farms'[2] for the DTI in 1996, acted as peer reviewer for the 'Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'[3], and contributed to the RenewableUK work on Amplitude Modulation[4]. Publications include:

- 'An Investigation of Blade Swish from Wind Turbines', P Dunbabin, Proceedings of the 1996 International Congress on Noise Control Engineering (Internoise '96), 30 July – 2 August 1996, Book 1, pp 463 – 469;
- 'An Automated System for Wind Turbine Tonal Assessment', R Ruffle, Proceedings of the 1996 International Congress on Noise Control Engineering (Internoise '96), 30 July – 2 August 1996, Book 6, pp 2997 – 3002;
- 'Wind Turbine Measurements for Noise Source Identification', ETSU W/13/003914/00.REP, 1999, Dr P Dunbabin, RES et al;
- 'A Critical Appraisal of Wind Farm Noise Propagation', ETSU W/13/00385/REP, 2000 Dr J Bass, RES;
- 'Aerodynamic Noise Reduction for Variable Speed Turbines', ETSU/W/45/00504/REP, 2000, Dr P Dunbabin, RES;
- 'Fundamental research in amplitude modulation - a project by RenewableUK', Dr J Bass et al, Fourth International Meeting on Wind Turbine Noise, Rome, April 2011;
- 'Investigation of the 'Den Brook' Amplitude Modulation methodology for wind turbine noise', Dr J Bass, Acoustics Bulletin Vol 36 No 6 November/December 2011;

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[1] DGXII European Commission funded projects in the field of Research and Technological Development in non-nuclear energy

[2] 'The Assessment and Rating of Noise from Wind Farms', The Working Group on Noise from Wind Turbines, ETSU Report for the DTI, ETSU-R-97

[3] 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise', Institute of Acoustics, May 2013

[4] 'Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effects', RenewableUK, 2013

- 'How does noise influence the design of a wind farm?', Dr M Cassidy, Fifth International Conference on Wind Turbine Noise, Denver, 2013;
- 'Propagation of Noise from Wind Farms According to the Good Practice Guide', A Birchby, Sixth International Conference on Wind Turbine Noise, Glasgow, 2015;
- 'Addressing the Issue of Amplitude Modulation', Dr M Cassidy, Sixth International Conference on Wind Turbine Noise, Glasgow, 2015;
- 'A Method for Rating Amplitude Modulation in Wind Turbine Noise', Institute of Acoustics Noise Working Group, August 2016; and
- 'Pre-construction Site Prediction Tool for Wind Farm AM – Do We Now Know Enough?', A Birchby, Seventh International Conference on Wind Turbine Noise, Rotterdam, 2017.

Wind Turbine Noise

10.4 In the context of other sources of environmental noise, the noise levels produced by wind turbines are generally low and have greater dependence upon wind speed. The combination of these two factors implies that a degree of masking would often be provided by background noise.

10.5 As described by the Department of the Environment in Best Practice Guidance to Planning Policy Statement 18[5]:

"There are two quite distinct types of noise source within a wind turbine. The mechanical noise produced by the gearbox, generator and other parts of the drive train; and the aerodynamic noise produced by the passage of the blades through the air. Since the early 1990s there has been a significant reduction in the mechanical noise generated by wind turbines and it is now usually less than, or of a similar level to, the aerodynamic noise. Aerodynamic noise from wind turbines is generally unobtrusive – it is broad-band in nature and in this respect is similar to, for example, the noise of wind in trees."

Construction Noise

10.6 The sources of construction noise, which are temporary, would vary both in location and duration as the different elements of the wind farm are constructed and would arise primarily through the operation of large items of plant.

10.7 Noise would also arise due to the temporary increase in construction traffic near the site. This level would also depend on the particular construction phase of the Development.

Scope of Assessment

10.8 Noise can have an effect on the environment and on the quality of life enjoyed by individuals and communities. The effect of noise, both in the construction and operational phase, is therefore a material consideration in the determination of planning applications.

[5] 'Best Practice Guidance to Planning Policy Statement 18: Renewable Energy', PPS18, August 2009

Operational Noise

10.9 The main focus of the assessment of operational noise presented here is based on the most relevant type of noise emission for modern wind turbines: aerodynamic noise, which is broadband in nature. Mechanical noise, which can be tonal in nature, is also considered albeit less relevant to modern wind turbines. Implicitly incorporated within this assessment is the normal character of the noise associated with wind turbines (commonly referred to as 'blade swish') and consideration of a range of noise frequencies, including low frequencies.

10.10 An acoustic assessment considering the operation of the proposed energy storage facility can be found in **Technical Appendix 10.1**.

10.11 Low frequency content of the noise from wind farms shall be considered through the use of octave band specific noise emission and propagation modelling, however it is considered that specific and targeted assessment on low frequency content of noise emissions from the proposed wind farm is unjustified. Details for scoping out low frequency noise from the acoustic assessment, as well as infrasound, sleep disturbance, vibration, amplitude modulation and wind turbine syndrome can be found in **Technical Appendix 10.2**.

10.12 A summary of the findings of a comprehensive study into wind turbine noise and associated health effects can also be found in **Technical Appendix 10.2**.

Construction Noise

10.13 The acoustic impact assessment of construction noise from the wind farm presented here is based on RES's experience of constructing wind farms and calculated for the operation of the primary large items of construction equipment. Additionally, consideration is given to the increased noise levels due to increased traffic flows during the construction phase to and from the site.

10.14 Whilst noise would also arise during decommissioning of the wind farm (through turbine deconstruction and breaking of the exposed part of the concrete bases) this is not discussed separately as noise levels resulting from it are expected to be lower than those from the construction activity.

Legislative Framework & Guidance

Operational Noise

10.15 Within Northern Ireland, noise from wind farms is defined within the planning context by Planning Policy Statement 18: Renewable Energy[6]. Best Practice Guidance to Planning Policy Statement 18: Renewable Energy[5] refers to the use of the Department of Trade and Industry's 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97). In relation to noise from wind farms the Planning Policy states:

"The report, 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97), describes a framework for the measurement of wind farm noise and gives indicative noise levels calculated to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development."

[6] 'Planning Policy Statement 18: Renewable Energy', PPS18, August 2009

10.16 It is therefore considered that the use of ETSU-R-97, as a criterion for assessment of wind farm noise, fulfils the requirements of Planning Policy Statement 18.

10.17 The methodology described in ETSU-R-97 was developed by a working group comprised of a cross section of interested persons including, amongst others, environmental health officers, wind farm operators and independent acoustic experts.

10.18 ETSU-R-97 makes it clear from the outset that any noise restrictions placed on a wind farm must balance the environmental impact of the wind farm against the national and global benefits that arise through the development of renewable energy resources. The principle of balancing development needs against protection of amenity may be considered common to any type of noise control guidance.

10.19 The basic aim of ETSU-R-97, in arriving at the recommendations contained within the report, is the intention to provide:

"Indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development or adding unduly to the costs and administrative burdens on wind farm developers or local authorities."

10.20 An article published in the Institute of Acoustics Bulletin (IoA Bulletin) Vol. 34 No. 2, March/April 2009[7], recommends a methodology for addressing issues not made explicit by, or outside the scope of, ETSU-R-97, such as in relation to wind shear or noise propagation modelling. Whilst this article does not represent formal legislation or guidance it was authored by a group of independent acousticians experienced in wind farm noise issues who have undertaken work on behalf of wind farm developers, local planning authorities and third parties and as such is a good indicator of best practice techniques. The assessment presented herein adopts the recommendations made within this article.

10.21 A Good Practice Guide (IoA GPG) on the application of ETSU-R-97 for the assessment and rating of wind turbine noise[3], issued by the Institute of Acoustics in May 2013 and endorsed by the Northern Ireland Executive, along with the governments in England, Scotland and Wales, provides guidance on all aspects of the use of ETSU-R-97 and reaffirms the recommendations of the Acoustics Bulletin article with regard to propagation modelling and wind shear. The assessment presented herein adopts the recommendations of the Good Practice Guide.

10.22 Supplementary guidance notes were published by the Institute of Acoustics in July and September 2014, and these provide further details on specific areas of the IoA GPG[8]. The assessment presented herein adopts the recommendations made within these supplementary guidance notes.

10.23 ETSU-R-97 has been applied at the vast majority of wind farms currently operating in the UK and provides a robust basis for assessing the noise impact of a wind farm when used in accordance with the IoA GPG. It is the only relevant guidance referenced in Northern Irish planning policy for rating and assessing operational wind farm noise. Based on planning policy and guidance, as outlined above, a wind farm which can

[7] 'Prediction and Assessment of Wind Turbine Noise', Bowdler et al, Acoustics Bulletin Vol 34 No 2 March/April 2009

[8] 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise - Supplementary Guidance Notes', Institute of Acoustics, July & September 2014

operate within noise limits derived according to ETSU-R-97 shall be considered acceptable.

Construction Noise

10.24 In Northern Ireland, advice on construction noise assessment is referred to in 'The Control of Noise (Codes of Practice for Construction and Open Sites) Order (Northern Ireland) 2002'[9]. This legislation points to BS 5228: Part 1:1997 for guidance on appropriate methods for minimising noise from construction and open sites in Northern Ireland.

10.25 Since the 1997 version of BS 5228 has been superseded by BS 5228-1:2009 'Code of practice for noise and vibration control on construction and open sites - Part 1: Noise'[10] this has been identified as being the appropriate source of guidance on appropriate methods for minimising noise from construction activities, and is adopted herein.

10.26 The Pollution Control and Local Government (NI) Order 1978 provides information on the need for ensuring that best practicable means are employed to minimise noise[11].

Consultation

10.27 Details of the consultation undertaken are outlined in **Table 10.1**.

Table 10.1: Acoustic Assessment Consultation

Consultees	Date of Consultation	Nature and Purpose of Consultation
Causeway Coast & Glens Borough Council	31/07/18	A letter of Intention to Submit an Environmental Statement (ES) and Proposal of Application Notice for the proposed Magheramore Wind Farm was issued to Causeway Coast & Glens Borough Council.
Causeway Coast & Glens Borough Council	21/11/18	Response to Letter of Intention to Submit an ES received from Causeway Coast & Glens Borough Council requesting that Environmental Health Department is consulted.
Causeway Coast & Glens Borough Council	26/06/18	Report 'Planned Acoustic Assessment at the Proposed Magheramore Wind Farm' (ref. 03426-000098-01) sent to Environmental Health Officer (EHO), to review methodology and locations for background noise survey.
Causeway Coast & Glens Borough Council	17/07/18	Email response from EHO reviewing the proposed acoustic assessment for Magheramore Wind Farm and agreement of background noise survey locations.
Causeway Coast & Glens Borough Council	30/07/18	Arranging for EHO to visit survey locations on 10/08/18
Causeway Coast & Glens Borough Council	15/08/18	Report "Noise Survey Locations for the Acoustic Assessment of the Proposed Magheramore Wind Farm" (ref. 03426-000153-01) sent to EHO. This report provided details of actual survey locations after setting

[9] 'The Control of Noise (Codes of Practice for Construction and Open Sites) Order (Northern Ireland) 2002', The Department of the Environment, November 2002

[10] 'Code of Practice for Noise and vibration control on construction and open sites - Part 1: Noise', British Standards Institution, BS 5228-1:2009

[11] 'Pollution Control and Local Government (NI) Order 1978', published by Her Majesty's Stationary Office, 1978

Consultees	Date of Consultation	Nature and Purpose of Consultation
		up the background noise survey.
Public	26/03/19	Public Exhibition at the Dromboughil Community Centre on the Magheramore Road, which included information boards regarding the project and noise specifically.

Methodology

Operational Noise

10.28 To ensure adequate assessment of the potential impacts of the operational noise from the proposed wind farm the following steps have been taken, in accordance with relevant guidance detailed above:

- The baseline noise conditions at each of the nearest residential properties to the wind farm are established by way of representative background noise surveys;
- The noise levels at the nearest residential properties from the operation of the wind farm are predicted using a sound propagation model considering: the locations of the wind turbines; the intervening terrain; and the likely noise emission characteristics of the wind turbines;
- With due regard to relevant guidance or regulations the acoustic assessment criteria are derived; and
- The evaluation of the acoustic impact is undertaken by comparing the predicted noise levels with the assessment criteria.

Establishing Baseline Conditions

10.29 Similar to other assessments of noise impacts (most notably BS 4142, 'The Method for Rating Industrial Noise affecting Mixed Residential and Industrial Areas' which ETSU-R-97 identifies as forming the basis of its recommendations), the ETSU-R-97 methodology requires the comparison of predicted noise levels due to turbine emissions (which vary with hub height wind speed) with noise limits based upon the noise levels already existing under those same conditions (i.e. the baseline conditions).

10.30 Since background noise levels depend upon wind speed, as indeed do wind turbine noise emissions, it is important when making reference measurements to put them in that context. Thus, the assessment of background noise levels at potentially sensitive residential properties requires the measurement of not only noise levels, but concurrent wind conditions, covering a representative range of wind speeds. These wind measurements are made at the wind turbine site rather than at the residential properties, since it is this wind speed that would subsequently govern the wind farm's noise generation. Often the residential properties themselves will be sheltered from the wind and may consequently have relatively low background noise levels.

10.31 To establish the baseline conditions, sound level meters and associated apparatus are set-up to record the required acoustic information at a selection of the most noise sensitive residential properties geographically spread around the proposed wind farm site, agreed with Causeway Coast & Glens Borough Council, and which are likely to be representative of other residential properties in the locale.

10.32 Wind speed and direction are recorded as 10 minute averages for the same period as for the noise measurements, and are synchronised with the acoustic data to allow correlations to be established. The wind speed that is adopted for use is the same wind speed as that which drives the turbine noise levels.

10.33 The adoption of this wind speed was recommended within the article published in the IoA Bulletin and the subsequent IoA GPG. The methodology used to calculate standardised 10 m wind speed is described in **Technical Appendix 10.3**.

10.34 Prior to establishing the baseline conditions the acoustic data is filtered as follows:

- For each background noise measurement location, the measured noise data is divided into two sets, as specified by ETSU-R-97 and shown in **Table** 10.2:

Table 10.2: Definition of Time of Day Periods

Time of Day	Definition
Quiet daytime	18:00 - 23:00 every day 13:00 - 18:00 Saturday 07:00 - 18:00 Sunday
Night-time	23:00 - 07:00 every day

- Rainfall affected data is systematically removed from the acoustic data set. To facilitate this, a rain gauge is deployed at the wind farm site to record 10 minute rainfall data and identify potentially affected noise data. Both the 10 minute period containing the bucket tip and the preceding 10 minute period are removed from the dataset as recommended in the IoA GPG to account for the time it takes for the rain gauge tipping bucket to fill;
- Periods of measured background noise data thought to be affected by extraneous, i.e. non-typical, noise sources are identified and removed from the data set. Whilst some 'extraneous' data may actually be real, it tends to bias any trend lines upwards so its removal is adopted as a conservative measure.
- In practice this means close inspection of the measured background noise levels, comparison with concurrent data measured at nearby locations and consideration of both directional and temporal variation.

Modelling Noise Propagation

10.35 Whilst there are several sound propagation models available, the ISO 9613 Part 2 model has been used[12], this being identified as most appropriate for use in such rural sites[13]. The specific interpretation of the ISO 9613 Part 2 propagation methodology recommended in the aforementioned IoA Bulletin and the subsequent IoA GPG has been employed.

10.36 To make noise predictions it is assumed that:

- the turbines are identical;
- the turbines radiate noise at the power specified in this report;
- each turbine can be modelled as a point source at hub-height;

[12] 'Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation', International Organisation for Standardisation, ISO 9613-2:1996

[13] 'A Critical Appraisal of Wind Farm Noise Propagation', ETSU Report W/13/00385/REP, 2000

- each residential property is assigned a reference height to simulate the presence of an observer.

10.37 The sound propagation model takes account of attenuation due to geometric spreading and atmospheric absorption. The assumed temperature and relative humidity are 10 ˚C and 70 % respectively, as recommended in the IoA Bulletin and IoA GPG. Ground effects are also taken into account by the propagation model with a ground factor of 0.5 and a receiver height of 4 m used as recommended in the IoA Bulletin and IoA GPG.

10.38 The barrier attenuations predicted by ISO 9613 Part 2 have been shown to be significantly greater than those measured in practice under downwind conditions[13]. Therefore, barrier attenuation according to the ISO 9613 Part 2 method has been discounted. In lieu of this, where there is no direct line of sight between the residential property in question and any part of the wind turbine, 2 dB attenuation has been assumed as recommended in the IoA Bulletin and the IoA GPG.

10.39 Additionally, verification studies have also shown that ISO 9613 Part 2 tends to slightly underestimate noise levels at nearby dwellings in certain exceptional cases, notably in a valley type environment where the ground drops off between source and receiver. In these instances an addition of 3 dB(A) has been applied to the resulting overall A-weighted noise level as recommended by the IoA GPG. Further detail is provided in **Technical Appendix 10.4**.

10.40 To generate the ground cross sections between each turbine and each dwelling necessary for reliable propagation modelling, ground contours at 5 m intervals for the area of interest have been generated from 50 m grid resolution digital terrain data.

10.41 The predicted noise levels are calculated as L_{Aeq} noise levels and changed to the L_{A90} descriptor (to allow comparisons to be made) by subtraction of -2 dB, as specified by ETSU-R-97.

10.42 It has been shown by measurement based verification studies that the ISO 9613 Part 2 model tends to slightly overestimate noise levels at nearby dwellings[13]. Examples of conservative assumptions modelled which increase the likelihood of the calculated noise levels being an overestimate are:

- properties are assumed to be downwind of all noise sources simultaneously and at all times. In reality, this is not the case and additional attenuation would be expected when a property is upwind or crosswind of the proposed wind turbines;
- although, in reality, the ground is predominantly porous (acoustically absorptive) it has been modelled as ‘mixed’, i.e. a combination of hard and porous, corresponding to a ground absorption coefficient of 0.5 as recommended by the IoA Bulletin and IoA GPG;
- receiver heights are modelled at 4 m above local ground level, which equates roughly to first floor window level, as recommended by the IoA Bulletin and IoA GPG. This results in a predicted noise level anything up to 2 dB(A) higher than at the typical human ear height of 1.2-1.8 m;
- trees and other non-terrain shielding effects have not been considered;
- an allowance for measurement uncertainty has been included in the sound power levels for the presented turbine.

Operational Noise Impact Criteria

10.43 Noise is measured in decibels (dB) which is a measure of the sound pressure level, i.e. the magnitude of the pressure variations in the air. Measurements of environmental noise are usually made in dB(A) which includes a correction for the sensitivity of the human ear.

10.44 ETSU-R-97 seeks to protect the internal and external amenity of wind farm neighbours by defining acceptable limits for operational noise from wind turbines. The test applied to operational noise is whether or not the noise levels produced by the combined operation of the wind turbines lie below noise limits derived in accordance with ETSU-R-97 at nearby residential properties.

10.45 Whilst ETSU-R-97 presents a comprehensive and detailed assessment methodology for wind farm noise, it also provides a simplified methodology:

"if the noise is limited to an $L_{A90,10min}$ of 35dB(A) up to wind speeds of 10 m/s at 10 m height, then these conditions alone would offer sufficient protection of amenity, and background noise surveys would be unnecessary".

10.46 In the detailed methodology, ETSU-R-97 states that different limits should be applied during daytime and night-time periods. The daytime limits, derived from the background noise levels measured during quiet daytime periods, are intended to preserve outdoor amenity, while the night-time limits are intended to prevent sleep disturbance. The general principle is that the noise limits should be based on existing background noise levels, except for very low background noise levels, in which case a fixed limit may be applied. The suggested limits are given in **Table 10.3** below, where L_B is the background $L_{A90,10min}$ and is a function of wind speed. During daytime periods and at low background noise levels, a lower fixed limit of 35–40 dB(A) is applicable. The exact value is dependent upon a number of factors: the number of nearby dwellings, the effect of the noise limits on energy produced, and the duration and level of exposure.

Table 10.3: Permissible Noise Level Criteria

Time of Day	Permissible Noise Level
Daytime	• 35-40 dB(A) for L_B less than 30-35 dB(A) • L_B + 5 dB, for L_B greater than 30-35 dB(A)
Night-time	• 43 dB(A) for L_B less than 38 dB(A) • L_B + 5 dB, for L_B greater than 38 dB(A)

10.47 Note that a higher noise level is permissible during the night than during the day as it is assumed that residents would be indoors. The night-time criterion is derived from sleep disturbance criterion referred to in ETSU-R-97, with an allowance of 10 dB for attenuation through an open window.

10.48 The wind speeds at which the acoustic impact is considered are less than or equal to 12 ms^{-1} at a height of 10 m and are likely to be the acoustically critical wind speeds. Above these wind speeds, as stated in ETSU-R-97, reliable measurements of background and turbine noise are difficult to make. However, if a wind farm meets the noise criteria at the wind speeds presented, it is most unlikely that it would cause any greater loss of amenity at higher wind speeds due to increasing background noise levels masking wind farm generated noise.

10.49 It is important to note that, since reactions to noise are subjective, it is not possible to guarantee that a given development would not result in any adverse comment with regard to noise as the response to any given noise will vary from person to person. Consequently, standards and guidance that relate to environmental noise are typically presented in terms of criteria that would be expected to be considered acceptable by the majority of the population.

Construction Noise

10.50 To ensure adequate assessment of the potential impacts of the construction noise from the proposed wind farm the following steps have been taken:

- Baseline noise criteria are established from the appropriate guidance BS 5228-1:2009;
- Noise levels due to on-site construction activities are predicted at the most sensitive residential properties in accordance with the BS 5228-1:2009 standard;
- Predicted noise levels due to construction traffic at the same residential properties are made using the BS 5228-1:2009 standard; and
- The combined effect of on-site construction activities with construction traffic is compared with the target level specified by BS 5228-1:2009.

Baseline Conditions

Operational Noise

10.51 The Development is located approximately 4 km south of Dungiven. The surrounding area is predominantly rural in nature with an A-class road running to the north of the site and Banagher Forest to the south. The general noise character is typical of a rural environment with noise from farm machinery, sheep, cattle, and birds, with the occasional overhead aircraft.

10.52 Work to convert the A6 to a dual carriageway, and bring it closer to the Development, is currently underway. Once complete, increased background noise levels would be expected in the vicinity of the Development due to the closer proximity of the road and potential increase in traffic volumes and speeds. Should this result in increased noise levels at the baseline survey locations during the times of day relevant to this assessment the data recorded in the baseline survey would be conservative, i.e. the measured noise levels are expected to be lower than if surveys were made after the road works have been completed.

10.53 Background noise measurements were undertaken at 3 residential property locations in accordance with ETSU-R-97 as detailed in **Table 10.4**.

Table 10.4 - Background Noise Survey Details

House Name	Measurement Period		
	Start	End	Duration (days)
H1	18/07/18	25/08/18	39
H4	18/07/18	25/08/18	39
H8	18/07/18	25/08/18	39

10.54 The background noise monitoring equipment was housed in weather-proof enclosures and powered by lead-acid batteries. The microphones were placed at a height of approximately 1.2 m above ground and equipped with all-weather wind shields which also provide an element of water resistance.

10.55 The proprietary wind shields used are designed to reduce the effects of wind-generated noise at the microphone and accord with the recommendations of the IoA GPG in that they are the appropriate size and, in combination with the microphone, are certified by the manufacturer as meeting Type 1 / Class 1 precision standards.

10.56 Noise levels are monitored continuously, and summary statistics stored every 10 minutes in the internal memory of each meter. The relevant statistic measured is the $L_{A90,10min}$ (The A-weighted sound pressure level exceeded for 90 % of the 10 minute interval).

10.57 The sound level meters were placed away from reflecting walls and vegetation. Photos of the equipment, in situ, may be seen in **Technical Appendix 10.5**. The apparatus were calibrated before and after the survey period and the maximum drift detected was 0.2 dB, which is within the required range recommended in the IoA GPG. All instrumentation has been subject to laboratory calibration traceable to national standards within the last 24 months, as recommended in the IoA GPG. Details are provided in **Technical Appendix 10.6**.

10.58 **Chart 1** (see **Technical Appendix 10.7** for all charts) shows the measured wind rose over the background noise survey period, as measured by the LiDAR located on-site.

10.59 LIDAR (Light Detection and Ranging) is a remote sensing device that measures conditions in the atmosphere by using pulses from a LASER by applying the principle of the Doppler Effect, detecting the movement of air in the atmospheric boundary layer to measure wind speed and direction. LIDAR provides measurements at several heights, and this enables wind speed data to be obtained that describe the wind profile across a range of heights.

10.60 LIDAR has been successfully tested, by independent third parties using suitable test sites, against conventional anemometry[14,15]. From the technical reports, these tests have demonstrated that, over a range of relevant heights, the accuracy of the LIDAR is comparable to that of the conventional anemometry.

10.61 For illustrative purposes, **Chart 2** shows the wind rose over an extended period (10/12/11 – 12/01/17), as measured by a meteorological mast located 14 km from the proposed site. As previously discussed, the noise prediction model employed is likely to overestimate the real noise immission levels for locations not downwind of the turbines. **Chart 2** therefore may aid the reader as to the likelihood of over-estimation due to this factor.

10.62 The noise data has been cross-referenced with rainfall data measured at the on-site LiDAR using a rain gauge. Any noise data identified as having been affected by rainfall has been removed from the analysis as shown in **Charts 3 to 8.**

10.63 Short-term periods of increased noise levels considered to be atypical have been removed from the dataset. The excluded data is shown in **Charts 3 to 8.**

[14] "Evaluation of WINDCUBE", Albers et al, Deutsche WindGuard Consulting GmbH, Report PP 08007, 16 March 2008

[15] "Verification test for three WindCubeTM WLS7 LiDARs at the Høvsøre test site", Gottschall et al, DTU Report Risø-R-1732, May 2010

10.64 **Charts 3 to 5** show $L_{A90,10min}$ correlated against wind speed for quiet daytime periods at each survey location. In each case, a 'best fit' line has been fitted to the data and the noise limits added. The equation of the regression polynomial has been provided in the charts.

10.65 **Charts 6 to 8** show $L_{A90,10min}$ correlated against the wind speed for night-time periods at each survey location. In each case, a 'best fit' line has been fitted to the data and the noise limits added. The equation of the regression polynomial has been provided in the charts.

