AA Screening and Natura Impact Statement

Muingmore Wind Farm

RWE Renewables Ireland Limited

Prepared by:

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Making Sustainability Happen

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Basis of Report

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Glossary of terms

Term	Acronym	Definition
Appropriate Assessment	AA	An assessment under Article 6(3) of the Habitats Directive to determine whether a plan or project will adversely affect the integrity of a European site.
Appropriate Assessment Screening	AA Screening	The initial stage of Article 6(3) assessment to determine, based on objective scientific information, whether likely significant effects on a European site can be excluded.
Natura Impact Statement	NIS	A scientific report informing Appropriate Assessment, assessing the implications of a project for European sites in view of their conservation objectives.
Habitats Directive	—	Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (as amended).
Birds Directive	—	Directive 2009/147/EC on the conservation of wild birds (as amended).
European Site	—	A Special Area of Conservation (SAC) or Special Protection Area (SPA), including candidate and proposed sites, designated under the Habitats and Birds Directives.
Special Area of Conservation	SAC	A site designated under the Habitats Directive for the protection of Annex I habitats and Annex II species including a candidate site.
Special Protection Area	SPA	A site designated under the Birds Directive for the protection of bird species listed in Annex I and regularly occurring migratory species including proposed sites.
Qualifying Interests	QIs	Habitats and species for which a SAC is designated.
Special Conservation Interests	SCIs	Bird species and habitats for which a SPA is designated.
Conservation Objectives	—	Site-specific objectives defining the required condition of qualifying interests necessary to maintain or restore site integrity.
Site Integrity	—	The coherence of a European site's ecological structure and function, across its whole area, enabling it to sustain its qualifying interests.
Likely Significant Effect	LSE	Any effect that may undermine a site's conservation objectives, either alone or in combination, and which cannot be excluded on the basis of objective information.
In-Combination Effects	—	Cumulative or synergistic effects arising from a project together with other plans or projects.
Source–Pathway–Receptor Model	SPR	A conceptual framework identifying how a project source may affect a receptor via an ecological or physical pathway.
Zone of Influence	ZoI	The spatial area within which project activities could give rise to effects on environmental receptors, defined case-by-case rather than by fixed distance thresholds.
Best Available Scientific Knowledge	—	The most up-to-date, relevant and reliable scientific information available at the time of assessment.
Competent Authority	—	The public authority responsible for carrying out Appropriate Assessment and determining consent (e.g. An Coimisiún Pleanála or a planning authority).

Term	Acronym	Definition
Collision Risk Model	CRM	A quantitative model used to estimate the risk of bird collisions with wind turbines based on flight activity and turbine parameters.
Conservation Status	—	The overall condition of a habitat or species, assessed in terms of range, structure, function and long-term viability.
Mitigation Measures	—	Measures designed to avoid or reduce adverse effects on European sites; considered at Appropriate Assessment stage, not at screening.
Adverse Effect on Site Integrity	—	An effect that prevents a European site from maintaining or restoring its qualifying interests in a favourable condition.
Construction Environmental Management Plan	CEMP	A document setting out measures to manage and mitigate environmental effects during construction, operation and decommissioning.
Sustainable Drainage Systems	SuDS	Drainage techniques designed to manage surface water runoff in a way that mimics natural processes and protects water quality.

1.0 Introduction

SLR Environmental Consulting (Ireland) Ltd was commissioned by RWE Renewables Ireland Limited to assist with the Appropriate Assessment (AA) Screening process and Natura Impact Statement (NIS) and produce the Appropriate Assessment (AA) Screening Report and NIS to accompany a planning application for the Proposed Development. The Proposed Development comprises the construction of a 13 no. turbine wind farm development. The Proposed Project also includes an 110kV underground Grid Connection Route (GCR) (approx. 25.5 km long) which runs from the substation on Main Wind Farm Development Site to the Bellacorick Substation. The underground GCR will be located entirely within the public roads and while being assessed in this AA Screening and NIS does not form part of the planning application. The NIS has assessed the entire Proposed Project.

1.1 Definition of terms

The following terms (Capitalised) are used within this report.

Proposed Project: Refers to the Proposed Development including the GCR.

Proposed Development: Refers to the elements of the Proposed Project for which planning consent is being sought. This encompasses the wind farm and associated infrastructure (including the 33kV collector cables), Habitat Enhancement Area in the north-west quadrant (NWQ), any development associated with the Turbine Delivery Route (TDR), onsite substation, and battery energy storage system (BESS).

Proposed Development Site: The site where the Proposed Development is located, as defined by the Planning Application Boundary.

Main Wind Farm Development Site: part of the Proposed Development Site which includes the proposed wind turbines and associated infrastructure.

The Northern Cluster of the Main Wind Farm Development Site is comprised of a geographical area to the north of the local road, the L5252. Elements of the Proposed Development which will be located in the Northern Cluster comprise.

- 7 no. turbines (turbine nos. 1-7) and their associated access tracks, hardstandings and foundations.
- 1 no. 110kV substation.
- 1 no. temporary construction compound (TCC1).
- 1 no. BESS.
- 2 no. site access points (AP1 and AP2).
- Internal underground 33kV collector cables which connects both clusters to the onsite substation which is located within the Northern Cluster.
- Habitat Enhancement Area in the north-west quadrant (NWQ).

The Southern Cluster of the Main Wind Farm Development Site is defined by the area to the south of the local road, the L5252. Elements of the Proposed Development which will be located in the Southern Cluster comprise:

- 6 no. turbines (turbine nos. 8-13) and their associated access tracks, hardstandings and foundations.
- 1 no. temporary construction compound (TCC2).
- 1 no. meteorological mast.
- 1 no. site access point (AP3).

- Internal underground 33kV collector cables, connecting to the onsite substation which is located within the Northern Cluster.

Turbine Delivery Route (TDR): Refers to the proposed turbine delivery route from Killybegs Port to the Main Wind Farm Development Site and includes the 3 no. Over-run Areas.

Over-run Areas: Refers to the 3 no. areas (Over-run Areas 1, 2 & 3) along the TDR where temporary accommodation works on private lands are required.

Grid Connection Route (GCR): The designated route for the 110kV Underground Electricity Cable from the Proposed Development onsite substation to the national grid connection point at Bellacorick 110 kV Substation. The GCR will be the subject of a separate planning application.

Habitat Enhancement Area in the (NWQ): An area to the north-west of the Main Wind Farm Development Site which will not include any infrastructure related to the Proposed Project other than that to enhance habitat.

1.2 Relevant Legislation and Policy

The requirement for AA screening and AA is set out in the Habitats Directive (Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, which is transposed into Irish law primarily through the European Communities (Birds and Natural Habitats) Regulations 2011–21, (S.I. 477 of 2011, as amended) ("Birds and Natural Habitats Regulations") and the Planning and Development Act 2000, (as amended).

The Habitats Directive requires that where a plan or project is likely to have a significant effect on a Natura 2000 Site, either individually or in combination with other plans or projects, while not directly connected with or necessary to the nature conservation management of the site, it will be subject to 'Appropriate Assessment' to identify any implications for the Natura 2000 site in view of the site's Conservation Objectives. Specifically, Article 6(3) of the Habitats Directive states:

'6(3) Any plan or project not directly connected with or necessary to the management of the [Natura 2000] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public'.

Habitats Directive and Birds directives provide legal protection for habitats and species of European importance. In Ireland these protections relate to Special Areas of Conservation (SACs) and Special Protected Area (SPAs) which collectively are referred to as European Sites in the Council Directive 92/43/EEC.

Under the implementing legislation in Ireland, all candidate SACs and potential SPAs are afforded full protections until a formal decision on designation has been reached, therefore for the purpose of this report they are referred to as SACs and SPAs. All designated and proposed SACs and SPAs are classified as 'European sites'.

Under the implementing legislation in Ireland, the competent authority must carry out a screening for Appropriate Assessment to determine, in view of objective information and the best scientific knowledge, whether a proposed project, either individually or in combination with other plans or projects, is likely to have a significant effect on a European site.

Where likely significant effects cannot be excluded at screening, an Appropriate Assessment is required. The Appropriate Assessment must examine the implications of the proposed

project for the European site(s) in view of their conservation objectives and may only conclude no adverse effects on site integrity where it can be established, beyond reasonable scientific doubt, that such effects will not occur. The provisions of Article 6(3) do not apply where the proposed plan or project is 'connected with or necessary to the management of the site'.

1.3 Report Purpose

This report presents an Appropriate Assessment Screening of the Proposed Project to determine, a preliminary assessment based on objective information and best available scientific knowledge, whether the Proposed Project, either alone or in combination with other plans or projects, could have a significant effect on a European site; in view of the site's conservation objectives.

Where likely significant effects cannot be excluded, the report also includes a Natura Impact Statement, which is based on the best available scientific knowledge assessing the implications of the proposed project for European site(s), in view of their conservation objectives and site integrity.

The report has been prepared to inform the competent authority in carrying out an Appropriate Assessment, as required under Article 6(3) of Council Directive 92/43/EEC (the Habitats Directive).

The information presented will allow the Competent Authority to make their determination regarding likely significant effects on European sites resulting from the Proposed Project, in accordance with and fulfilment of the requirements of Article 6 of the Habitats Directive

1.4 Guidance

The assessment was conducted in accordance with the following guidance:

- European Commission. (2021). Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC. Commission Notice (2021) Brussels, 28.9.2021 C (2021) 6913 final.
- Environment Heritage and Local Government. (2009, updated 2010). Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities. Dublin: National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government.
- European Commission. (2019). Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC. Brussels, (2019/C 33/01). OJ C 33, 25.1.2019.
- European Commission. (2013). Interpretation Manual of European Union Habitats. Version EUR 28.
- Office of the Planning Regulator. (2021). OPR Practice Note PN01 Appropriate Assessment Screening for Development Management.

1.5 Sources of Information

Sources of information for the assessment of the project /plan 'alone' and in combination with other plans and projects consists of the following:

- Environmental Protection Agency (EPA) (on-line map-viewer including the Appropriate Assessment Tool)[1];

[1] https://gis.epa.ie/EPAMaps, accessed 30 January 2025

- Geological Survey Ireland (GSI) Spatial Resources[2];
- Department of Housing, Planning, and Local Government- EIA Portal[3];
- National Planning Database for information on other projects and plans[4];
- National Parks and Wildlife Service – online European site network information, including site conservation objectives[5];
- National Parks and Wildlife Service – Information on the status of EU protected habitats and species in Ireland (including Article 17 and Article 12 Reports);
- National Biodiversity Data Centre[6]
- Fitzgerald Ecology (2024) Habitat survey of Muingmore Wind Farm, Co. Mayo;
- Fitzgerald Ecology (2023) Marsh Fritillary Survey – Muingmore Wind Farm, Co. Mayo;
- Triturus (2024) Fisheries assessment of the proposed Muingmore Wind Farm, Co. Mayo (**Appendix 3**);
- Triturus (2024) Aquatic baseline report for the proposed Muingmore Wind Farm, Co. Mayo (**Appendix 3**);
- Woodrow (2024) Ornithology Results Reports for Muingmore Wind Farm, Co. Mayo 2021-24 (**Appendix 2**); and
- Muingmore Wind Farm, Environmental Impact Assessment Report, especially Chapters 2, 5 and 7.

Sources of information for the plans and projects for the "in combination" assessment were as above and consists of:

- Mayo County Council Online Planning Portal[7]
- Mayo County Development Plan 2022 - 2028[8];
- National Biodiversity Action Plan[9]; and
- Regional Spatial and Economic Strategy 2020-2032 (RSES)[10]
- Sustainable Energy Authority of Ireland Wind Energy Mapping[11];
- National Planning Database for project data[12].

[2] https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228, accessed 22 December 2025
[3] https://housinggovie.maps.arcgis.com/apps/webappviewer/index.html?id=d7d5a3d48f104ecbb206e7e5f84b71f1, accessed 22 December 2025
[4] https://housinggovie.maps.arcgis.com/apps/webappviewer/index.html?id=9cf2a09799d74d8e9316a3d3a4d3a8de, accessed 22 December 2025
[5] www.npws.ie, accessed 22 December 2025
[6] www.biodiversityireland.ie, accessed 22 December 2025
[7] Search For Planning- Mayo County Council Accessed 10/11/2025
[8] VOL-1-Book_2.pdf (mayo.ie) Accessed 10/11/2025
[9] https://www.npws.ie/sites/default/files/publications/pdf/National%20Biodiversity%20Action%20Plan%20English.pdf Accessed 10/11/2025
[10] https://www.nwra.ie/rses/#:~:text=Regional%20Spatial%20and%20Economic%20Strategy%202020%2D2032%20(RSES)&text=The%20RSES%20introduces%20the%20concept,we%20need%20effective%20regional%20planning. Accessed 10/11/2025
[11] https://gis.seai.ie/wind/ Accessed 30/03/2022
[12] https://data.gov.ie/dataset/national-planning-applications Accessed 10/11/2025

1.6 Methodological Approach to Article 6(3) Assessment (Screening and Appropriate Assessment)

The methodological framework described below applies to both stages of the Article 6(3) process. At Stage 1, the information presented is used to support the competent authority in screening for Appropriate Assessment. Where likely significant effects cannot be excluded, the same framework is applied in greater detail at Stage 2 through the preparation of a Natura Impact Statement to inform the Appropriate Assessment carried out by the competent authority.

The assessment of potential effects on European sites is an iterative process informed by a Source–Pathway–Receptor (SPR) model and is based on best available scientific knowledge. This report identifies and examines potential SPR linkages associated with the proposed project in order to provide objective scientific information to support the competent authority in determining whether likely significant effects on European sites, either alone or in combination with other plans or projects, can be excluded at screening stage, or, where required, to inform the Appropriate Assessment of the project's implications for European sites in view of their conservation objectives and site integrity.

For an effect to occur, a source, a pathway and a receptor must all be present. Where one or more of these elements is demonstrably absent, the report provides evidence to support the exclusion of a potential effect. Where all elements are present, the potential for effects is examined in greater detail having regard to the sensitivity of the receptor, the characteristics of the pathway, and the nature and scale of the source.

In the context of this assessment:

- Sources are any identifiable elements of the Proposed Project that may interact with the receiving environment, such as physical disturbance, emissions, resource use or operational activities;
- Pathways are any ecological, hydrological or functional connections by which a source may affect a receptor; and
- Receptors are the Qualifying Interests of Special Areas of Conservation and the Special Conservation Interests of Special Protection Areas, as well as ecological features known to support those interests. The term qualifying features is used in this report to collectively refer to these interests.

The assessment commences with a description of the Proposed Project and the receiving environment, including relevant baseline conditions. Potential sources of impact associated with the Proposed Project are identified having regard to the nature, scale, duration and timing of the project and its constituent activities. These sources are used to define the Zone of Influence (ZoI) of the Proposed Project, representing the geographical area over which the project could reasonably give rise to effects on the receiving environment (See Section 3.3.2.2. for further details).

The identification of relevant European sites within the ZoI is informed by the guidance set out in the European Commission Notice on the assessment of plans and projects in relation to Natura 2000 sites (2021), including consideration of:

- European sites that overlap with, are adjacent to, or are located within the ZoI of the proposed project;
- European sites that could be indirectly affected by the project, including through the use of natural resources or the emission of substances or energy; and
- European sites whose ecological connectivity or functional relationships could be affected by the project.

The ZoI is established on a case-by-case basis using the SPR framework and is not defined by arbitrary distance thresholds. Potential pathways linking identified sources to European sites and their qualifying features are examined to determine whether ecological or functional connectivity exists.