10.66 **Table 10.5** and **Table 10.6** detail the $L_{A90,10min}$ background noise levels calculated from the derived 'best fit' lines, as described above:

Table 10.5 - Quiet Daytime Noise Levels (dB(A) re 20 µPa)

House Name	Standardised 10 m Wind Speed (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	22.5	23.1	24.3	26.0	28.1	30.5	33.1	35.9	38.8	41.6	44.5	47.2
H4	24.3	24.9	25.7	26.8	28.1	29.7	31.5	33.7	36.1	38.8	41.8	45.1
H8	25.1	25.1	25.3	25.9	27.1	28.8	30.8	33.2	35.7	38.5	41.3	44.2

Table 10.6 - Night-time Noise Levels (dB(A) re 20 µPa)

House Name	Standardised 10 m Wind Speed (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	19.6	19.6	20.6	22.6	25.3	28.5	31.9	35.2	38.1	40.2	41.4	41.4
H4	21.7	21.7	21.8	22.7	24.3	26.5	29.0	31.7	34.6	37.3	39.9	39.9
H8	19.7	19.7	20.0	21.2	23.2	25.7	28.6	31.5	34.2	36.6	38.4	38.4

Construction Noise

10.67 For the on-site construction noise assessment, Annex E of BS 5228-1:2009 provides guidance on setting environmental noise targets. Several methods of assessing the significance of noise levels are presented in Annex E and the most applicable to the construction of the proposed wind farm development is the ABC method. The ABC method sets threshold noise levels for specific periods based on the ambient noise levels.

Potential Impacts

Potential Operational Impacts

Noise Propagation Modelling

10.68 The locations of the turbines that make up the Development are provided in **Table 10.7** and shown in **Figure 10.1**.

Table 10.7: Location of Proposed Turbines

Turbine	Co-ordinates	
	X (m)	Y (m)
T1	269287	404624
T2	269046	404858
T3	268597	405170
T4	268302	405328
T5	268701	404659
T6	268374	404794

10.69 The locations of the nearest residential properties to the turbines have been determined by inspection of relevant maps and through site visits. More residential properties may have been identified but have not been considered critical to this acoustic assessment or may be adequately represented by another residential property. The locations considered are listed in **Table 10.8** and are also shown in **Figure 10.1**.

10.70 The distances from each residential property to the nearest turbine are given in **Table 10.8**. It can be seen that the minimum house-to-turbine separation is 1003 m.

Table 10.8: Location of Residential Properties and Distances to Nearest Proposed Turbine

House ID	Co-ordinates		Distance (m)	Nearest Turbine
	X (m)	Y (m)		
H1	267720	404034	1003	T6
H2	267031	405186	1279	T4
H3	267216	405477	1096	T4
H4	267195	405586	1137	T4
H5	267345	405961	1147	T4
H6	267370	406025	1164	T4
H7	267401	406087	1178	T4
H8	268344	406462	1135	T4
H9	268382	406674	1348	T4
H10	268528	406780	1469	T4
H11	268917	406800	1595	T4
H12	269378	406917	1914	T3
H13	270014	406877	2218	T3
H14	270260	406657	2170	T2
H15	271242	406044	2416	T1
H16	271598	405890	2635	T1
H17	271911	405839	2892	T1
H18	272285	405520	3129	T1
H19	270930	405697	1962	T1
H20	267261	405010	1088	T4
H21	272009	405511	2863	T1
H26	267308	405981	1189	T4

House ID	Co-ordinates		Distance (m)	Nearest Turbine
	X (m)	Y (m)		
H27	267336	405990	1171	T4
H28	267265	406037	1256	T4
H29	267343	406116	1241	T4
H30	267421	406259	1282	T4
H31	269549	406980	2045	T3
H32	269700	406993	2131	T3
H33	269772	406997	2172	T3
H34	267317	405918	1148	T4
H35	267744	404487	701	T6
H36	267583	405760	839	T4
H37	267845	405664	567	T4
H38	267874	406440	1192	T4
H39	268853	406395	1201	T4
H40	269488	406524	1621	T3

Properties highlighted grey are identified as being unoccupied for the lifetime of the Development and not considered further

10.71 Although not finalised, the candidate turbine type for the acoustic impact assessment of the Development is the Vestas V117-3.6 MW on a 91.5 m hub. Whilst the Vestas V112-3.6 MW machine with a 94 m hub height would also fit within the proposed tip height envelope the V117 results in greater predicted noise levels at nearby properties so is considered as a worst case. Acoustic data from the manufacturer's general specification is used for all analysis[16]. The manufacturer has identified these values as warranted although no independent test reports are available to indicate whether any margin has been incorporated. 2 dB has therefore been added to the warranted levels as a conservative measure as recommended by the IoA GPG. Details used in this analysis are as follows:

- a hub height of 91.5 m;
- a rotor diameter of 117.0 m;
- sound power levels, L_{WA}, for standardised 10 m height wind speeds (v_{10}) as shown in **Table 10.9**;
- octave band sound power level data, at the wind speeds where it is available, as shown in **Table 10.10**;
- tonal emission characteristics such that no clearly audible tones are present at any wind speed.

[16] 'Performance Specification V117–3.6 MW 50/60 Hz, Vestas Document ID: 0056-4781 V01, 2016-10-07

Table 10.9 – A-Weighted Sound Power Levels (dB(A) re 1 pW) for the Vestas V117-3.6 MW Wind Turbine

Standardised 10m Height Wind Speed, v_{10} (ms^{-1})	Warranted	Plus Uncertainty
1	92.6	94.6
2	92.6	94.6
3	92.6	94.6
4	96.0	98.0
5	100.7	102.7
6	104.8	106.8
7	106.9	108.9
8	107.0	109.0
9	107.0	109.0
10	107.0	109.0
11	107.0	109.0
12	107.0	109.0

Table 10.10 - Octave Band A-Weighted Sound Power Levels (dB(A) re 1 pW) at a Standardised 10m Height Wind Speed of 8 ms^{-1} for the Vestas V117-3.6 MW Wind Turbine

Octave Band (Hz)	8 ms^{-1}
63	89.3
125	96.3
250	99.0
500	100.7
1000	101.3
2000	99.1
4000	95.2
8000	84.1
OVERALL	107.0

Predictions of Noise Levels at Residential Properties

10.72 **Table 10.11** shows the predicted noise immission levels at the nearest residential properties at each wind speed considered, calculated from the operation of the proposed wind farm. The property with the highest predicted noise immission level of 41.5 dB(A) is H1.

10.73 **Figure 10.1** shows an isobel (i.e. noise contour) plot for the site at a 10 m height wind speed of 8 ms^{-1}. Such plots are useful for evaluating the noise ‘footprint’ of a given development.

Table 10.11: Predicted Noise Levels At Nearby Residential Properties, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	27.1	27.1	27.1	30.5	35.2	39.3	41.4	41.5	41.5	41.5	41.5	41.5
H2	19.9	19.9	19.9	23.3	28.0	32.1	34.2	34.3	34.3	34.3	34.3	34.3
H3	23.0	23.0	23.0	26.4	31.1	35.2	37.3	37.4	37.4	37.4	37.4	37.4
H4	22.6	22.6	22.6	26.0	30.7	34.8	36.9	37.0	37.0	37.0	37.0	37.0
H5	22.2	22.2	22.2	25.6	30.3	34.4	36.5	36.6	36.6	36.6	36.6	36.6
H6	22.0	22.0	22.0	25.4	30.1	34.2	36.3	36.4	36.4	36.4	36.4	36.4
H7	21.9	21.9	21.9	25.3	30.0	34.1	36.2	36.3	36.3	36.3	36.3	36.3
H8	22.7	22.7	22.7	26.1	30.8	34.9	37.0	37.1	37.1	37.1	37.1	37.1
H9	21.1	21.1	21.1	24.5	29.2	33.3	35.4	35.5	35.5	35.5	35.5	35.5
H10	20.5	20.5	20.5	23.9	28.6	32.7	34.8	34.9	34.9	34.9	34.9	34.9
H11	20.1	20.1	20.1	23.5	28.2	32.3	34.4	34.5	34.5	34.5	34.5	34.5
H12	19.6	19.6	19.6	23.0	27.7	31.8	33.9	34.0	34.0	34.0	34.0	34.0
H13	17.4	17.4	17.4	20.8	25.5	29.6	31.7	31.8	31.8	31.8	31.8	31.8
H14	17.5	17.5	17.5	20.9	25.6	29.7	31.8	31.9	31.9	31.9	31.9	31.9
H15	15.6	15.6	15.6	19.0	23.7	27.8	29.9	30.0	30.0	30.0	30.0	30.0
H16	14.5	14.5	14.5	17.9	22.6	26.7	28.8	28.9	28.9	28.9	28.9	28.9
H17	13.5	13.5	13.5	16.9	21.6	25.7	27.8	27.9	27.9	27.9	27.9	27.9
H18	12.5	12.5	12.5	15.9	20.6	24.7	26.8	26.9	26.9	26.9	26.9	26.9
H19	15.7	15.7	15.7	19.1	23.8	27.9	30.0	30.1	30.1	30.1	30.1	30.1
H21	13.5	13.5	13.5	16.9	21.6	25.7	27.8	27.9	27.9	27.9	27.9	27.9
H26	21.9	21.9	21.9	25.3	30.0	34.1	36.2	36.3	36.3	36.3	36.3	36.3
H27	22.0	22.0	22.0	25.4	30.1	34.2	36.3	36.4	36.4	36.4	36.4	36.4
H28	21.3	21.3	21.3	24.7	29.4	33.5	35.6	35.7	35.7	35.7	35.7	35.7
H29	21.4	21.4	21.4	24.8	29.5	33.6	35.7	35.8	35.8	35.8	35.8	35.8
H30	21.1	21.1	21.1	24.5	29.2	33.3	35.4	35.5	35.5	35.5	35.5	35.5
H31	18.9	18.9	18.9	22.3	27.0	31.1	33.2	33.3	33.3	33.3	33.3	33.3
H32	18.5	18.5	18.5	21.9	26.6	30.7	32.8	32.9	32.9	32.9	32.9	32.9
H33	18.3	18.3	18.3	21.7	26.4	30.5	32.6	32.7	32.7	32.7	32.7	32.7
H34	22.2	22.2	22.2	25.6	30.3	34.4	36.5	36.6	36.6	36.6	36.6	36.6

10.74 Noise levels at 15 of the 29 nearest residential properties are below 35 dB(A), indicating that the noise immission levels would be regarded as acceptable and the residents amenity as receiving ‘sufficient protection’ without further assessment requiring to be undertaken.

10.75 There are 14 properties that have predicted noise levels greater than this simplified noise criteria as indicated in **Table 10.11**. Therefore the ‘full’ acoustic assessment has only been considered at these.

Acoustic Acceptance Criteria

10.76 As stated previously, during daytime periods and at low background noise levels, a lower fixed limit of 35-40 dB(A) is applicable with the exact value dependent upon a number of factors: the number of noise affected residential properties; the potential impact on the power output of the wind farm and the likely duration and level of exposure. Through consideration of these factors RES have adopted a 37.5 dB(A) level. Justification is provided in the following paragraph, and the resulting criteria are shown in **Table 10.12**.

10.77 Justification for the daytime lower limit, considering each of the factors recommended by ETSU-R-97 and the guidance provided by the IoA GPG, is as follows:

- ***Number of noise affected residential properties:*** There are 14 residential properties with a predicted noise level greater than 35 dB(A) although the majority of these would not be downwind of the Development in the predominant wind direction. Given that the proposed scheme could generate significant social, economic and environmental benefits, this would suggest a limit towards the middle end of the range is justifiable;
- ***Potential impact on the power output of the wind farm:*** The Development can be considered a medium scale development as it has a rated power output of 21.6 MW (6 x 3.6 MW) should the turbine type considered in the acoustic assessment be installed (note the V112 has the same rated power as the V117). A daytime lower limit at the lower end of the range would reduce the amount of energy that could be generated by such a scheme;
- ***The likely duration and level of exposure:*** The amount of the time that noise levels of greater than 35 dB(A) are predicted is limited to periods of sufficiently high wind speed. Noise levels would also be reduced when properties are not located downwind of the wind turbines. The orientation of the proposed turbines relative to the nearest residential properties suggests that a daytime lower limit in the middle of the range is appropriate.

Table 10.12: Permissible Noise Level Criteria

Time of Day	Permissible Noise Level
Daytime	• 37.5 dB(A) for L_B less than 32.5 dB(A) • L_B + 5 dB, for L_B greater than 32.5 dB(A)
Night-time	• 43.0 dB(A) for L_B less than 38.0 dB(A) • L_B + 5 dB, for L_B greater than 38.0 dB(A)

Calculation of Acceptable Noise Limits from Baseline Conditions

10.78 The 'best-fit' lines of **Charts 3-8** have been used to calculate the acceptable noise limits at the background noise measurement locations. **Table 10.13** shows the daytime noise limits and **Table 10.14** the night time noise limits.

Table 10.13 - Recommended Daytime Noise Limits (dB(A) re 20 μPa)

House Name	Standardised 10 m Wind Speed (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	37.5	37.5	37.5	37.5	37.5	37.5	38.1	40.9	43.8	46.6	49.5	52.2
H4	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.7	41.1	43.8	46.8	50.1
H8	37.5	37.5	37.5	37.5	37.5	37.5	37.5	38.2	40.7	43.5	46.3	49.2

Table 10.14 - Recommended Night-time Noise Limits (dB(A) re 20 μPa)

House Name	Standardised 10 m Wind Speed (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.2	46.4	46.4
H4	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	44.9
H8	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4

10.79 The recommendations of ETSU-R-97 state that where there are groups of properties that are likely to have a similar background noise environment, it is appropriate to use data from one representative location as the basis for assessment at the other properties. The survey results inferred to be representative for each property is shown in **Table 10.15**. The specific choice of noise survey chosen has been made considering the distance to the nearest survey location and the likelihood of experiencing a broadly similar exposure as the survey.

Table 10.15 - Assumed Representative Background Noise Survey Locations

House ID	Survey Location
H1	H1
H2	H4
H3	H4
H4	H4
H5	H4
H6	H4
H7	H4
H8	H8
H9	H8
H10	H8
H11	H8
H12	H8
H13	H8
H14	H8
H15	H8
H16	H8
H17	H8
H18	H8
H19	H8
H21	H8

House ID	Survey Location
H26	H4
H27	H4
H28	H4
H29	H4
H30	H4
H31	H8
H32	H8
H33	H8
H34	H4

10.80 As recommended in ETSU-R-97, the absolute lower noise limits may be increased up to 45 dB(A) if the occupant has a financial involvement in the wind farm. However, whilst some of the nearby properties may qualify for such an increase, these limits have not been adopted in the presented results.

Acoustic Assessment

10.81 **Table 10.16** shows a comparison of the predicted noise levels with the recommended daytime noise limits for each residential property where the full assessment procedure is being applied. The predicted noise levels at 1 ms^{-1} and 2 ms^{-1} have been assumed as equal to 3 ms^{-1} as a conservative measure as noise levels at these wind speeds would typically be less. The term ΔL is used to denote the difference between the predicted wind farm noise level and the recommended limit. A negative value indicates that the predicted noise level is within the limit. **Table 10.17** shows a comparison with the recommended night-time noise limits.

10.82 Noise levels at H1 are predicted to exceed the daytime noise limit at standardised 10m wind speeds of 6-8 ms^{-1} by a maximum of 3.3 dB(A). Noise levels at all other assessed locations are within the daytime noise limit at all wind speeds considered. Noise levels at all locations are within the night-time noise limits at all wind speeds considered. The minimum margin during night-time periods is -1.5 dB(A).

10.83 **Chart 9** shows the predicted noise levels due to the Development and noise limits at the property where the minimum margin occurs during daytime and night time periods.

Table 10.16 - Comparison of Predicted Noise Levels and Daytime Noise Limits - (dB(A) re 20 μPa)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1			2			3			4		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	27.1	37.5	-10.4	27.1	37.5	-10.4	27.1	37.5	-10.4	30.5	37.5	-7.0
H3	23.0	37.5	-14.5	23.0	37.5	-14.5	23.0	37.5	-14.5	26.4	37.5	-11.1
H4	22.5	37.5	-15.0	22.5	37.5	-15.0	22.5	37.5	-15.0	25.9	37.5	-11.6
H5	22.2	37.5	-15.3	22.2	37.5	-15.3	22.2	37.5	-15.3	25.6	37.5	-11.9
H6	22.0	37.5	-15.5	22.0	37.5	-15.5	22.0	37.5	-15.5	25.4	37.5	-12.1
H7	21.9	37.5	-15.6	21.9	37.5	-15.6	21.9	37.5	-15.6	25.3	37.5	-12.2
H8	22.7	37.5	-14.8	22.7	37.5	-14.8	22.7	37.5	-14.8	26.1	37.5	-11.4
H9	21.1	37.5	-16.4	21.1	37.5	-16.4	21.1	37.5	-16.4	24.5	37.5	-13.0
H26	21.8	37.5	-15.7	21.8	37.5	-15.7	21.8	37.5	-15.7	25.3	37.5	-12.2
H27	22.0	37.5	-15.5	22.0	37.5	-15.5	22.0	37.5	-15.5	25.4	37.5	-12.1
H28	21.3	37.5	-16.2	21.3	37.5	-16.2	21.3	37.5	-16.2	24.7	37.5	-12.8
H29	21.4	37.5	-16.1	21.4	37.5	-16.1	21.4	37.5	-16.1	24.8	37.5	-12.7
H30	21.1	37.5	-16.4	21.1	37.5	-16.4	21.1	37.5	-16.4	24.5	37.5	-13.0
H34	22.2	37.5	-15.3	22.2	37.5	-15.3	22.2	37.5	-15.3	25.6	37.5	-11.9

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	5			6			7			8		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	35.2	37.5	-2.3	39.3	37.5	1.8	41.4	38.1	3.3	41.5	40.9	0.6
H3	31.1	37.5	-6.4	35.2	37.5	-2.3	37.3	37.5	-0.2	37.4	38.7	-1.3
H4	30.6	37.5	-6.9	34.8	37.5	-2.7	36.9	37.5	-0.6	37.0	38.7	-1.7
H5	30.3	37.5	-7.2	34.4	37.5	-3.1	36.5	37.5	-1.0	36.6	38.7	-2.1
H6	30.1	37.5	-7.4	34.2	37.5	-3.3	36.3	37.5	-1.2	36.4	38.7	-2.3
H7	30.0	37.5	-7.5	34.1	37.5	-3.4	36.2	37.5	-1.3	36.3	38.7	-2.4
H8	30.8	37.5	-6.7	34.9	37.5	-2.6	37.0	37.5	-0.5	37.1	38.2	-1.1
H9	29.2	37.5	-8.3	33.3	37.5	-4.2	35.4	37.5	-2.1	35.5	38.2	-2.7
H26	30.0	37.5	-7.5	34.1	37.5	-3.4	36.2	37.5	-1.3	36.3	38.7	-2.4
H27	30.1	37.5	-7.4	34.2	37.5	-3.3	36.3	37.5	-1.2	36.4	38.7	-2.3
H28	29.4	37.5	-8.1	33.5	37.5	-4.0	35.6	37.5	-1.9	35.7	38.7	-3.0
H29	29.5	37.5	-8.0	33.6	37.5	-3.9	35.7	37.5	-1.8	35.8	38.7	-2.9
H30	29.2	37.5	-8.3	33.3	37.5	-4.2	35.4	37.5	-2.1	35.5	38.7	-3.2
H34	30.3	37.5	-7.2	34.4	37.5	-3.1	36.5	37.5	-1.0	36.6	38.7	-2.1

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	9			10			11			12		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	41.5	43.8	-2.3	41.5	46.6	-5.1	41.5	49.5	-8.0	41.5	52.2	-10.7
H3	37.4	41.1	-3.7	37.4	43.8	-6.4	37.4	46.8	-9.4	37.4	50.1	-12.7
H4	37.0	41.1	-4.1	37.0	43.8	-6.8	37.0	46.8	-9.8	37.0	50.1	-13.1
H5	36.6	41.1	-4.5	36.6	43.8	-7.2	36.6	46.8	-10.2	36.6	50.1	-13.5
H6	36.4	41.1	-4.7	36.4	43.8	-7.4	36.4	46.8	-10.4	36.4	50.1	-13.7
H7	36.3	41.1	-4.8	36.3	43.8	-7.5	36.3	46.8	-10.5	36.3	50.1	-13.8
H8	37.1	40.7	-3.6	37.1	43.5	-6.4	37.1	46.3	-9.2	37.1	49.2	-12.1
H9	35.5	40.7	-5.2	35.5	43.5	-8.0	35.5	46.3	-10.8	35.5	49.2	-13.7
H26	36.3	41.1	-4.8	36.3	43.8	-7.5	36.3	46.8	-10.5	36.3	50.1	-13.8
H27	36.4	41.1	-4.7	36.4	43.8	-7.4	36.4	46.8	-10.4	36.4	50.1	-13.7
H28	35.7	41.1	-5.4	35.7	43.8	-8.1	35.7	46.8	-11.1	35.7	50.1	-14.4
H29	35.8	41.1	-5.3	35.8	43.8	-8.0	35.8	46.8	-11.0	35.8	50.1	-14.3
H30	35.5	41.1	-5.6	35.5	43.8	-8.3	35.5	46.8	-11.3	35.5	50.1	-14.6
H34	36.6	41.1	-4.5	36.6	43.8	-7.2	36.6	46.8	-10.2	36.6	50.1	-13.5

The term L_p is used to denote the predicted noise level due to the operation of the proposed wind farm
The term ΔL is used to denote the difference between the predicted wind farm noise level and the recommended limit
Grey highlighting indicates limit predicted to be exceeded

Table 10.17 - Comparison of Predicted Noise Levels and Night Time Limits - (dB(A) re 20 μPa)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1			2			3			4		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	27.1	43.0	-15.9	27.1	43.0	-15.9	27.1	43.0	-15.9	30.5	43.0	-12.5
H3	23.0	43.0	-20.0	23.0	43.0	-20.0	23.0	43.0	-20.0	26.4	43.0	-16.6
H4	22.5	43.0	-20.5	22.5	43.0	-20.5	22.5	43.0	-20.5	25.9	43.0	-17.1
H5	22.2	43.0	-20.8	22.2	43.0	-20.8	22.2	43.0	-20.8	25.6	43.0	-17.4
H6	22.0	43.0	-21.0	22.0	43.0	-21.0	22.0	43.0	-21.0	25.4	43.0	-17.6
H7	21.9	43.0	-21.1	21.9	43.0	-21.1	21.9	43.0	-21.1	25.3	43.0	-17.7
H8	22.7	43.0	-20.3	22.7	43.0	-20.3	22.7	43.0	-20.3	26.1	43.0	-16.9
H9	21.1	43.0	-21.9	21.1	43.0	-21.9	21.1	43.0	-21.9	24.5	43.0	-18.5
H26	21.8	43.0	-21.2	21.8	43.0	-21.2	21.8	43.0	-21.2	25.3	43.0	-17.7
H27	22.0	43.0	-21.0	22.0	43.0	-21.0	22.0	43.0	-21.0	25.4	43.0	-17.6
H28	21.3	43.0	-21.7	21.3	43.0	-21.7	21.3	43.0	-21.7	24.7	43.0	-18.3
H29	21.4	43.0	-21.6	21.4	43.0	-21.6	21.4	43.0	-21.6	24.8	43.0	-18.2
H30	21.1	43.0	-21.9	21.1	43.0	-21.9	21.1	43.0	-21.9	24.5	43.0	-18.5
H34	22.2	43.0	-20.8	22.2	43.0	-20.8	22.2	43.0	-20.8	25.6	43.0	-17.4

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	5			6			7			8		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	35.2	43.0	-7.8	39.3	43.0	-3.7	41.4	43.0	-1.6	41.5	43.0	-1.5
H3	31.1	43.0	-11.9	35.2	43.0	-7.8	37.3	43.0	-5.7	37.4	43.0	-5.6
H4	30.6	43.0	-12.4	34.8	43.0	-8.2	36.9	43.0	-6.1	37.0	43.0	-6.0
H5	30.3	43.0	-12.7	34.4	43.0	-8.6	36.5	43.0	-6.5	36.6	43.0	-6.4
H6	30.1	43.0	-12.9	34.2	43.0	-8.8	36.3	43.0	-6.7	36.4	43.0	-6.6
H7	30.0	43.0	-13.0	34.1	43.0	-8.9	36.2	43.0	-6.8	36.3	43.0	-6.7
H8	30.8	43.0	-12.2	34.9	43.0	-8.1	37.0	43.0	-6.0	37.1	43.0	-5.9
H9	29.2	43.0	-13.8	33.3	43.0	-9.7	35.4	43.0	-7.6	35.5	43.0	-7.5
H26	30.0	43.0	-13.0	34.1	43.0	-8.9	36.2	43.0	-6.8	36.3	43.0	-6.7
H27	30.1	43.0	-12.9	34.2	43.0	-8.8	36.3	43.0	-6.7	36.4	43.0	-6.6
H28	29.4	43.0	-13.6	33.5	43.0	-9.5	35.6	43.0	-7.4	35.7	43.0	-7.3
H29	29.5	43.0	-13.5	33.6	43.0	-9.4	35.7	43.0	-7.3	35.8	43.0	-7.2
H30	29.2	43.0	-13.8	33.3	43.0	-9.7	35.4	43.0	-7.6	35.5	43.0	-7.5
H34	30.3	43.0	-12.7	34.4	43.0	-8.6	36.5	43.0	-6.5	36.6	43.0	-6.4

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	9			10			11			12		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	41.5	43.1	-1.6	41.5	45.2	-3.7	41.5	46.4	-4.9	41.5	46.4	-4.9
H3	37.4	43.0	-5.6	37.4	43.0	-5.6	37.4	44.9	-7.5	37.4	44.9	-7.5
H4	37.0	43.0	-6.0	37.0	43.0	-6.0	37.0	44.9	-7.9	37.0	44.9	-7.9
H5	36.6	43.0	-6.4	36.6	43.0	-6.4	36.6	44.9	-8.3	36.6	44.9	-8.3
H6	36.4	43.0	-6.6	36.4	43.0	-6.6	36.4	44.9	-8.5	36.4	44.9	-8.5
H7	36.3	43.0	-6.7	36.3	43.0	-6.7	36.3	44.9	-8.6	36.3	44.9	-8.6
H8	37.1	43.0	-5.9	37.1	43.0	-5.9	37.1	43.4	-6.3	37.1	43.4	-6.3
H9	35.5	43.0	-7.5	35.5	43.0	-7.5	35.5	43.4	-7.9	35.5	43.4	-7.9
H26	36.3	43.0	-6.7	36.3	43.0	-6.7	36.3	44.9	-8.6	36.3	44.9	-8.6
H27	36.4	43.0	-6.6	36.4	43.0	-6.6	36.4	44.9	-8.5	36.4	44.9	-8.5
H28	35.7	43.0	-7.3	35.7	43.0	-7.3	35.7	44.9	-9.2	35.7	44.9	-9.2
H29	35.8	43.0	-7.2	35.8	43.0	-7.2	35.8	44.9	-9.1	35.8	44.9	-9.1
H30	35.5	43.0	-7.5	35.5	43.0	-7.5	35.5	44.9	-9.4	35.5	44.9	-9.4
H34	36.6	43.0	-6.4	36.6	43.0	-6.4	36.6	44.9	-8.3	36.6	44.9	-8.3

The term L_p is used to denote the predicted noise level due to the operation of the proposed wind farm
The term ΔL is used to denote the difference between the predicted wind farm noise level and the recommended limit

Directional Assessment

10.84 Rather than making the conservative assumption that properties are downwind of the turbines at all times, a more detailed assessment, accounting for the fact that noise levels will be less when properties are upwind and crosswind of the turbines, has been undertaken. The directional attenuation factors applied, detailed in **Table 10.18**, are consistent with the recommendations of the IoA GPG, with reductions in noise of 2 dB(A) when a receiver is crosswind, and 10 dB(A) when a receiver is upwind of a noise source respectively and a polynomial interpolation in the intermediate directions.