The potential for in-combination effects with other plans or projects is considered by examining whether overlapping sources, pathways or receptors could give rise to cumulative or synergistic effects on European sites.

In accordance with the precautionary principle, as articulated by the European Commission, the absence of complete scientific certainty cannot be relied upon to exclude the possibility of effects where a risk to European sites remains. Where likely significant effects cannot be excluded based on objective scientific information, the project is required to be subject to Appropriate Assessment. Further detail on how the likelihood of significant effects is defined, interpreted and considered in the context of this report is provided in section 3.4.

The consideration of mitigation measures and the assessment of effects on site integrity are addressed at Appropriate Assessment stage and are not applied at screening stage.

This report is based on best available scientific knowledge and professional ecological judgement. It draws on published scientific literature, available data from the National Parks and Wildlife Service, including site-specific conservation objectives, and other relevant environmental information; as listed above. The authors have the appropriate scientific qualifications and experience to support the works undertaken as set out in section 1.6 below.

1.7 Statement of Scientific Competence

Kathryn Robson

This report has been written by Kathryn Robson BSc Hons, MSc. Kathryn is a senior ecologist at SLR Consulting Ltd with 8 years of experience as a professional ecological consultant. Her project experience has primarily been in the renewable energy sector, mainly onshore wind farms, at all stages of the development process, from design to completion. Competent in undertaking most terrestrial ecology surveys, her survey experience has focussed on ornithology and bat surveys. Kathryn holds a MSc in Ecological Management and Conservation Biology and a BSc in Biological Sciences, both from Queen's University Belfast.

Andrew Torsney

Andrew Torsney BSc, MRes, PhD, ACIEEM provided oversight in the project direction as well as technical review of this report. The Annex I habitat condition assessment survey was also conducted by Andrew. Andrew has undertaken AAs for several national regional and local plans as well as project level assessments. Andrew has experience undertaking technical assessments of largescale wind farms on projects such as Carrownaglough, Coomatalin and Dublin Array. Andrew is a technical specialist in AA processes and has undertaken review processes for competent authorities such as the Department of Public Expenditure and Reform and County Councils such as Dun Laoghaire Rathdown and Kilkenny. Andrew has also delivered training on the role of county councils in the AA process as well as having authored NIS reports for a variety of project types.

Jonathon Dunn

The collision risk modelling report was written by Jonathon Dunn MA (Cantab.) MSc PhD MCIEEM, and he also provided additional technical review. Jonathon also undertook the initial site walkover and survey of the grid route and turbine delivery route. Jonathon has worked in the environmental sector since 2014 and joined SLR Consulting in 2021. Prior to working in environmental consultancy, he used to undertake research at Newcastle University on avian ecology and conservation. He holds a PhD in avian ecology from Newcastle University, a MSc in Ecology, Evolution and Conservation from Imperial College London and a MA (Cantab.) in

Natural Sciences from the University of Cambridge. Jonathon has extensive experience undertaking and managing bird surveys, along with bat, botanical and mammalian surveys. Jonathon has worked on a wide variety of projects with a focus on wind farms.

Sinéad Clifford

The initial site walkover and survey of the GCR and TDR was undertaken by Sinéad Clifford BSc (Hons). Sinéad has worked in the environmental sector since 2015 and joined SLR Consulting in 2021. She holds a BSc. in Wildlife Biology from Institute of Technology Tralee, and a Certificate (Distinction) in Ecological Consultancy from Ecology Training UK (formerly Acorn Ecology). Sinéad has strong field skills, and regularly carries out bat, ornithological, botanical and mammalian surveys. In addition, she has extensive experience managing bat surveys for large scale projects, including wind energy developments.

Ross Macklin

The aquatic ecology and fisheries reports were written by Ross Macklin PhD (in preparation) B.Sc. (Hons) MCIEEM., MIFM, HDip GIS, PDip IPM (Principal ecologist with Triturus Environmental Ltd). Ross is an ecologist with over 16 years' professional experience in Ireland. He specialises in freshwater fisheries ecology, biology and water quality. He has considerable experience in a wide range of ecological and environmental projects including EIAR, EcIA, AA/NIS, CEMP reporting, as well as biodiversity, water quality monitoring, invasive species and fisheries management. He also has expert identification skills in macrophytes, freshwater invertebrates, protected aquatic habitats and protected aquatic species including freshwater pearl mussel.

Alexis Fitzgerald

The initial habitat survey was undertaken by Alexis Fitzgerald BA MSc ACIEEM (Director of FitzGerald Ecology consultancy). Alexis is a passionate field botanist and vegetation ecologist with over 9 years of professional experience in Ireland. He has extensive expertise in vascular (terrestrial and aquatic) plant, bryophyte and charophyte identification and habitat surveying, including Irish Heritage Council classification (Fossitt, 2007), Annex I habitat classification, Irish Vegetation Classification (IVC), National Parks and Wildlife Service 'Uplands Manual' habitat classification and Flora (Protection) Order, 2022 species identification and conservation.

Woodrow Personnel

Baseline ornithology data were provided by Woodrow and the relevant specialisms of the personnel can be found in **Appendix 2**.

1.8 Consultation

A scoping request in relation to the Proposed Project was sent to various consultees in April 2024.). A total of 12 biodiversity-related consultees were contacted, of which three provided responses. (see **Chapter 3** for more information). A summary of the responses relating to biodiversity and how they have been addressed are also provided in **Table 1-1** below.

Table 1-1: Response to consultation comments

Prescribed Body	Comment Summary	Response
Development Applications Unit, National Parks and Wildlife Service (NPWS)	Merlin recorded on site. Guidance documents provided. Two meetings were held with NPWS (6th March 2024 and 12 March 2025) to discuss the overall approach. It was noted that an appropriate reference population should be selected for key species within the collision	Four years of baseline bird survey effort has been undertaken within the Main Wind Farm Development Site and immediate area, including vantage point surveys and breeding raptor surveys. Three years of the data was used to inform the assessment

Prescribed Body	Comment Summary	Response
	risk modelling process. It was stated that there is a very small breeding Golden Plover population in Mayo, vulnerable to cumulative impacts and that cumulative assessment shouldn't reiterate conclusions of other assessments but focus on mortality effects. It was noted that offshore bird species and developments should be considered in cumulative assessment. A key point of discussion was that the existing site is degraded due to extensive drainage and peat cutting, so suitable for enhancement with the wind farm able to provide a positive Biodiversity Net Gain (BNG). NPWS welcomed opportunities for BNG. Ongoing communication was undertaken with NPWS in relation to the Annex I habitats and approach being taken. It was agreed in a meeting on the 16th of September 2025 that the following was required. • Apply Irish Vegetation Classification (IVC) alongside existing habitat classification systems. • Develop a clear methodology for Annex I impact characterisation, including hydrological and elevation modelling. • Define potential compensatory enhancement scenarios for poor-condition Annex I habitat, recognising this may evolve. Establish appropriate long-term monitoring metrics for habitat condition.	process as the analysis was undertaken as the final year of data was being collected. Appropriate reference populations have been selected for communication with NPWS which include those specified related to Merlin and Golden Plover. Offshore bird species were considered extensively regarding offshore windfarms and ranging patterns. Particularly regarding SPAs. Detailed restoration plans and BNG assessments have been undertaken. The annex I condition assessments have been undertaken for the all the peatland habitats – which includes IVC classifications **Appendix 4 Habitat Condition Assessment Report.** This data was then used to model the outcomes and calculate the overall habitat loss areas and inform the net gain assessment. The details of which were used to create the Habitat Management Plan (HMP) has been written and is included as part of the Peatland Restoration Plan (Appendix A) in **Appendix 7** of this NIS to ensure the improvement of the condition of the cutover blanket bog within the Main Wind Farm Development Site. This approach is consistent with that which was outlined to the NPWS.
Irish Peatland Conservation Council (IPCC)	The IPCC state that while they understand the need to shift to renewable energy, installing wind farm infrastructure on the cutaways, cutovers and blanket bog habitats does not maximise the benefit that peatlands can provide. It has been highlighted by the European Commission that for every €1 spent on nature restoration €4-38 is returned in other areas of our lives. The hydrology of an industrial wind farm site has to be continually managed, the fragmentation from the roadways and cabling further disrupts the peat mass and the question as to whether the large wader birds which are under threat of extinction such as the Curlew, will return, has not been answered.	Surveys of the Main Wind Farm Development Site have been undertaken to assess the bird assemblage including species such as curlew. The CRM specifically details potential risks to the species and re-uptake of lands nationally by rare species is not known but the habitat enhancement will support this. A Habitat Management Plan (HMP) has been written and is included within the Peatland Restoration Plan which can be found as part of the Peatland Restoration Plan (Appendix A) in **Appendix 7** of this NIS. This plan is to ensure the improvement of the condition of the cutover blanket bog within the Main Wind Farm Development Site.
Minister for Rural and Community Development	No comment was made specifically with regard to the AA process.	No comment was made specifically with regard to the AA process.

2.0 Proposed Project

2.1 Detailed Description of Proposed Project

The Proposed Project will primarily consist of a wind farm of 13 No. wind turbine generators (WTGs), meteorological mast, 110kV substation compound along with ancillary civil and electrical infrastructure, BESS, and 3 no. temporary Overrun Areas along the TDR. Construction of two temporary construction compounds will be required, with associated temporary site offices, parking areas, welfare facilities and security fencing.

The total installed capacity of the Proposed Development is estimated to be between 74.1 to 91 MW[13].

The exact turbine will be subject to a competitive procurement process that will only commence if the Proposed Development receives consent. The proposed turbines will be detailed by the turbine manufacturer at award of the contract.

As such the proposed turbines will be within the following specifications:

- The turbines will be three bladed, horizontal axis type.
- The turbines will have a height range of 179-180m from top of foundation (at ground level) to blade tip height.
- The rotor diameter of the proposed turbines will be within the range of 149-163m.
- The hub height will be within the range of 98.5 to 105m.
- Foundation diameters will either be gravity or piled foundations.

A 33kv collector cable will run between the Northern and Southern Clusters of the Proposed Development.

The associated GCR will consist entirely of an underground cable route. This GCR has been assessed in the EIAR but does not form part of the Proposed Development. This chapter does include details of the Proposed Development and the Proposed Project.

Construction methodologies provided in this Chapter of the EIAR are based on initial site investigations and intended to enable a robust assessment of the potential impacts of the Proposed Project. Further details are provided in the Construction Environmental Management Plan (CEMP).

The CEMP will be updated prior to commencement of construction activities to address the requirements of any relevant planning conditions, including any additional measures which are conditioned and will be submitted to the planning authority for written approval.

2.2 Temporary Construction Compounds

Two temporary construction compounds will be provided, one each within the Northern and Southern clusters. The compound boundaries will be set out and marked prior to any works commencing. Any significant surface undulations or irregularities will be trimmed and the removed peat placed in designated peat storage areas for reuse or reinstatement, subject to ECoW approval. Otherwise, surface vegetation is to remain intact to increase founding strength.

Where the fibrous top layer is weak or saturated, a geotextile or geocomposite material will be placed directly upon the ground surface to improve load distribution, separation, filtration and drainage.

[13] Note: the MW output is stated here based on turbines of between 5.7 MW and 7 MW output only for the purposes of assessment of benefits towards climate as set out in **Chapter 8**.

A base geosynthetic layer, to be specified pending the specific site conditions identified at the pre-construction stage, will be installed across the full compound footprint. Overlaps, anchorage, and tensile orientation will conform to manufacturer requirements.

Imported well-graded granular fill will be tipped incrementally across the compound footprint, progressing outward from the floating access track, and spread by a wide tracked dozer. The initial stone layer will be compacted through a contractor specified method that minimises vibration and excessive loading such as tracking or dead rolling.

Where required, an intermediate geogrid layer will be installed. This will be placed upon the first stone layer and will be overlapped and tensioned in accordance with the manufacturer's specification.

A second layer of granular fill will be placed upon the intermediate geogrid to the designed thickness. Where very low CBR values are encountered, a third geogrid layer may be required.

A final compacted wearing layer of appropriately graded stone will be installed to accommodate construction traffic and pedestrian use.

Where necessary, pressure berms (stabilising berms) will be constructed around the perimeter of the compounds to enhance stability and reduce lateral displacement.

Ongoing consolidation and localised settlement of the compound surface should be expected throughout the construction period. The Contractor will be responsible for maintaining the compound to required standards, including remediation of rutting, settlement, or lateral spread using additional granular fill and localised geogrid repairs where appropriate.

Shallow drainage ditches will be excavated at a safe offset from the compound to prevent undercutting of peat. Existing field drains will be connected where appropriate and protected using silt-management measures such as silt fences or settlement features.

Once all construction works are complete, the work areas will be reinstated with excavated soil and either seeded out with native species, allowed to vegetate naturally, or reinstated with excavated grass turves and will be restored to their original condition. This work will be carried out in in consultation with the landowner and in line with any relevant measures outlined in the planning application, CEMP and planning conditions.

2.3 Turbines

2.3.1 Candidate Turbines

Whilst the exact make and model of the turbine will be dictated by a competitive tender process it is envisaged at this time that it will meet with the parameters as set out in **Table 2-1.**

Table 2-1: Turbine Details

Turbine Type	Tip Height (m)	Hub Height (m)	Rotor Diameter (m)
Vestas V150	180	105	150
Nordex N163	180	98.5	163
Nordex N149	179	104.5	149

2.3.2 Turbine Layout

The Northern Cluster consists of seven turbines (nos. 1-7) with 4 no. turbines (or associated buffer areas) located in forested areas (nos. 1‑3 and 7). The remaining 3 no. (nos. 4‑6) turbines are located in open areas of peatland.

The Southern Cluster comprises 6 no. turbines (nos. 8-13), with a further 4 turbines (or associated buffer areas) within forested areas (nos. 10, 11, 12 and 13) with the remainder located in open areas of peatland.

The Main Wind Farm Development Site layout reflects the outcome of an iterative design process. The turbines referenced from T1-T13 and coordinates in Irish Transverse Mercator [ITM] are detailed in **Table 2-2 .**

Table 2-2: Proposed Turbine Coordinates

Turbine ID	X (ITM)	Y (ITM)
1	475806	823891
2	476156	824041
3	476506	823991
4	477006	823091
5	476998	823635
6	477564	823173
7	477624	823705
8	476357	822557
9	476464	822151
10	476198	821592
11	476576	821830
12	477164	821788
13	477072	822318

2.3.3 Turbine Foundations

An access track will be constructed to the turbine location where the turbine location, foundation footprint and associated working area shall be set out and marked prior to commencement of works.

A temporary working area shall be established at the end of the track using geogrid(s) and granular stone to provide a stable platform for excavators, piling rigs and ancillary construction plant. The bases of the turbine foundations will be excavated to a competent-bearing stratum or founded on piles. Ground investigations to date have provided an outline indication of the possible ground conditions expected to be encountered at the proposed turbine locations. Deep peat (greater than 1m) was encountered at the majority (12 of 13) of turbine locations. Hence, based on the available ground investigation data it is assumed that turbine foundations will utilise a piled solution, with the potential for a small number to be gravity foundations based on depths to competent strata. Shallow surface water drains will be excavated around the working area to prevent surface water runoff into it.

Where peat is present, subject to its depth, water ingress and stability conditions, excavation support shall be provided through one of the following methods:

- Sheet Pile, Rock or Modular Cofferdam - Used where peat is saturated or unstable. A method will be chosen based on ground conditions with sheet piled and modular cofferdams being temporary and rock cofferdams being left in situ.
- Benched Excavation - Used where peat has sufficient shear strength to maintain stable slopes, subject to geotechnical approval and slope toe support where required.

A designed piling pad will be constructed at formation layer consisting of geogrid and stone build up to the specified requirement based on the piling rig used.

The final pile type and installation method shall be determined by detailed ground investigation results, accounting for peat characteristics, underlying strata and environmental constraints. Piling methods may include:

- Bored Piles with Temporary Casing - Suitable in saturated or unstable peat to prevent ingress or instability.
- Continuous Flight Auger - Typically used where bore stability can be maintained and groundwater inflow is manageable.

Piles shall be installed to a competent bearing layer. After installation, a blinding layer shall be placed across the foundation footprint to provide a level, clean surface for the foundation reinforcement installation.

A large reinforcement cage, with a central anchor cage, will be prepared for all foundations and complete with cable routing.

Once temporary formwork has been placed, a high strength, specified concrete is poured in a continuous operation and completed through a site-specific methodology. After concrete has been cured, backfilling of the excavation, with engineered fill, and surface grading is completed, leading to the final stages of preparation to install the turbine tower upon the foundation plinth.

Based upon the proposed tip height and ground conditions, it is estimated a typical gravity foundation design will require 1,000m^3 of concrete in the turbine foundation. Where piled foundations are required, reduced quantities of concrete will be needed. This assessment is based on 1,000m^3 of concrete for each turbine foundation and as such reflects a worst case scenario. Foundations range from circular to hexagonal and square, depending on the requirements of the final turbine supplier.

Following the completion and quality assurance of the turbine foundation, the crane pad and full hardstand footprint will be marked out for construction. The footprint will consist of, but not be limited to, the crane pad, access track, blade laydown, assembly area, storage area and auxiliary crane pads.

2.3.4 Crane Pad Hardstands

Each turbine will have a hardstanding area constructed at its base to provide a stable surface for the main installation crane, which will be used to erect the turbine. The dimensions of the main crane hardstandings can be utilised to a maximum of 82m by 35m. The dimensions of the designated blade laydown areas are 90m x 25m. Interchangeable dimensions and extra storage room has been incorporated into the design to provide sufficient area of hardstanding to cover any of the possible three candidate specifications.

Turbine crane hardstands will consist of up to 1,000mm of hardcore placed on top of a base geotextile layer with additional geotextiles installed subject to ground conditions. There are two construction methodologies, one for hardstands to be founded on competent bearing strata and one for deep peat.

The construction methodology for the crane pad and hardstand on competent bearing strata will be as follows:

- Topsoil and unsuitable material within the hardstand footprint will be stripped to the required depth and stockpiled or disposed of. Subgrade preparation will include proof-rolling, localised excavation of soft spots, and replacement with engineered fill where necessary.
- Where ground conditions require improvement, a base geogrid layer will be installed.
- Stone placement upon the excavated formation level will be carried out in layers with each layer being suitable compacted until specified thickness is achieved.
- The crane pad will be constructed to the design platform level and bearing capacity specified by final crane model.
- Peripheral drainage, such as shallow ditches, will be formed around the hardstand to intercept surface water runoff and to prevent water ingress.
- Surplus topsoil will be placed along the side of the hard standing and dressed to blend in with surrounding landscaping.

Crane pads will be constructed to facilitate the installation of turbine components. Their location and orientation have been optimised to utilise the existing topography, minimise land take and avoid environmental constraints where applicable.

The construction methodology for the crane pads located in deep peat will be as follows:

- Temporary geosynthetic-reinforced working platforms, or piling pads, for piling rigs shall be constructed on top of the ground surface to a specified requirement based on the piling rig proposed. The platforms will consist of geogrid(s) and granular stone.
- The specified piling method shall be carried out across the crane pad area in accordance with the specified number, spacing, and arrangement of piles as indicated in the design documentation.
- The piling type and installation method will have piles installed to a competent bearing layer.
- The piles will receive a reinforcement cage and specified concrete.
- Once cured, each pile will be cut down to specified elevation to create a uniform cap level and cleaned prior to pile caps being constructed.
- High-strength specified geogrids will be installed over the set pile caps to the manufacturer's specification and quantity. A well-graded granular material will be placed and compacted in controlled layers over the geogrids to completion.
- Blade laydowns, assembly areas, and temporary storage areas will generally be constructed as floating hardstands. These will consist of a designed stone depth with interchangeable geosynthetic quality and quantity based on ground conditions.
- The Contractor will be responsible for maintaining the hardstands to required standards, including remediation of rutting, settlement, or lateral spread using additional granular fill and localised geogrid repairs where appropriate.
- Peripheral, shallow drainage ditches will be formed around the hardstand to intercept surface runoff and protect peat stability.

Crane pads will remain in place for the operational life of the Proposed Development, with stored topsoil and peat being used to restore the edges, blade laydowns and jib assembly areas.

2.4 Turbine Erection

The turbine components will be delivered to the Main Wind Farm Development Site where they will be placed on prepared hardstanding storage and laydown areas prior to assembly. The components include the turbine towers (which will be delivered in sections), nacelle, hub and individual turbine blades (which will be delivered one by one). Once all components are available, and there is suitable weather, each turbine will be assembled.

The tower of a turbine is a conical steel tube, with a corrosion resistant paint finish. Tower sections are generally transported to the Main Wind Farm Development Site in 4 to 5 sections. The base section is lifted by crane and bolted to the foundation anchor cage with upper sections bolted to their lower section in ascending order. The base of the tower is 4m to 5m in diameter, tapering to between 3m and 4m, where it is attached to the nacelle. The base is accessed by a galvanised steel staircase and a steel hatch door which will be kept locked except during maintenance.

The size and configuration of the turbine foundations will vary depending on the selected turbine model, site-specific ground conditions and the detailed geotechnical and structural design. Where piled foundations are required, they will comprise of reinforced concrete caps of diameter of 22m. Where gravity foundations are suitable, they will consist of a foundation diameter of 27m.

Each turbine will take approximately a week to erect, weather dependent, and will require two cranes in the assembly process. The turbines will then be commissioned and tested.

2.4.1 Turbine Blades

The blades of a modern turbine comprise glass fibre reinforced polyester. The turbine blades rotate between five and 15 revolutions per minute, dependent on wind speed and turbine manufacturer make and model. A turbine begins generating electricity at a wind speed of approximately 3 to 4 m/s depending on the turbine type, with rated power generation at wind speeds of approximately 12 to 14 m/s.

Turbines are usually shut down at wind speeds greater than 25m/s, although some machines are designed to operate up to 30m/s. The yaw mechanism, controlled by a wind vane, turns the nacelle and blades into and out of the wind. Blades are pitched to match the wind conditions.

Operational safeguards against the effects of extreme temperatures will be incorporated into the design in the form of anti-vibration sensors to detect any imbalance resulting from ice formation on the blades and delay the turbine's operation until the blades have been de-iced.

2.4.2 Turbine Transformer

The turbine will have a transformer located within the tower. The turbine transformer steps up the voltage of the electricity generated by the turbine to approximately 33kV to reduce the electrical loss on the internal collector cabling that connects to the onsite substation.

2.4.3 Power Output

The Proposed Development will have an estimated installation capacity of between 74.1 MW to 91 MW depending on the final turbine technology installed. Turbines of the exact same make, model and dimensions can have different power outputs depending on the capacity of the electrical generator installed in the turbine nacelle. Rated capacity of 74.1-91 MW has been used below to calculate the power output of the Proposed Development. Assuming installed capacity of 74.1 MW to 91MW, the Proposed Development has the potential to produce approximately 226,884 to 279,006 MWh (megawatt hours) of electricity per year, based on the following calculation:

- A x B x C = megawatt hours of electricity produced per year

Where:

- A = the number of hours in a year: 8,760 hours.
- B = the capacity factor, which takes into account the intermittent nature of wind, the availability of wind turbines and array losses. The capacity factor of 0.35 is applied here based on the turbines operating 35% of the time.
- C = rated capacity of the proposed turbines: 74.1 MW-91 MW.

The 226,884 to 279,006 MWh of electricity produced by the Proposed Development will be sufficient to supply approximately 54,020 to 66,430 Irish households with electricity per year, based on the average Irish household using 4.2 MWh of electricity[14].

According to the 2022 Census of Ireland, there are a total of 52,114 private households within County Mayo. Based on a capacity factor of 35%, the Proposed Development will produce enough electricity for the equivalent of 104% to 127% of all households in County Mayo as per the Housing stock of the 2022 Census.

2.4.4 Turbine Colour

Turbines have multiple painted coatings which protect against corrosion. They are coloured light grey to blend into the sky background. The colour of the turbines minimises visual impact, as recommended by the following guidelines on wind energy developments:

- Draft Wind Energy Development – Planning Guidelines (2019)[15].
- Wind Energy Development – Planning Guidelines (2006)[16].
- The Influence of Colour on The Statics of Wind Turbine Generators – ETSU W/14/00533/00/00[17].
- PPG 22, Department of The Environment – Welsh Office[18].
- Technical Advice Note 8, Welsh Assembly, 2005[19].

2.5 Turbine Delivery Route

A turbine delivery route selection and assessment was carried out to identify the optimum delivery route to the Main Wind Farm Development Site. The nodes relate to minor works within the public carriageway. In addition, there are three over-run areas where temporary tracks will be constructed to avoid pinch points. Turbine delivery will be from Killybegs Port to the Main Wind Farm Development Site. Leaving Killybegs, the TDR continues via the R263 to merge with the N56 north of Killybegs and then along the N56 south through Dunkineely, Mountcharles Bypass, and onto the Donegal Bypass. At this point it merges onto the N15, following it for approximately 65 km through Ballyshannon, Bundoran, before merging onto the N4 at Sligo. The route continues on the N4 southbound to junction S1, then

[14] March 2017 Commission for Energy Regulation Review of Typical Domestic Consumption CER/17042 (still in use in renamed Commission for Regulation of Utilities most recent Estimated Annual Bills https://www.cru.ie/publications/28025/)
[15] Department of Housing, Planning and Local Government (2019) Draft Revised Wind Energy Development Guidelines https://www.gov.ie/en/department-of-housing-local-government-and-heritage/publications/draft-revised-wind-energy-development-guidelines-december-2019/
[16] Department of the Environment, Heritage and Local Government (2006) Wind Energy Development Guidelines https://www.gov.ie/en/department-of-housing-local-government-and-heritage/publications/wind-energy-development-guidelines-2006/
[17] Department of Trade and Industry and Energy Technology Support Unit (2021) The Influence of Colour on the Aesthetics of Wind Turbine Generators W/14/00533/00/00
[18] Department of the Environment - Welsh Office (1993) Planning Policy Guidance Note 22: Renewable Energy
[19] Welsh Assembly Government (2005) Planning Policy Wales Technical Advice Note 8: Planning for Renewable Energy

onto the N59 through Ballysadare. From here it follows the N59 through Dromore west, turning south to Ballina. Continuing on the N59 through Crossmolina to Bangor Erris. At Bangor Erris, the TDR follows the R313 before branching onto the L1206. Following the L1206 to the local access road the L5252 to the Main Wind Farm Development Site.

2.6 Meteorological Mast

Meteorological conditions will be monitored by a permanent, free standing anemometry mast with a height of up to 100m. The design will be of a steel lattice type and the mast will be left in situ for the operational period.

2.7 Onsite Electricity Substation

It is proposed to construct one onsite electricity substation within the Proposed Development Site. This substation will provide a connection point between the Main Wind Farm Development Site and the national grid, via the proposed GCR which will connect to the Bellacorick 110kV ESB Station.

The dimensions of the proposed 110kV substation compound will be 84.5m wide on the southwest width and 82m wide on the northeast width by 149m long on the northwest length and 147.5m on the southeast length,. The substation compound will incorporate a connected Independent Power Producer (IPP) compound area measuring 84.5m wide on the southwest width and 82m wide on the northeast width by 38.5m on the northwest length and 36.5m on the southeast length. The compounds will be surrounded by a 2.6m high steel palisade fence and will include two buildings along with electrical components necessary to export electricity generated from the Main Wind Farm Development Site to the National Grid. Internal fences will be provided to segregate different areas within the compounds.

The proposed Transmission System Operator (TSO) control building (the ‘Eirgrid Building) will be operated and maintained by EirGrid. It will measure 27m x 20m and will have an overall height of 7.85m. It will contain a control room, associated electrical equipment and apparatus and will also include storage and welfare facilities.

The IPP Building will measure 22.1m x 12.m and will have an overall height of 6.17m. It will house switchgear, associated electrical equipment and apparatus, storage and welfare facilities.

Staff welfare facilities will introduce a small water requirement for occasional toilet flushing and hand washing. It is proposed to install a rainwater harvesting system as the source of water for toilet facilities and this rainwater harvesting tank will be installed adjacent to the control buildings. It is proposed to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater being tankered off-site by a permitted waste collector to a wastewater treatment plant. The proposed wastewater storage tank will be fitted with an automated alarm system that will provide sufficient notice that the tank requires emptying.

The compound will also include associated outdoor electrical equipment, including a 110 kV transformer and an internal access track. A 110 kV cable sealing end and associated cable equipment will be required to connect the 110 kV incoming underground cables into the substation.

Prior to construction of the substation compound, an area incorporating a drainage system surrounding it will be marked out by a qualified engineer prior to excavation and installation of the drainage system. Peat is present at a depth from 1.8m to up to 3m across the proposed BESS and substation compound area and will be excavated in accordance with the proposed design, including details on slope excavation of peat. This will remove the need for piled foundations.

The compound extents will be excavated to the required formation level. The excavation will remove peat and other unsuitable materials. Excavated peat will be placed in designated peat storage areas for reuse or reinstatement in accordance with the Peat Management Plan (PMP). A layer of geotextile material will be laid over the footprint of the compound. Using an excavator and dozer, a base layer of suitable backfill material will be laid and compacted, followed by a capping layer which will provide the finished surface for machinery and pedestrian use. Each layer will be compacted using a vibrating roller.

A range of different concrete foundations will be constructed across the substation compound. All concrete works will be carried out in accordance with the relevant Irish and European standards.

Raft foundations will be constructed for the IPP and Eirgrid buildings.

Earthing cable will be laid underground around the substation for connection to the various electrical components during the electrical fit out phase. Marker tape and cable tiles, where required, will be placed above the buried services.

Lighting will only be required during the operational phase of the Main Wind Farm Development Site when staff personnel are onsite. This will be provided by lighting columns to be installed around the substation compound.

A lightning protection mast of approximately 18m height will be installed to protect the station from direct lightning strikes.

This element of the Proposed Development Site is to be a permanent fixture, and the Eirgrid Building will be taken in charge by EirGrid at the end of the construction phase.

2.8 Battery Energy Storage System (BESS)

It is proposed to construct one onsite BESS compound with a capacity to reflect the generation capacity of the Proposed Development . The BESS will have the future ability to store excess power being generated locally on the grid and will release it back into the grid when there is a demand for it. The BESS will comprise 120 Battery Containers and 15 Inverter Containers in total, within a compound measuring 156m long on the northwest length, 153m long on the southeast length and 99m wide either side , secured by a 2.6m high palisade fence.

Each of the 120 battery container units will measuring 2.9m in overall height, 2.54m in width and 6m in overall length. Each of the 15 inverter units will measure 2.9m in overall height, 2.7m in width and 6m in overall length.