Table 10.18: Directional Attenuation Factors

Directional Offset from Directly Downwind (º)	Directional Attenuation Factor (dB)
0	0.0
30	0.0
60	0.0
90	-2.0
120	-6.7
150	-9.3
180	-10.0
210	-9.3
240	-6.7

Directional Offset from Directly Downwind (º)	Directional Attenuation Factor (dB)
270	-2.0
300	0.0
330	0.0

10.85 The IoA GPG goes on to state that such reductions would only come into play gradually at distances of between five and ten tip heights. As such, the attenuation factors applied have been adjusted by the separation distance between the source and receiver accordingly.

10.86 The results of the directional assessment at property H1 during daytime periods are shown in **Table 10.19**, **Table 10.20** and **Table 10.21** (cells highlighted grey show where the limit is predicted to be exceeded) and graphically in **Charts 10, 11 & 12** for standardised 10m wind speeds of 6, 7 and 8 ms^{-1} respectively.

Table 10.19: Directional Assessment at H1 at 6 ms^{-1}

Direction Sector (°)	0	30	60	90	120	150	180	210	240	270	300	330
Noise Level	39.3	39.3	39.3	39.3	39.2	37.6	35.1	33.9	33.8	34.4	36.2	38.6
Noise Limit	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5
Margin	1.8	1.8	1.8	1.8	1.7	0.1	-2.4	-3.6	-3.7	-3.1	-1.3	1.1

Table 10.20: Directional Assessment at H1 at 7 ms^{-1}

Direction Sector (°)	0	30	60	90	120	150	180	210	240	270	300	330
Noise Level	41.4	41.4	41.4	41.4	41.3	39.7	37.2	36.0	35.9	36.5	38.3	40.7
Noise Limit	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Margin	3.3	3.3	3.3	3.3	3.2	1.6	-0.9	-2.1	-2.2	-1.6	0.2	2.6

Table 10.21: Directional Assessment at H1 at 8 ms^{-1}

Direction Sector (°)	0	30	60	90	120	150	180	210	240	270	300	330
Noise Level	41.5	41.5	41.5	41.5	41.4	39.8	37.3	36.1	36.0	36.6	38.4	40.8
Noise Limit	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9
Margin	0.6	0.6	0.6	0.6	0.5	-1.1	-3.6	-4.8	-4.9	-4.3	-2.5	-0.1

10.87 When directional attenuation is taken into account the daytime noise limit is only predicted to be exceeded in certain direction sectors. At a standardised 10m wind speed of 6 ms^{-1} the limit is predicted to be met in the 180-300 degree sectors. At a standardised 10m wind speed of 7 ms^{-1} the limit is predicted to be met in the 180-270 degree sectors. At a standardised 10m wind speed of 8 ms^{-1} the limit is predicted to be met in the 150-330 degree sectors.

Noise Management

10.88 Turbine management has been considered to reduce the noise levels at H1 to comply with the noise limits during daytime periods. A turbine management strategy involves operating selected turbines within the Proposed Wind Farm Development in reduced noise mode for certain wind speeds and directions.

10.89 The Vestas V117 machine has six reduced noise modes of operation whereby the pitch of the turbine blades can be altered in a trade-off between power production and noise reduction. Each of the noise reduced modes has a reduced rated power of 3.45 MW compared to 3.6 MW for the standard mode. Acoustic emission data for the available modes are shown in Table 10.22 and Table 10.23. A 2 dB(A) allowance for measurement uncertainty has been added to the quoted warranted values as for the standard mode of operation.

Table 10.22 – A-Weighted Sound Power Levels (dB(A) re 1 pW) for Vestas V117 Reduced Noise Modes

Standardised 10m Height Wind Speed, v_{10} (ms^{-1})	3.45MW M0	3.45MW M1	3.45MW M2	3.45MW M3	3.45MW M4	3.45MW M5
1	92.6	92.6	92.6	92.6	92.6	92.6
2	92.6	92.6	92.6	92.6	92.6	92.6
3	92.6	92.6	92.6	92.6	92.6	92.6
4	96.0	96.0	96.0	96.0	96.0	95.9
5	100.7	100.6	100.6	100.4	99.7	98.8
6	104.7	104.0	103.4	102.2	99.8	101.1
7	106.7	105.2	103.7	102.4	99.8	102.9
8	106.8	105.2	103.7	102.4	99.8	103.8
9	106.8	105.2	103.7	102.4	99.8	104.4
10	106.8	105.2	103.7	102.4	99.8	104.4
11	106.8	105.2	103.7	102.4	99.8	104.4
12	106.8	105.2	103.7	102.4	99.8	104.4

Table 10.23 - Octave Band A-Weighted Sound Power Levels (dB(A) re 1 pW) at a Standardised 10m Height Wind Speed of 8 ms^{-1} for Vestas V117 Reduced Modes

Octave Band (Hz)	3.45MW M0	3.45MW M1	3.45MW M2	3.45MW M3	3.45MW M4	3.45MW M5
63	79.7	78.1	75.7	74.2	73.5	76.3
125	89.1	87.5	86.1	85.2	84.7	86.5
250	96.1	94.5	93.2	92.1	90.1	93.4
500	98.9	97.3	96.2	95.1	92.2	96.2
1000	100.5	98.9	97.3	95.8	92.3	97.3
2000	101.1	99.5	97.5	95.9	92.4	97.6
4000	98.9	97.3	95.9	94.8	92.7	96.1
8000	95.0	93.4	92.5	91.6	90.4	92.6
OVERALL	106.8	105.2	103.7	102.4	99.8	103.8

10.90 A noise management strategy has been designed for the wind speeds and directions where the daytime limits at H1 are predicted to be exceeded. Operating the proposed turbines in the modes detailed in **Table 10.24**, **Table 10.25** and **Table 10.26** is predicted to result in the noise limit being met. Note for all other wind speeds and directions during the day, and all wind speeds and directions during night time periods, the turbines are able to operate in their standard mode (referred to in the tables as "3.6MW M0"). Note the rated power of the site would remain 21.6 MW with the noise management strategy in place as noise management is not required at high wind speeds.

Table 10.24: Suggested Daytime Operational Modes at 6 ms^{-1}

Turbine	0°	30°	60°	90°	120°	150°	330°
T1	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0
T2	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0
T3	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0
T4	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0
T5	3.45MW M3	3.45MW M3	3.45MW M3	3.45MW M3	3.45MW M3	3.6MW M0	3.6MW M0
T6	3.45MW M4	3.45MW M4	3.45MW M4	3.45MW M4	3.45MW M4	3.45MW M1	3.45MW M5

Table 10.25: Suggested Daytime Operational Modes at 7 ms^{-1}

Turbine	0°	30°	60°	90°	120°	150°	300°	330°
T1	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0
T2	3.45MW M1	3.45MW M1	3.45MW M1	3.45MW M1	3.45MW M1	3.6MW M0	3.6MW M0	3.6MW M0
T3	3.45MW M2	3.45MW M2	3.45MW M2	3.45MW M2	3.45MW M1	3.6MW M0	3.6MW M0	3.45MW M1
T4	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0
T5	3.45MW M3	3.45MW M3	3.45MW M3	3.45MW M3	3.45MW M3	3.45MW M2	3.6MW M0	3.45MW M1
T6	3.45MW M4	3.45MW M4	3.45MW M4	3.45MW M4	3.45MW M4	3.45MW M2	3.45MW M1	3.45MW M4

Table 10.26: Suggested Daytime Operational Modes at 8 ms^{-1}

Turbine	0°	30°	60°	90°	120°
T1	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0
T2	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0
T3	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0
T4	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0
T5	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0	3.6MW M0
T6	3.45MW M5	3.45MW M5	3.45MW M5	3.45MW M5	3.45MW M1

10.91 Predicted noise levels with the above noise management strategy in place are shown in **Table 10.27**, **Table 10.28** and **Table 10.29**. They are also displayed graphically in **Charts 10, 11 & 12**.

Table 10.27: Directional Assessment at H1 at 6 ms^{-1} with Noise Management

Direction Sector (°)	0	30	60	90	120	150	180	210	240	270	300	330
Noise Level	37.5	37.5	37.5	37.5	37.3	37.3	35.1	33.9	33.8	34.4	36.2	37.4
Noise Limit	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5
Margin	0.0	0.0	0.0	0.0	-0.2	-0.2	-2.4	-3.6	-3.7	-3.1	-1.3	-0.1

Table 10.28: Directional Assessment at H1 at 7 ms^{-1} with Noise Management

Direction Sector (°)	0	30	60	90	120	150	180	210	240	270	300	330
Noise Level	38.0	38.0	38.0	38.0	38.1	37.9	37.2	36.0	35.9	36.5	37.5	38.1
Noise Limit	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
Margin	-0.1	-0.1	-0.1	-0.1	0.0	-0.2	-0.9	-2.1	-2.2	-1.6	-0.6	0.0

Table 10.29: Directional Assessment at H1 at 8 ms^{-1} with Noise Management

Direction Sector (°)	0	30	60	90	120	150	180	210	240	270	300	330
Noise Level	40.7	40.7	40.7	40.7	40.9	39.8	37.3	36.1	36.0	36.6	38.4	40.8
Noise Limit	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9
Margin	-0.2	-0.2	-0.2	-0.2	0.0	-1.1	-3.6	-4.8	-4.9	-4.3	-2.5	-0.1

10.92 It should be acknowledged that there will be many different combinations of turbine management that result in predicted noise levels below the specified criteria. The suggestion of operating turbines in the reduced operational modes presented represents a potential turbine management scheme which may feasibly not be the most efficient from an energy capture perspective but demonstrates the principle of the use of turbine management to mitigate noise levels at H1 to acceptable levels.

10.93 Downwind predicted noise levels at all of the properties considered with a noise management strategy applied to meet the daytime limit in this scenario are detailed in **Table 10.30** and shown in **Chart 9**. The non-directional noise management strategy is consistent with that for the 0-90 degree direction sectors in **Table 10.24**, **Table 10.25** and **Table 10.26**.

Table 10.30: Downwind Predicted Noise Levels At Nearby Residential Properties with Noise Management, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	27.1	27.1	27.1	30.5	35.2	37.5	38.0	40.7	41.5	41.5	41.5	41.5
H2	19.9	19.9	19.9	23.3	28.0	31.0	32.0	33.8	34.3	34.3	34.3	34.3
H3	23.0	23.0	23.0	26.4	31.1	34.2	35.3	36.9	37.4	37.4	37.4	37.4
H4	22.6	22.6	22.6	26.0	30.7	33.8	34.9	36.5	37.0	37.0	37.0	37.0
H5	22.2	22.2	22.2	25.6	30.3	33.6	34.7	36.2	36.6	36.6	36.6	36.6
H6	22.0	22.0	22.0	25.4	30.1	33.4	34.5	36.0	36.4	36.4	36.4	36.4
H7	21.9	21.9	21.9	25.3	30.0	33.3	34.4	35.9	36.3	36.3	36.3	36.3
H8	22.7	22.7	22.7	26.1	30.8	34.3	35.3	36.8	37.1	37.1	37.1	37.1
H9	21.1	21.1	21.1	24.5	29.2	32.7	33.7	35.2	35.5	35.5	35.5	35.5
H10	20.5	20.5	20.5	23.9	28.6	32.0	33.0	34.6	34.9	34.9	34.9	34.9
H11	20.1	20.1	20.1	23.5	28.2	31.7	32.6	34.2	34.5	34.5	34.5	34.5
H12	19.6	19.6	19.6	23.0	27.7	31.3	31.8	33.8	34.0	34.0	34.0	34.0
H13	17.4	17.4	17.4	20.8	25.5	28.9	29.8	31.5	31.8	31.8	31.8	31.8
H14	17.5	17.5	17.5	20.9	25.6	29.1	30.0	31.7	31.9	31.9	31.9	31.9
H15	15.6	15.6	15.6	19.0	23.7	27.2	28.2	29.8	30.0	30.0	30.0	30.0
H16	14.5	14.5	14.5	17.9	22.6	26.1	27.1	28.7	28.9	28.9	28.9	28.9
H17	13.5	13.5	13.5	16.9	21.6	25.0	26.0	27.6	27.9	27.9	27.9	27.9
H18	12.5	12.5	12.5	15.9	20.6	24.1	25.1	26.7	26.9	26.9	26.9	26.9
H19	15.7	15.7	15.7	19.1	23.8	27.3	28.3	29.9	30.1	30.1	30.1	30.1
H21	13.5	13.5	13.5	16.9	21.6	25.0	26.0	27.6	27.9	27.9	27.9	27.9
H26	21.9	21.9	21.9	25.3	30.0	33.3	34.3	35.8	36.3	36.3	36.3	36.3
H27	22.0	22.0	22.0	25.4	30.1	33.4	34.5	36.0	36.4	36.4	36.4	36.4
H28	21.3	21.3	21.3	24.7	29.4	32.7	33.8	35.3	35.7	35.7	35.7	35.7
H29	21.4	21.4	21.4	24.8	29.5	32.8	33.9	35.4	35.8	35.8	35.8	35.8
H30	21.1	21.1	21.1	24.5	29.2	32.5	33.6	35.1	35.5	35.5	35.5	35.5
H31	18.9	18.9	18.9	22.3	27.0	30.6	31.2	33.1	33.3	33.3	33.3	33.3
H32	18.5	18.5	18.5	21.9	26.6	30.2	30.7	32.7	32.9	32.9	32.9	32.9
H33	18.3	18.3	18.3	21.7	26.4	30.0	30.6	32.5	32.7	32.7	32.7	32.7
H34	22.2	22.2	22.2	25.6	30.3	33.6	34.7	36.2	36.6	36.6	36.6	36.6

Potential Construction Impacts

Construction Noise Assessment

10.94 Primary activities creating noise during the construction period are the construction of the turbine bases; the erection of the turbines; the excavation of trenches for cables; and the construction of associated hard standings, access tracks and construction compound. Noise from vehicles on local roads and access tracks would also arise due to the delivery of turbine components and construction materials, notably aggregates, concrete and steel reinforcement.

10.95 It should be noted that the exact methodology and timing of construction activities cannot be predicted at this time, this assessment is therefore based on assumptions representing a worst-case approach.

Construction Noise Predictions

10.96 The plant assumed for each construction activity is shown in **Table 10.31**. The number of items indicates how many of each plant are required for the specified activity, and the duration of activity is a percentage of a given 12 hour day period needed for that plant to operate. Overall sound power levels are based upon the data in Annex C of BS 5228-1:2009.

Table 10.31: Construction Phases and Sound Power Levels

Activities	Plant	Sound Power (L_{WA})	No. Items	Activity Duration (%)	Effective Sound Power (L_{WA})
Upgrade Site Track	Tracked excavator	113	3	100	121
	Dump truck	113	3	100	
	Dozer	109	2	75	
	Vibratory roller	102	1	75	
Construct Temporary site compounds	Tracked excavator	113	2	100	119
	Dump truck	113	2	100	
	Tipper lorry	107	2	50	
	Vibratory roller	102	1	75	
	Lorry	108	2	75	
Construct Site Tracks	Tracked excavator	113	3	100	122
	Dump truck	113	2	75	
	Tipper lorry	107	4	50	
	Dozer	109	1	100	
	Vibratory roller	102	1	75	
	Excavator mounted rock breaker	121	1	50	
Construct Substations	Tracked excavator	113	1	100	115
	Concrete mixer truck	108	2	50	
	Lorry	108	1	50	
	Telescopic Handler	99	1	100	

Activities	Plant	Sound Power (L_{WA})	No. Items	Activity Duration (%)	Effective Sound Power (L_{WA})
Construct Crane Hardstandings	Tracked excavator	113	3	100	120
	Dump truck	113	2	100	
	Tipper lorry	107	4	50	
	Vibratory roller	102	1	50	
Construct Turbine Foundations	Tracked excavator	113	2	75	122
	Dump truck	113	2	75	
	Concrete mixer truck	108	4	50	
	Mobile telescopic crane	110	1	50	
	Concrete pump	106	2	50	
	Water pump	93	1	100	
	Hand-held pneumatic breaker	111	1	75	
	Compressor	103	3	50	
	Poker vibrator	106	3	50	
	Excavator mounted rock breaker	121	1	50	
Excavate and Lay Site Cables	Tracked excavator	113	2	100	122
	Dump truck	113	2	75	
	Tractor (towing equipment)	108	1	75	
	Tractor (towing trailer)	107	1	75	
	Vibratory plate	108	1	50	
	Excavator mounted rock breaker	121	1	50	
Erect Turbine	Mobile telescopic crane	110	2	75	118
	Lorry	108	1	75	
	Diesel generator	102	1	100	
	Torque guns	111	4	100	
Reinstate Crane Bases	Tracked excavator	113	1	75	115
	Dump truck	113	1	75	
Lay Cable to Substations	Wheeled loader	108	1	100	117
	Saw	114	1	50	
	Hand-held pneumatic breaker	111	1	50	
	Dump truck	113	1	75	
	Tipper lorry	107	1	50	
	Vibratory plate	108	1	75	
	Tandem roller	102	1	75	
	Tractor (towing equipment)	108	1	50	
	Lorry	108	1	75	
Construct New Water Crossing	Tracked Excavator	113	1	100	118
	Dump Truck	113	1	100	

Activities	Plant	Sound Power (L_{WA})	No. Items	Activity Duration (%)	Effective Sound Power (L_{WA})
	Tipper lorry	107	4	50	
	Dozer	109	1	75	
	Vibratory Roller	102	1	75	
	Telescopic Handler	99	1	100	
	Water pump	93	2	100	
Forestry Felling	Saw	114	1	100	116
	Harvester	108	2	100	

10.97 Predictions of construction noise levels have been carried out using the methods prescribed in Annex F of BS 5228-1:2009[17]. The worst case scenario, where each construction activity takes place at the nearest proposed location to the residential property being assessed, is considered. The locations of the construction activities are taken from the infrastructure layout shown in **Figure 2.1**. The results of these predictions, made at three of the nearest residential properties to the Development, are shown in **Table 10.32**.

10.98 In all cases average noise levels over the construction period would be lower as the worst case is presented for when the activities are closest to the residential property.

Table 10.32: Predicted Sound Pressure Level due to Construction Noise (dB L_{Aeq})

Activity	H1	H4	H8
Upgrade Site Track	47.2	49.1	58.6
Construct Temporary site compounds	44.0	41.6	42.4
Construct Enabling Compound	37.6	44.5	52.6
Construct Site Tracks	50.3	50.3	58.8
Construct Substations	39.6	36.9	37.5
Construct Crane Hard-standings	48.3	47.0	47.1
Construct Turbine Foundations	50.1	48.8	48.9
Excavate and Lay Site Cables	49.5	48.2	48.3
Erect Turbine	46.6	45.3	45.4
Reinstate Crane Bases	42.6	41.3	41.4
Lay Cables to Substations	42.2	39.5	40.1
Construct New Water Crossing	43.0	45.3	54.3
Forestry Felling	42.3	42.5	42.6

Construction Traffic

10.99 Due to the delivery of construction material and wind farm components, vehicle movements either into or away from the site shall increase levels of traffic flow on public roads in the area. Traffic regularly accessing the site is shown in **Chapter 11:**

[17] A 50% mixed ground attenuation has been used throughout to conservatively account for the arable nature of the ground conditions.

Traffic and Transport and is assumed to be characterised by the sound power levels of Dump Trucks, Lorries and Concrete Mixers as a worst case. It is estimated that a total of 140 vehicle movements per day would be required during the most intense period of construction activity although this would only be the case for a maximum of six days during foundation pouring.

10.100 Construction traffic noise has been quantified using the method described in BS 5228:2009 Part 1. Using the distances from residential properties to the centre of the relevant carriageway where site traffic would be, the noise levels predicted are presented in **Table 10.33**. The maximum sound pressure level due to traffic flows during the most intensive period of activity at the assessed properties is predicted to be 57.4 dB L_{Aeq}. Some properties along the delivery route are located closer to the highway than the assessed locations. The maximum traffic noise level at these properties is predicted to be 60.4 dB L_{Aeq}.

Table 10.33: Traffic Noise Predictions by Activity (dB L_{Aeq})

House ID	Dump Truck	Lorries	Concrete Mixer	Total
H1	31.7	27.1	37.1	38.5
H4	50.6	46.0	56.0	57.4
H8	35.8	31.2	41.2	42.6

10.101 The increase in noise level due to the presence of construction traffic on nearby roads has been quantified using the methodology set out in CRTN[18]. The maximum predicted increase in daytime average traffic noise level, during the most intense period of construction, on Carnanbane Road is 4.8 dB(A). The maximum predicted increase on Magheramore Road is 4.2 dB(A). Such changes in noise level may be perceptible although the impact is not expected to be significant due to the short-term nature of the change.

General Construction Noise in Conjunction with Traffic Noise

10.102 Worst case construction noise levels may arise when the following simultaneous activities occur: construction of nearest access tracks and construction of nearest turbine foundations. Therefore cumulative predictions of these construction activities and the additional noise contribution from construction traffic have been calculated and are shown in **Table 10.34**.

10.103 In addition to the properties assessed in **Table 10.34** the acoustic impact from the construction of the enabling works compound and upgrade of site tracks at properties close to the site entrance has also been considered. At the property closest to the site entrance a noise level of 72.6 dB dB L_{Aeq} is predicted when work to upgrade the site track is at its closest point. A noise level of 69.9 dB dB L_{Aeq} is predicted at this same location during the construction of the enabling works compound.

10.104 It should be noted that the predictions exclude the screening effects of local topography therefore actual levels of noise experienced at nearby residential properties could be lower.

[18] Calculation of Road Traffic Noise (CRTN), HMSO Department of Transport, 1988.

Table 10.34: Predicted Noise Due to Combined Traffic Noise and Turbine Construction (dB L_{Aeq})

House ID	Construction Plant Noise	Traffic Noise	Combined Noise
H1	53.2	38.5	53.2
H4	52.6	57.4	58.6
H8	59.2	42.6	59.2

Assessment of Construction Noise

10.105 In accordance with the ABC method of Annex E of BS 5228-1:2009, due to the relatively low levels of ambient noise in the vicinity of the Development, a Category A assessment is appropriate. This category sets significant effect threshold L_{Aeq} criteria of 65 dB(A) during weekdays (0700-1900) and Saturdays (0700-1300); 55 dB(A) at evenings and weekends; and 45 dB(A) for night-time (2300-0700) periods.

10.106 **Table 10.34** shows that predicted noise levels from the combined effect of increased traffic flows and activities associated with the peak of construction activities are below the 65 dB(A) daytime target level specified by BS 5228-1:2009 at the assessed residential properties. However, a temporary exceedance of this level is predicted at properties near the site entrance during work to upgrade the closest site tracks and establish the enabling works compound.

10.107 Levels of construction noise above 65 dB(A) at the properties nearest the site entrance would be temporary and only occur for the time taken to construct the enabling works compound and complete track upgrade works within a certain distance. The enabling works compound is expected to take no more than a week to construct and noise levels due to site track upgrade works are predicted to fall below 65 dB(A) after 3-4 days based on typical rates of construction.

10.108 Peak construction noise levels are predicted to exceed the 55 dB(A) target level for evenings and weekends at two of the assessed properties although, of the times when this criterion applies, construction is only scheduled to take place on Saturdays 1300-1700 with the exception of turbine erection and commissioning or periods of emergency work.

10.109 An assessment against the target levels for night-time periods has not been undertaken as construction work is not scheduled to take place during these times with the exception of turbine erection, commissioning or periods of emergency work. Predicted noise levels of slightly above 45 dB(A) due to turbine erection (see **Table 10.32**) imply that this activity should be avoided at night as far as possible.

10.110 The predictions made represent the worst case combination of most intensive traffic activity with simultaneous construction activity at the nearest possible location to each residential property.

Mitigation

Operational Noise

10.111 One of the key constraints and considerations in designing the layout of the turbines was the minimisation of potential noise impacts at the nearest residential receptors. As such the turbine layout was designed to ensure that there is an adequate separation distance between any of the proposed turbines and the nearest residential property.

10.112 Due to this consideration of noise impacts in the design of the wind farm, embedding mitigation measures in the turbine layout, when a conservative candidate machine is modelled a limited amount of noise management is required for the proposed Development to meet noise limits derived in accordance with ETSU-R-97.

10.113 Noise management involves altering the operational mode of the turbines in certain conditions by changing the pitch of the blades, resulting in a trade-off between power production and noise reduction. This provides a potential mechanism for further reducing the level of noise experienced at nearby residential properties although the acoustic assessment demonstrates that this is not required.

10.114 If planning permission is granted for the proposed wind farm, planning conditions can be proposed to provide a degree of protection to nearby residents in the form of limits relating to noise level and tonality.

10.115 **Technical Appendix 10.8** contains a set of conditions that RES considers appropriate.

Construction Noise

10.116 For all activities, measures would be taken to reduce noise levels with due regard to practicality and cost as per the concept of 'best practicable means' as defined in Pollution Control and Local Government (NI) Order 1978.

10.117 BS 5228-1:2009 states that the 'attitude of the contractor' is important in minimising the likelihood of complaints therefore consultation with the local authority and Community Liaison Groups is advised along with letter drops to inform residents of intended activity. Non-acoustic factors, which influence the overall level of complaints such as mud on roads and dust generation, would also be controlled through construction practices adopted on the site.