Prior to construction of the BESS, an area incorporating a drainage system surrounding it will be marked out by a qualified engineer prior to excavation and installation of the drainage system. Peat is present at a depth from 1.8m to up to 3m across the proposed BESS and substation compound area and will be excavated in accordance with the proposed design, including details on slope excavation of peat. This will remove the need for piled foundations.

The construction of the BESS compound, the battery container units and associated equipment will sit on reinforced concrete foundations.

Raft foundations will be constructed for the BESS switchgear building.

The associated battery cable equipment will be required to connect the substation via underground cables into the substation. Marker tape and cable tiles, where required, will be placed above the buried services.

Adequate lighting will be installed on the lighting masts around the compound.

2.9 Internal Access Tracks

The Main Wind Farm Development Site will require 8.75 km of internal access tracks. Of this, 1.95 km of existing internal access tracks will be utilised and upgraded where required. It is anticipated that 6.80 km of new track will be constructed to a floating track standard, as will the existing tracks to be upgraded. The construction specification for the access tracks will be confirmed by further site investigations. This will include in-situ testing, such as Dynamic Cone Penetrometer (DCP) testing, to determine the California Bearing Ratio (CBR) of the underlying peat. The CBR values will inform the track design, including the required thickness of the stone sub-base and the need for, and specification of, any geogrid or other geosynthetic reinforcement necessary to achieve the required load-bearing capacity for construction and operational traffic.

The proposed internal site track layout will permit access for vehicles during the construction phase, for maintenance during the operational phase, and for vehicles to decommission the turbines at the end of their operational life.

All tracks will be constructed to a 6-metre surface, inclusive of a minimum 5 metre running track and space for stone shoulders where required. Existing drainage infrastructure will be retained and utilised, where possible, and improved, as necessary. New drainage infrastructure will be required on all new access tracks. Drainage infrastructure and cable runs will be constructed in parallel with new access track construction.

Cables connecting turbines to the substation will be alongside the access tracks during their construction. Electrical cables will need to cross the access tracks in a number of locations.

At construction stage the specific requirements such as number of cable crossing points and duct size will be confirmed to allow suitable ducts to be installed through / below the access track during track construction works. This will then allow cable to be pulled through in the future without need for future disturbance to the track.

A cable crossing of the public road which routes through the Main Wind Farm Development Site is required to connect Turbines T8 to T13 to the substation. Due to the low volume of traffic recorded using the road, it is proposed that this cable crossing is achieved by open cut trenching with either partial closure with traffic management or full closure of the road required. The cable ducts will be installed at a minimum 0.75m below the road surface and may be surrounded by either natural soil arising, stabilised backfill material or concrete, depending on the cable duct selected. Following cable installation, the road will be reinstated to existing make-up and condition.

2.9.1 New Access Tracks

It is anticipated that the stone required for the construction of all new internal access roads will be sourced from quarries in the vicinity of the Main Wind Farm Development Site.

As mentioned above, the depth and makeup of the floating tracks will vary dependent on the peat’s CBR value which will be obtained during detailed site investigations. The range of the depth can be between 400mm and 1500mm with a varied depth and quantity of geocomposite layer placement. A standard floating track incorporates two geogrid layers, or similar.

A general construction methodology of floating tracks will be followed and will consists of the following procedures where applicable:

- The designed alignment of the track will be marked out and clearly indicated prior to any construction works.
- The ground surface will receive a base geogrid, placed directly along the track alignment, in line with the geogrid manufacturer's specification. Where the ground

surface lacks a fibrous surface layer, a geotextile or geocomposite (typically bonded geogrid and geotextile) will be placed to improve strength, separation, filtration and drainage.

- The makeup of the track will follow the designed requirement which may differ across the Main Wind Farm Development Site subject to the grounds CBR values. General methodology consists of an initial layer of specified, well-graded, granular fill being tipped in sections, typically 10m, on the base geogrid and spread using a suitable dozer, followed by a second geogrid, topped with the same specified fill and completed with a surface layer to accommodate construction traffic requirements.
- The stone buildup can range with interchangeable geogrid depths and quantities subject to the ground condition requirements. Very low CBR values may require up to three geogrid installations throughout its depth.

In sections of floating tracks where lateral support is deemed necessary, pressure berms or stabilising berms will be constructed either side of the track. This is an unlikely requirement due to the flat topography on site but may be beneficial for the reuse of excavated material. The berms act as a counterweight which widen the base of an embankment load to increase the factor of safety against slip failure.

- Shallow drainage ditches will be excavated and will tie into the existing field drains where applicable.
- Both drainage ditches and cable trenches will follow the alignment of the access tracks and will be suitably distanced to ensure track stability is maintained.

2.9.2 Upgraded Access Tracks

The existing tracks onsite are utilised within the Main Wind Farm Development Site's design to form a foundation on which the floating roads will be constructed on or the potential for cut roads. In both cases, the existing tracks will have their depth increased as well as their width to ensure track specifications are met. The historic peat compaction and drainage caused by the continued use of the tracks will benefit the founding of the upgraded floating tracks.

The improvement and extension of the existing floating tracks will follow the same methodology of the floating track construction where existing tracks are located on deep peat. The upgraded track will have interlocking geogrids installed over and around the existing track to form a base in which the upgraded track will utilise.

Where existing tracks are located on shallow peat or soils, the methodology of cut access tracks will be used. The width of the existing track and the required distance on either side of the track, will be extended to suit the requirement.

In-situ strength testing and confirmation testing on the existing track make-up, such as trial pits through the track, will be required to assess the existing tracks suitability to form part of the upgraded route.

2.9.3 Cut Access Tracks

Where applicable, cut access tracks will be formed on suitable underlying material (superficial soil or rock with sufficient bearing capacity) in the following manner:

- stripping of surface vegetation (turves) and careful stockpiling of this material.
- excavating the remaining superficial soil materials and stockpiling this material.

- where different superficial materials are present these will be stored according to type. This material will be retained for reinstatement purposes.
- the exposed suitable track formation will receive a geogrid prior to rock fill material being tipped from dumper trucks directly onto the proposed access track alignment.
- this material will then be either spread by a dozer or placed by a hydraulic excavator and compacted in layers, typically using vibratory rollers.

Access tracks will be formed from a sub-base of general fill and finished off with a cap- stone / wearing course of graded crushed rock to provide a nominal Type-B (Series 800) finish. Wearing course stone will be of a suitable material that is not susceptible to breaking down / weathering to a high fines content material.

Maintenance of the running surface on all access tracks will be carried out on a regular basis, as required, to prevent undue deterioration. Loose track material generated during the use of access tracks will be prevented from reaching watercourses by maintaining an adequate cross fall on the tracks. Periodic maintenance of tracks by way of brushing or scraping will be carried out to minimise the generation of wheel ruts, which could lead to some track material being washed away. In dry weather, dust suppression methods may be required for track and hardstanding areas.

2.10 Watercourse Crossings

Construction of water crossings has the potential to cause sediment loading to water receptors. Measures to prevent the release of any pollution/sediment are outlined in **Section 7** of the CEMP and are as follows:

- Areas exposed due to the removal of vegetation are more susceptible to erosion during heavy rainfall, so areas will be reinstated as soon as possible to reduce the potential for silt, chemicals and/or other contaminants being washed into existing watercourses.
- Best practice guidance in relation to drainage (and control of pollution to the water environment) will be followed in watercourse crossing areas.
- Ditches will remain in place to convey surface water flows during the operational life of the Proposed Project. With the notable exception of extensive ditch blocking as described in the Habitat Management Plan (Appendix A of Peatland Restoration Plan, **Appendix 7** of this NIS).

2.10.1 Internal Access Track Watercourse Crossings

The proposed wind turbine layout will utilise, in total, four watercourse crossings. These comprise two existing and two proposed crossings. Watercourse crossings can be classified as follows:

- Existing structures (bridges or culverts) that need to be crossed by infrastructure (access tracks or cables) associated with the Proposed Project, without a need to modify the structure.
- Installation of new structures to facilitate the crossing of watercourses by infrastructure associated with the Proposed Project.
- Existing structures that need to be either replaced or upgraded to facilitate the crossing of watercourses by infrastructure associated with the Proposed Project.

There are two new and two upgraded watercourse crossings for new and upgraded access tracks within the Main Wind Farm Site. New watercourse crossings will be provided as culverts according to typical specifications identified

New crossings are designed to convey 1% Annual Exceedance Probability Mid-range Future Scenario (AEP MRFS) storm event, with a minimum 300mm freeboard level. This is in line with the Office of Public Works (OPW) requirements. A Section 50 application will be required to obtain the consent of the OPW for the construction of the crossings. Existing crossings will be upgraded.

Table 2-3: Watercourse Crossings

Crossing Point	Existing / Proposed	X coordinate (ITM)	Y coordinate (ITM)
WCX1	Proposed	476064	823774
WCX2	Proposed	476880	822463
WCX3	Existing	477113	822549
WCX4	Existing	477286	822437

2.10.2 Watercourse Crossings Along the Turbine Delivery Route

Construction of water crossings has the potential to cause sediment loading to water receptors. Measures to prevent the release of any pollution/sediment are outlined in **Section 7** of the CEMP and are as follows:

- Areas exposed due to the removal of vegetation are more susceptible to erosion during heavy rainfall, so areas will be reinstated as soon as possible to reduce the potential for silt, chemicals and/or other contaminants being washed into existing watercourses.
- Best practice guidance in relation to drainage (and control of pollution to the water environment) will be followed in watercourse crossing areas.
- Ditches will remain in place to convey surface water flows during the operational life of the Proposed Project.

Over-run area 1 is located c. 94m west of the Tristia river, Over-run Area 2 intersects with the Moneynierin River and is the only watercourse crossing associated with the TDR Over-run Areas. The works for Over-run Area 2 are temporary and will not involve any in stream works, modification of the river channel or obstruction of flow. Upon completion of works, the site will be restored to its existing land use without delay.

Over-run Area 3 is located within an area of moorland with drainage ditches located within 50m of the temporary track. This Over-run Area is located within the 50m buffer due to constraints associated with land access. As there will be proposed construction or infrastructure located within 50m of the stream, further mitigation measures will be proposed to facilitate the turbine delivery with minimal impact to nearby water receptors.

There will be no construction works required on the crossing structures to facilitate the turbine delivery.

2.10.3 Watercourse Crossings Along the GCR

The GCR is approximately 25.5 km in length all located on public roads. The GCR will utilise 32 existing crossings with minimal direct impact with water environment receptors.

Crossing methodology will be either by a standard trenched crossing technique or by utilising incline Horizontal Direction Drilling (HDD) methodology.

2.11 Electrical Cabling

The electricity generated from wind turbines within both the Northern and Southern Clusters will be collected by a medium voltage 33kV circuit of underground collector cables which will follow the onsite access tracks. The collector cables will be embedded beneath the public roadway to connect the Southern Cluster to the proposed onsite substation in the Northern Cluster and forms part of the Proposed Development.

Ultimately, the electricity from the Northern and Southern Clusters will be exported from the onsite substation to the national grid via a 110kV underground cable via the GCR, which will be the subject of a separate application. Once consented and built, the GCR will be a permanent fixture and will be taken in charge by EirGrid / ESBN.

2.12 Traffic Management

2.12.1 Wind Farm

via the central spine road (L5252) taken off the L1206. There are three Access Points (AP1, AP2 and AP3) located roughly equidistant along the spine road. A Construction Traffic Management Plan (CTMP) will be implemented, covering vehicle routing, signage, road condition monitoring, and engagement with Mayo County Council.

2.12.2 Cable routes

An internal 33kV underground collector cables will connect the Northern and Southern Clusters to the proposed onsite substation.

The GCR, a 110 kV underground cable connecting the Main Wind Farm Development Site to the Bellacorick Substation, will be the subject of a separate planning application but has been assessed in this EIAR as part of the Proposed Project, as defined in **Chapter 1** of the EIAR.

2.13 Peat Management

Peat depths vary across the Main Wind Farm Development Site, with an average thickness of 2.5m across the surveyed area up to a maximum depth of 6.4m

2.14 Balances of Materials Required for Site Works

Table 2-4 below sets out the estimated cut and fill balance for soil, aggregate and concrete materials required on site.

Table 2-4: Cut and Fill Balances of Materials Required for Site Works

Material	Cut (m^3)*	Fill (m^3)*	Import Requirement (m^3)*	Balance (m^3)*
Topsoil	32,572	N/A	N/A	-32,572
Subsoil / Substrate	117,573	N/A	N/A	-117,573
Aggregate	N/A	254,398	254,398	254,398
Concrete	N/A	20,223	20,223	20,223
*Numbers rounded to nearest hundred.				

Topsoil: Topsoil has been classified as acrotelm peat or nutrient rich soil due to its lack of saturation. The depth has been taken as 0.4 m, which is at the higher end of recommended topsoil cover following best practice such as British Standard BS3882:2015 Specification for Topsoil.

Subsoil / Substrate: The subsoil quantities refers to peat, which is saturated and has been assumed as 0.4 m and deeper due to the nature of the Main Wind Farm Development Site. The substate accounts for the underlying silt and granular material found under the peat layers. Finally, the substrate also includes pile arisings from the competent bearing strata.

Due to the varied depths of peat across the Main Wind Farm Development Site, all excavated subsoil and substrate material have been accumulated in the absence of detailed site investigations. The PMP accounts for the estimated peat removal volumes whereas the cut and fill balances account for all excavation works including the Civil 3D model cut volumes.

As this is an overview assessment of likely volumes, a bulking factor has not been considered in **Table 2-4**.

Concrete volumes are included for the substation platform, BESS platform, main crane working pad, turbine foundations and met mast foundation.

The Proposed Project will utilise local quarries for the importation of materials to the Main Wind Farm Development Site and Over-run Areas. These quarries will be sourced once planning consent for the Proposed Development is secured. Further information on the quarries most likely to be utilised is found in **Chapter 6**. An assessment of trips required for the transportation of material is provided in **Chapter 14** within this EIAR.

2.15 Tree Felling

To facilitate the construction of the various infrastructural elements of the Proposed Development, the permanent removal of existing commercial forestry is planned, totalling between 27.17 – 31.37 hectares, contingent on the chosen candidate turbine model.

The felling of trees for wind farm construction is subject to and can only occur following the granting of a felling licence by the Minister for the Department of Agriculture, Food and the Marine (DAFM).

The Forest Service policy[20] requires that a copy of the planning permission for a wind farm is submitted with a felling licence application, therefore, the felling licence cannot be applied for until planning permission is received for the Proposed Development. The licence will include the provision of relevant replant lands to be planted in view of the proposed tree felling on the Main Wind Farm Development Site.

The construction methodology for tree clearance will follow the specifications set out in the Standards for Felling & Reforestation (DAFM, 2019) and Felling and Reforestation Policy (DAFM, 2017).

Before harvesting works commence onsite, all personnel, particularly machine operators, will be made aware of the following and will have copies of the relevant documentation including:

- The CEMP, felling plan, surface water management, construction management, emergency plans and any contingency plans.
- Environmental issues relating to the Main Wind Farm Development Site.
- The outer perimeter of all buffer and exclusion zones.
- All health and safety issues relating to the Main Wind Farm Development Site.