10.118 Furthermore, the following noise mitigation options could be implemented where appropriate:

- Consideration would be given to noise emissions when selecting plant and equipment to be used on site;
- All equipment should be maintained in good working order and fitted with the appropriate silencers, mufflers or acoustic covers where applicable;
- Stationary noise sources would be sited as far away as reasonably possible from residential properties; and
- The movement of vehicles to and from the site would be controlled and employees instructed to ensure compliance with the noise control measures adopted.

10.119 Site operations would be limited to 0700-1900 Monday to Friday and 0700-1700 on Saturdays except during turbine erection and commissioning or during periods of emergency work. Should it be necessary to reduce noise levels to adhere to the 55 dB(A) target level for Saturdays 1300-1700, the following mitigation measures would be considered:

- Reduce the number of construction activities occurring simultaneously;
- Restrict the distance of construction activity from nearby properties during these times; &
- Reduce construction traffic as appropriate.

10.120 The temporary increase of construction noise above the 65 dB(A) daytime target level at the properties nearest the site entrance could be further mitigated through the use of acoustic barriers and reducing the number of activities occurring simultaneously if required.

10.121 There are many strategies to reduce construction noise by the limitation of activities that would result in predicted noise levels being lower than the specified target. Any such measures should be considered adequate and the mitigation adopted should not be limited to the measures proposed.

Residual Effects

Operational

10.122 The acoustic assessment demonstrates that predicted noise levels at all residential properties do not exceed the derived noise limits across all wind speeds. This should not be interpreted to mean that wind farm operational noise would be inaudible (or masked by background noise) under all conditions, but that the levels of noise are acceptable under ETSU-R-97 and associated guidance.

Construction

10.123 There is predicted to be a temporary increase above the 65 dB(A) criteria noise level at the properties nearest the site entrance due to access track upgrades and construction of the enabling works compound. Noise levels above the 55 dB(A) criteria level for Saturdays 1300-1700 are also expected in some locations although this can be mitigated if necessary. At all other locations and times, predicted noise levels due to the worst-case combination of increased traffic and site construction noise would not exceed relevant criteria such that no significant impacts are expected.

Cumulative Effects

Cumulative Operational Noise Assessment

10.124 An assessment of the cumulative acoustic impact of the Development in conjunction with a single turbine located to the north-west has been undertaken in accordance with the guidance on wind farm noise assessment; ETSU-R-97 and the IoA GPG.

10.125 ETSU-R-97 states:

"It is clearly unreasonable to suggest that, because a wind farm has been constructed in the vicinity in the past which resulted in increased noise levels at some properties, the residents of those properties are now able to tolerate higher noise levels still. The

existing wind farm should not be considered as part of the prevailing background noise."

10.126 The locations of the turbines considered in the cumulative assessment are shown in **Figure 10.2**.

10.127 The residential properties considered in the cumulative assessment are those detailed in **Table 10.8.** The distances to the nearest turbine included in the cumulative assessment are given in **Table 10.35**.

Table 10.35: Distances from Residential Properties to Nearest Cumulative Turbine

House ID	Distance (m)	Nearest Turbine
H1	1003	T6
H2	1279	T4
H3	1096	T4
H4	1137	T4
H5	933	J1
H6	864	J1
H7	795	J1
H8	702	J1
H9	662	J1
H10	795	J1
H11	1183	J1
H12	1648	J1
H13	2218	T3
H14	2170	T2
H15	2416	T1
H16	2635	T1
H17	2892	T1
H18	3129	T1
H19	1962	T1
H21	2863	T1
H26	931	J1
H27	911	J1
H28	903	J1
H29	796	J1
H30	633	J1
H31	1823	J1
H32	1975	J1
H33	2047	J1
H34	984	J1

Turbines prefixed 'T' belong to the Development, 'J1' is the existing single turbine

Cumulative Assessment Methodology

10.128 ETSU-R-97 recommends that the derived noise limits applicable at nearby residential properties shall relate to the cumulative effects of noise from all wind turbines that may affect a particular location.

10.129 The methodology is therefore to:

- Predict noise immission levels at the nearest residential properties due to the Development, along with the other turbines to be considered in the cumulative assessment;
- Calculate the predicted cumulative noise levels by combining the predicted noise levels from all of the projects that are being considered; and
- Compare the cumulative predicted noise levels to criteria specified by relevant guidance, ETSU-R-97, to determine whether the cumulative predicted noise levels comply.

10.130 The methodology outlined above is in accordance with the appropriate guidance on cumulative wind farm noise assessment as described in ETSU-R-97 and the IoA GPG.

Predictions of Cumulative Noise Levels at Residential Properties

10.131 The existing single turbine is a Jacobs 25 kW machine on a 20 m hub. Details used in this analysis are as follows, 2 dB has been added to the acoustic emission data as a conservative measure as recommended by the IoA GPG:

- a hub height of 20 m;
- a rotor diameter of 13.1 m;
- sound power levels, L_{WA}, for standardised 10 m height wind speeds (v_{10}) as shown in **Table 10.9**;
- octave band sound power level data, at the wind speeds where it is available, as shown in **Table 10.10**;
- tonal emission characteristics such that no clearly audible tones are present at any wind speed.

Table 10.36 – A-Weighted Sound Power Levels (dB(A) re 1 pW) for the Jacobs 25 kW

Standardised 10m Height Wind Speed, v_{10} (ms^{-1})	Warranted	Plus Uncertainty
1	77.8	79.8
2	77.8	79.8
3	77.8	79.8
4	77.8	79.8
5	80.5	82.5
6	83.1	85.1
7	85.8	87.8
8	88.4	90.4
9	91.1	93.1
10	93.7	95.7
11	96.4	98.4
12	99.0	101.0

Table 10.37 - Octave Band A-Weighted Sound Power Levels (dB(A) re 1 pW) at a Standardised 10m Height Wind Speed of 8 ms^{-1} for the Jacobs 25 kW

Octave Band (Hz)	8 ms^{-1}
63	67.6
125	77.1
250	79.2
500	81.8
1000	83.5
2000	81.2
4000	75.5
8000	69.4
OVERALL	88.4

Predictions of Cumulative Noise Levels at Residential Properties

10.132 Table 10.38 shows the cumulative predicted noise levels at the nearest residential properties due to the operation of the sites considered in the cumulative assessment with no noise management strategy applied to the Development. Table 10.39 contains the cumulative predicted noise levels with the daytime noise management strategy considered in the assessment of the Development alone in place.

10.133 The methodology used to calculate the cumulative predicted noise levels makes the assumption that the properties in question are downwind of all of the considered wind turbines simultaneously which is not the case in practice. The cumulative predicted noise levels are conservative due to the reductions in noise that would be expected when a property is situated crosswind or upwind of a noise source.

Table 10.38: Cumulative Downwind Predicted Noise Levels At Nearby Residential Properties with no Noise Management applied to the Development, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	27.2	27.2	27.2	30.6	35.2	39.3	41.4	41.6	41.6	41.6	41.6	41.6
H2	20.0	20.0	20.0	23.4	28.1	32.2	34.3	34.4	34.4	34.4	34.4	34.4
H3	23.0	23.0	23.0	26.4	31.1	35.2	37.3	37.4	37.4	37.4	37.4	37.5
H4	22.6	22.6	22.6	26.0	30.7	34.8	36.9	37.0	37.0	37.0	37.0	37.1
H5	22.3	22.3	22.3	25.6	30.3	34.4	36.5	36.6	36.7	36.7	36.8	37.0
H6	22.1	22.1	22.1	25.5	30.2	34.2	36.4	36.5	36.5	36.6	36.7	37.0
H7	22.0	22.0	22.0	25.4	30.0	34.1	36.2	36.4	36.4	36.5	36.7	37.0
H8	23.0	23.0	23.0	26.2	30.9	34.9	37.1	37.2	37.3	37.5	37.9	38.4
H9	21.7	21.7	21.7	24.8	29.4	33.5	35.6	35.8	35.9	36.3	36.8	37.6
H10	20.9	20.9	20.9	24.1	28.7	32.8	34.9	35.0	35.2	35.4	35.9	36.5
H11	20.3	20.3	20.3	23.6	28.3	32.4	34.5	34.6	34.7	34.8	35.0	35.3
H12	19.7	19.7	19.7	23.1	27.7	31.8	33.9	34.1	34.1	34.1	34.2	34.4
H13	17.4	17.4	17.4	20.8	25.5	29.6	31.7	31.8	31.8	31.8	31.9	32.0
H14	17.6	17.6	17.6	21.0	25.6	29.7	31.8	32.0	32.0	32.0	32.0	32.1
H15	15.6	15.6	15.6	19.0	23.7	27.8	29.9	30.0	30.0	30.0	30.0	30.1
H16	14.5	14.5	14.5	17.9	22.6	26.7	28.8	28.9	28.9	29.0	29.0	29.0
H17	13.5	13.5	13.5	16.9	21.6	25.7	27.8	27.9	27.9	27.9	27.9	28.0
H18	12.5	12.5	12.5	15.9	20.6	24.7	26.8	26.9	26.9	27.0	27.0	27.0
H19	15.8	15.8	15.8	19.1	23.8	27.9	30.0	30.1	30.2	30.2	30.2	30.2
H21	13.5	13.5	13.5	16.9	21.6	25.7	27.8	27.9	27.9	27.9	27.9	27.9
H26	22.0	22.0	22.0	25.3	30.0	34.1	36.2	36.3	36.3	36.4	36.5	36.7
H27	22.1	22.1	22.1	25.4	30.1	34.2	36.3	36.4	36.5	36.5	36.7	36.9
H28	21.5	21.5	21.5	24.8	29.5	33.6	35.7	35.8	35.8	35.9	36.1	36.3
H29	21.6	21.6	21.6	24.9	29.6	33.7	35.8	35.9	36.0	36.1	36.2	36.6
H30	21.7	21.7	21.7	24.8	29.4	33.4	35.5	35.8	36.0	36.3	36.9	37.8
H31	19.0	19.0	19.0	22.4	27.0	31.1	33.2	33.4	33.4	33.4	33.5	33.7
H32	18.6	18.6	18.6	21.9	26.6	30.7	32.8	32.9	32.9	33.0	33.0	33.1
H33	18.4	18.4	18.4	21.7	26.4	30.5	32.6	32.7	32.7	32.8	32.8	32.9
H34	22.3	22.3	22.3	25.6	30.3	34.4	36.5	36.6	36.7	36.7	36.8	37.0

Table 10.39: Cumulative Downwind Predicted Noise Levels At Nearby Residential Properties with Daytime Noise Management applied to the Development, dB(A)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1	2	3	4	5	6	7	8	9	10	11	12
H1	27.2	27.2	27.2	30.6	35.2	37.5	38.0	40.7	41.6	41.6	41.6	41.6
H2	20.0	20.0	20.0	23.4	28.1	31.0	32.0	33.8	34.4	34.4	34.4	34.4
H3	23.0	23.0	23.0	26.4	31.1	34.2	35.3	36.9	37.4	37.4	37.4	37.5
H4	22.6	22.6	22.6	26.0	30.7	33.8	34.9	36.5	37.0	37.0	37.0	37.1
H5	22.3	22.3	22.3	25.6	30.3	33.6	34.7	36.2	36.7	36.7	36.8	37.0
H6	22.1	22.1	22.1	25.5	30.2	33.5	34.6	36.1	36.5	36.6	36.7	37.0
H7	22.0	22.0	22.0	25.4	30.0	33.4	34.5	36.0	36.4	36.5	36.7	37.0
H8	23.0	23.0	23.0	26.2	30.9	34.3	35.4	36.9	37.3	37.5	37.9	38.4
H9	21.7	21.7	21.7	24.8	29.4	32.8	33.9	35.5	35.9	36.3	36.8	37.6
H10	20.9	20.9	20.9	24.1	28.7	32.1	33.1	34.7	35.2	35.4	35.9	36.5
H11	20.3	20.3	20.3	23.6	28.3	31.7	32.7	34.3	34.7	34.8	35.0	35.3
H12	19.7	19.7	19.7	23.1	27.7	31.3	31.9	33.8	34.1	34.1	34.2	34.4
H13	17.4	17.4	17.4	20.8	25.5	29.0	29.9	31.5	31.8	31.8	31.9	32.0
H14	17.6	17.6	17.6	21.0	25.6	29.1	30.0	31.7	32.0	32.0	32.0	32.1
H15	15.6	15.6	15.6	19.0	23.7	27.2	28.2	29.8	30.0	30.0	30.0	30.1
H16	14.5	14.5	14.5	17.9	22.6	26.1	27.1	28.7	28.9	29.0	29.0	29.0
H17	13.5	13.5	13.5	16.9	21.6	25.0	26.0	27.6	27.9	27.9	27.9	28.0
H18	12.5	12.5	12.5	15.9	20.6	24.1	25.1	26.7	26.9	27.0	27.0	27.0
H19	15.8	15.8	15.8	19.1	23.8	27.3	28.3	29.9	30.2	30.2	30.2	30.2
H21	13.5	13.5	13.5	16.9	21.6	25.0	26.0	27.6	27.9	27.9	27.9	27.9
H26	22.0	22.0	22.0	25.3	30.0	33.3	34.4	35.9	36.3	36.4	36.5	36.7
H27	22.1	22.1	22.1	25.4	30.1	33.4	34.5	36.0	36.5	36.5	36.7	36.9
H28	21.5	21.5	21.5	24.8	29.5	32.8	33.9	35.4	35.8	35.9	36.1	36.3
H29	21.6	21.6	21.6	24.9	29.6	32.9	34.0	35.5	36.0	36.1	36.2	36.6
H30	21.7	21.7	21.7	24.8	29.4	32.7	33.8	35.4	36.0	36.3	36.9	37.8
H31	19.0	19.0	19.0	22.4	27.0	30.6	31.2	33.1	33.4	33.4	33.5	33.7
H32	18.6	18.6	18.6	21.9	26.6	30.2	30.8	32.7	32.9	33.0	33.0	33.1
H33	18.4	18.4	18.4	21.7	26.4	30.0	30.6	32.5	32.7	32.8	32.8	32.9
H34	22.3	22.3	22.3	25.6	30.3	33.6	34.7	36.2	36.7	36.7	36.8	37.0

10.134 Cumulative noise levels at 14 of the 29 nearest residential properties are below 35 dB(A) at wind speeds of up to 10 ms^{-1}, indicating that the noise immission levels would be regarded as acceptable and the residents amenity as receiving 'sufficient protection' without further assessment requiring to be undertaken.

10.135 There are 15 properties that have cumulative predicted noise levels greater than this simplified noise criteria, as indicated in Table 10.38 and Table 10.39, therefore the 'full' acoustic assessment has only been considered at these. Only one additional property, H10, is considered in the cumulative assessment than in the assessment of the

Development on its own. H11 is not included as the cumulative noise levels at this location are only predicted to exceed 35 dB(A) at wind speeds of greater than 10 ms^{-1}.

Derived Acoustic Acceptance Criteria

10.136 The assessment criteria adopted in the cumulative assessment are the same as those used in the assessment of the Development alone.

Cumulative Acoustic Assessment

10.137 A comparison of the cumulative predicted noise levels (with the daytime noise management strategy considered in the assessment of the Development alone in place) with the daytime noise limits at nearby residential properties is shown in Table 10.40. The term ΔL is used to denote the difference between the cumulative noise level and the recommended limit. A negative value indicates that the predicted noise level is within the limit. Table 10.41 shows a comparison of the cumulative predicted noise levels (without noise management applied to the Development) with the night-time noise limits.

10.138 With the same noise management strategy applied during daytime periods as in the assessment of the Development alone, the cumulative noise levels are within both the daytime and night-time noise limits at all wind speeds considered. The minimum margin is 0.0 dB(A) during daytime periods due to the noise levels from the Development being reduced by the amount required for the limit to be met. The minimum margin is -1.4 dB(A) at night.

10.139 At the residential property where the minimum margins occur, H1, the predicted noise levels due to the sites considered in the cumulative assessment, along with the noise limits for the relevant period, are shown graphically in **Chart 13** and **Chart 14**.

10.140 **Figure 10.2** shows a cumulative noise contour plot for the Development (without noise management) and the other projects considered in the cumulative assessment calculated using the ISO 9613 Part 2 propagation model. The plot is provided to illustrate the cumulative noise ‘footprint’ and should be considered indicative only. Where properties are located such that they cannot be downwind of all turbines simultaneously, the predictions made using a downwind propagation model such as ISO 9613-2 are conservative given that reductions in noise would be expected when a property is crosswind or upwind of a noise source.

Table 10.40 - Comparison of Cumulative Predicted Noise Levels and Daytime Noise Limits - (dB(A) re 20 µPa)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1			2			3			4		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	27.2	37.5	-10.3	27.2	37.5	-10.3	27.2	37.5	-10.3	30.6	37.5	-6.9
H3	23.0	37.5	-14.5	23.0	37.5	-14.5	23.0	37.5	-14.5	26.4	37.5	-11.1
H4	22.6	37.5	-14.9	22.6	37.5	-14.9	22.6	37.5	-14.9	26.0	37.5	-11.5
H5	22.3	37.5	-15.2	22.3	37.5	-15.2	22.3	37.5	-15.2	25.6	37.5	-11.9
H6	22.1	37.5	-15.4	22.1	37.5	-15.4	22.1	37.5	-15.4	25.5	37.5	-12.0
H7	22.0	37.5	-15.5	22.0	37.5	-15.5	22.0	37.5	-15.5	25.4	37.5	-12.1
H8	23.0	37.5	-14.5	23.0	37.5	-14.5	23.0	37.5	-14.5	26.2	37.5	-11.3
H9	21.7	37.5	-15.8	21.7	37.5	-15.8	21.7	37.5	-15.8	24.8	37.5	-12.7
H10	20.9	37.5	-16.6	20.9	37.5	-16.6	20.9	37.5	-16.6	24.1	37.5	-13.4
H26	22.0	37.5	-15.5	22.0	37.5	-15.5	22.0	37.5	-15.5	25.3	37.5	-12.2
H27	22.1	37.5	-15.4	22.1	37.5	-15.4	22.1	37.5	-15.4	25.4	37.5	-12.1
H28	21.5	37.5	-16.0	21.5	37.5	-16.0	21.5	37.5	-16.0	24.8	37.5	-12.7
H29	21.6	37.5	-15.9	21.6	37.5	-15.9	21.6	37.5	-15.9	24.9	37.5	-12.6
H30	21.7	37.5	-15.8	21.7	37.5	-15.8	21.7	37.5	-15.8	24.8	37.5	-12.7
H34	22.3	37.5	-15.2	22.3	37.5	-15.2	22.3	37.5	-15.2	25.6	37.5	-11.9

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	5			6			7			8		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	35.2	37.5	-2.3	37.5	37.5	0.0	38.0	38.1	-0.1	40.7	40.9	-0.2
H3	31.1	37.5	-6.4	34.2	37.5	-3.3	35.3	37.5	-2.2	36.9	38.7	-1.8
H4	30.7	37.5	-6.8	33.8	37.5	-3.7	34.9	37.5	-2.6	36.5	38.7	-2.2
H5	30.3	37.5	-7.2	33.6	37.5	-3.9	34.7	37.5	-2.8	36.2	38.7	-2.5
H6	30.2	37.5	-7.3	33.5	37.5	-4.0	34.6	37.5	-2.9	36.1	38.7	-2.6
H7	30.0	37.5	-7.5	33.4	37.5	-4.1	34.5	37.5	-3.0	36.0	38.7	-2.7
H8	30.9	37.5	-6.6	34.3	37.5	-3.2	35.4	37.5	-2.1	36.9	38.2	-1.3
H9	29.4	37.5	-8.1	32.8	37.5	-4.7	33.9	37.5	-3.6	35.5	38.2	-2.7
H10	28.7	37.5	-8.8	32.1	37.5	-5.4	33.1	37.5	-4.4	34.7	38.2	-3.5
H26	30.0	37.5	-7.5	33.3	37.5	-4.2	34.4	37.5	-3.1	35.9	38.7	-2.8
H27	30.1	37.5	-7.4	33.4	37.5	-4.1	34.5	37.5	-3.0	36.0	38.7	-2.7
H28	29.5	37.5	-8.0	32.8	37.5	-4.7	33.9	37.5	-3.6	35.4	38.7	-3.3
H29	29.6	37.5	-7.9	32.9	37.5	-4.6	34.0	37.5	-3.5	35.5	38.7	-3.2
H30	29.4	37.5	-8.1	32.7	37.5	-4.8	33.8	37.5	-3.7	35.4	38.7	-3.3
H34	30.3	37.5	-7.2	33.6	37.5	-3.9	34.7	37.5	-2.8	36.2	38.7	-2.5

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	9			10			11			12		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	41.6	43.8	-2.2	41.6	46.6	-5.0	41.6	49.5	-7.9	41.6	52.2	-10.6
H3	37.4	41.1	-3.7	37.4	43.8	-6.4	37.4	46.8	-9.4	37.5	50.1	-12.6
H4	37.0	41.1	-4.1	37.0	43.8	-6.8	37.0	46.8	-9.8	37.1	50.1	-13.0
H5	36.7	41.1	-4.4	36.7	43.8	-7.1	36.8	46.8	-10.0	37.0	50.1	-13.1
H6	36.5	41.1	-4.6	36.6	43.8	-7.2	36.7	46.8	-10.1	37.0	50.1	-13.1
H7	36.4	41.1	-4.7	36.5	43.8	-7.3	36.7	46.8	-10.1	37.0	50.1	-13.1
H8	37.3	40.7	-3.4	37.5	43.5	-6.0	37.9	46.3	-8.4	38.4	49.2	-10.8
H9	35.9	40.7	-4.8	36.3	43.5	-7.2	36.8	46.3	-9.5	37.6	49.2	-11.6
H10	35.2	40.7	-5.5	35.4	43.5	-8.1	35.9	46.3	-10.4	36.5	49.2	-12.7
H26	36.3	41.1	-4.8	36.4	43.8	-7.4	36.5	46.8	-10.3	36.7	50.1	-13.4
H27	36.5	41.1	-4.6	36.5	43.8	-7.3	36.7	46.8	-10.1	36.9	50.1	-13.2
H28	35.8	41.1	-5.3	35.9	43.8	-7.9	36.1	46.8	-10.7	36.3	50.1	-13.8
H29	36.0	41.1	-5.1	36.1	43.8	-7.7	36.2	46.8	-10.6	36.6	50.1	-13.5
H30	36.0	41.1	-5.1	36.3	43.8	-7.5	36.9	46.8	-9.9	37.8	50.1	-12.3
H34	36.7	41.1	-4.4	36.7	43.8	-7.1	36.8	46.8	-10.0	37.0	50.1	-13.1

The term L_p is used to denote the predicted noise level due to the operation of the proposed wind farm
The term ΔL is used to denote the difference between the predicted wind farm noise level and the recommended limit

Table 10.41 - Comparison of Cumulative Predicted Noise Levels and Night Time Limits - (dB(A) re 20 µPa)

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	1			2			3			4		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	27.2	43.0	-15.8	27.2	43.0	-15.8	27.2	43.0	-15.8	30.6	43.0	-12.4
H3	23.0	43.0	-20.0	23.0	43.0	-20.0	23.0	43.0	-20.0	26.4	43.0	-16.6
H4	22.6	43.0	-20.4	22.6	43.0	-20.4	22.6	43.0	-20.4	26.0	43.0	-17.0
H5	22.3	43.0	-20.7	22.3	43.0	-20.7	22.3	43.0	-20.7	25.6	43.0	-17.4
H6	22.1	43.0	-20.9	22.1	43.0	-20.9	22.1	43.0	-20.9	25.5	43.0	-17.5
H7	22.0	43.0	-21.0	22.0	43.0	-21.0	22.0	43.0	-21.0	25.4	43.0	-17.6
H8	23.0	43.0	-20.0	23.0	43.0	-20.0	23.0	43.0	-20.0	26.2	43.0	-16.8
H9	21.7	43.0	-21.3	21.7	43.0	-21.3	21.7	43.0	-21.3	24.8	43.0	-18.2
H10	20.9	43.0	-22.1	20.9	43.0	-22.1	20.9	43.0	-22.1	24.1	43.0	-18.9
H26	22.0	43.0	-21.0	22.0	43.0	-21.0	22.0	43.0	-21.0	25.3	43.0	-17.7
H27	22.1	43.0	-20.9	22.1	43.0	-20.9	22.1	43.0	-20.9	25.4	43.0	-17.6
H28	21.5	43.0	-21.5	21.5	43.0	-21.5	21.5	43.0	-21.5	24.8	43.0	-18.2
H29	21.6	43.0	-21.4	21.6	43.0	-21.4	21.6	43.0	-21.4	24.9	43.0	-18.1
H30	21.7	43.0	-21.3	21.7	43.0	-21.3	21.7	43.0	-21.3	24.8	43.0	-18.2
H34	22.3	43.0	-20.7	22.3	43.0	-20.7	22.3	43.0	-20.7	25.6	43.0	-17.4

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	5			6			7			8		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	35.2	43.0	-7.8	39.3	43.0	-3.7	41.4	43.0	-1.6	41.6	43.0	-1.4
H3	31.1	43.0	-11.9	35.2	43.0	-7.8	37.3	43.0	-5.7	37.4	43.0	-5.6
H4	30.7	43.0	-12.3	34.8	43.0	-8.2	36.9	43.0	-6.1	37.0	43.0	-6.0
H5	30.3	43.0	-12.7	34.4	43.0	-8.6	36.5	43.0	-6.5	36.6	43.0	-6.4
H6	30.2	43.0	-12.8	34.2	43.0	-8.8	36.4	43.0	-6.6	36.5	43.0	-6.5
H7	30.0	43.0	-13.0	34.1	43.0	-8.9	36.2	43.0	-6.8	36.4	43.0	-6.6
H8	30.9	43.0	-12.1	34.9	43.0	-8.1	37.1	43.0	-5.9	37.2	43.0	-5.8
H9	29.4	43.0	-13.6	33.5	43.0	-9.5	35.6	43.0	-7.4	35.8	43.0	-7.2
H10	28.7	43.0	-14.3	32.8	43.0	-10.2	34.9	43.0	-8.1	35.0	43.0	-8.0
H26	30.0	43.0	-13.0	34.1	43.0	-8.9	36.2	43.0	-6.8	36.3	43.0	-6.7
H27	30.1	43.0	-12.9	34.2	43.0	-8.8	36.3	43.0	-6.7	36.4	43.0	-6.6
H28	29.5	43.0	-13.5	33.6	43.0	-9.4	35.7	43.0	-7.3	35.8	43.0	-7.2
H29	29.6	43.0	-13.4	33.7	43.0	-9.3	35.8	43.0	-7.2	35.9	43.0	-7.1
H30	29.4	43.0	-13.6	33.4	43.0	-9.6	35.5	43.0	-7.5	35.8	43.0	-7.2
H34	30.3	43.0	-12.7	34.4	43.0	-8.6	36.5	43.0	-6.5	36.6	43.0	-6.4

House ID	Reference Wind Speed, Standardised v_{10} (ms^{-1})											
	9			10			11			12		
	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL	L_p	Limit	ΔL
H1	41.6	43.1	-1.5	41.6	45.2	-3.6	41.6	46.4	-4.8	41.6	46.4	-4.8
H3	37.4	43.0	-5.6	37.4	43.0	-5.6	37.4	44.9	-7.5	37.5	44.9	-7.4
H4	37.0	43.0	-6.0	37.0	43.0	-6.0	37.0	44.9	-7.9	37.1	44.9	-7.8
H5	36.7	43.0	-6.3	36.7	43.0	-6.3	36.8	44.9	-8.1	37.0	44.9	-7.9
H6	36.5	43.0	-6.5	36.6	43.0	-6.4	36.7	44.9	-8.2	37.0	44.9	-7.9
H7	36.4	43.0	-6.6	36.5	43.0	-6.5	36.7	44.9	-8.2	37.0	44.9	-7.9
H8	37.3	43.0	-5.7	37.5	43.0	-5.5	37.9	43.4	-5.5	38.4	43.4	-5.0
H9	35.9	43.0	-7.1	36.3	43.0	-6.7	36.8	43.4	-6.6	37.6	43.4	-5.8
H10	35.2	43.0	-7.8	35.4	43.0	-7.6	35.9	43.4	-7.5	36.5	43.4	-6.9
H26	36.3	43.0	-6.7	36.4	43.0	-6.6	36.5	44.9	-8.4	36.7	44.9	-8.2
H27	36.5	43.0	-6.5	36.5	43.0	-6.5	36.7	44.9	-8.2	36.9	44.9	-8.0
H28	35.8	43.0	-7.2	35.9	43.0	-7.1	36.1	44.9	-8.8	36.3	44.9	-8.6
H29	36.0	43.0	-7.0	36.1	43.0	-6.9	36.2	44.9	-8.7	36.6	44.9	-8.3
H30	36.0	43.0	-7.0	36.3	43.0	-6.7	36.9	44.9	-8.0	37.8	44.9	-7.1
H34	36.7	43.0	-6.3	36.7	43.0	-6.3	36.8	44.9	-8.1	37.0	44.9	-7.9

The term L_p is used to denote the predicted noise level due to the operation of the proposed wind farm
The term ΔL is used to denote the difference between the predicted wind farm noise level and the recommended limit

Cumulative Construction Noise Assessment

10.141 There is no cumulative construction noise impact as the single turbine is already operational.

Summary

10.142 The acoustic impact for the operation of the Development on nearby residential properties has been assessed in accordance with the guidance on wind farm noise as issued in the DTI publication "The Assessment and Rating of Noise from Wind Farms", otherwise known as ETSU-R-97, and Institute of Acoustics Good Practice Guide (IoA GPG), as recommended for use by Northern Irish planning policy.

10.143 To establish baseline conditions, background noise surveys were carried out at 3 nearby properties and the measured background noise levels used to determine appropriate noise limits, as specified by ETSU-R-97 and the IoA GPG.

10.144 Operational noise levels were predicted using a noise propagation model, the proposed wind farm layout, terrain data and assumed turbine emission data. The predicted noise levels, with the suggested noise management strategy in place, are within noise limits derived in accordance with ETSU-R-97 at all properties at all considered wind speeds when the Development is considered on its own.

10.145 A cumulative operational noise assessment with a nearby existing single turbine scheme found that the noise limits would be met with no additional mitigation measures being required.

10.146 A construction noise assessment has been carried out in accordance with BS 5228-1:2009 "Noise control on construction and open sites Part 1 - Noise" indicates that construction noise levels are predicted to temporarily exceed construction noise criteria at certain locations, however appropriate mitigation measures have been identified.

10.147 The potential impact of the proposed Development, along with the mitigation proposed and any residual impact, is summarised in **Table 10.42**.

Table 10.42: Summary of Potential Impacts of the Proposed Wind Farm, Mitigation and Residual Impacts

Potential Impact	Mitigation Proposed	Means of Implementation	Outcome/ Residual Impact
Operational Noise			
Potential for operational noise to exceed daytime noise limit	Reduction of noise levels for certain wind speeds and directions during the day	Noise management by operating certain turbines in noise reduced mode	No significant impacts identified
Construction Noise			
Potential for construction noise to exceed recommended daytime limits at properties close to the site entrance and limit for 1300-1700 on Saturdays	Noise levels at these properties could be reduced to comply with the relevant criteria if necessary although the temporary nature of the exceedances indicates that the impact would not be significant	Reduce number of construction activities occurring simultaneously, increase distance between activities and properties, install barriers or reduce construction traffic as necessary	No significant impacts identified

Glossary

A-weighting

A frequency-response function providing good correlation with the sensitivity of the human ear.

Broadband Noise

Noise which covers a wide range of frequencies (see Frequency).

Decibel dB(A)

The decibel (dB) is a logarithmic unit used in acoustics to quantify sound levels relative to a 0 dB reference (e.g. a sound pressure level of $2*10^{-5}$ Pa). The 'A' signifies A-weighting.

Equivalent Continuous Sound Level (L_{eq})

The equivalent continuous sound level is a notional steady noise level, which over a given time would provide the same energy as the intermittent noise.

Frequency

Refers to how quickly the air vibrates, or how close the sound waves are to each other and is measured in cycles per second, or Hertz (Hz). The lowest frequency audible to humans is 20 Hz and the highest is 20,000 Hz. The human ear is most sensitive to the 1 kHz, 2 kHz and 4 kHz octave bands and much less sensitive at lower audible frequencies.

Frequency Spectrum

Description of the sound pressure level of a source as a function of frequency.

Percentile Sound Level (L_{90})

Sound pressure level exceeded for 90% of the time for any given time interval. For example, $L_{(A)90,10min}$ means the A-weighted level that is exceeded for 90% of a ten minute interval. This indicates the noise levels during quieter periods, or the background noise level. It represents the lower estimate of the prevailing noise level and is useful for excluding such effects as aircraft or dogs barking on background noise levels.

Noise Emission

The noise energy emitted by a source (e.g. a wind turbine).

Noise Immission

The sound pressure level detected at a given location (e.g. nearest dwelling).

Octave Band

Range of frequencies between one frequency ($f_0*2^{-1/2}$) and a second frequency ($f_0*2^{+1/2}$). The quoted centre frequency of the octave band is f_0.

Sound Power Level

Sound power level is the acoustic power radiated from a sound source and is independent of the surroundings. It is a logarithmic measure in comparison to a reference level (10^{-12} watts).

Sound Pressure Level

A logarithmic measure of the effective sound pressure of a sound relative to a reference value which is for minimum audible field conditions ($20*10^{-6}$Pa).

Third Octave Band

The range of frequencies between one frequency ($f_0*2^{-1/6}$) and a second frequency equal to ($f_0*2^{+1/6}$). The quoted centre frequency of the third octave band is f_0.

Tonal Noise

A noise that contains a noticeable or discrete, continuous note and includes noises such as hums, hisses, screeches.

11

Traffic & Transport

11 Traffic & Transport

Introduction

11.1 This assessment considers the potential impacts on traffic and transport associated with the construction, operation and decommissioning phases of the proposed Magheramore Wind Farm, hereinafter referred to as the 'the Development'.

11.2 The site entrance for the Development is located on the Magheramore Road, within the townland of Carnanbane, approximately 4.0 km south of Dungiven, Co. Derry / Londonderry. The Planning Application Boundary, hereinafter referred to as the 'Site', is shown in **Figure 1.2: Planning Application Boundary**.

11.3 The following have been considered in this chapter:

- Legislation and policy
- Access routes for abnormal indivisible loads (AIL), normal construction traffic and associated road improvements
- The type and volume of traffic generated by the Development
- Identification of sensitive/critical locations along the delivery route
- Assessment of construction, operation and decommissioning traffic impacts
- Outline of suitable mitigation measures and the evaluation of residual impacts
- Cumulative impact of surrounding consented and proposed developments.

11.4 This assessment has been carried out in-house by Renewable Energy Systems Ltd (RES) with at least one in-house Member of the Institution of Engineers Ireland and Institution of Civil Engineers involved in its production.

11.5 This assessment is supported by the following Technical Appendices:

- **Technical Appendix 11.1: Delivery Analysis**

Legislation, Policy and Guidance

DOE - Planning Policy Statement 3 - Access, Movement and Parking (2005)

11.6 Policy AMP2 of PPS3 issued by the Department of Environment (DOE) in 2005 states that:

- "Planning permission will only be granted for a development proposal involving direct access, or the intensification of the use of an existing access, onto a public road where:
  a) such access will not prejudice road safety or significantly inconvenience the flow of traffic; and

b) the proposal does not conflict with Policy AMP 3 Access to Protected Routes”

11.7 Policy AMP3 of PPS3 (Clarification) published by the Department of Environment (DOE) in October 2006 states that:

“The Department will restrict the number of new access and control the level of use of existing accesses onto Protected Routes as follows:

- Motorways and High Standard Dual Carriageways;
- Other Dual Carriageways, Ring Roads, Through-Passes and By-Passes – all Locations
- Other Protected Routes – Outside Settlement Limits
- Other Protected Routes - Within Settlement Limits”

Strategic Planning Policy Statement (SPPS)

11.8 The SPPS highlights that transportation issues to be addressed in the LDP should include Protected Routes. Whilst regional policy is to restrict the number of new access and control the level of use of existing accesses onto protected routes, there are exceptions where the principle of development accords with policy elsewhere in the SPPS.

Northern Area Plan 2016 (2015)

11.9 Route Protection – Rural Schemes Under policy TRA1: Rural Route Protection, one of the proposals that is relevant to the Development is the A6 Dungiven bypass, which would provide a dual carriageway bypass of the town. This strategic scheme is in line with the The Regional Strategic Transport Network Transport Plan 2015.

11.10 The A6 Dualling commenced in April 2018 and will see the construction of 25.5 km of new high standard dual carriageway between Dungiven and Drumahoe, including a bypass of Dungiven with the works due to be completed in Spring 2022. The amendments to the road network surrounding Dungiven will not alter the traffic management proposals set out below.

DOE - Planning Policy Statement 18: Renewable Energy (2009)

11.11 Policy RE1 of PPS18 issued by the Department of Environment (DOE) in 2009 requires applications for wind energy development to demonstrate that no part of the development will have an unacceptable impact on roads, rail or aviation safety:

- “*Where any project is likely to result in unavoidable damage during its installation, operation or decommissioning, the application will need to indicate how this will be minimised and mitigated, including details of any proposed compensatory measures… This matter will need to be agreed before planning permission is granted*.”

DOE - Best Practice Guidance to Planning Policy Statement 18 'Renewable Energy' (2009)

11.12 Section 1 of the Guidance relates to wind energy and names the "Adequacy of local access road network to facilitate construction of the project and transportation of large machinery and turbine parts to site" as one of the main concerns that needs to be considered by the developer when applying for a wind farm development.

IEMA - Guidelines for the Environmental Assessment of Road Traffic (1993)

11.13 The Institute of Environmental Management and Assessment (IEMA) Guidelines (hereinafter referred to as IEMA Guidelines (1993)) are the most widely used guidance document for assessing traffic impacts as part of Environmental Statements, and are referred to throughout this Chapter.

11.14 The IEMA Guidelines (1993) suggest two general rules for identifying the extent of the assessed area:

- **Rule 1** – include highway links where traffic flows will increase by more than 30% (or the number of heavy good vehicles will increase by more than 30%).
- **Rule 2** – include any other specifically sensitive areas where traffic flows have increased by 10% or more.

11.15 Where the change is less than the above thresholds, the impact shall be considered 'negligible'.

Consultation

11.16 Consultations with stakeholders relevant to traffic, roads and infrastructure on and near the delivery routes were undertaken. The feedback from this consultation process helped to clarify the local transport strategy, identify issues of specific local importance and gather basic information on local infrastructure and structures. A summary of consultation responses and proposed mitigation measures are included in **Table 11.1**.

Table 11.1: Consultation Responses

Consultee	Issue	Solution / Further Steps
DfI Roads - 20/09/18	A Traffic & Transport Chapter is to be included within the Environmental Statement. The proposed haul routes and any mitigation measures required on the public road network should be addressed.	Details of existing traffic numbers along proposed haul route within the vicinity of the Development are detailed within Table 11.2. Details of predicted traffic numbers during construction, of the Development are included in **Table 11.3** Increases in HGVs associated with the construction of the

		Development as a percentage of existing HGV traffic are illustrated in Table 11.4 Widening works adjacent to the public road network are detailed in para 11.25 and Appendix 11.1

11.17 Please note that, further consultation is required post consent with stakeholders relevant to traffic, roads and infrastructure on and near the delivery routes to finalise the preferred HGV access route strategy to the Development.

Scope of the Assessment

11.18 The main transport effects will be associated with the movements of commercial Heavy Goods Vehicles (HGVs) and Abnormal Indivisible Loads (i.e. turbine component delivery) to and from the site during the construction phase of the Development. Once operational, it is envisaged that the amount of traffic associated with the Development would be minimal, comprising service and maintenance visits. Occasional visits may also be made to the site for more extensive maintenance/repairs. The vehicle used for maintenance visits is likely to be a 4x4 vehicle (or similar) but there may be an occasional need for HGV deliveries, road-going cranes or AILs loads to access the site for heavier maintenance and repairs. However, it is considered that the effects of such operational traffic will be negligible and therefore, detailed consideration of the operational phase of the Development is not included in this assessment.

11.19 For details of the assessment of construction noise associated with deliveries, see **Chapter 10: Noise**.

11.20 The proposed access routes for AILs (turbine delivery) is illustrated on **Figure 11.1 - Turbine Delivery Route**. It is proposed that HGV deliveries of concrete and stone respectively will also utilise the Magheramore Road but could do so from either direction depending on the source of material and subject to confirmation with DfI Roads.

Abnormal Indivisible Loads (turbine component delivery) and HGV deliveries

11.21 Specialist vehicles are required to transport turbine components to the site. One vehicle would transport turbine blades, while another type would transport the tower sections. Swept path analyses have been carried out for both these types of vehicle to determine the works required to allow passage through pinch-points on the route, as illustrated in **Appendix 11.1**.

11.22 The proposed access route for AILs from Lisahally Port has been used previously for the construction of various wind farms that have subsequently utilised the A6. From Lisahally, the route will travel onto Maydown Road and turn west onto the Clooney Road and travel west for approximately 2.5km to Cresent Link and continuing west to the Altnagelvin Roundabout before heading east along Glenshane Road (A6) for approximately 26km and turning south on to the Feeney Road for 2.5km before heading east on the Bangaher Road, turning left onto the Carnanbane Road and continuing south until the junction with the Magheramore Road. AIL vehicles would turn right and travel southwest until the delivery vehicle had cleared the junction before reversing northeast along the Magheramore Road for approximately 320 metres before turning left into an existing farm entrance on the Magheramore Road that will be modified to create a suitable Site Entrance.

11.23 The proposed return route for the delivery vehicles is similar to the proposed delivery route noted above. Once the turbine components have been delivered, the vehicles will be shortened so they are no longer than a typical articulated HGV.

11.24 Where required, approval to temporarily remove street furniture (for the minimum period as is reasonably practical), will be obtained from the appropriate bodies prior to deliveries post planning consent.

Widening Works

11.25 Widening works would be required at three locations along the abnormal load delivery route, as illustrated in **Appendix 11.1**. Widening locations are the:

- To south of Banagher Road – Detail 3;
- To south of Carnanbane Road -Detail 4; and
- Junction of Carnanbane Road and Magheramore Road –Detail 6;

11.26 All widening works will occur in third party land take and accordingly these works are included in the Planning Application Boundary.

11.27 Widening areas will be reinstated once turbine delivery has been undertaken. If road widenings require the removal of boundary features such as fences, trees or hedgerows, these will be reinstated at suitable locations. Reinstatement will also be applied to any street furniture which may be removed on a temporary basis. In the unlikely event that a replacement blade is required during the operational phase of the wind farm, the widenings will need to be reopened temporarily, after which they will be reinstated.

Normal HGV Delivery

11.28 Normal HGV load delivery routes (including stone and concrete) will utilise the Banagher and Carnanbane Roads from the Feeny Road and / or the Magheramore Road, with sources of material to be confirmed prior to construction. No passing bays will be required as the roads are largely two-way with adequate passing bays located where the road is narrower to accommodate traffic to and from the existing quarry on the Magheramore Road.

11.29 Where agreed by DfI Roads, circular HGV haul routes may be implemented for the construction phase of the project.

11.30 Post consent, a detailed review of all bridges/structures along the preferred route will be undertaken and, if required, structural surveys will be carried out. The requirement (if any) of any subsequent improvement works will be undertaken following consultation with DfI Roads.

Site Entrance

11.31 The site entrance is located on the Magheramore Road where an existing farm access is located but would be modified accordingly to accommodate AIL deliveries.

11.32 The proposed site entrance design is shown in **Figure 2.8** and has been designed in accordance with the requirements of Development Control Advice Note (DCAN) 15, 2nd Edition.

13. As specified in DCAN 15, visibility splays measuring 120m x 4.5m are provided in both directions. Following construction, the site entrance will be reinstated to reduce the extent of hardstanding back to its original pre-construction state. Stone pillars and walls removed to allow access will be reinstated as will stock proof fencing. Any trees and hedgerows removed will be replanted.

Assessment Methodology

11.1 The assessment has been undertaken in accordance with the Institute of Environmental Assessment's 'Guidelines for the Environmental Assessment of Road Traffic' (1993).

11.2 The IEA Guidelines (1993) is the only document available that sets out a methodology for assessing potentially significant environmental impacts where a proposed development is likely to give rise to changes in traffic flows.

11.3 The IEA Guidelines (1993) suggest that, in order to determine the scale and extent of the assessment and the level of impact the development will have on the surrounding road network, the following two 'rules' should be followed:

1. Include highway links (public roads) where traffic flows are predicted to increase by more than 30% (or where the number of heavy goods vehicle movements is predicted to increase by more than 30%).

2. Include any other specifically sensitive areas where traffic flows are predicted to increase by 10% or more.

11.4 Where possible, the significance of each impact is considered against the criteria within the IEA Guidelines (1993). However, the IEA Guidelines (1993) state that:

11.5 "for many effects there are no simple rules or formulae which define the thresholds of significance and there is, therefore, a need for interpretation and judgement on the part of the assessor, backed-up by data or quantified information wherever possible. Such judgements will include the assessment of the numbers of people experiencing a change in environmental impact as well as the assessment of the damage to various natural resources."

11.6 In the absence of established significance criteria for traffic and transport impacts, professional judgement has been used to assess whether the impacts on traffic and transport are considered to be significant, using the IEA Guidelines (1993) to identify the scale and extent of the assessment to be undertaken. The significance falls into two categories; 'not significant' and 'significant', the latter corresponding to significant impacts in accordance with the IEA Guidelines (1993).

11.7 The IEA Guidelines (1993) state projected changes in traffic of less than 10% creates no discernible environmental impact, given that daily variations in background traffic flow may fluctuate by this amount, and that a 30% change in traffic flow represents a reasonable threshold for including a highway link (public road) within the assessment. The threshold for a detailed assessment has therefore been set at a 30% change in HGV traffic flow.

11.8 The following receptors have been used for this assessment:

- ATC 1, Feeny Road
- ATC 2, Banagher - Carnanbane Road
- ATC 3, Magheramore Road.

11.9 Automatic Traffic Count (ATC) surveys were carried out during a period of seven consecutive days starting on 20th March 2019 as listed in **Table 11.2**.

Table 11.2: Existing Daily Traffic Flows

Road Reference	24 hr Average Daily Flow[1]
ATC 1, Feeny Road	3233
ATC 2, Banagher - Carnanbane Road	237
ATC 3, Magheramore Road	262

Potential Significant Effects

11.10 The construction of the Development is anticipated to take approximately 18 months. Construction site working will be from 0700 to 1900, Monday to Friday and 0700 to 1300 on Saturdays but deliveries may occur outside these times to minimise disruption to local residents and/or to comply with Health and Safety, quality or any specific environmental requirements. During both turbine erection and commissioning periods site workings could be seven days a week.

11.11 The associated traffic flows will vary over that time as different elements of the Development are constructed and will depend on the chosen Contractor's preferred method of working. A Traffic Management Plan (TMP) will be prepared by the Applicant or the chosen Contractor once the construction schedule, plant requirements and the turbine model have been defined, pre-construction. This will ensure impacts to the users of the delivery route are minimised where possible. The TMP will be submitted to Causeway Coast & Glens BC and DfI Roads for approval prior to the start of construction.

11.12 Estimated traffic generation during the construction stage has been based on the assumption that the following activities will take place:

- Delivery of components for site set-up
- Delivery of materials for road and hard standings
- Delivery of materials and components associated with foundation construction
- Delivery of components associated with the turbines, including meteorological masts
- Delivery of components and materials associated with cable installation
- Delivery of substation components and materials
- Other miscellaneous deliveries/removal
- Construction workers commuting.

11.13 **Table 11.3** provides the estimated traffic generation across an assumed 12-month construction period. The assessment has been based on the assumption that all material has to be imported to site, including ready mixed concrete for the turbine foundations and all aggregate for the access tracks and areas of hardstanding, thus providing a worst case.

Table 11.3 Estimated traffic generation across an assumed 12-month construction period

Phase	Purpose	Vehicle	Approximate No of deliveries for project duration	Approximate highest No of daily deliveries	Approximate Period when Deliveries Occur (assumes 10 months programme)
Site Set-Up	Portacabin delivery	Low loader	6	5	1
	Skip delivery	Low loader	5	5	1
	Generator delivery	Low loader	2	2	1
	Water and fuel tank delivery	Low loader	1	1	1
	Excavator delivery	Low loader	2	2	1-2
	Tool container delivery	Low loader	2	2	1-2
	Roller-compactor	Low loader	1	1	1-2
	Articulated dumper truck	Low loader	1	1	1-2
Site tracks & hard standings	Stone for site tracks	Tipper lorry	1407	50	1-5
	Stone for control building and substation compounds	Tipper lorry	82	50	1-5
	Stone for construction compound and gatehouse	Tipper lorry	36	36	1-5
	Stone for pathways	Tipper lorry	26	26	4-9
	Stone for crane hardstanding	Tipper lorry	897	50	1-5
Foundation construction	Excavator delivery	Low loader	2	2	2-3
	Misc works	Backhoe loader	2	2	2-3
	Concrete for turbine foundations, piles & transformer plinths	Mixer truck	360	60	2-5
	Steel delivery	Flat bed	12	12	2-5
	Foundation bolts or steel insert delivery	Flat bed	6	6	4-5
	Place foundation bolt cage or steel insert	30t to 50t crane	1	1	4-5
Turbine erection	Tower section delivery	Clamp lift trailer	24	8	7-8
	Blade delivery	Extendible trailer	18	6	7-8
	Nacelle	Low loader	6	2	7-8
	Hub and rotor	Low loader	6	2	7-8
	Drive Train	Low loader	6	3	7-8
	Large crane delivery and removal	1000t to 1200t crane	2	1	7-8

Phase	Purpose	Vehicle	Approximate No of deliveries for project duration	Approximate highest No of daily deliveries	Approximate Period when Deliveries Occur (assumes 10 months programme)
	Crane associated equipment delivery and removal	Low loader	20	10	7-8
	Smaller crane delivery and removal	150t to 200t crane	2	1	7-8
Cable Installation	Cable delivery	Flat bed	6	6	5
	Sand delivery	Tipper lorry	123	20	5
	Excavator delivery	Low loader	2	1	5
	Cable laying	Tele handler	2	1	5
Sub-Station and Control Building	Concrete delivery	Mixer truck	36	36	5
	Brick delivery	Flat bed	3	3	5
	Roofing & Cladding	Flat bed	3	3	6-7
	Switchgear	Flat bed	2	2	6-7
	Misc electrical equipment	Flat bed	3	3	6-7
Reinstatement	Removal of temporary compound & gate house stone	Tipper lorry	36	36	9-10
	Removal of temporary hardstanding stone	Tipper lorry	269	50	9-10
Misc	Waste removal	Skip lorry	87	1	1-10
	Water/fuel deliveries	Small tanker	87	1	1-10
Site Demobilisation	Portacabin removal	Low loader	6	6	10
	Skip removal	Low loader	5	5	10
	Generator removal	Low loader	2	2	10
	Water and fuel tank removal	Low loader	1	1	10
	Roller-compactor	Low loader	1	1	7-8
	Dumper truck	Low loader	1	1	10
	Excavator removal	Low loader	2	2	5-10
	Misc works	Backhoe loader	2	2	10
TOTAL Heavy Good Vehicles			**3613**		
Site Staff and Deliveries	Staff	Cars & minivans	5417	25	1-10
	Miscellaneous deliveries	Vans	867	4	1-10
TOTAL Cars & Light Good Vehicles			**6283**		
TOTAL VEHICLES			**9897**		

11.14 The above has been derived from experience gained from previous wind farm construction phases and assumes approximately 40 stone deliveries per day.

11.15 It is estimated that the greatest concentration of construction traffic occurs on the days when concrete is delivered to the Development for the construction of turbine foundations.

11.16 Technical ('best practice') construction requirements may necessitate that the concrete for an individual turbine base foundation will have to be delivered and poured in one day to prevent 'cold' joints forming in the structure. As a result, there may be a period in which there will be an increased number of delivery vehicles, compared with the rest of the construction period, entering and leaving the Site. The total number of concrete deliveries for each turbine base foundation may be up to 65 journeys per day.

11.17 This equates to approximately one vehicle movement every five minutes over the working day (0700 to 1900). The following table (**Table 11.4**) illustrates the worst-case percentage change of traffic flow (i.e. on the busiest 6 days) along the proposed access route during the turbine base construction stage of the Development.