The proposed method of tree felling near infrastructure will be limited to:

[20] Forest Service, Department of Agriculture, Food and the Marine (2017) Felling and Reforestation Policy https://teagasc.ie/wp-content/uploads/2025/05/Felling-and-Reforestation-Policy-4.pdf

- 10m-wide exclusion zone to be established from the edges of any aquatic zones or water hotspots as per *Standards for Felling & Reforestation* (Department of Agriculture, Food and the Marine (DAFM), 2019).
- 5m-wide exclusion zone to be established from the edges of any relevant watercourses (DAFM, 2019).
- Appropriate exclusion zone to be established from the outer edges of any archaeological features: see Environmental Requirements for Afforestation (DAFM, 2024). The archaeological assessment assumes a worst-case scenario that the entire footprint of the proposals will require ground intrusive works. Turbine 11, the closest turbine, is located c.0.23 km away from the zone of protection of the national monument located within the Main Wind Farm Development Site boundary (crannog registered as Site and Monument Record MA025-004). As such is not predicted to cause direct effects to the asset. Any unknown remains related to the crannog would also not be anticipated to extend outside the Zone of Protection and within the footprint of the development.
- Should any palaeoenvironmental materials within the Main Wind Farm Development Site be preserved within the peat, it is unlikely to comprise substantial materials due to the likely low level of activity across the Site, and the disturbances caused by the extensive modern drainage ditches, peat cutting and commercial forestry. In the event that an unrecorded archaeological feature is found during harvesting, the discovery must be immediately reported to the National Museum of Ireland or the Garda Síochána. A minimum exclusion zone of 20m must be established around the feature until the site of the find has been investigated (Forest Service, 2000[21]).
- Appropriate exclusion zones and work programme for harvesting areas to be established for any areas of ecological sensitivity, such as buffers around habitats deemed valuable for breeding birds in the appropriate season and timing of works will to avoid bat roosting periods. The location of such exclusion zones will be included in the CEMP and will be well known by all operators on site.

Project Construction Management

2.16 CEMP

Overview details of the key stages of construction of the Proposed Project are provided under the respective headings set out within this section. The CEMP sets out the key environmental management measures associated with the construction of the Proposed Project, to ensure that during this phase of the Proposed Project, the environment is protected, and any potential impacts are avoided and minimised.

No oils, greases, hydraulic fluids or other hazardous substances (or associated wastes) will be stored outside designated areas within the Main Wind Farm Development Site. All such materials will be stored only within designated COSHH storage areas located in the construction compounds, substation and BESS compounds. These storage areas will comprise impermeable surfaces, be covered where appropriate, and include fuel spill trays and/or bunded containers.

A separate decommissioning environmental management plan will be prepared prior to decommissioning the Proposed Project in line with the requirements of legislation, guidance and best practice at the time of this phase commencing 35 years from operation starting.

[21] Forest Service (2000) Forestry and Archaeology Guidelines

In the event that An Coimisiún Pleanála (ACP) grants permission for the Proposed Development, the CEMP will be updated as required to address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned by ACP. The CEMP will be a key construction contract document which will ensure that the contractor will implement the prescribed measures to protect the environment. It will provide a framework for ensuring that any remaining sensitivities following construction will be appropriately managed and monitored during the operational phase of the Proposed Project. The CEMP will also be used as a framework for a future Decommissioning Plan to manage any potential environmental impacts arising at that stage. The Decommissioning Plan will be expanded in line with experience of the Proposed Project over time, as well as best practice measures as they will have evolved in the intervening period.

2.17 Phasing of Construction Activities

The construction phase of the Proposed Project, which includes civil, electrical, grid works, and turbine assembly is anticipated to take 18-24 months once the proposed turbines are acquired via a competitive tender process.

2.17.1 Wind Farm, Substation and Battery Energy Storage System

For these elements of the Proposed Development, the construction sequence will be as follows:

- off-site TDR works.
- mobilisation and site set up.
- site clearance and tree felling.
- site access and internal access tracks turbine hardstands turbine foundation construction.
- onsite substation, BESS and collector cable .onsite cable delivery and installation.
- turbine delivery & installation.
- wind farm commissioning and testing; and
- landscaping, reinstatement and demobilisation.

The electrical installation of the substation compound is expected to take 17 months (including 2 months of commissioning activities) and includes the following:

- Delivery and installation of 110 kV transformer.
- Wiring and cabling of HV/LV equipment, protection and control cabinets.
- Commissioning of all newly installed equipment.

The BESS compound installation is expected to take 14 months (including 2 months of commissioning activities) and includes the following:

- Delivery and installation of the battery units.
- Wiring and cabling of MV/LV equipment.
- Commissioning of all newly installed equipment.

2.17.2 Electrical Works and Collector Cable

Construction of the Proposed onsite Substation, BESS and internal cable network between turbines will be carried out in tandem with the wind farm element of the Proposed Development in sequenced activities.

2.17.3 Grid Connection Route

The GCR will follow a 25.5 km route from the Main Wind Farm Development Site to the Bellacorick 110 kV Substation. The GCR will follows a large section of the National Road (N59) and the local road (L1206) from the Proposed Substation. For most of the route, and subject to consultation with the TII and Mayo County Council as part of a future Planning Application, the GCR will use the National Road which will accommodate a single circuit 110 kV cable. Typical trenched method can be utilised for watercourse crossings with a likely requirement for horizontal directional drilling (HDD) at bridge crossings.

2.18 Drainage Design and Hydrological Management

2.18.1 Existing Site Drainage

The Main Wind Farm Development Site is located in an area with an extensive network of peat drainage channels. The channels are present throughout all of the open land and link with V-ditches parallel to the existing farm tracks.

There are two watercourses in proximity to the site. The northern watercourse follows the alignment of the northern red line boundary, with a small tributary stream which splits Turbine 1 and Turbine 2. The second watercourse follows the centre-eastern red line boundary and cuts through the Main Wind Farm Development Site, west of Turbine 13 and east of Turbine 11. It realigns with the south-eastern red line boundary.

2.18.2 Drainage Design

The drainage design for the Main Wind Farm Development Site utilises the existing peat drains and drainage ditches. Surface water runoff from the hardstanding areas within the Main Wind Farm Development Site will be controlled and diverted into the surrounding drainage channels and attenuation basins following the topography of the site to permit a gravity flow. All drainage is designed to incorporate Sustainable Drainage Systems (SuDS) through the use of permeable surfaces, attenuation basins, shallow ditches, stone check dams, silt fences and swales, where applicable.

Prior to main earthwork activities, interceptor drains, or diversion ditches will be created to minimise the pooling water in areas of development. The employed diversion method will flow into the existing peat drainage channels. The diversion method will follow the topography of the site and installation shall commence up gradient of all construction to commence. The clean surface water will be collected and diverted to the existing ditches via the peat channels.

Preservation of the existing local hydrology and its incorporation into the design is important to maintain equilibrium between the new tracks and the underlying peat. To ensure a lesser effect on the local hydrology, flat ditches will be employed parallel to tracks opposed to standard V-ditches. The shallower excavation will not lower the water table, preventing lateral effects to the infrastructure.

The construction of the Main Wind Farm Development Site’s drainage comprises:

- The excavation of in channel rock drainage channels 2m in width and 275mm in depth from the edge of the Main Wind Farm Site’s access tracks.
- Silt fence textile will be laid within the channel. The silt fence textile will be Hy-tex Terrastop premium or similar and will be fixed to the upslope side of the supporting slope within the main drainage channel.
- Support posts for silt fence support and for channel supports will be inserted at the edge of the drainage channel at 1,500mm intervals.

- Silt fence textile will be anchored using clean drainage stone.

The area behind silt fences will be maintained regularly and silt will be removed and buried. The proposed drainage system will be based on the following methods:

- The first method will involve protecting existing water quality by avoiding disturbance to natural drainage features, minimising any works in or around drainage features, and diverting clean surface runoff around excavations and construction areas.
- The second will involve collecting any drainage water from works areas that might carry silts or sediments, and to route them towards settlement ponds prior to controlled diffuse release over vegetated natural surfaces. To achieve this, shallow surface water drains will be excavated around areas of earthworks to prevent surface water runoff into the working area and thereby protect the wider water network from siltation. The CEMP identifies appropriate options for protecting watercourses and choosing stable design methods depending on the specific nature of ground conditions encountered during construction.

Perimeter drainage channels will be installed around the compounds and surface water drainage pipework will be installed within trenches in the stone platform, with downpipes from the buildings discharging to the surface water network.

Surface water runoff from impermeable surfaces will be managed via attenuation basins. These basins will provide the required storage for runoff within their respective compounds while also providing treatment of the water prior to discharge. To mitigate the risk of attracting protected bird species into the turbine sweep path, the basins are designed to be dry-bottomed features with no permanent standing water.

The basins will only temporarily store surface water runoff up to a maximum peak depth of 500mm following substantial and prolonged rainfall. The basins will also comprise a minimum 300mm freeboard above the peak water depth. Following such an event, the basins will gradually discharge at a controlled rate over a 24 to 48-hour period until fully emptied. To facilitate this full drainage cycle, the basin outlet will be positioned at the base level to ensure no permanent volume of water is retained. To prevent groundwater interaction, the basins will be lined with a combination of the geosynthetic clay liner (GCL) and natural clay liner and topped with a 300mm soil protection layer. This layer will be seeded to maintain a vegetated dry bank that blends with the surrounding landscape while remaining unattractive as a foraging or nesting habitat for aerial fauna.

Separate surface water and foul drainage networks will be provided. The network will include manholes located at junctions and directional changes in the drainage pipework as appropriate.

Oil separators will be installed where required, particularly in transformer or plant areas, to prevent hydrocarbons entering the surface water system. Discharge from the built compounds and turbine hardstandings will be directed to a network of associated attenuation ponds, which will be connected by a series of underground pipes. The compounds will utilise rainwater harvesting to collect roof runoff for reuse where feasible.

A separate system consisting of foul water drainage pipework, manholes and a foul water holding tank will be installed. The foul water holding tank will be tankered off-site by a permitted waste collector to a wastewater treatment plant.

A comprehensive water quality monitoring regime is proposed to ensure that the measures are effective in protecting the water environment.

2.19 Cable Trenches

2.19.1 Collector Cable within the Main Wind Farm Development Site

Cable-ducts parallel to the Main Wind Farm Development Site's access tracks will be laid in cable trenches when the track is being constructed and will follow the alignment of the access tracks.

Marker tape and cable tiles, where required, will be placed above the buried services.

HV circuits, transformer connections, auxiliary power supplies, control cabling and BESS interconnections will be installed within designated trenches.

All cable routes will be surveyed and recorded.

Trenches will be backfilled with specified, suitable material and reinstate to finished platform levels.

2.19.2 Internal Track Crossings

Collector cables connecting turbines to the substation will be laid alongside the access tracks as identified within the Access Track Construction methodology above. On the route from the turbines to the substation the cable will need to cross the access tracks in a number of locations. Prior to construction the number of cable crossing points, duct size and requirements will be confirmed to allow suitable ducts installed through / below the access track during track construction works. This will then allow cable to be pulled through in the future without need for future disturbance to the track.

2.19.3 Internal Collector Cable - Public Road Crossings

A cable crossing of the public road which routes through the Main Wind Farm Development Site is required to connect Turbines T8 to T13 to the substation. Due to the low volume of traffic recorded using the road it is proposed that this cable crossing is achieved by open cut trenching with either partial closure with traffic management or full closure of the road required. The cable ducts will be installed minimum 0.75m below the road surface and may be surrounded by either, natural soil arising, stabilised backfill material or concrete depending on the cable duct selected. Following cable installation, the road will be reinstated to existing make-up and condition.

2.19.4 Proposed GCR

Cable ducts will be laid and joint bays will be located within the public roadway. A separation distance of 600mm from existing services will be preserved where possible. The trenches within these locations will be backfilled using the excavated material. The contractor will excavate cable trenches and then lay high density polyethylene (HDPE) ducting in the trench in a surround of cement bound material (CBM). A rope will be inserted into the ducts to facilitate cable-pulling later. The as-constructed detail of the cable duct locations will be carefully recorded. Cable marker strips will be placed above the ducts and the two communication ducts will also be laid. An additional layer of cable marker strips will be laid above the communication ducts and the trench backfilled. Back-filling and reinstatement in public roads will be to a specification to be agreed with the road authority and at least as good as the existing.

During the construction stage of the Proposed Project, records of services such as water mains, sewers, gas mains and other power cables will be obtained from the relevant service providers ahead of construction works to ensure that all new developments between the period of assessment and pre-‑ construction is captured.

Where required, cable detection tools, ground penetrating radar, and slit trenches will be used as appropriate to find the exact locations of existing services. The final locations of the cable routes within the public roadway will be selected following these investigatory works to minimise conflicts with other services.

2.19.5 General Construction Sequence for All Cable Trenches

A general overview of the construction sequence is detailed below:

- All relevant bodies i.e. ESBN, Gas Networks Ireland, Eir, Mayo County Council, Irish Water etc. will be contacted and all drawings for all existing services will be sought to confirm the conditions predicted in this EIAR.
- Immediately prior to construction taking place the area where excavations are planned will be surveyed and all existing services will be identified, and temporary warning signs erected where necessary.
- For cable works in the public road, the Construction Traffic Management Plan (CTMP) will be agreed with Mayo County Council Road's Department and implemented. Clear and visible temporary safety signage will be erected all around the perimeter of the live work area to visibly warn members of the public of the hazards of ongoing construction works.
- An excavator will be used to excavate the trench to the dimensions of 600mm wide by 1.2m deep.
- A silt filtration system will be installed on all existing drainage channels for the duration of the cable construction to prevent contamination of any watercourse.
- Any ingress of ground water will be removed from the trench using submersible pumps and pumped to the nearest available existing drainage channel.
- Once the trench has been excavated, a bedding layer of sand or 15 Newton concrete will be installed and compacted. All concrete will be offloaded directly from the concrete truck into the trench.
- PVC ducts will be installed on top of the compacted base layer material in the trench.
- Once the ducts have been installed, couplers will be fitted and capped to prevent any dirt etc. entering the unjointed open end of the duct.
- In poor ground conditions, the open end of the duct will be shimmed up off the bed of the trench to prevent any possible ingress of water and dirt into the duct. The shims will be removed once the next length of duct has been joined to the duct system.
- The as-built location of the installed ducts will be surveyed and recorded using a total station/GPS before the trench is backfilled to ensure recording of exact location of the ducts, and hence the operational electricity cable. These co-ordinates will be plotted on as-built record drawings for the cable route cable operational phase.
- When ducts have been installed in the correct position on the trench base layer, sand (in road trench) or Lean-mix CBM4 (CL1093) (off road trench) will be carefully installed in the trench around the ducts so as not to displace the duct and compacted.

- Spacer templates will be used during installation to ensure that the correct cover of duct surround material is achieved above, below and at the sides of the duct in the trench.
- A red cable protection strip will be installed above duct surround layer of material and for the full length of the cable route.
- A layer of Lean-mix CBM4 (CL1093) (in road) or excavated material (off road) will be installed on top of the duct surround material to a level 300mm below the finished surface level.
- Yellow marker warning tape will be installed for the full width of the trench, and for the full length of the cable route, 300mm from the finished surface level.
- The finished surface of the road, road verge, or agricultural land will be reinstated as per its original condition or to the requirements of the Mayo Area Engineer.
- Precast concrete cable joint bays will be installed within excavations in line with the trench. The cable joint bays are backfilled and the finished surface above the joint bay reinstated as per its original condition. The cable joint bays are re-excavated a second time during cable pulling and jointing, after which the finished surface above the joint bays is reinstated again to its original condition.
- When trenching and ducting is complete, the installation of the cable route cable will commence between the onsite sub-stations to the Bellacorick 110kV substation.
- Construction work areas and traffic management measures will be setup at 2 no. consecutive cable joint bays simultaneously. The underground cable will be pulled through the installed ducts from a cable drum set up at one joint bay and using a winch system which is set up at the next joint bay, the cable is pulled through.
- The cables are jointed within the precast concrete cable joint bays.
- The finished surface above each cable joint bay is reinstated to its original condition, and the construction work area removed.

2.20 Waste Generation

Any waste that is generated during the Proposed Project' construction phase will be collected, separated and stored in dedicated receptacles at the temporary construction compounds in accordance with the details outlined in the CEMP.

The contractor for the main construction works will nominate a suitable site representative such as a Project Manager, Site Manager or Site Engineer as the Waste Manager who will have overall responsibility for the management of waste. The Waste Manager will have overall responsibility to instruct all site personnel including subcontractors to comply with onsite requirements.

The following categories of waste will most likely be generated during the construction phase of the Proposed Project:

- construction waste and pile arisings.
- waste oil and hydrocarbons.
- paper and cardboard.
- timber and steel; and
- municipal solid waste generated from the office and canteen.

Sanitary waste will be removed from site by a licensed waste disposal contractor. All portaloo units located on the Proposed Project during the construction phase will be operated and maintained in accordance with the manufacturer's instructions and will be serviced under contract with the supplier. All such units will be removed offsite following the completion of the construction phase.

A fully authorised and licenced waste management contractor will be appointed prior to the commencement of construction works. This contractor will provide the appropriate receptacles for the collection of the various waste streams and ensure regular emptying and/or collection of these receptacles.

2.20.1 Waste Reduction Practices

Waste generation throughout the operational phase of the Proposed Project is expected to be minimal. Measures to further reduce operational waste include the following:

- Material ordering will be optimised to ensure only the necessary quantities of materials are delivered to the Proposed Project.
- All plant will be serviced before arriving to the Proposed Project which will reduce the risk of breakdown and the possible generation of waste oil or hydrocarbons onsite.
- Where material such as concrete are to be ordered, great care will be taken in the calculation of quantities to reduce wastage.
- All operators and foreman will be instructed in measures to cut back on the amount of wastage and will only order the materials necessary to complete each construction task as required.
- Prefabrication of design elements will be used where appropriate to eliminate waste generation on sites.

2.20.2 Waste Reuse

When possible, materials will be reused onsite for other suitable purposes as follows:

- Re-use of shuttering etc. Where it is safe to do so.
- Re-use of rebar cut-offs where suitable.
- Re-use of excavated materials for screening, berms etc.
- Re-use of excavated material – it will be used as suitable fill elsewhere onsite for access tracks, the hardstanding areas and embankments where possible.

Any excess excavated material that will be used for fill, re-instatement, or similar activities, within the Proposed Project is not categorised as a waste material under relevant waste legislation, rather this material is exempt from waste classification.

Article 2 (1) (c) of Directive 2008/98/EC on waste, transposed through Article 26 (1) (c) of the European Communities (Waste Directive) Regulations (S.I. 126 of 2011) identifies the following as being an exemption from waste regulation:

> *"uncontaminated soil and other naturally occurring material excavated in the course of construction activities where it is certain that the material will be used for the purposes of construction in its natural state on the site from which it was excavated".*

Surplus material will be re-instated in its natural condition on the site from which it was excavated, this material is not considered as waste as it is being reused on site. The PMP confirms that peat excavation volumes will be reused for peatland restoration during the construction, operational, and decommissioning phases of the project.

2.21 Waste Management

Wastewater holding tanks will be provided within the substation and IPP compounds. The wastewater holding tank will be a sealed storage tank with all wastewater tankered offsite as required by an authorised waste collector to a wastewater treatment plant. Only waste collectors holding valid waste collection permits under the Waste Management (Collection Permit) Regulations, 2007, will be employed to transport wastewater away from the Main Wind Farm Development Site. The proposed wastewater storage tank will be fitted with an automated alarm system that will provide sufficient notice that the tank requires emptying. The wastewater storage tank alarm will be part of a continuous stream of data from the Proposed Development's turbines, wind measurement devices and electricity substation that will be monitored 24 hours a day seven days per week. This approach for managing wastewater onsite has become a standard practice in wind farm sites.

Receptacles will be clearly labelled, signposted and stored in dedicated areas.

The provision of receptacles for the separation and collection of dry recyclables such as paper, cardboard, plastics will be provided and removed to a licenced facility by a suitable contractor.

The Applicant and the appointed contractor will seek to prevent, reduce, reuse and recover as much of the waste generated at the Proposed Project as possible and to ensure the appropriate transport and disposal of residual waste is undertaken offsite in accordance with the Waste Management Act 1996 (as amended) and in alignment with the National Waste Management Guidelines and the European Waste Management hierarchy.

2.21.1 Waste Recycling, Recovery and Disposal

National waste policy requires the separation of recyclable material at source. During the construction phase of the Proposed Project, receptacles will be provided for the separation and collection of dry recyclables (paper, cardboard, plastics), biological waste (canteen waste).

All receptacles will be clearly labelled, signposted and stored in dedicated areas.

Receptacles for the following sources aggregated materials will be made available onsite at a suitable location:

- food waste.
- packaging waste.
- dry mixed recyclables.
- aluminium.
- ferrous materials; and
- timber.

These materials will be transported offsite by an authorised contractor to a permitted recovery centre. These materials will then be processed through the various recovery operations.

Residual waste generated onsite may require disposal. This waste will be deposited within dedicated receptacles and collected by the permitted waste management contractor who will then transport this waste to an appropriate facility. All waste movements will be recorded, and the waste manager onsite will hold these records.

2.22 Site Security

In addition to the palisade fencing which will be erected around the perimeters of both the substation and BESS compounds, the following security measures will also be incorporated to the Main Wind Farm Development Site.

- Access gates will be installed at designated entry points.
- CCTV cameras will be mounted on poles to provide full site coverage.
- Security lighting will be installed and directed downward to minimise light spill.
- Signage and safety notices will be erected.

Project Operation and Lifespan

During the operational phase of the Proposed Development, turbines will function automatically on a day-to-day basis. The turbines will respond to changes in wind speed and direction by means of anemometry-equipment and control systems.

As mentioned above, there will be minimal operational waste associated with the wind farm once construction is finalised. As such, operational residues and emissions are expected to be negligible.

Twice a year each turbine will undergo a scheduled service. The operation of the wind turbines will be monitored remotely, and a caretaker will oversee the day-to-day running of the Proposed Development.

1. The expected physical lifetime of a turbine is 35 years, and permission is sought for a 35-year operation period commencing from full operational commissioning of the wind farm. At the end of the operational period, the developer will either decommission the Proposed Development or, subject to a new planning application, seek permission to extend its operation or re-power. The proposed substation, and the GCR (subject to a separate planning application) will continue to exist on a permanent basis.

The applicant respectfully requests that a 10-year planning permission is granted in addition to a 35-year operational period.

Decommissioning

During the decommissioning phase of the Proposed Project, cranes will disassemble the above ground turbine components and meteorological mast which will be removed offsite for recycling.

The foundations will be covered over and allowed to re-vegetate naturally. Leaving turbine foundations in situ is considered a more environmentally sensible option as to remove the reinforced concrete associated with each turbine will result in environmental effects such as noise, vibration and dust. It is likely that the onsite access tracks will be left in situ, subject to agreement with Mayo County Council and the relevant landowners at that time.

The BESS and associated electrical equipment will be removed offsite for recycling.

Underground cabling will be cut back and left in situ.

The onsite substation and GCR will be taken in charge by ESBN / EirGrid upon completion and will be left in place forming part of the national electricity network.

A detailed decommissioning plan will be agreed with Mayo County Council in advance of decommissioning.

3.0 Stage 1: Screening

3.1 Step 1: Management of European sites

The Proposed Project is the construction, operation and decommissioning of a proposed wind farm – along with all other works. Therefore, it is not connected with, or necessary for, the management of a European site.

3.2 Step 2: Description of the Proposed Project

Full details of the Proposed Project can be found in Section 2.0 of this report; however, key details relevant to the AA process are summarised below. It is important to note that the CEMP (detailed above) was not considered within the AA Screening.

The Proposed Development seeks permission for a period of 10 years, for development comprising of the construction of a 13 no. turbine wind farm development, with associated 110 kV substation, battery storage, and all associated works on land within the townlands of Muingmore (An Mhoing Mhór), Doolough (Dumha Locha), Tristia (Troiste), Moneynierin (Moing an Iarainn) and Bangor (Baingear) County Mayo. The planning application area is approximately 454 ha in size. Certain details of the Proposed Development are unconfirmed in this planning application and an opinion on unconfirmed details from the Commission (Case Reference: ABP -321948-25) pursuant to section 37CD of the Planning and Development Act 2000 (as amended) accompanies this planning application. The details unconfirmed in this application are the turbine tip height, rotor diameter and hub height (blade tip height ranging from 179-180m, rotor diameter ranging from 149-163m, hub height ranging from 98.5m to 105m). The range of parameters under which the turbine dimensions will fall are specified on the site notice.

A 35-year operational life from the date of full commissioning of the Proposed Development is being sought for all works (other than temporary and permanent works specified above), and the subsequent decommissioning. The Proposed Substation, and the 110kV cable from this substation will continue to exist on a permanent basis. Permanent planning permission is being sought for these elements. A separate planning application for a 110kV underground grid connection from the Main Wind Farm Development Site Substation to the Bellacorick Substation will be lodged to An Coimisiún Pleanála.

The Proposed Project consists of the Main Wind Farm Development Site, the Grid Connection Route (GCR) and the Turbine Delivery Route (TDR). The Main Wind Farm Development Site predominately consists of cutover lowland blanket bog (which also aligns with non-priority Annex I Blanket Bog) as well as areas of Conifer Plantation on peated substrate. The bog is extensively drained, is subject to scrub encroachment and there is the pervasive presence of invasive species such as rhododendron (*Rhododendron ponticum*) and prickly heath (*Gaultheria mucronate*). Small areas of scrub and wet grassland are also present within the Main Wind Farm Development Site. These habitats are relatively consistent with the general surrounding area – with more peatland habitat available in the surrounding landscape than conifer plantation. Other habitats identified within the Main Wind Farm Development Site were scrub (WS1), buildings and artificial lands (BL3) - these habitats are all marginal around the dominant habitat types. There are also a series of drains and watercourses in various locations.

The Main Wind Farm Development Site is generally flat with levels ranging from 3 m AOD at the southern end to 33 m AOD at the northeastern portion. Several small streams are present within, and along the boundaries of, the Main Wind Farm Development Site. For example, a stream runs west along the northern boundary, and another flows south along the lower portion of the eastern boundary. The L5252 road bisects the Main Wind Farm Development Site east to west.

The TDR extends from Killybegs, Co. Donegal to the Main Wind Farm Development Site with temporary works to facilitate delivery in 3 areas. The TDR habitat comprise primarily public roads – with three key areas referred to as the Over-run Areas which are dominated by blanket bog (PB3) in good condition or cutover bog (PB4) in unfavourable condition. These habitats align with Annex I Blanket Bog for TDR Over-run Area 1 – but not in the other two Over-run Areas. However, as Over-run Area 3 shows signs of recent management and is mapped as a favourable reference area in the Article 17 data, it is assumed to be Annex I regardless of its current state. Please refer to **Appendix 4** for more information, including habitat maps. In addition, full details of the habitats on site can be found in the associated EIAR Biodiversity chapter – however, the key elements necessary for the AA process are contained within this report throughout the assessment.

3.3 Step 3: Identification of European Sites

3.3.1 Sources of Potential Impacts

The potential impacts associated with the construction and decommissioning phases of the Proposed Project are:

- Loss or Damage of habitats and flora during the construction/removal of infrastructure;
- Loss of habitats and reduction in home ranges of QI and SCI;
- Changes in hydrology and hydrogeology (water quality/ quantity), for instance due to accidental spillages of pollutants during maintenance;
- Disturbance and displacement of qualifying feature species;
- Spread of non-native invasive species to European Sites; and
- Changes in hydrology and hydrogeology (water quality/ quantity).

The potential impacts associated with the operational phase of the Proposed Project are:

- Changes in hydrology and hydrogeology (water quality/ quantity), for instance due to accidental spillages of pollutants during maintenance;
- Mortality of bats and birds through collisions with wind turbines;
- Disturbance and displacement of birds from the area around the wind turbines;
- Reduction of prey availability for some raptors due to displacement of small birds by turbines;
- Disturbance and displacement of birds during routine maintenance operations; and
- Barrier effect, disruption of migratory or other routes used by birds due to avoidance of wind turbines.

3.3.2 Ecological Connections

3.3.2.1 General Overview of Connection Rationale

SACs are designated for Qualifying Interests (QIs) and SPAs for Special Conservation Interests (SCIs). For assessment purposes, these are collectively referred to as Qualifying Features (QFs). Many QFs are mobile species whose home ranges, distributions, movements, and dispersal abilities vary across space and time. As a result, a population of a mobile QF associated with a European site may also utilise habitat within, or adjacent to, a proposed development site.

Where such use occurs - even intermittently - there is a functional ecological connection between a proposed development site and the relevant European site. These connections can involve a range of taxa, including birds, mammals, migratory fish, and other mobile species that form the QFs of European sites.

Other examples of potential ecological connections include habitat connections either directly or as 'stepping stones'. Moreover, the area surrounding a proposed development site may support a population of the QF species which occasionally exchanges individuals with a connected European site. Furthermore, a proposed development site may support populations of species which are prey/ food or hosts to the QFs of a European site.

It is important to note that the presence of an ecological connectivity does not necessarily equate to an impact pathway as there also needs to be a source for impact which interacts with this pathway. Similarly, the receptor needs to be sensitive to these sources for an effect to be realised.

3.3.2.2 Ecological Connections – Zone of Influence

NPWS guidelines (NPWS, 2010) recommend that a 15 km study area is adopted; however the Office of the Planning Regulator's Practice Note PN01 (OPR, 2021) suggest that a 15 km study area should not be adopted, but a case-by-case basis is undertaken when assessing the potential for -SPR connectivity between a project and European sites.

Each QI and SCI species or habitat operates at a different ecological scale, with unique spatial and functional characteristics. For instance:

- Terrestrial habitats are influenced by factors such as seed dispersal distances, community composition dynamics, edge effects, and broader land-use changes.
- Mobile species are shaped by home ranges, population connectivity, and the permeability of the intervening landscape.
- Some species (e.g. *Vertigo* snails) are highly groundwater-dependent, with extremely restricted distributions and habitat requirements measurable at a microhabitat scale of just a few metres.

For SACs in general, most QIs are influenced by local scale ecological processes such as seed dispersal, edge effects, and small-scale species movement. However, larger spatial buffers were applied for species known to operate at broader scales - such as Otter (*Lutra lutra*) and Lesser Horseshoe Bat (*Rhinolophus hipposideros*). Otters have a known core range of 13.2 km (Reid et al., 2013[22]) whereas Lesser horseshoe bats typically forage within 2.5 km of their roosts during summer, with seasonal movements of up to 10 km also recorded (Collins 2023[23]); therefore, distances of 13.2 km and 10 km (respectively) were used for each of these. There is potential for dispersal of populations between landscape features - such as juvenile/sub-adult otters moving from one catchment to another beyond these distances, and lesser horseshoe bats moving between core areas. However, in the context of this assessment these interactions are not foreseen to have likely effects.