Table 11.4: Summary of Percentage Increase in Traffic on Local Roads

Road Reference	24 hr Average Daily Flow[2]	Average Recorded Daily HGV Flow[3] as a percentage (No. of HGVs)	Percentage increase of HGVs (No. of HGVs,)	Is the IEA (1993) threshold of 30% increase in HGV[4] Traffic Flow exceeded?
ATC 1 Feeny Road	3233	18% (591)	22% (130)	No
ATC 2 Banagher - Carnanbane Road	237	22% (51)	254% (130)	Yes
ATC 3 Magheramore Road	262	22% (57)	228% (130)	Yes

11.18 It is predicted that there will be increases in vehicle movements of between 22% and 254%. Along the Banagher – Carnanbane Road section from the Feeny Road and on the Magheramore Road, the increase is 254% and 228% respectively. The percentage increase is high given the low volume of traffic which the roads currently accommodate. These roads are largely two-way and where not have been widened to accommodate vehicles travelling to and from the existing quarry on the

[2] 2016 Average Annual Daily Traffic Flow (AADT) (7 day), TRAFFIC and TRAVEL INFORMATION 2016, Department for Infrastructure

[3] 2016 Average Annual Daily Traffic Flow (AADT) (7 day), TRAFFIC and TRAVEL INFORMATION 2016, Department for Infrastructure

[4] HGV corresponds to both OGV1 and OGV2 vehicle classes

Magheramore Road. If material was supplied by the existing quarry, this would potentially reduce recorded and /or predicted increases of HGV traffic flow particularly on the Banagher and Carnanbane Roads.

11.19 The IEA (1993) threshold of 30% is exceeded on the Banagher – Carnanbane section and the Magheramore Roads, and therefore an assessment of potential significant impacts has provided in Table 11.5.

11.20 The above table takes into account maximum HGVs deliveries (65 per day) accessing the site from east or west and returning by the same route.

Table 11.5: IEA Environmental Impact

Predicted Impact	Description	Applicability to Tertiary Road Network
Severance	Severance is a perception that a road is more difficult or possibly less safe to cross. Increased severance can result in the isolation of areas of a settlement or individual properties. However, It is important to note that the impact is largely a function of traffic volumes, rather than one of vehicle composition amongst traffic.	The IEA guidelines suggest changes in traffic flow of 30% are likely to affect severance. There is low existing traffic flow and little pedestrian activity. As part of the TMP, consultation will be undertaken with existing quarry and local residents. An agreement will be made to ensure that delivery times do not coincide with 'pick-up' and 'drop-off' times that may affect access to local services. With this measure the temporary impact of severance is considered to be **Not Significant.**
Driver Delay	Driver delay is that experienced by non-development related road users on the surrounding roads and particularly as a consequence of slow moving traffic associated with construction.	The IEA guidelines suggest that delays are only likely to be of significance when the traffic on the surrounding network is at, or close to, full capacity. Given that this is not the case, this is not considered to be an issue. It is acknowledged that there may be an element of localised delays directly attributable to construction traffic due to the large increase in construction traffic on the Banagher –

Predicted Impact	Description	Applicability to Tertiary Road Network
		Carnanbane section & Magheramore Road although this is most likely to be restricted to junctions and local road users are used to encountering HGVs. The delivery of turbine components will involve large, slow moving vehicles however these will be escorted and where possible timed to cause minimal disruption. The potential impact is considered **Not Significant** given that there is a low volume of vehicles on the tertiary road network and these roads are largely two-way and where not have been widened to accommodate vehicles travelling to and from the existing quarry on the Magheramore Road. Deliveries will be timed to minimise disruption, escorted where necessary and information regarding deliveries will be made available via the TMP, prior to construction
Pedestrian Delay	Pedestrian delay is affected by changes in traffic volume, HGV movements and traffic speed. Pedestrian delay also depends on the existing level of pedestrian activity, visibility and current infrastructure provision. There is no threshold on which pedestrian delay is assessed.	Pedestrian movement on the Banagher - Carnanbane Road section and Magheramore Road is minimal. Therefore, the area has a low sensitivity rating in relation to pedestrian delay and impacts will be **Not Significant**.
Pedestrian Amenity	Pedestrian amenity can be affected by traffic volumes and the distance between pedestrians on a footway and passing traffic. The IEA guidelines suggest that changes to pedestrian amenity may be considered significant where the traffic is doubled or halved.	There is minimal volume of pedestrian movement along Banagher - Carnanbane Road section and the Magheramore Road and whilst the volume of HGV traffic sees a significant increase, given the lack of pedestrian movement this does not pose a significant risk.

Predicted Impact	Description	Applicability to Tertiary Road Network
		The Banagher – Carnanbane Road section and the Magheramore Road are part of the Banagher Cycle Route and whilst the volume of HGV traffic sees a significant increase, as recreational pursuits are typically undertaken outside working hours and at weekend's vehicle movements may be less or have ceased. It is considered the impact on pedestrian's / cyclist's amenity will be **Not Significant** given that the worst case of vehicle movements will be one per five minutes on the six days associated with the turbine foundations.
Fear & Intimidation	The IEA guidelines state that the degree of fear and intimidation experienced by pedestrians is affected by the volume of passing traffic, the proportion of HGV traffic and its proximity to pedestrians.	Despite the predicted temporary increase in traffic flows, the minimal volume of pedestrian movement along Banagher - Carnanbane Road section and Magheramore Road combined with the largely two-way nature of these roads means this impact will be **Not Significant.**
Accidents & Safety	The IEA guidelines state that road accidents are attributable to a variety of local factors and as such do not provide a threshold to determine significance. Instead the IEA guidelines relies more on the assessor to use their own judgement.	Construction and predicted changes will be temporary and given that consultation will be undertaken with the quarry and local residents, and traffic generation is low, there is unlikely to be an impact upon road safety and accident levels. Furthermore, all abnormal loads will be escorted, and the movement of these vehicles will be programmed to avoid busy periods thus reducing the potential impacts further. It is considered the overall impact on accidents and safety is **Not Significant** given that the worst case of vehicle

Predicted Impact	Description	Applicability to Tertiary Road Network
		movements will be one per five minutes on the six days associated with the turbine foundations.

11.21

Cumulative Impact

11.22 There are a few consented and proposed projects within 10 km of the Site (**Table 11.5**).

11.23 There is one consented wind farm (Ballyhanedin) approximately 6.7 km to the northwest of Magheramore and that could theoretically result in cumulative traffic impacts albeit these would be limited to the primary road network from Lisahalley Port and could include Maydown Road, Kilfennan Link Road, Crescent Link and Glenshane Road (B74) and the A6. Whilst both developments intend to partially utilise the same turbine delivery route to access the A6, in the unlikely event that the construction periods where to coincide, construction traffic is likely to occur on the same primary and secondary roads and vehicle movements would not exceed the 30% threshold. One other consented project (Evishagaron) approximately 8.2 km northeast of Magheramore may use Lisahalley Port for delivery but is likely to travel east along the A2 rather than utilising the A6. Even if using the A6 to Dungiven, it would subsequently utilise the secondary and tertiary roads to the east of Dungiven. As part of the TMP, consideration of any cumulative effects arising from the construction of other wind farm developments will be reviewed in detail and mitigated accordingly.

Table 11.5: Wind Farms in the Vicinity of the Development

Name	Status	Number of Turbines	Distance from Proposed Site Boundary
Ballyhanedin	Consented	8	6.7 km northwest
Evishagaron	Consented	14	8.2 km northeast

Mitigation

11.24 A Traffic Management Plan (TMP) will be prepared by the Applicant in accordance with the requirements of Department of Infrastructure NI, Causeway Coast & Glens BC, the local PSNI, and if required, any other relevant stakeholders. Features of the TMP will include:

- Details of the access route, conformation of any points along the access route that require street furniture removal, details of traffic numbers, delivery timings, and signage and escort requirements

- A delivery schedule for normal and abnormal loads so as to minimise disruption as far as reasonably practicable
- Details of how any movements will comply with legislation regarding the movement of abnormal loads e.g. notice procedures and notice periods
- Details on the use of escorts where required. Where long vehicles and abnormal loads would have to use the wrong side of the carriageway or need to swing into the path of oncoming vehicles a lead warning vehicle would be used. One escort vehicle would drive ahead and pull oncoming traffic into identified passing places. An escort vehicle would travel directly in front of the convoy and pull over any oncoming traffic that comes onto the road after the first escort vehicle has passed. A further convoy escort vehicle would follow the convoy
- Information about marking of vehicles as long/abnormal loads

11.25 Information will be given on how warning signs will be used. These will be used to advise other road users of '*Caution Slow Plant Turning Ahead*' and will be placed at intervals from both directions along the main road approaching the site entrance during the construction phase. The TMP will also detail additional measures to ensure impacts from traffic movements are minimised where possible, for example provision of road sweepers and/or wheel wash facilities.

11.26 If required, the wheel wash facilities will include a waterless drive over wheel wash for lorries. This will be provided at the site entrance to prevent mud and dust being brought out from the Site onto the public highway and anything being brought onto Site from public highway. Although experience has shown the majority of mud is shaken off wheels on site before the vehicle reaches the public road, the site entrance and adjacent public highway will also be monitored and cleaned if necessary.

11.27 The TMP will include details about Video Surveying and Road Repairs. A video survey of the pre-construction condition of all public roads will be recorded around the site entrances and access routes (but including the site entrance and access roads), to provide a baseline record of the state of the roads prior to construction work commencing. This will enable any repairs and maintenance work required to the relevant road due to any damage caused by the passing of heavy vehicles associated with the wind farm construction to be identified following the construction phase. The roads will be returned, at minimum, to the baseline condition at the end of the construction phase. Any damage caused by wind farm traffic during the construction period, which would be hazardous to public traffic, will be repaired immediately. These works will be carried out under permits with DfI Roads, as appropriate.

11.28 The TMP will include plans for notifying relevant stakeholders in advance of delivery periods, including the emergency services, DfI Roads, local residents, local business, local services and schools. The local community will be informed prior to the commencement of construction and prior to the commencement of turbine deliveries by letter and through local press. The contact details of the Construction Site Manager will be made available as a contact point for enquiries. Local schools on the delivery routes will be contacted to identify school and nursery drop-off and pick up locations and times. Construction deliveries will be scheduled to avoid these busy periods as far as reasonably possible.

11.29 If cutting or removal of hedges and trees is required then this should be done outside the bird breeding season (1st March to 31st August). If work is to be done during the breeding season then there should be a survey to establish whether nesting birds are present.

Summary

11.30 The main traffic impacts are associated with the increase in HGV vehicle movements along the Banagher - Carnanbane Road section from the Feeny Road and the Magheramore Road during the construction stage of the project. These roads have low levels of existing traffic and a small number of receptors will be affected. At worst, the frequency of vehicle movements is expected to be one vehicle every five minutes during the 6 days when the construction of each wind turbine foundation would occur.

11.31 Consideration has been given to the effect of increased HGV traffic flow on Severance, Driver Delay, Pedestrian Delay, Pedestrian Amenity, Fear and Intimidation, Accidents and Safety and Cumulative Impacts. Furthermore, consideration has been given to the environmental effects of any road improvement/widening works.

11.32 A TMP will be developed and agreed with the relevant stakeholders post consent and pre-construction in order to control and mitigate impacts associated with increased vehicles movements.

11.33 Taking into account the existing vehicle movements on the affected roads, and the proposed type and frequency of vehicle numbers, it is considered that with the appropriate mitigation measures as set out above, there will be no significant impacts.

List of References, Figures and Appendices

References

Department of Environment (2009); Best Practice Guidance to Planning Policy Statement 18 – Renewable Energy, Planning and Environmental Policy Group.

Department of Environment (2005); Access, Movement and Parking Planning Policy Statement 3, PPS 3, The Planning Service.

Department of Environment (2015); Northern Area Plan 2016.

Institute of Environmental Assessment (1993); The Institute of Environmental Assessment's Guidelines for the Environmental Assessment of Road Traffic.

Figures

Figure 11.1: Turbine Delivery Route

Appendices

Appendix 11.1: Delivery Analysis

12

Shadow Flicker

12 Shadow Flicker

Introduction

12.1 In sunny conditions, any shadow cast by a wind turbine will mirror the movement of the rotor. When the sun is high, any shadows will be confined to the wind farm area but when the sun sinks to a lower azimuth moving shadows can be cast further afield and potentially over adjacent properties. Shadow flicker is generally not a disturbance in the open as light outdoors is reflected from all directions. The possibility of disturbance is greater for occupants of buildings when the moving shadow is cast over an open door or window; since the light source is more directional.

12.2 Whether shadow flicker is a disturbance depends upon the observer's distance from the turbine, the direction of the dwelling and the orientation of its windows and doors from the wind farm, the frequency of the flicker and the duration of the effect, either on any one occasion or averaged over a year.

12.3 In any event and irrespective of distance from the turbines, the flickering frequency will depend upon the rate of rotation and the number of blades. It has been recommended (Clarke, 1991) that the critical frequency should not be above 2.5 Hz, which for a three-bladed turbine is equivalent to a rotational speed of 50 rpm. The proposed turbines at Magheramore Wind Farm would rotate at a maximum of approximately 12.8 rpm, well below this threshold.

Reflected Light

12.4 A related visual effect to shadow flicker is that of reflected light. Theoretically, should light be reflected off a rotating turbine blade onto an observer then a stroboscopic effect would be experienced. In practice a number of factors limit the severity of the phenomenon and there are no known reports of reflected light being a significant problem at other wind farms.

12.5 Firstly, wind turbines have a semi-matt surface finish which means that they do not reflect light as strongly as materials such as glass or polished vehicle bodies.

12.6 Secondly, due to the convex surfaces found on a turbine, light will generally be reflected in a divergent manner.

12.7 Thirdly, the variability in flow within a wind farm results in slightly differing orientation of rotor directions, therefore it is unlikely that an observer will experience simultaneous reflections from a number of turbines.

12.8 Fourthly, as with shadow flicker, certain weather conditions and solar positions are required before an observer would experience the phenomenon.

12.9 It is therefore concluded that Magheramore Wind Farm will not cause a material reduction to amenity owing to reflected light.

Policy & Guidance

12.10 Whilst there is no specific standard for the assessment of shadow flicker in the UK, planning requirements of shadow flicker are contained within Planning Policy Statement 18 (RE 1) "Renewable Energy" (2009) which states:

"... the development will not cause significant harm to the safety or amenity of any sensitive receptors (including future occupants of committed developments) arising from noise; shadow flicker; ice throw; and reflected light;"

12.11 The Best Practice Guidance to Planning Policy Statement 18 "Renewable Energy" (2009) further describes that,

"...at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low".

Methodology

12.12 An analysis of shadow flicker throughout the year from Magheramore Wind Farm was carried out, taking into account the behaviour of the sun, the local topography and the turbine layout and dimensions[1]. The analysis was performed using a turbine layout consisting of six turbines, each with maximum tip heights of 149.9 m and maximum rotor diameters of 112 m.

12.13 In accordance with The Best Practice Guidance to Planning Policy Statement 18 "Renewable Energy" (2009), as described above, analysis would be performed on all occupied houses within 1120 metres of any proposed wind turbine. There are two inhabited houses within ten rotor diameters of any of the proposed turbines.

Results

12.14 With due reference to The Best Practice Guidance to Planning Policy Statement 18 "Renewable Energy" (2009) there are two inhabited houses within 10 rotor diameters of the wind farm. It is predicted that one of these houses (H3 – see Noise Figure 10.1) would receive a maximum of 11.5 hours of shadow flicker a year.

12.15 It should be emphasised that this analysis provides an extremely conservative estimate of the extent that houses will be affected by shadow flicker. Due to frequent cloud cover, turbines not turning on at all times and turbine rotors not being aligned with the sun in a way to cast maximum shadow onto habitations, the actual amount of shadow flicker seen in these areas is likely to be much less.

12.16 It is therefore concluded that Magheramore Wind Farm will not cause a material reduction to residential amenity owing to shadow flicker.

[1] Turbine layout ref 03246D0001-07

Mitigation

12.17 Mitigation measures can be incorporated into the operation of the wind farm to reduce the instance of shadow flicker. Mitigation measures range from planting tree belts between the affected dwelling and the responsible turbine(s) or installing blinds at the affected dwellings. When there is extreme nuisance, mitigation could be to the extreme of shutting down individual turbines during periods when shadow flicker could theoretically occur.

References

[1] The Scottish Office (2002), Planning Advice Note 45

[2] Planning Policy Statement PPS22 (2004)

[3] Clarke A.D (1991), A case of shadow flicker/flashing: assessment and solution, Open University, Milton Keynes

[4] Clarke, A.D (1995), Assessment of Proposed Wind energy Project at Meenacahan, Donegal, Ireland, for Shadow Flicker, Report for B9 Energy Services Ltd

[5] Cloud Cover Statistics from the IPCC Data Distribution Centre: Visualisation Pages (2004), http://www.ipcc-data.org/java/visualisation.html

[6] Planning Policy Statement 18 “Renewable Energy” (including Best Practice Guidance to Planning Policy Statement 18) August 2009

13

Socioeconomics

13. Socioeconomics

Introduction

Background to the Study

13.1 RES commissioned Oxford Economics in the summer of 2018 to undertake a socioeconomic impact report of the proposed Magheramore Wind Farm, hereinafter referred to as 'the Development', which is located within the Causeway Coast and Glens Borough Council area.

13.2 The Development located in the Causeway Coast and Glens Borough Council area will have a total installed capacity of up to 21.6 megawatts (MW), consisting of six three-bladed turbines, with a planned operational lifespan of 30 years. It is anticipated that the electricity generated will be exported to the grid.

13.3 This report presents estimates relating to the direct, indirect and induced benefits that could be generated. It also provides a brief discussion on the unquantifiable benefits associated with a development of this type and scale, and the current macroeconomic and socioeconomic environments.

About RES

13.4 RES is one of the world's leading independent renewable energy project developers with operations across Europe, the Americas and Asia-Pacific. At the forefront of renewable energy development for over 30 years, RES has developed and/or built more than 16,000MW of renewable energy capacity worldwide. In the UK alone, RES currently has more than 1,000MW of projects either constructed, under construction or consented. RES is active in a range of renewable energy technologies including both onshore and offshore wind, solar and enabling technologies such as energy storage.

13.5 RES has been building wind farms in Ireland since the early 1990s and from their office in Larne, Co. Antrim, they have a team of over 20 working across a range of disciplines. In Northern Ireland, RES has developed and/or built seventeen wind farms with a total generation capacity of nearly 229MW.

Structure of the Report

13.6 This section of the report is structured as follows:

- Firstly, the estimated quantifiable benefits of the construction and on-going phases of the Development are presented – concentrating on employment, gross value added (GVA)[1] and wages. An assessment of the potential fiscal and environmental benefits is also included;

[1] Gross value added (GVA) measures the value of goods and services produced in an area, industry or sector of an economy and is equal to output minus intermediate consumption.

- Secondly, an overview of the socioeconomic conditions, both at the regional and local level, is provided;
- Finally, we set out our overall conclusions in respect to the Development.

Caveat

13.7 Specific information related to the Development was provided where possible by RES. The estimated benefits are based on a mix of this information, published data and reasonable assumptions.

13.8 The cost of construction could inflate or deflate depending on movements in variables such as exchange rates, demand for wind turbines and metal prices. As such the information is the best current estimate at the time of writing.

13.9 This economic impact study has been developed to form part of the environmental information to be provided to the decision maker. As such, if and when the time comes that the Development is granted full planning permission and has been built, the economic environment may look different. The analysis assumes all facilities contained in the Development are fully developed. We have considered the possibility of displacement during both the construction and operational phases of the development. It is our view that given the current and likely future performance of the local economy, there is little scope for displacement, therefore we have assumed zero levels of displacement in the modelling – see section 13.24-13.27 for further discussion.

13.10 There is no analysis within the report focusing on how the Development would impact income distribution and deprivation levels in the area. This is outside of the scope of this piece of work.

13.11 The quantifiable impacts calculated by Oxford Economics and outlined in this report come from an Economic Impact Model which uses an input-output framework, standard economic underpinnings, published data and few clearly documented reasonable working assumptions. We are aware of other reports such as the Northern Ireland Renewable Industry Group (NIRIG) commissioned study by Redpoint (referred to as “the Redpoint study”) titled “The economic effects of increasing wind deployment in Northern Ireland”[2] or from the Irish Wind Energy Association (IWEA) which try to place a figure on the number of direct and indirect jobs per activity from wind farms. We normally use these only as a test of robustness when job estimates are provided by the client. We have also used reports completed by BiGGAR Economics on behalf of RenewableUK and the Department of Energy and Climate

[2] http://149.255.57.18/~nirigweb/wp-content/uploads/2017/03/Economic-effects-2012.pdf

Change (DECC)[3] and on behalf of NIRIG, IWEA and RenewableUK[4] for Northern Ireland specifically, to check the number of construction- and professional-related jobs per megawatt and have found the figures to be similar in scale to those we have calculated.

13.12 Our modelling does not factor in industry support mechanisms.

Glossary of Definitions

13.13 **Backward linkages**: Backward linkages refer to the channels through which money, materials or information flows between a company and its suppliers, creating a network of economic interdependence. In terms of this study, it refers to the fact that the construction phase of the Development will require the purchase and use of raw materials from sectors like building materials; steel, architectural services etc., which themselves will create supply chain jobs in the economy.

13.14 **Full-time equivalents (FTE)**: All the modelling completed by Oxford Economics and all the impacts associated with this modelling, assumes that employment is expressed in terms of FTE, which is important given the prevalence of part-time working especially in the construction sector. Accordingly, two part-time workers make up one full-time equivalent worker.

13.15 **Gross value added (GVA):** GVA measures the value of goods and services produced in an area, industry or sector of an economy and is equal to output minus intermediate consumption.

13.16 **Direct (impact)**: The direct impact is defined as the economic activity and numbers of people employed by the wind farm (both in construction and in on-going roles).

13.17 **Indirect (impact):** The indirect impact is defined as the economic activity and employment supported in the wind farm's supply chain, as a result of their purchasing of inputs of goods and services from suppliers.

13.18 **Induced (impact):** The induced impact is defined as economic activity and employment supported by those directly or indirectly employed spending their wage income on goods and services in the wider UK economy.

13.19 **Jobs:** Any references to the employment benefits from the on-going phase once the Development becomes operational are expressed in terms of "jobs" per annum. As noted above, these jobs are full-time equivalent in nature.

13.20 **Job years:** Any references to the employment benefits from the construction phase of the Development are expressed in terms of "job years". This is necessary given that construction phase activity normally spans more than a single year. A job year

[3] Onshore Wind Direct & Wider Economic Impacts, May 2012, BiGGAR Economics. Date accessed: 26th July 2017. Accessed using: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48359/5229-onshore-wind-direct--wider-economic-impacts.pdf

[4] http://149.255.57.18/~nirigweb/wp-content/uploads/2017/03/Onshore-Wind-Economic-Benefits-NI.pdf

does not necessarily mean one job. Instead it refers to the amount of activity that is required. So, for example two people could be employed for six months – this would equate to one job year of work. Alternatively, one person could be employed for two years - this would equate to two job years of employment. We do not need to use the term job years when talking about the on-going phase, as these benefits are all expressed in per annum terms as discussed above.

13.21 **Nominal prices:** Nominal prices are those which reflect the current situation and are not adjusted for seasonality or inflation.

13.22 **Real prices (2016 prices):** Real prices refer to values that have been adjusted to remove the effects of inflation and are thus measured in terms of the general price level in some base reference year. They give a more accurate measure. In this case, 2016 is the base year as it is consistent with the base/reference year used within UK ONS National Accounts: the Blue Book 2018.

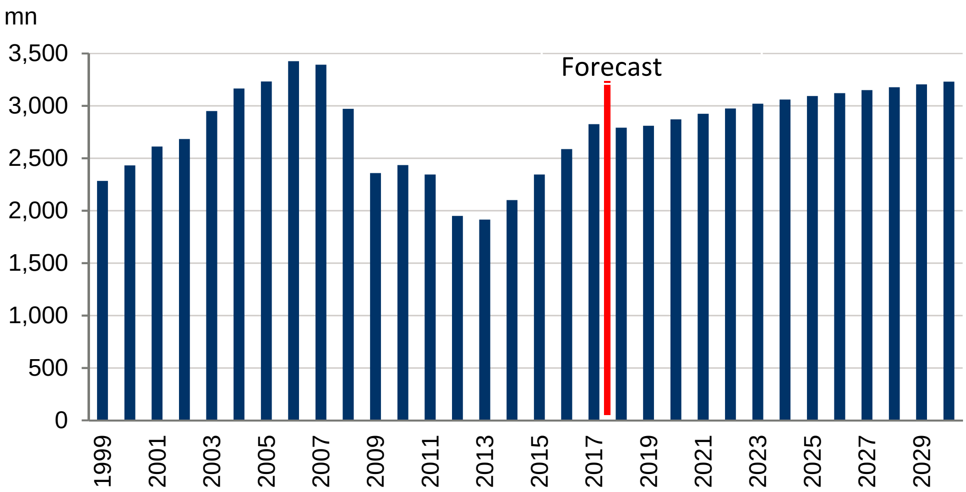
Quantifiable Benefits

13.23 This section analyses the estimated quantifiable benefits of the construction and operational phases of the Development - concentrating on employment, GVA and wages, as well as assessing fiscal and further benefits.

13.24 A key assumption behind Oxford Economics' analysis relates to displacement. We have assumed that there will be zero displacement during both the construction and operational phases of the windfarm. Displacement assumptions are subjective, but we have provided an analysis below to show how we arrived at our modelling assumptions.

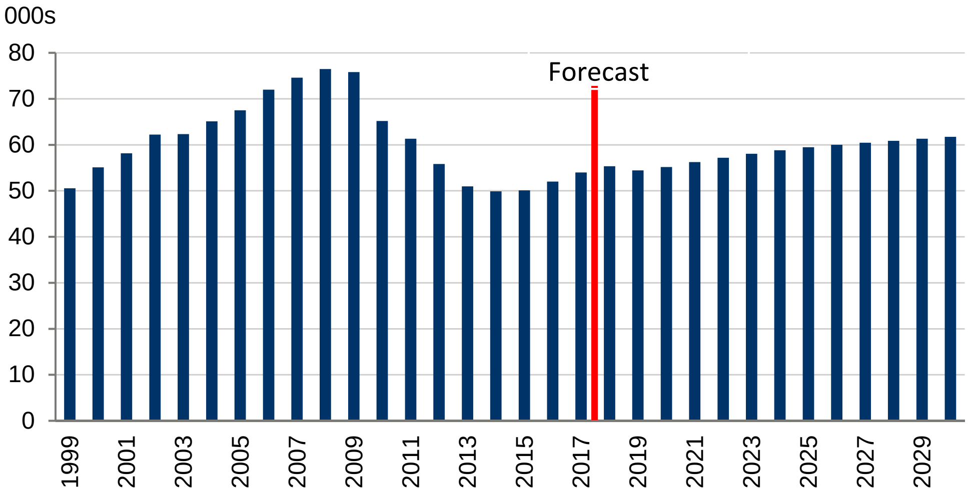
13.25 Construction output and employment in Northern Ireland were heavily impacted by the financial recession. Figures 1 and 2 present the scale of decline and shows that recovery in both output and employment terms has been slow. Construction employment levels remain almost 30 percent below those recorded in 2008, while the value of output in the sector is six percent lower.