In the absence of any specific European or Irish guidance in relation to establishing ecological connectivity to SPAs, NatureScot guidance (formerly Scottish Natural Heritage or 'SNH') (SNH, 2016) was consulted. This document provides guidance in relation to the identification of ecological connectivity between development sites and SPAs. The guidance takes into consideration the distances species may travel beyond the boundary of relevant SPAs and

[22] Reid, N., Hayden, B., Lundy, M.G., Pietravalle, S., McDonald, R.A. & Montgomery, W.I. (2013) National Otter Survey of Ireland 2010/12. Irish Wildlife Manuals No. 76. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
[23] Collins, J. (ed.) (2023). Bat Surveys for Professional Ecologists: Good Practice Guidelines (4th Edition). London: Bat Conservation Trust.

provides information on dispersal and foraging ranges of bird species which are frequently encountered when considering plans and projects. It goes on to state that *"in most cases the core range should be used when determining whether there is connectivity between the proposal and the QIs"*. Where SPAs and developments are separated by a greater distance than the core foraging ranges for the SPAs listed SCI species, there is no likely ecological connectivity to the development.

According to NatureScot guidance (SNH, 2016), the core foraging distances of wintering grey geese (greylag goose *Anser anser* and pink-footed goose *Anser brachyrhynchus*) from SPAs is 15-20 km. This represents the largest foraging range of all the species listed in this guidance document recorded in Ireland. It is acknowledged that information on core foraging ranges is not available for all Irish SCI species. In such cases, the 15-20 km core foraging range for grey geese has been adopted as a precautionary approach.

Thus, all SPAs within 20 km from the Main Wind Farm Development Site were considered for ecological source-receptor connectivity.

SNH Guidance Note 3[24] has been used to consider marine birds from SPAs beyond 20 km as the distances provided in this guidance relates to foraging at-sea ranges. Given the coastal location of the Main Wind Farm Development Site, we also assessed potential functional connectivity with more distant SPAs, including sites whose qualifying species may range offshore. This was considered in the context of existing and consented offshore wind farms to ensure cumulative pressures were captured. Collision risk was evaluated for each relevant SPA species group with explicit reference to the current and planned wind farm footprint surrounding those sites. Therefore, the ZOI for radial distances for SACs was 15 km, for SPAs was 20 km, and further considerations were made in the marine species specifically regarding offshore wind energy projects for in-combination effect considerations. Other ZOI considerations are detailed below.

3.3.2.3 Airborne Connectivity

Airborne emissions were considered using the approaches outlined in IAQM guidance (IAQM, 2019) (IAQM, 2014), which suggests that air pollution and dust from road schemes are only likely to be important for sensitive European sites within 200 m and 500 m, respectively.

3.3.2.4 Hydrological and Hydrogeological Connections

There is potential hydrological connectivity between any European site located downstream of the Main Wind Farm Development Site. The Main Wind Farm Development Site (i.e. 13 no. wind turbines and associated infrastructure) is connected to two streams (IE_WE_33R010800 and IE_WE_33T070130) that flow into Blacksod Bay which is part of the Mullet/Blacksod Bay Complex SAC. SACs with vagile species are also considered if upstream from the Main Wind Farm Development Site.

The Main Wind Farm Development Site is located within the Belmullet, IE_WE_G_0057 groundwater body. Therefore, there is a potential hydrogeological connection with any European site located within this groundwater body.

Hydrological connectivity beyond 20 km was also searched for using GIS to identify any European sites downstream of the Main Wind Farm Development Site connected via watercourses.

[24] Guidance Note 3: Guidance to support Offshore Wind applications: Marine Birds - Identifying theoretical connectivity with breeding site Special Protection Areas using breeding season foraging ranges | NatureScot. Accessed 10/11/2025

3.3.2.5 Identification of European Sites - Sensitive Receptors

European sites have been identified to have potential ecological connections to the Proposed Project – this has been determined in view of the sources for impacts which have been identified. These sites are detailed in **Table 3-1** to interrogate the sensitive receptors present (if any). Given the nature of the project – all point sources such as noise, dust etc – are identified to have been captured within these considerations. Therefore, no further distances are required. The locations of these sites, along with hydrological and hydrogeological details, are shown in **Figure 2** from **Appendix 1**.

The closest European sites are the Bellacorick Bog Complex SAC and Mullet/Blacksod Bay Complex SAC which are both directly adjacent to the Main Wind Farm Development Site boundary.

Appendix 6 details the background and baseline information for each European site, including references to each of the Site-Specific Conservation Objectives, which were all reviewed in the preparation of this assessment.

Table 3-1: Designated Sites considered for Screening

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
SAC				
Mullet/Blacksod Bay Complex SAC 000470	Directly adjacent to the west of the Main Wind Farm Development Site.	Mudflats and sandflats not covered by seawater at low tide [1140] Large shallow inlets and bays [1160] Reefs [1170] Salicornia and other annuals colonising that mud and sand [1310] Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120] Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130] Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) [2150] Machairs (* in Ireland) [21A0] Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation [3150] Alkaline fens [7230] *Lutra lutra* (Otter) [1355] Salmon Salmo salar Petalophyllum ralfsii (Petalwort) [1395]	This SAC is directly adjacent to the Main Wind Farm Development Site. There are hydrological and hydrogeological connections present. Hydrological Construction/ decommissioning of the Proposed Development - release of suspended solid (and other) pollution into two streams IE_WE_33R010800 and IE_WE_33T070130) that flow into the SAC – alkaline fens, Salmon and otter. There is connection to the marine environment and the following QFs may be impacted: • Mudflats and sandflats not covered by seawater at low tide [1140] • Salicornia and other annuals colonising mud and sand [1310] • Large shallow inlets and bays [1160] • Reefs [1170] • Alkaline fens [7230] • *Lutra lutra* (Otter) [1355] • Salmon Salmo sala The Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation [3150] habitats are upstream and pollutants will not interact with this habitat. The remaining QIs are terrestrial habitats thus no hydrological connectivity from the Main Wind Farm Development Site to the QIs.	Yes

[25] For SPAs, the bird species that are the reason for designation are Species of Conservation Interest (SCIs) and for SACs the habitats and species that are the reason for designation are its Qualifying Interests (QIs). For convenience, the term qualifying interest or QI is used here for both SPAs and SACs.

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			Hydrogeological The SAC is located in the same ground waterbody (IE_WE_G_0057, Belmullet) and same sub-catchment (Glencastle_SC_010) as the Proposed Development and therefore they are hydrogeologically connected. Ecological Otter have been identified on the Main Wind Farm Development Site. This is a highly mobile species and it is likely that the individuals recorded on site are part of the host population from the SAC. Similarly, Salmon are assumed to be present and active within the watercourse. There is also potential hydrological connectivity between the Main Wind Farm Development Site and the downstream aquatic habitats in the marine environment as stated above. All other ecological connections are excluded.	
Bellacorick Bog Complex SAC 001922	Directly Adjacent to Over-run Area 2. >5 km from the Main Wind Farm Development Site.	Marsh saxifrage (Saxifraga hirculus) [1528], Blanket bogs * if active bog [7130], Depressions on peat substrates of the Rhynchosporion [7150], Alkaline fens [7230], Northern Atlantic wet heaths with Erica tetralix [4010], Geyer`s whorl snail (Vertigo geyeri) [1013], Natural dystrophic lakes and ponds [3160]	There are hydrological and hydrogeological connections present because the SAC is directly adjacent to Over-run Area 3. There is no hydrological or hydrogeological connectivity between the SAC and the Main Wind Farm Development Site. Hydrological Construction/ decommissioning of the Proposed Development - release of suspended solid (and other) pollution into two streams IE_WE_33R010800 and IE_WE_33T070130) that flow into the SAC – alkaline fens. The other aquatic dependent habitats are all upstream from the Main Wind Farm Development Site. Hydrogeological The SAC is located in the same ground waterbody (IE_WE_G_0057, Belmullet) and same sub-catchment (Glencastle_SC_010) as the Proposed Development and therefore they are hydrogeologically connected. Ecological Over-run Area 3 comprises an existing access track and a mosaic of habitats which include some species which	Yes

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			could be present in the peatland habitats for which this SAC is designated. • Blanket bogs * if active bog [7130], Depressions on peat substrates of the Rhynchosporion [7150], • Alkaline fens [7230], • Northern Atlantic wet heaths with Erica tetralix [4010], Given the potential hydrological interactions with Alkaline fens this habitat, is further considered in this regard. All other ecological connections are excluded.	
Owenduff/Nephin Complex SAC 000534	900 m SE of Over-run Area 3 and 7.7 km SE of the Proposed Development Site	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3110] Natural dystrophic lakes and ponds [3160] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] Northern Atlantic wet heaths with *Erica tetralix* [4010] Alpine and boreal heaths [4060] *Juniperus communis* formations on heaths or calcareous grasslands [5130] Blanket bogs (* if active bog) [7130] Transition mires and quaking bogs [7140] *Salmo salar* (Salmon) [1106] *Lutra lutra* (Otter) [1355] *Saxifraga hirculus* (Marsh saxifrage) [1528] *Hamatocaulis vernicosus* (Slender green feather-moss) [6216]	Hydrological A study of local water courses confirms there is no downstream hydrological connectivity between the Main Wind Farm Development Site and the SAC which is situated upstream of the nearest potentially connected water course. However, Over-run Area 3 is located 900m NW of the SAC and hydrological interactions at a small scale could occur.- Furthermore due to the vagile nature of Salmon, the pollution of local water courses from the Main Wind Farm Development Site could result in changes to salmon dependent rivers, including upstream. Hydrogeological Owenduff/Nephin Complex SAC is located within the same ground waterbody as the Main Wind Farm Development Site. The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L). There are no identified karst features within a 2 km zone from the Main Wind Farm Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water	Yes

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			supply schemes are located along the TDR route, six GWS and two PWS. Therefore, there is no realistic hydrogeological connection for potential effects to the SAC. Ecological None of the QIs are particularly sensitive to groundwater interactions except for Blanket bogs and Transition mires and quaking bogs. Although the SAC and the Main Wind Farm Development Site are mapped within the same regional groundwater body, the SAC lies within a separate surface water catchment and there are no identified karst features, preferential flow paths or hydrogeological conduits that would enable groundwater-mediated connectivity. In the absence of such pathways, groundwater-dependent qualifying interests within the SAC are functionally isolated from the Proposed Project, and effects on these habitats cannot reasonably occur. Additionally, these habitats are largely ombitrophic meaning they are rainwater fed systems. Furthermore, for all of the habitat QIs the Seed and spore dispersal in these systems is typically restricted to tens to hundreds of metres, largely via local surface water movement or wind under specific microtopographic conditions. At a separation distance of approximately 7.7 km, and in the absence of hydrological or habitat continuity, there is no realistic mechanism by which propagule exchange or other functional landscape-scale processes could occur. Accordingly, the SAC peatland habitats are functionally isolated from the Main Wind Farm Development Site and ecological connectivity can be excluded Otter have been identified on site. This is a highly mobile species, and it is possible that the individuals recorded on site are part of the host population from the SAC. Salmon was recorded in the streams and rivers connected to the Main Wind Farm Development Site during baseline aquatic surveys. Due to the vagile nature of Salmon, the pollution of	

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			local water courses could result in changes to salmon dependent rivers.	
Carrowmore Lake Complex SAC 000476	1.8 km NW of Over-run Area 3 and 5.9 km NE from the Main Wind Farm Development Site.	Blanket bogs (* if active bog) [7130] Depressions on peat substrates of the *Rhynchosporion* [7150] *Saxifraga hirculus* (Marsh saxifrage) [1528] *Hamatocaulis vernicosus* (Slender green feather-moss) [6216]	Hydrological A study of local water courses confirms there is no hydrological connectivity as the SAC is situated upstream of the nearest potentially connected water course. Hydrogeological Carrowmore Lake Complex SAC is located within the same groundwater body as the Main Wind Farm Development Site. The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L). There are no identified karst features within a 2 km zone from the Main Wind Farm Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water supply schemes are located along the TDR route, six GWS and two PWS. Therefore, there is no realistic hydrogeological connection for potential effects to the SAC. Ecological Although the SAC and the Main Wind Farm Development Site are mapped within the same regional groundwater body, the SAC lies within a separate surface water catchment and there are no identified karst features, preferential flow paths or hydrogeological conduits that would enable groundwater-mediated connectivity. In the absence of such pathways, groundwater-dependent qualifying interests within the SAC (including blanket bog and Rhynchosporion depressions) are functionally isolated from the Proposed Project, and effects on these habitats cannot reasonably occur. Additionally, these habitats are largely ombitrophic meaning they are rainwater fed systems. Furthermore, the Seed and spore dispersal in	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			these systems is typically restricted to tens to hundreds of metres, largely via local surface water movement or wind under specific microtopographic conditions. At a separation distance of approximately 1.6 km, and in the absence of hydrological or habitat continuity, there is no realistic mechanism by which propagule exchange or other functional landscape-scale processes could occur. Accordingly, the SAC peatland habitats are functionally isolated from the Main Wind Farm Development Site and ecological connectivity can be excluded. No ecological connectivity as the designated features are habitats and species that are functionally isolated from the Main Wind Farm Development Site. Therefore, no connections.	
Lough Dahybaun SAC 002177	1.82 km E from Over-run Area 2	Slender naiad (Najas flexilis) [1833]	Hydrological A study of local water courses confirms there is no hydrological connectivity as the SAC is situated upstream of the nearest potentially connected water course. Hydrogeological Lough Dahybaun SAC is located within the same groundwater body as the Main Wind Farm Development Site. The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L). There are no identified karst features within a 2 km zone from the Main Wind Farm Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water supply schemes are located along the TDR route, six GWS and two PWS. This is based on the characteristics of the development and the likely flow dynamics from the Proposed Project. Ecological	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			The QI species is an aquatic plant and therefore is surface water dependent no groundwater sensitive. No ecological connectivity as the designated features are habitats and species that are functionally isolated from the Main Wind Farm Development Site. Therefore, there are no sources for impacts with pathways for potential effects to the qualifying interests (sensitive receptors) identified.	
River Moy SAC 002298	4.8 km SE from Over-run Area 2, but over 20 km SE from the Main Wind Farm Development Site.	Active raised bogs [7110], Otter (Lutra lutra) [1355], White-clawed crayfish (Austropotamobius pallipes) [1092], Depressions on peat substrates of the Rhynchosporion [7150], Brook lamprey (Lampetra planeri) [1096], Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0], Sea lamprey (Petromyzon marinus) [1095], Degraded raised bogs still capable of natural regeneration [7120], Atlantic salmon (Salmo salar) [1106], Alkaline fens [7230], Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0], Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) [6510]	Hydrological A study of local water courses confirms there is no hydrological connectivity as the SAC is in a different catchment. Hydrogeological River Moy SAC is located within the same groundwater body as the Main Wind Farm Development Site. The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L). There are no identified karst features within a 2 km zone from the Main Wind Farm Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water supply schemes are located along the TDR route, six GWS and two PWS. This is based on the characteristics of the Proposed Project and the likely flow dynamics from the Proposed Project. Ecological Although River Moy SAC and the Main Wind Farm Development Site are mapped within the same groundwater body, the SAC lies within a separate surface water catchment and there are no identified karst features, preferential flow paths or hydrogeological conduits that would enable groundwater-mediated connectivity. In the absence of such pathways, groundwater-dependent qualifying interests within the SAC (including alkaline fens, active raised bogs and	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			Rhynchosporion depressions) are functionally isolated from the Proposed Project, and effects on these habitats cannot reasonably occur. Qualifying interest habitats within the SAC are maintained by site-specific environmental conditions, including local hydrology, substrate, management regime and microclimate, and do not rely on landscape-scale dispersal or propagule exchange over kilometre-scale distances. In the absence of direct habitat continuity, surface water connectivity or other functional pathways linking the Main Wind Farm Development Site to the SAC, there is no plausible mechanism by which effects on habitat structure, function or regeneration could be transmitted. Accordingly, pathways for effects on qualifying interest habitats can be excluded. While there is potential for hydrological connectivity between the Main Wind Farm Development Site and the immediate receiving marine environment, any materials or contaminants potentially mobilised would be subject to rapid dilution, dispersion, tidal mixing and settlement within coastal waters. These physical processes act to markedly reduce concentration, persistence and spatial extent of any residual effects. As a result, effects would be highly localised and confined to the near-field marine environment, with no plausible mechanism for transmission at a scale capable of affecting qualifying interests within more distant marine SACs. Accordingly, likely significant effects on the marine dependent QIs for this SAC can be excluded. No ecological connectivity as the designated features are habitats and species that are functionally isolated from the Main Wind Farm Development Site. Therefore, there are no sources for impacts with pathways for potential effects to the qualifying interests (sensitive receptors) identified.	
Bellacorick Iron Flush SAC 000466	5.3 km NE from Over-run Area 2, but over 20 km from the Main Wind Farm Development Site.	Marsh saxifrage (Saxifraga hirculus) [1528]	Hydrological A study of local water courses confirms there is no hydrological connectivity as the SAC in a different catchment.	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			Hydrogeological Bellacorick Iron Flush SAC is located within the same groundwater body as the Main Wind Farm Development Site. The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L). There are no identified karst features within a 2 km zone from the Main Wind Farm Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water supply schemes are located along the TDR route, six GWS and two PWS. Therefore, there is no realistic hydrogeological connection for potential effects to the SAC. Ecological This QI species is not groundwater sensitive. No ecological connectivity as the designated features are habitats that are functionally isolated from the Main Wind Farm Development Site. Therefore, there are no sources for impacts with pathways for potential effects to the qualifying interests (sensitive receptors) identified.	
Slieve Fyagh Bog SAC 000542	11.3 km NE of the Main Wind Farm Development Site and 5.5 km NE from Over-run Area 3	Blanket bogs * if active bog [713	Hydrological A study of local water courses confirms there is no hydrological connectivity as the SAC is in a different catchment from the Proposed Project. Hydrogeological This SAC is located within the same ground waterbody as the Main Wind Farm Development Site. The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L). There are no identified karst features within a 2 km zone from the Main Wind Farm	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water supply schemes are located along the TDR route, six GWS and two PWS. Therefore, there is no realistic hydrogeological connection for potential effects to the SAC. Ecological Given the distances, although Slieve Fyagh Bog SAC and the Main Wind Farm Development Site are mapped within the same groundwater body, the SAC lies within a separate surface water catchment and there are no identified karst features, preferential flow paths or hydrogeological conduits that would enable groundwater-mediated connectivity. In the absence of such pathways, groundwater-dependent qualifying interests within the SAC (including blanket bogs) are functionally isolated from the Proposed Project, and effects on these habitats cannot reasonably occur. Seed and spore dispersal in these systems is typically restricted to tens to hundreds of metres, largely via local surface water movement or wind under specific microtopographic conditions. At a separation distance of approximately 5.5 km from the closest point, and in the absence of hydrological or habitat continuity, there is no realistic mechanism by which propagule exchange or other functional landscape-scale processes could occur. Accordingly, the SAC peatland habitats are functionally isolated from the Main Wind Farm Development Site and ecological connectivity can be excluded. No ecological connectivity as the designated feature is a habitat. Therefore, there are no sources for impacts with pathways for potential effects to the qualifying interests (sensitive receptors) identified.	