Figure 1: Construction GVA in Northern Ireland (£2016 prices)



Source: Oxford Economics

Figure 2: Construction employment in Northern Ireland



Source: Oxford Economics

13.26 Weekly (median) wages in Northern Ireland's construction sector has experienced strong growth in recent years. Between 2013 and 2018, wages have averaged growth of 3.8 percent a year – notably higher than the region as a whole (2.6 percent). Growing demand for labour in this sector, a limited supply of construction related skills or a combination of both can explain the sector's wage inflation. Nonetheless, Figure 2 shows that Northern Ireland's construction employment levels remain notably below pre-recession peaks.

13.27 Therefore, we can conclude that the construction sector in Northern Ireland is likely to have enough spare capacity to accommodate the Development. As such we have applied a zero rate of displacement of current or future economic activity on the construction phase impacts.

13.28 We understand that the site for the proposed development is currently agricultural land, however, RES has informed us that the footprint of the Wind Farm is likely to be miniscule. Given the above and that the fact that the number of on-going jobs is limited in volume terms and specialised in nature, our estimates for the benefits arising from the operational phase assumes no displacement of economic or leisure activity.

13.29 We are aware of the argument that increased developments of this nature could displace jobs in fossil fuel activity. We would argue that given its size, the Development would not in isolation displace any actual activity away from the various fossil fuel power stations in Northern Ireland (Kilroot, Coolkeeragh and Ballylumford[5]).

13.30 While it could be acknowledged that cumulatively and in the long-run there may be displacement from the fossil fuel industry because of the on-going drive for increased renewables as a collective, to meet the 2020 targets for energy production; this is itself implicit in government policy promoting such renewables in the first place.

Economic impact of the Construction Phase

13.31 The benefits associated with the construction phase of the Development (jobs, wages, GVA and fiscal) are presented as a range. This range results from the implementation of two separate methods of estimating direct construction phase impacts. The first approach uses full-time job year equivalent figures provided by RES, based on previous projects they have carried out.

13.32 The second approach uses value of investment expected to be realised in Northern Ireland. By assigning this to sectors of the economy we can estimate GVA levels, jobs and wages (using published and or forecast data).

13.33 We then use an input-output model to estimate the indirect and induced impacts that are likely to flow from a given level of investment / activity. An input-output table provides information on how sectors purchase from one another. It also shows how households spend their income. We use UK input-output tables and adjust them to account for the local characteristics.

[5] Department for Business, Energy & Industrial Strategy: *Power stations in the United Kingdom*, May 2018. Kilroot, Coolkeeragh and Ballylumford were operational at the end of May 2018.

Method 1: Job posts approach

13.34 We have pro-rated the job figures based on six turbines of the Development, adjusted for the 12-month construction phase[6]. This figure is shared across the construction and professional sector, based on the split used in Method 2 – see below.

13.35 The job figures used for modelling purposes are outlined in Table 13.1.

Table 13.1: Job year information provided by RES and adjusted for Development

Job years	6 turbine project, 12-month construction phase
Construction	29
Professional	7
Total	**37**

Source: RES.
Note: May not add due to rounding.

Method 2: Expenditure approach

13.36 The Development is estimated to result in a capital spend of approximately £18.46 million in nominal prices. This figure is based on information provided by RES. Only a fraction of this investment will be realised in Northern Ireland.

13.37 The total construction phase spend realisable within Northern Ireland is £4.88 million (in nominal prices)[7]. This includes approximately five percent of the estimated £12.33 million turbine cost value, through activities such as the use of local haulage companies and crane companies.

13.38 This regional/total spend split (£6.08 million/£18.46 million) is within ballpark range of that observed in reports carried out by Deloitte and IWEA.[8] The split between construction related spend and professional services related spend in Northern Ireland is assumed to be £4.88 million and £1.2 million respectively. For the purposes of our modelling, we have converted all this expenditure information into 2016 real prices, to keep it consistent with our model inputs and national accounts publications.[9]

[6] RES provided Oxford Economics with job figures based on a nine-turbine project (totalling 18MW) with a 24-month construction phase. These job number have been pro-rated and adjusted for the Development.

[7] For this analysis, the total construction phase spend is defined as the cost for turbines, Balance of Plant (BoP), food, fuel, plant hire, road maintenance and miscellaneous.

[8] Jobs and Investment in Irish Wind Energy, Powering Ireland's Economy. Deloitte and IWEA. Accessed on April 1st 2019. Weblink.

[9] The construction phase and operational phase benefits within this section are expressed in real/constant prices with a 2016 base year – this is because 2016 is the base year used for all financial variables within Oxford Economics' suite of models – and thus the Economic Impact Model used to calculate this development's impacts. This is not to say 2016 data has been used – we have used the latest available data and the relevant forecast

13.39 The construction phase of the Development is scheduled to commence in May 2023 and last 12 months, starting operations in May 2024. The analysis therefore assumes a constant spend per quarter, leading to 66.7 percent of total spend being realised in 2023 and the remaining 33.3 percent in 2024. As such we use Oxford Economics baseline forecasts for GVA, productivity and wages to estimate the future impacts.

Direct construction phase impacts

13.40 The Development's 12-month construction phase is estimated to create or sustain between 37-48 direct job years of employment, 29-34 of which are involved with construction related activities and the remaining 7-14 job years account for professional services related activities (Table 13.2).

13.41 This direct construction phase employment would be likely to create or sustain between £1.04-£1.40 million of additional direct wages in the Northern Ireland economy. Furthermore, the investment is estimated to directly contribute between £1.83-£2.38 million to regional direct GVA.

Table 13.2: Direct benefits from the construction phase

Direct benefits	Job years	Wages (£2016m)	GVA (£2016m)
Construction related	29-34	0.83-0.96	1.51-1.74
Professional services related	7-14	0.21-0.43	0.31-0.63
Total	**37-48**	**1.04-1.4**	**1.83-2.38**

Source: Oxford Economics
Note: May not add due to rounding

Indirect and induced construction phase impacts

13.42 The supply chain (or indirect) impacts arising from the construction related activity have been estimated using the latest 2014 UK input-output tables (published by ONS) adjusted to take account of the structure and size of the Northern Ireland economy. In doing so we use academic guidelines like those contained in academic papers such as Flegg, A. T. and Tohmo, T. (2013) "Regional input-output tables and the FLQ formula: A case study of Finland" (Regional Studies, 47 (5). pp. 703-721).

13.43 Construction activity typically has strong "backward linkages" with sectors such as building materials, architectural services, legal services and insurance. These linkages tend to result in job creation elsewhere in the local economy. This makes investment in construction particularly effective in fuelling economic growth. Typically offering high economic multipliers of 2.42 and 1.34 for the UK and Northern

year in every case – 2016 simply refers to the base year for the constant price series. The construction spend figures provided by RES have been adjusted accordingly for consistency. This base year is used as it is consistent with the base/reference year used within UK ONS National Accounts: the Blue Book 2018.

Ireland respectively. This means that for every £1 of direct output by the sector, an additional £1.42 and £0.34 is created in the wider UK or Northern Ireland economy, respectively.

13.44 Indirect GVA impacts in Northern Ireland are therefore estimated to be approximately £0.38-£0.46 million, creating or sustaining an estimated 9-10 job years of employment, with associated wages of £0.23-£0.28 million (Table 13.3).

Table 13.3: Total benefits from the construction phase

Total (direct, indirect and induced) benefits	Job years	Wages (£2016m)	GVA (£2016m)
Direct	37-48	1.04-1.4	1.83-2.38
Indirect	9-10	0.23-0.28	0.38-0.46
Induced	11-14	0.26-0.34	0.43-0.57
Total	**56-73**	**1.53-2.02**	**2.64-3.41**

Source: Oxford Economics
Note: May not add due to rounding

13.45 As both direct and indirect wages generated through the construction phase are spent—a further round of benefits will spread through the region. This induced effect will support wider employment of approximately 11-14 job years alongside £0.26-£0.34 million of wages. Through the numerous rounds of supply chain and consumer spending, all sectors in the economy will experience some degree of benefit (Table 13.4).

13.46 It is worth noting that the estimated benefits are at a Northern Ireland level. An exact amount attributable to the Causeway Coast and Glens Borough Council area is more difficult to identify and outside the scope of this report. Invariably it depends on the location of the companies appointed that enjoy the direct benefits and the location of the suppliers who provide them with the materials. However, speaking qualitatively, RES has informed Oxford Economics that their previous projects have utilised local contractors when possible and it remains their intention to use local suppliers and labour for much of the Balance of Plant (BOP) work. It makes sense, not least in terms of the costs and distance argument, to use local firms (e.g. looking at the cost of transporting aggregates). That is, local firms can prove to be more cost efficient given the closer proximity to required capital, personnel and resources. This means that the vast majority of the direct and indirect benefits are likely to be realised within Northern Ireland, with Causeway Coast and Glens Borough enjoying some uplift at the local level.

13.47 The benefits quantified above have been tested for robustness against reports compiled by BiGGAR Economics on behalf of RenewableUK and the Department of

Energy and Climate Change (DECC)[10], and on behalf of NIRIG, IWEA and RenewableUK, for Northern Ireland specifically[11]. In most cases, the benefits were of a similar magnitude when looking at jobs per megawatt.

13.48 The aforementioned BiGGAR Economics report backs up the scale of benefits that can be experienced locally, citing the: "…many local economies throughout the UK over the last few years, which have experienced significant direct, supply chain and wider economic benefits from onshore deployment."

Table 13.4: Total sectoral benefits from the construction phase

Total (direct, indirect and induced) benefits	Job years	Wages (£2016m)	GVA (£2016m)
Agriculture, forestry and fishing	0-0	0-0.01	0.01-0.01
Mining and quarrying	0-0	0-0	0.01-0.01
Manufacturing	1-2	0.04-0.04	0.09-0.11
Electricity, gas, steam and air conditioning supply	0-0	0-0	0.01-0.01
Water supply; sewerage, waste management and remediation activities	0-0	0-0	0.01-0.01
Construction	32-37	0.91-1.05	1.65-1.9
Wholesale and retail trade; repair of motor vehicles and motorcycles	3-4	0.06-0.08	0.13-0.17
Transportation and storage	1-1	0.02-0.02	0.03-0.04
Accommodation and food service activities	2-3	0.03-0.04	0.04-0.05
Information and communication	0-1	0.02-0.02	0.03-0.04
Financial and insurance activities	1-1	0.02-0.02	0.04-0.06
Real estate activities	3-4	0.07-0.09	0.13-0.17
Professional, scientific and technical activities	8-16	0.24-0.47	0.35-0.69
Administrative and support service activities	3-4	0.06-0.08	0.05-0.07
Public administration and defence; compulsory social security	0-0	0-0.01	0.01-0.01
Education	0-1	0.02-0.02	0.01-0.02
Human health and social work activities	0-1	0.01-0.02	0.01-0.02
Arts, entertainment and recreation	0-0	0.01-0.01	0.01-0.01
Other service activities	0-1	0.01-0.02	0.02-0.02
Total	**56-73**	**1.53-2.02**	**2.64-3.41**

Source: Oxford Economics
Note: May not add due to rounding

10 Onshore Wind Direct & Wider Economic Impacts, May 2012, BiGGAR Economics. Accessed on April 1st 2019. Weblink.

11 Onshore Wind: Economic benefits in Northern Ireland. NIGIR, IWEA, RenewableUK. Accessed on April 1st 2019. Weblink

Economic impact of the operational phase

13.49 The starting point for modelling the operational phase of the project uses operations and maintenance direct job post figures again provided by RES, based on their extensive experience of operating projects not only in Northern Ireland but across the UK. From there, all indirect and induced estimates are produced using the Economic Impact Model.

Direct operational impacts

13.50 Following the 12-month construction phase, the development is expected to be operational in May 2024. The operational phase impact estimates have therefore been produced using Oxford Economics' 2024 forecasts of both GVA, productivity and wages. Additional earnings/wages have been estimated using Oxford Economics forecasts for average annual earnings per worker from the broad sector 'Electricity, gas and steam' in 2024 (these forecasts are themselves based on published data in the Annual Survey of Hours and Earnings).

13.51 RES has informed Oxford Economics that the Development will sustain one direct FTE job per annum, in the capacity of an asset manager (Table 13.5).[12]

13.52 The total direct wage is estimated to be £0.06 million per year. After applying productivity estimates, this on-going direct employment is expected to generate £0.24 million of GVA per annum. Given the 30-year lifetime of the development, this equates to 30 direct job years of employment, £1.80 million of direct wages and £7.20 million of direct GVA over the entirety of the operational phase.

Table 13.5: Direct annual benefits from the operational phase

Direct benefits	Jobs	Wages (£2016m)	GVA (£2016m)
Asset manager	1	£0.06	£0.24
Total	**1**	**£0.06**	**£0.24**

Source: Oxford Economics
Note: May not add due to rounding

Indirect and induced operational impacts

13.53 The electricity industry plays a significant role in enabling other parts of the economy to be more productive. The sector itself is one of the most productive in Northern Ireland, with output per worker significantly above that of the region overall. This reflects both the impact of high levels of investment and improving technology on productivity in the sector.

[12] Given spare capacity in the economy and the relatively small scale of the development, assumptions include job displacement of zero relating to the operational phase estimates - see 6.48 – 6.50 for further discussion.

13.54 Using the adjusted UK input-output tables to identify the supply chain spending, it is estimated that the Development is likely to create or sustain a further indirect job in the Northern Ireland economy each year, with wages of £0.03 million and GVA of £0.08 million per annum respectively (Table 13.6).

Table 13.6: Total annual benefits from the operational phase

Total (direct, indirect and induced) benefits	Jobs	Wages (£2016m)	GVA (£2016m)
Direct	1	£0.06	£0.24
Indirect	1	£0.03	£0.08
Induced	1	£0.02	£0.03
Total	**3**	**£0.11**	**£0.35**

Source: Oxford Economics
Note: May not add due to rounding

Table 13.7: Total annual sectoral benefits from the operational phase

Total (direct, indirect and induced) sectoral benefits	Jobs	Wages (£2016m)	GVA (£2016m)
Agriculture, forestry and fishing	0.00	0	0
Mining and quarrying	0.2	0.01	0.02
Manufacturing	0.1	0	0.01
Electricity, gas, and steam	1.1	0.06	0.27
Water supply; sewerage and waste	0	0	0
Construction	0	0	0
Wholesale and retail	0.2	0	0.01
Transportation and storage	0	0	0
Accommodation and food	0.1	0	0
Information and communication	0.1	0	0
Financial and insurance	0.1	0	0.01
Real estate	0.2	0.01	0.01
Professional, scientific and technical	0.1	0	0
Administrative and support	0.2	0	0
Public administration and defence	0	0	0
Education	0	0	0
Human health and social work	0	0	0
Arts, entertainment and recreation	0	0	0
Other services	0	0	0
Total	**3**	**0.11**	**0.35**

Source: Oxford Economics
Note: May not add due to rounding

Increased tax revenues and benefit savings

13.55 As part of this analysis it is assumed that approximately 34.8 percent of total wages would be paid to the Treasury through the channels of taxation.[13] This considers not only income tax, but value added tax through the purchase of goods and services by those in direct, indirect and induced employment.

13.56 During the construction period of the Development, tax receipts are likely to reach between £0.53-£0.7 million (including direct, indirect and induced wage impacts).

13.57 The operational phase is estimated to generate approximately £0.04 million in additional tax receipts each year of operation (Table 13.8). Over 30 years this would equate to £1.15 million in additional tax revenue.

Table 13.8: Annual tax revenues arising from the proposed Development

Tax revenue (over entire construction phase; per annum of on-going phase)	Wages (£2016m)	Tax revenue (£2016m)
Construction phase	1.53-2.02	0.53-0.70
Operational phase	0.11	0.04
Total	**1.64-2.13**	**0.57-0.74**

Source: Oxford Economics
Note: May not add due to rounding

13.58 In addition to tax receipts, employment creation will provide benefit savings. That is, assuming that each additional job attracts someone from the ranks of the unemployed directly or indirectly through the "job chain" effect, the construction or on-going operation of the site. While the Development may take someone from their current job, they will leave a vacancy and that will have to be filled, and so on and so forth – so eventually, a job will be filled down the line by someone from the ranks of the unemployed, though not necessarily directly. As such, the creation of a new job in the economy will lead to a reduction in the unemployed by a similar amount.

13.59 Currently, unemployment benefit varies between £57.90 and £114.85 per week.[14] Using these lower and upper levels, we estimate between £0.17-£0.44 million of savings will be made during the construction phase of the Development (Table 13.9).

[13] Based on the ONS publication 'The effects of taxes and benefits on household incomes, 2016/17'. Table 9. Accessed April 1st 2019. Weblink. Direct tax as a share of gross income is 20.6 percent, and indirect taxes as a share of disposable income is 17.9 percent. Combined this information suggests that 34.8 percent of gross income is paid to the Treasury via taxation.

[14] Figures taken from https://www.gov.uk/jobseekers-allowance/overview. Date accessed: 27th March 2019

Table 13.9: Annual benefits saving arising from the construction phase

Construction phase	Unemployment savings (£2013m)	
	Upper	Lower
Direct	0.22-0.29	0.11-0.15
Indirect	0.05-0.06	0.03-0.03
Induced	0.06-0.08	0.03-0.04
Total	**0.33-0.44**	**0.17-0.22**

Source: Oxford Economics
Note: May not add due to rounding

13.60 In addition, the on-going benefits are estimated to provide unemployment savings of between £0.27-£0.54 million over the project's lifetime.

Other quantifiable benefits of the Development

Rates and taxes

13.61 Wind farms in Northern Ireland are assigned a rateable value charged of £27,000 per megawatt per annum, based on information received from RES. Using the current rateable value and given that the Development will have a total capacity of 21.6MW, this means a figure of £583,200 in rates payments to the government annually, or approximately £17.50 million over the course of the project.

13.62 It should be noted that there is a difference in the rateable value charged on which the above figures are based, and the business rates revenue collected by the local Councils and the Northern Ireland Assembly – allowing for regional and Borough rate poundages. The most recent figures for Causeway Coast and Glens Borough Council indicate (total) non-domestic poundage rates of 58.9p for every £1, of which 34.0p is a regional rate paid to the Northern Ireland Assembly, and 24.8p of which is a Borough rate paid to the local Council.[15]

13.63 By applying the Non-Domestic Rate Poundage for Causeway Coast and Glens Council area, the above rateable values would leave additional business rates revenue of £343,246 per annum and £10.30 million over the 30-year lifetime of the project. In every case, 42.2% of the totals would be attributable to the local Council and the remaining 57.8% would be realised by the Northern Ireland Assembly.

13.64 All these additional payments referred to in this paragraph will result in increased income to the recipients, who will spend it in the Northern Ireland economy; over and above those already accounted for in the construction and on-going operations phase results.

[15] https://www.finance-ni.gov.uk/articles/poundages-2019-2020. Date accessed: 28th March 2019.

13.65 Over the lifetime of the project, rates and taxes will collectively amount to approximately £11.45 million. This figure does not include land rent contributions.

Energy and Environmental benefits

13.66 According to a report published by Northern Ireland's Department for the Economy, namely 'Energy in Northern Ireland 2018'[16], Northern Ireland had the largest percentage increase in the number of enterprises in the energy sector between 2013 to 2017. Over this period, the region recorded an increase of 88 percent compared to 40 percent across the UK as a whole. Furthermore, of the total Low Carbon and Renewable Energy (LCRE) activity in Northern Ireland in 2016, Energy Efficient Products was the group that accounted for the largest proportion of activity. This progress complements energy policies both nationally and regionally which highlight the need to move away from finite energy sources toward more renewable energy.

13.67 The Development is a 21.6 MW wind farm consisting of six x 3.6 MW turbines. The amount of electricity that could be produced by the Development is estimated at 87 gWh per year which is enough electricity to meet the needs of 22,700 homes each year.[17] This is equivalent to 40.6 percent of the housing stock in Causeway Coast and Glens Borough Council area.[18]

13.68 The Development is also estimated to reduce CO_2 emissions by 40,000 tonnes each year. This equivalent to 25,200 newly registered cars.[19]

13.69 Not only does the generation of electricity through wind present environmental benefits but it also produces benefits for consumers. A recent independent study by Baringa Partners[20] into the benefits of wind energy in Northern Ireland found that renewable electricity produced by wind has benefited consumers. The study estimates that each consumer receives a payback of £4 each year since 2000.

Socioeconomic Context

Global growth in recent years

13.70 The global economy has shown consistent levels of growth in recent years despite considerable economic and political headwinds. Performance has, however, varied significantly across countries. A slowdown in China, along with other emerging countries in Asia-Pac, and elsewhere have seen world trade ease. Combined with

[16] https://www.economy-ni.gov.uk/sites/default/files/publications/economy/energy-northern-ireland-2018.pdf

[17] For Magheramore, a load fact of 0.46 was provided by RES and applied to Oxford Economics' calculations. This load factor allows us to account for wake and electrical losses using typical wind speeds/directions etc. to give a realistic prediction of electricity output (rather than using a theoretical maximum level whereby it is assumed that wind blows for 24 hours a day 365 days a year on every wind farm site.)

[18] Oxford Economics Internal Model Suite.

[19] https://www.gov.uk/government/publications/new-car-carbon-dioxide-emissions

[20] http://res-group.mediaroom.com/how-wind-pays-back-to-consumers

growing political uncertainties surrounding Brexit and US-China trade wars have clouded the economic horizon.

13.71 The risk of protectionism snowballing has risen in response to President Trump's latest threat to implement tariffs on Chinese imports. Weaker growth in China is likely to have implications for global trade and markets. While the decision made by the public to leave the EU (Brexit) will have a marked impact on growth in the UK. Nonetheless, political events in the UK are far from certain and so the exact outcome of Brexit remains unclear, particularly with concerns around the final trade deal.

13.72 As a result, global growth is expected to moderate to 1.4 percent by the end of 2019, and over the next decade is forecast to average growth of 1.7 percent a year.

Causeway Coast and Glens Borough Council area

13.73 Not only will Brexit impact growth prospects in the UK, but also across its regions and local areas, including Causeway Coast and Glens Borough Council area. The following section considers the recent and future labour market performances of the local area.

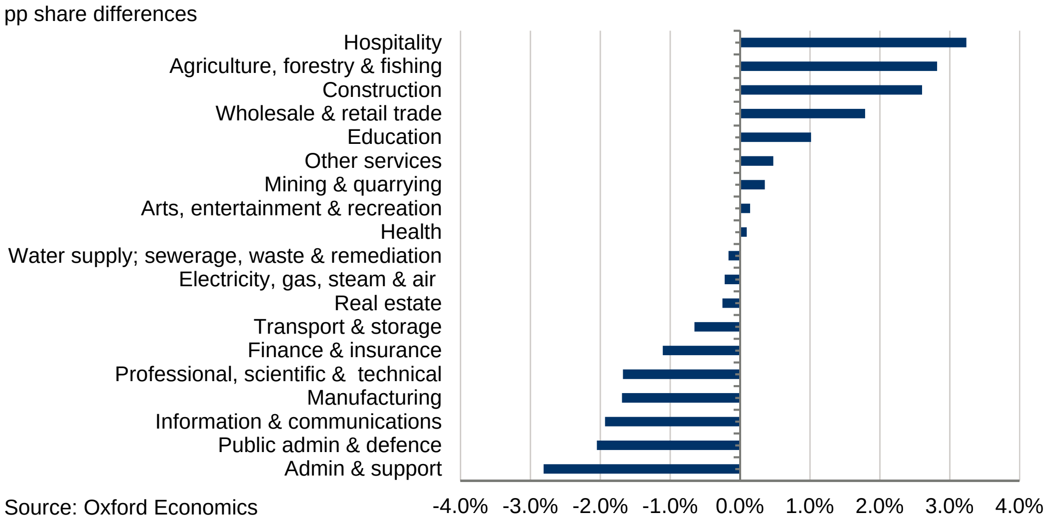
13.74 Total employment in Northern Ireland was the most heavily impacted region by the financial recession, and recovery has been slow. Between 2008 and 2012, the number of jobs in the region contracted by 6.9 percent – notably more than the UK average (of -0.6 percent) – and it was only recently, in 2016, when levels surpassed pre-recession records. Over the same period, construction employment in Northern Ireland was among the hardest hit sector in the region, accounting for 60 percent of the region's overall job losses. Though the sector has seen some recovery in recent years, employment in this sector remains below levels recorded before the downturn. More specifically, the number of construction jobs in 2018 are estimated to be 26 percent below those recorded in 2007.

13.75 The local area has struggled to generate jobs. Between 2008 and 2018, 2,800 jobs were lost in the local Council, while the region recorded muted growth (of 0.2 percent a year on average). Causeway Coast and Glens Borough Council area is also small in size – sustaining six percent of all jobs in Northern Ireland in 2018. As a result the local area was among the weakest contributors to overall job growth in Northern Ireland over the period.

13.76 Looking ahead job growth in the local area is expected to be muted. Between 2019 and 2029, growth in employment will average 0.1 percent a year at the local level. In number terms this translates to an increase of 500 jobs over the period. This rate of growth is significantly slower than for Northern Ireland (0.4 percent) and the UK (0.5 percent).

Employment growth prospects in the Council area can be, in part, explained by the area's employment structure. The figure below plots the percentage point difference between the share of employment by sector in Causeway Coast and Glens Borough Council area to the average for Northern Ireland. Sectors with a positive value employ a greater share of employment in the local area than the region as a whole. Conversely, sectors with a negative value employ a smaller share of employment in the local area compared to the regional average.

Figure 3: Sectoral concentration of employment, Council area v Northern Ireland, 2018



Source: Oxford Economics

13.77 Compared to Northern Ireland as a whole, the local area is over represented in sectors which have weak employment growth prospects – such as agriculture. Over the next decade, between 2019 and 2029, this sector is expected to see further job losses. By the same token, the local area is largely underrepresented in sectors likely to drive employment growth at the national level – such as admin & support, professional, scientific & technical and information & communications. Overall the largest contributors to job growth are expected from construction, health and hospitality. Combined these sectors are forecast to create 1,200 jobs in the local area over the period.

13.78 Analysis of other labour market indicators further support the economic need for new employment opportunities. Our data shows that not only is the inactivity rate (the people who are not in employment or unemployed such as the retired and long-term sick) for the local area above the regional average, but it also has a higher unemployment rate.

13.79 According to our latest estimates, the unemployment rate (ILO definition) for the local area stood at 4.8 percent in 2018, compared to 3.8 in Northern Ireland as a whole.

13.80 Furthermore, estimates from the Annual Population Survey show that working age economic inactivity rates within the local area are one of the highest in Northern Ireland. Over a third of working age residents were economically inactive in 2017. This is around six percentage points higher than the regional average. Combined, this highlights the need for new job prospects, including those stemming from the construction of the proposed Wind Farm.

Local skill levels among the lowest in Northern Ireland

13.81 At both ends of the educational spectrum, the Causeway Coast and Glens Borough Council area underperforms compared to others in Northern Ireland. According to figures published by NINIS, the proportion of the Council area's working age residents (aged between 16-6) having attained degree level qualification or above stood at 28 percent in 2017 – the second lowest of Northern Ireland's Council areas and significantly lagging behind the regional average (32 percent). In addition, the local area has the highest share of working age residents with below NVQ 4 at 56 percent in 2017. Once again this is notably below the regional average (51 percent).

13.82 Relatively poor skill levels are likely to mean residents invariably do not possess the skills demanded by employers and are therefore more likely be excluded from the labour market. Weak job growth coupled alongside below average skill levels are likely to contribute to economic inactivity and social exclusion within the local community.

13.83 The local economy faces some key socio-economic challenges, which have been further exposed by the last recession. The relatively weak employment outlook is likely to make it more challenging for the local council to address economic need and development. Therefore, investment and development opportunities in the area should be encouraged in order to promote opportunities and boost economic growth prospects.

Conclusions

13.84 The Development will offer a much-needed impetus to the local and regional economy. Job creation and economic activity will result throughout its construction, with a strong likelihood of local labour involvement. Both the construction and operational phase will generate l increased tax and business rates revenue payable to central, regional and local government.

13.85 Investment of this type and scale can provide positive catalytic benefits which can in turn attract further investment into Northern Ireland. For example, the knowledge, expertise and skills accumulated can act as a contributing factor to future investments in the area. Other local areas within Northern Ireland may also benefit as a result, helping to reduce the inequality across the region. Funding for such developments are usually project specific and involve a considerable amount of sunk costs. Therefore, if the development does not take place the benefits, including the catalytic impact, are unlikely to be realised elsewhere in the Northern Ireland economy.

13.86 The Development is estimated to involve a capital spend of £18.46 million. Of this total, £6.08 million (nominal prices) will be realised within the Northern Ireland economy. The projected 12-month construction phase is estimated to create or sustain 56-73 total (direct, indirect and induced) job years of employment, £1.53-£2.02 million (2016 prices) of wages and £2.64-£3.41 million (2016 prices) of GVA to the Northern Ireland economy.

13.87 The estimated total (direct, indirect and induced) benefits realised in Northern Ireland by the operational phase of the proposed Development includes wages of £3.3 million (2016 prices) and £10.5 million (2016 prices) in GVA over the 30-year operating period.

13.88 We also expect a fiscal injection from the Development. During the construction, the UK Exchequer is estimated to benefit from increased tax revenue and benefits saving of £0.70-£0.87 million (including direct, indirect and induced wage impacts). [21] Over the 30-year operational phase, an estimated £1.42-£1.69 million revenue and benefits savings will be generated.

13.89 Based on rateable values of £27,000 per MW—we calculate that the Development will increase rateable value by £583,200 each year, or by £17.50 million over the project horizon. From these values business rates are calculated and collected for local Councils and the Northern Ireland Assembly. By applying Causeway Coast and Glens Borough Council non-domestic poundage rates, we estimate additional business rates of £343,246 each year and £10.30 million over the 30-year lifetime of the project.

[21] This analysis relates to results from Method 1.

14

Summary of Mitigation

14 Summary of Mitigation

Alongside each mitigation measure identified, the proposed mechanism by which it will be adopted, implemented or enforced has been provided as well as the period by and /or timing which the mitigation measure will be undertaken.

Summary of Mitigation

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
4. LVIA	Landscape & Visual impact	The exterior surfaces of the turbines will be painted in a recessive, non-reflective light grey colour to minimise their visual prominence against the sky in most weather conditions.	By condition.
		The control room and substation compound will be designed in a manner that is sensitive to the immediate landscape character with regards to colour and choice of materials.	Through Construction & Decommissioning Method Statement (CDMS) to be agreed with CC & G BC prior to construction and implemented during construction.
		The site entrance is located at an existing access to farm lands on the south side of the Magheramore Road where two stone pillars and walls mark a well-defined farm entrance. Following construction, the site entrance will be reinstated to reduce the extent of hardstanding back to its original pre-construction state. Stone pillars and walls removed to allow access will be reinstated as will stock proof fencing. Any trees and hedgerows removed will be replanted.	By Condition. Decommissioning Method Statement to be agreed with CC & G BC prior to decommissioning and implemented during decommissioning.
5. Archaeology and Cultural Heritage	Potential direct effects on currently undiscovered archaeological remains and heritage assets on site	Programme of mitigation in advance of works to be agreed with HED:HM This programme will allow for features to be recorded appropriately and is likely to comprise; • Evaluation, by trial trenching, test-pitting and/or geophysical survey, as appropriate, of areas where extensive disturbance will occur (such as compounds and	By Condition. Programme of Works to be agreed with CC & G BC prior to construction and implemented during construction

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		turbine bases), particularly at lower altitudes (below 300m OD); and • Archaeological monitoring of groundworks where appropriate.	
6. Ecology	General	Measures required to address ecological concerns described in this ES during the construction phase will be incorporated within a Construction and Decommissioning Method Statement (CDMS), which will be submitted to and agreed with the CC & G BC at the pre-construction stage.	By Condition. CDMS will be agreed with the CC & G BC prior to construction and implemented during construction.
	Designated Watercourses	Avoidance during infrastructure design and SuDS drainage management (Appendix 9.1). No in-stream works will be required. Application of the SuDS drainage management and CMS as detailed in Appendix 9.1	By Condition HMP to be agreed with NIEA / CC & G BC prior to construction and implemented during construction and operation.
	Loss of Wet Heath / degraded Blanket Bog	Heathland restoration and enhancement according to the Outline HMP.	By Condition CDMS will be agreed with the CC & G BC prior to construction and implemented during construction
	Temporary disturbance to bats	Soft-felling and preconstruction inspection surveys have been recommended. Two Schwegler 1FF bat boxes will also be erected.	
	Potential collision risk of bats with turbine blades	The proposed turbine layout was amended to ensure a minimum stand-off distance of 50 m (Natural England TIN051) to all habitat edges (shelterbelts and natural watercourses) which will be maintained through the lifetime of the Development. A Bat Monitoring & Mitigation Plan (BMMP) will be implemented under the Precautionary Principle.	

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
	Bats (under precautionary principle).	The Bat Monitoring Plan (BMP) will be agreed with NIEA/The Council and monitoring will be undertaken in years 1, 2, 3 & 5 and will be reviewed after each survey period to determine whether remedial action is required to mitigate the effects of the Development on bats. At the end of year 5, the data will be reviewed to determine whether monitoring should continue.	By Condition BMP to be agreed with NIEA / CC & G BC prior to construction and implemented during construction and operation.
	Impact on Common Lizard	Depending on the commencement of construction on site, the works corridor will be mowed. If possible, this work will be undertaken before the end February (to avoid a conflict with the bird breeding season). If this is not possible, then mowing will take place between August and September, when common lizards are likely to be fully active. Should the latter be required, the corridor will be subjected to an active nest survey by a suitably qualified ornithologist immediately prior to the commencement of mowing operations. Clearance of stones, tree stumps, logs, brash, rocks or piles of similar debris will be undertaken carefully and by hand. Although this is only required in a few areas where the proposed site tracks traverse low stone walls. This work will not take place during the hibernation period for common lizard (i.e. mid-October to mid-March). Clearance of tall vegetation will be undertaken using a strimmer or brush cutter with all cuttings raked and removed the same day. Cutting will only be undertaken in a phased way which will either include: Cutting vegetation to a height of no less than 30mm, clearing no more	By Condition CDMS and HMP, which will be agreed with NIEA / CC & G BC prior to construction and implemented during construction.

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		than one third of the site in anyone day or; Cutting vegetation over three consecutive days to a height of no less than 150mm at the first cut, 75mm at the second cut and 30mm at the third cut; Following removal of tall vegetation using the methods outlined above, the remaining vegetation will be maintained at a height of 30mm through regular mowing or strimming to discourage common lizards from returning. Ground clearance of any remaining low vegetation (if required) and any ground works will only be undertaken following the works described above. As an additional precaution the ECoW will be present from the commencement of clearance/construction with a watching brief to ensure that no common lizards remain within the construction corridor and remain in situ until the area is cleared to ensure no species or habitat conflicts emerge affecting damage to the local lizard population. If any common lizards are found during excavation works, all works within the affected area will cease until the ECoW has safely removed them (under licence) from the construction corridor.	
	Badgers – Potential for disturbance	None required, no badger setts found within 25m of the construction area. However, given the foraging records for this species, a pre-construction badger survey will be completed. A detailed Protected Species Management Plan (PSMP) will be developed and agreed with NIEA prior to construction commencing. This will include details of the protection of	By Condition CDMS which will be agreed with NIEA / CC & G BC prior to construction and implemented during construction.

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		badgers. The following will be included within the PSMP (as a minimum): All excavations will be fenced off and/or ramps provided to prevent entrapment in the event that a badger was to fall into an excavation. No fencing that restricts access for badgers will to their foraging grounds will be permitted. An emergency procedure will be implemented by site workers if signs of badger (e.g. setts, latrines or animals) are encountered. All work within 25m to cease, and the Ecological Clerk of Works to inspect site and define mitigation (if required).	
7. Ornithology	Impacts during bird breeding season	To allow construction work to take place during the bird breeding season (1st March – 31st August) whilst avoiding any significant adverse effects on breeding birds	By Condition CDMS which will be agreed with NIEA / CC & G BC prior to construction and implemented during construction. During Construction
8. Fisheries	Sediment run-off	50m minimum width for significant watercourses (catchment area within site >0.25 km2 with the exception of essential watercourse crossings.	CDMS, to be agreed with CC & G BC prior to construction and implemented during construction.
	Construction Methods & Timing	All works at stream crossings will adhere to the measures outlined in the Good Practice Guidance notes PPG5: Works In, Near or Liable to Affect Watercourses (Environment Agency, 2014). It is also recommended that to minimise the risk of suspended sediment entrainment in surface water run-off, the site drainage system should only be constructed during periods of low rainfall and therefore low run-off rates.	

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
	Surface Water Management	The surface water management plan outlined in Chapter 9 will include a series of measures minimise modification and disruption of the existing hydrology. This approach will include a system for the drainage of the temporary works during the construction phase, with use of swales, check dams and settlement ponds to provide a surface water management system that will prevent any adverse effects on the ecology of the principal receiving watercourses during the construction phase of the project. Additional measures to prevent the release of suspended solids will include: • Preservation of natural run-off patterns; • Reduction of flow rates from access tracks through use of attenuating check-dams; • Use of shallow ponds to aid settlement; • Linear track drainage swales with regular outflow points throughout the SuDS system to limit the potential for large flows at single outflow points; • Avoidance of peat storage within denoted watercourse buffer zones or in areas of overland water flow.	
	Release of pollutants	All precautions will be taken to avoid spillages of diesel, oil or other polluting substances during the construction phase. This will be achieved through good site practices as described in the Good Practice Guidance notes proposed by EA/SEPA/NIEA (Environment Agency, 2014) A contingency plan will be prepared setting out the procedure to be followed in the event of a significant spillage occurring. Specific measures	

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		will be included in the Construction and Decommissioning Method Statement (CDMS), which will be agreed with DOE Planning prior to construction.	
	Sediment run-off, release of pollutants during decommissioning	Mitigation measures during decommissioning will be the same as during the construction phase with regard to addressing the potential for run-off of suspended solids and other polluting substances. The level of mitigation will be determined by the level of reinstatement required. It is proposed that the surface water quality monitoring be extended into the decommissioning phase.	Through Decommissioning Method Statement, to be agreed with CC & G BC prior to decommissioning and implemented during decommissioning.
9. Geology and Water Environment	Changes in run-off and flow pattern, silt/suspended solid/chemical pollution of watercourses	The Site will adopt a surface water management plan / site drainage design using the principles of Sustainable Drainage, promoting the principles of on-site retention of flows and use of buffers and other silt removal techniques. All drainage-related mitigation measures proposed will be encompassed by a robust and proven Sustainable Drainage System (SuDS) design which will be used to control drainage and silt management on the Site.	CDMS and CEMP, which will be agreed with CC & G BC prior to construction and implemented during construction. Outline SUDS is provided in Revised Technical Appendix 9.1 – Water Framework Directive Assessment in Annex 2 of outline CEMP
		Hydraulic design of crossings will be undertaken as per the guidance and requirements provided in CIRIA C689 “Culvert Design and Operation Guide” (or other standard as may be required by Rivers Agency in post-consent consultation), with primary parameters likely to include: ▪ Width of the culvert will be greater than the width of the active drainage channel; ▪ Alignment of the culvert will suit the alignment of the drainage channel, i.e. preserve the existing direction of flow; ▪ The slope of the culvert will not exceed the slope of the bed of the existing drainage channel. ▪ Detailed design of crossings will assume a hydraulic	Statutory Approval, prior to construction

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		capacity requirement of 1% Annual Equivalent Probability flow as a conservative measure. Detailed hydraulic design of culverts and similar structures post permission is normal and accepted practice for wind farms in Northern Ireland. ▪	
		Fisheries shall be protected by adopting the guidance stated in Guidelines for Fisheries Protection during Development Works as published by Loughs Agency.	Through CDMS which will be agreed with CC & G BC prior to construction and implemented during construction.
		Consultation and approval will be sought from all relevant parties as required by the Department of the Environment Surface Waters Alteration Handbook (December 2013), including Rivers Agency in particular, at the pre-construction detailed design stage for all works in and affecting watercourses and drains, as per the requirements of Schedule 6 of the Drainage (Northern Ireland) Order 1973 and subsequent amendments.	Statutory Approval, prior to construction
		A water quality monitoring program will be implemented to monitor effects on the hydrological and groundwater regime and water quality during the infrastructure construction, operation and decommissioning phases of the wind farm.in order to: ▪ Demonstrate that the mitigation measures and surface water management is performing as designed; ▪ Provide validation that the in-place mitigation measures are not having an adverse effect upon the environment; ▪ Indicate the need for additional mitigation measures to prevent, reduce or remove any effects on the water environment, such as additional temporary settlement or filtration	Through CDMS, which will be agreed with CC & G BC prior to construction and implemented during construction. Operational phase. Decommissioning Method Statement

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		structures or short term flocculant dosing to suit observed Site conditions.	
		A detailed Pollution Prevention Plan (PPP) will be implemented and monitored by the site manager as part of a full Construction & Decommissioning Method Statement (CDMS) for the project	Through CDMS, which will be agreed with CC & G BC prior to construction and implemented during construction
		▪ Storage – all equipment, materials and chemicals on the Site will be stored away from any watercourse (i.e. outwith previously stated buffer zones). Chemical, fuel and oil stores will be sited on impervious bases in accordance with PPG2 and within a secured bund of 110% of the storage capacity, within the lay down area. ▪ Vehicles and refuelling – standing machinery will have drip trays placed underneath to prevent oil and fuel leaks causing pollution. Refuelling of vehicles and machinery will be carried out on an impermeable surface in designated areas, well away from any watercourse or drainage ditches (i.e. outwith previously stated buffer zones) and will adhere to best practice as detailed in PPG7. ▪ Maintenance – on site maintenance to construction plant will be avoided in all practicable instances, unless vehicles have broken down necessitating maintenance at the point of breakdown. Suitable measures in accordance with a pollution prevention plan will be put in place prior to commencement of maintenance in this instance. ▪ Cement and concrete batching – Preference shall be given to construction techniques that do not require use of cementitious	

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		materials where suitable practicable alternatives exist. When concrete / cement are used, concrete batching will not be permitted on Site. Wet concrete operations will not be carried out within watercourses or adjacent to watercourses. Measures to prevent discharge of alkaline wastewaters or contaminated storm water to watercourses will be outlined in a detailed Pollution Prevention Plan for the Site to be approved by NIEA before commencement of works. Wastewater spillage will be minimised by using settling tanks and recycling water. ▪ Mess and welfare facilities will be required during construction and decommissioning and will be located at the construction compound. Foul effluent disposal shall be via chemical facilities with periodic tankered removal by a licensed waste haulier for licensed offsite disposal (i.e. there shall be no emission on Site).	
		Methods to divert minor watercourses will include the following: ▪ Works to divert drains (at the locations shown on drainage drawings WFD01 to 06 in Annex A) shall be programmed to coincide with a period of anticipated low drain flow and shall be undertaken prior to adjacent main earthworks associated with the reason for the diversion or realignment. ▪ The new channel alignment will be excavated starting from its downstream extent. The channel will be lined to prevent scour of the newly excavated surface. Scour protection (liners or rip rap) will be placed at bends.	

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		▪ Temporary barriers (silt fences or check dams) may be placed in the new channel and the downstream in-situ channel. The upstream drain will be diverted into the realigned channel and the former channel dammed and backfilled.	
		The following procedures apply to the general construction activities either within the watercourses or in defined watercourse buffer zones: ▪ Due consideration will be given to the prevailing ground and weather conditions when programming the execution of the works in order to ensure that in-channel works are undertaken during periods of predicted low flow and low rainfall in order to minimise contact with water. Ensure that roadside drains do not discharge directly into watercourses, but rather through a riparian buffer area of intact vegetation as denoted on design drawings.	Through CDMS, which will be agreed with CC & G BC prior to construction and implemented during construction
		Construction of watercourse crossings will be programmed to coincide with periods of predicted low flow in the affected channel (determined by rainfall and would generally coincide with summer months) and adhere to working period restrictions imposed. Construction will be strictly as per the design for each identified watercourse crossing and will fully implement all SuDS and additional mitigating measures proposed at the detailed design stage. For purposes of outline design, the proposed mitigation will include: ▪ Installation of silt fences parallel to the watercourse channel in the vicinity of the proposed crossing; ▪ Installation of small cut-off drains to prevent natural	Through CDMS, which will be agreed with CC & G BC prior to construction and implemented during construction Through CDMS, which will be agreed with CC & G BC prior to construction and implemented during construction

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		surface runoff entering area of construction activity; ▪ Installation of filtration or other silt entraining features within the watercourse channel immediately downstream of the works location; ▪ Use of over pumping where deemed appropriate. ▪ Due consideration will be given to the prevailing ground conditions and season when programming the execution of cable trench excavations in order to ensure works are undertaken during periods with low rainfall and elevated shallow groundwater levels in order to reduce the likelihood of runoff entering the excavations. ▪ Excavation of cable trenches will be carried out over short distances, with frequent backfilling of trenches to minimise opportunity for the ingress of water into open trenches, temporary silt traps will be provided in longer trench runs and on steeper slopes and spoil will be stored in line with a spoil management plan, which will be produced as part of the CDMS at the pre-construction stage. ▪	
		Soil and subsoil excavation and movement will be undertaken in accordance with best practice guidelines such as Good Practice Guide for Handling Soils (MAFF, 2000) in order to minimise potential for silt laden runoff from spoil and excavations. Areas of stockpiled spoil including stored peat: ▪ will not be permitted within previously identified watercourse buffer zones; and ▪ will not be permitted to obstruct the flow of overland	CDMS, which will be agreed with CC& G BC prior to construction and implemented during construction. Outline SUDS is provided in Revised Technical Appendix 9.1 – Water Framework Directive Assessment in Annex 2 of outline CEMP

ES Chapter	**Potential Effect**	**Mitigation Proposed**	**Means of Implementation and timing**
		surface water with specific drainage to spoil mounds to be provided. Spoil drainage will be designed on a bespoke basis for spoil storage areas and ditch blocking areas contained in the HMP to allow controlled dewatering and prevent washout of suspended solids to the receiving water environment.	
		In dry weather dust suppression methods such as by dust suppression bowser will be employed.	CDMS, which will be agreed with DOE Planning prior to construction and implemented during construction.
		All swales, crossings and other hydraulic features will be engineered to ensure that dimensions etc. are suitable to convey predicted flows and so prevent build-up of surface water and / or flooding. Shallow groundwater (e.g. in areas of glaciofluvial sand/gravel deposits) or rainfall runoff collected in excavations will be discharged via settlement ponds or filter strips prior to entry to the receiving water environment. Any settlement lagoons or filter strips associated with dewatering will be regularly inspected, particularly after periods of heavy rainfall and prior to periods of forecast heavy rainfall. Maintenance (to clear blockages or remove silt) will be carried out in periods of dry weather where practicable.	CDMS, which will be agreed with CC & G BC prior to construction and implemented during construction.
		Mitigation of the effects of the wind farm development will comprise the following: ▪ Ensure best practice is adhered to on the Site and avoid pollution release to watercourses by incorporating NIEA Pollution Prevention Guidance notes into management policy. ▪ In the event that permanent welfare facilities are installed	Operational management

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		as part of control building / substation facilities, foul effluent will be disposed of through the use of sealed cesspools or chemical facilities with periodic tankered removal by a licensed waste haulier for licensed offsite disposal (i.e. there shall be no emission on the Site). ▪ Cyclical maintenance of permanent SuDS drainage features installed during the construction phase, including unblocking of drains, maintenance of access road and other hard standing surfaces, and removal of silt build-up from settlement features. An outline maintenance programme is included in Technical Appendix 9.1: Water Framework Directive Assessment.	
App 9.3. Peat Slide Risk Assessment	General Risk Management Recommend-ations	It is recommended a phased site investigation be carried out pre-construction to confirm the deeper geological conditions across the development to provide sufficient information to allow the detailed design of all components of the wind farm.	CDMS, which will be agreed with CC & G BC prior to construction and implemented during construction.
10. Noise	Potential for operational noise to exceed daytime noise limit	Reduction of noise levels for certain wind speeds and directions during the day Noise management by operating certain turbines in noise reduced mode	By condition

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
	Potential construction noise at nearby properties Potential short-term construction noise at nearby residential properties	The following noise mitigation options will be implemented where appropriate: ▪ Consideration will be given to noise emissions when selecting plant and equipment to be used on site; ▪ All equipment should be maintained in good working order and fitted with the appropriate silencers, mufflers or acoustic covers where applicable; Stationary noise sources will be sited as far away as reasonably possible from residential properties and where necessary and appropriate, acoustic barriers will be used to screen them.	Through CDMS, which will be agreed with CC & G BC prior to construction and implemented during construction
		The movement of vehicles to and from the site will be controlled and employees will be instructed to ensure compliance with the noise control measures adopted.	TMP within CDMS, to be agreed with DfI Roads and CC & G BC prior to construction and implemented during construction.
		Site operations will be limited to 0700-1900 Monday to Saturday except during turbine erection and commissioning or during periods of emergency work.	By Condition
		Action may be required to reduce construction noise levels at nearby properties for work scheduled to take place on Saturdays 1300-1900. The following may be considered: ▪ Reduce number of construction activities occurring simultaneously ▪ Restrict distance of construction activities from identified properties or ▪ Reduce construction traffic as required. ▪	TMP within CDMS, to be agreed with DfI Roads and CC & G BC prior to construction and implemented during construction.
11. Traffic and Transport	Impact on other road users	A Traffic Management Plan (TMP) will be prepared by the Applicant in accordance with the requirements of Department of Infrastructure - Roads, CC & G BC, the local PSNI, and if	TMP within CDMS, to be agreed with DfI Roads and CC & G BC prior to construction and

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		required, any other relevant stakeholders. Features of the TMP will include: ▪ Details of the access route, conformation of any points along the access route that require engineering works, details of traffic numbers, delivery timings, and signage and escort requirements; ▪ A delivery schedule for normal and abnormal loads so as to minimise disruption as far as reasonably practicable; ▪ Details of how any movements will comply with legislation regarding the movement of abnormal loads e.g. notice procedures and notice periods; ▪ Details on the use of escorts where required. Where long vehicles and abnormal loads would have to use the wrong side of the carriageway or need to swing into the path of oncoming vehicles a lead warning vehicle would be used. One escort vehicle would drive ahead and pull oncoming traffic into identified passing places. An escort vehicle would travel directly in front of the convoy and pull over any oncoming traffic that comes onto the road after the first escort vehicle has passed. A further convoy escort vehicle would follow the convoy; and ▪ Information about marking of vehicles as long/abnormal loads. ▪ Information on how warning signs will be used ▪ The TMP will include plans for notifying relevant stakeholders in advance of delivery periods, including the emergency services, Transport NI, local residents,	implemented during construction.

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
		local business, local services and schools.	
		A video survey of the pre-construction condition of all public roads will be recorded around the site entrances and access routes (but including the site entrance and immediate access roads), to provide a baseline record of the state of the roads prior to construction work commencing. This will enable any repairs and maintenance work required to the relevant road due to any damage caused by the passing of heavy vehicles associated with the wind farm construction to be identified following the construction phase. The roads will be returned, at minimum, to the baseline condition at the end of the construction phase. Any damage caused by wind farm traffic during the construction period, which would be hazardous to public traffic, will be repaired immediately. These works will be carried out under permits with DfI Roads, as appropriate.	CDMS, to be agreed with CC & G BC prior to construction and implemented during construction.
		The local community will be informed prior to the commencement of construction and prior to the commencement of turbine deliveries by letter and through local press. The contact details of the Construction Site Manager will be made available as a contact point for enquiries. Local schools on the delivery routes will be contacted to identify school and nursery drop-off and pick up locations and times. Construction deliveries will be scheduled to avoid these busy periods as far as reasonably possibl	TMP within CDMS, to be agreed with CC & G BC prior to construction and implemented during construction.
	Impact on breeding birds	If cutting or removal of hedges and trees is required then this should be done outside the bird breeding season (1st March to 31st August). If work is to be done during the breeding season then there should be a survey to establish whether nesting birds are present.	CDMS, to be agreed with CC & G BC prior to construction and implemented during construction.

ES Chapter	Potential Effect	Mitigation Proposed	Means of Implementation and timing
12. Shadow Flicker	Material reduction to residential amenity	Mitigation measures can be incorporated into the operation of the wind farm to reduce the instance of shadow flicker. Mitigation measures range from planting tree belts between the affected dwelling and the responsible turbine(s) or installing blinds at the affected dwellings. When there is extreme nuisance, mitigation could be to the extreme of shutting down individual turbines during periods when shadow flicker could theoretically occur.	By Condition