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
Broadhaven Bay SAC 000472	6.6 km N from the Main Wind Farm Development Site	Mudflats and sandflats not covered by seawater at low tide [1140] Large shallow inlets and bays [1160] Reefs [1170] Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330] Submerged or partially submerged sea caves [8330]	Hydrological A study of local water courses confirms there is no hydrological connectivity as the SAC is situated upstream of the nearest potentially connected water course. Hydrogeological Broadhaven Bay SAC is located within the same ground waterbody as the Main Wind Farm Development Site. Carrowmore Lake Complex SAC is located within the same groundwater body as the Main Wind Farm Development Site. The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L). There are no identified karst features within a 2 km zone from the Main Wind Farm Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water supply schemes are located along the TDR route, six GWS and two PWS. Therefore, there is no realistic hydrogeological connection for potential effects to the SAC. Ecological There are no groundwater sensitive QIs. Furthermore, there are no pathways for effect to the terrestrial habitats for which this site is designated. While there is potential for hydrological connectivity between the Main Wind Farm Development Site and the immediate receiving marine environment, any materials or contaminants potentially mobilised would be subject to rapid dilution, dispersion, tidal mixing and settlement within coastal waters. These physical processes act to markedly reduce concentration, persistence and spatial extent of any residual effects. As a result, effects would be highly localised and confined to the near-field marine environment, with no	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			plausible mechanism for transmission at a scale capable of affecting qualifying interests within more distant marine SACs. Accordingly, likely significant effects on the marine dependent QIs for this SAC can be excluded. No ecological connectivity as the designated features are habitats that do not occur on within the Main Wind Farm Development Site. Therefore, there are no sources for impacts with pathways for potential effects to the qualifying interests (sensitive receptors) identified.	
West Connacht Coast SAC 002998	8.0 km W from the Main Wind Farm Development Site	*Tursiops truncatus* (Common bottlenose dolphin) [1349]	Hydrological While there is a hydrological connection between onsite streams and the receiving coastal waters of Tullaghan Bay and Blacksod Bay, this linkage does not create a realistic impact pathway for the qualifying marine mammal species of the West Connacht Coast SAC. The freshwater streams on the site are very small, shallow systems that do not provide habitat or access for marine mammals. In addition, any potential pollutant loading from the site would be extremely limited in volume and would undergo substantial dilution and dispersion before reaching the marine environment. For these reasons, there is no credible mechanism by which the Proposed Project could affect the SAC's marine mammal features, despite the presence of a hydrological connection, given the volume of the water involved. Ecological No groundwater dependent QIs. While Common Bottlenose Dolphin (*Tursiops truncatus*) may intermittently occur within coastal waters in proximity to the Main Wind Farm Development Site , this is a wide-ranging marine mammal with large foraging ranges and high mobility. Any potential effects arising locally within the adjacent bay would be spatially limited and subject to rapid dilution within the marine environment and therefore would not be of a scale or persistence capable of giving rise to knock-on effects for the SAC populations located over 8 km away. Consequently, no functional ecological connectivity exists that would plausibly link localised effects	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			near the Main Wind Farm Development Site to adversely affect the conservation objectives of West Connacht Coast SAC.	
Glenamoy Bog Complex SAC 000500	8.7 km NE from Over-run Area 3 and 13.9 km NE from the Main Wind Farm Development Site.	Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] Machairs (* in Ireland) [21A0] Natural dystrophic lakes and ponds [3160] Northern Atlantic wet heaths with *Erica tetralix* [4010] Juniperus communis formations on heaths or calcareous grasslands [5130] Blanket bogs (* if active bog) [7130] Transition mires and quaking bogs [7140] Depressions on peat substrates of the Rhynchosporion [7150] *Salmo salar* (Salmon) [1106] Petalophyllum ralfsii (Petalwort) [1395] *Saxifraga hirculus* (Marsh saxifrage) [1528] *Hamatocaulis vernicosus* (Slender green feather-moss) [6216]	Hydrological A study of local water courses revealed confirms there is no downstream hydrological connectivity between the Proposed Project and the SAC as the SAC is situated upstream of the nearest potentially connected water course. The Main Wind Farm Development Site which is where the majority of the works will take place is in a different catchment to this SAC. Hydrogeological Glenamoy Bog Complex SAC is located within the same ground waterbody as the Main Wind Development Site. However, there is no realistic hydrogeological connection due to the distance between them (>13 km). This SAC is located within the same ground waterbody as the Main Wind Farm Development Site. The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L). There are no identified karst features within a 2 km zone from the Main Wind Farm Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water supply schemes are located along the TDR route, six GWS and two PWS. Therefore, there is no realistic hydrogeological connection for potential effects to the SAC. Ecological QI habitats are maintained by localised processes and lack mechanisms for kilometre-scale connectivity; in the absence of hydrological or habitat continuity, no pathways for effects exist.	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			With respect to Salmo salar (Atlantic salmon), the Proposed Project does not present a pathway for effects to the SAC population because the main wind farm works are located within a different catchment and therefore do not drain towards waters supporting the SAC. Potential sources of effect are limited to the temporary over-run works; however, these are hydrologically disconnected from the SAC (the SAC is upstream of the nearest potentially connected watercourse) and any residual, localised increases in suspended solids or associated pollutants would be rapidly attenuated through dilution, settling and deposition within the receiving drainage network. Consequently, any effects would be short-lived, spatially limited and would not propagate to habitats used by salmon within the SAC, and population-level effects can be excluded. Peatland qualifying habitats such as active raised bogs and Rhynchosporion depressions are characterised by highly localised landscape dynamics, with regeneration and maintenance processes driven primarily by in situ hydrology, peat accumulation and very limited short-range propagule dispersal. Seed and spore dispersal in these systems is typically restricted to tens to hundreds of metres, largely via local surface water movement or wind under specific microtopographic conditions. At a separation distance of approximately 8.7 km, and in the absence of hydrological or habitat continuity, there is no realistic mechanism by which propagule exchange or other functional landscape-scale processes could occur. Accordingly, the SAC peatland habitats are functionally isolated from the Main Wind Farm Development Site and ecological connectivity can be excluded. No ecological connectivity exists, as the designated features are predominantly immobile habitats and plant species that lack mechanisms to interact with the Main Wind Farm Development Site; salmon populations are hydrologically isolated due to catchment separation and dilution effects. Therefore, no sources of impact with viable pathways to the	

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			qualifying interests (sensitive receptors) are identified. No ecological connectivity as the designated features are habitats and plant species which are not mobile. Therefore, there are no sources for impacts with pathways for potential effects to the qualifying interests (sensitive receptor).	
Doogort Machair/Lough Doo SAC 001497	11.0 km SW from the Main Wind Farm Development Site	Machairs (* in Ireland) [21A0] Petalophyllum ralfsii (Petalwort) [1395]	Hydrological Several streams from within the Main Wind Farm Development Site, including Doolough Stream, discharge into Tullaghan Bay and Blacksod Bay. However, there is no realistic hydrological connection given the volume of the water involved. Furthermore, the QIs are not sensitive to hydrological interactions. Hydrogeological The SAC is located in a different groundwater body to the SAC. Therefore, no hydrogeological connectivity. Ecological QI habitats are maintained by localised processes and lack mechanisms for kilometre-scale connectivity; in the absence of hydrological or habitat continuity, no pathways for effects exist. No ecological connectivity as the designated features are habitats and plant species that do not occur within the Main Wind Farm Development Site.	No
Croaghaun/Slievemore SAC 001955	13.7 km SW from the Main Wind Farm Development Site	Northern Atlantic wet heaths with *Erica tetralix* [4010] European dry heaths [4030] Alpine and Boreal heaths [4060] Blanket bogs (* if active bog) [7130] Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) [8110] Siliceous rocky slopes with chasmophytic vegetation [8220]	Hydrological Several streams from within the Main Wind Farm Development Site, including Doolough Stream, discharge into Tullaghan Bay and Blacksod Bay. However, there is no realistic hydrological connection to Croaghaun/Slievemore SAC given the volume of the water and distances involved. Furthermore, the QIs are not sensitive to hydrological interactions. Hydrogeological The SAC is located in a different groundwater body to the SAC. Therefore, no hydrogeological connectivity. Ecological	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			No ecological connectivity as the designated features are habitats and there is considerable distance between the SAC and Main Wind Farm Development Site. Therefore, no sources with pathways for effects to these QIs. No connectivity.	
Erris Head SAC 001501	13.8 km NW from the Main Wind Farm Development Site	Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] Alpine and Boreal heaths [4060]	Hydrological No hydrological connectivity as the SAC is in a different catchment as stated above. Furthermore, the QIs are not sensitive to hydrological interactions. Hydrogeological Errris Head SAC is located within the same ground waterbody as the Main Wind Farm Development Site. However, there is no realistic hydrogeological connection due to the distance between them (>13.8 km) The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L).There are no identified karst features within a 2 km zone from the Main Wind Farm Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water supply schemes are located along the TDR route, six GWS and two PWS. Therefore, there is no realistic hydrogeological connection for potential effects to the SAC. Ecological No groundwater dependent QIs. No ecological connectivity as the designated features are habitats and the distances are far beyond natural dispersal pathway limits. Therefore, no sources with pathways for effects to these QIs. No connectivity.	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
Duvillaun Islands SAC 000495	14.8 km WSW from the Main Wind Farm Development Site	Common Bottlenose Dolphin (Tursiops truncatus) [1349], Grey Seal (Halichoerus grypus) [1364]	Hydrological No hydrological connectivity as the SAC marine based – and the distances stated are over land distances. Therefore, there is no functional connectivity due to the dilution effect of marine waters – considering the sources for impacts identified. Hydrogeological Duvillaun Islands SAC is located within the same ground waterbody as the Main Wind Farm Development Site. However, there is no realistic hydrogeological connection due to the distance between them (>14.8 km). The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L).There are no identified karst features within a 2 km zone from the Main Wind Farm Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water supply schemes are located along the TDR route, six GWS and two PWS. Therefore, there is no realistic hydrogeological connection for potential effects to the SAC. Ecological No groundwater dependent QIs. While Common Bottlenose Dolphin (*Tursiops truncatus*) and Grey Seal (*Halichoerus grypus*) may intermittently occur within coastal waters in proximity to the Main Wind Farm Development Site, both species are wide-ranging marine mammals with large foraging ranges and high mobility. Any potential effects arising locally within the adjacent bay would be spatially limited and subject to rapid dilution within the marine environment and therefore would not be of a scale or persistence capable of giving rise to knock-on effects for the SAC populations located over 14.8 km	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			away. Consequently, no functional ecological connectivity exists that would plausibly link localised effects near the wind farm to adverse effects on the conservation objectives of Duvillaun Islands SAC.	
Newport River SAC 002144	14.9 SE from Over-run Area 2	Freshwater pearl mussel (Margaritifera margaritifera) [1029], Atlantic salmon (Salmo salar) [1106]	Hydrological No hydrological connectivity as the SAC is in a different catchment as stated above. Hydrogeological Newport River SAC is located within the same ground waterbody as the Main Wind Farm Development Site. However, there is no realistic hydrogeological connection due to the distance between them (>14.9 km). The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L). There are no identified karst features within a 2 km zone from the Main Wind Farm Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water supply schemes are located along the TDR route, six GWS and two PWS. Therefore, there is no realistic hydrogeological connection for potential effects to the SAC. Ecological No groundwater dependent QIs. No ecological connectivity as the designated features are aquatic species from a different catchment.	No
SPA				
Owenduff/Nephin Complex SPA 004098	Adjacent to Over-run Area 3 and 7.76 km E	Merlin (Falco columbarius) [A098] (permanent)	Hydrological	Yes

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
	from the Main Wind Farm Development Site	Golden plover (Pluvialis apricaria) [A140] (breeding)	A study of local water courses confirms there is no downstream hydrological connectivity between the Main Wind Farm Development Site and the SPA which is situated upstream of the nearest potentially connected water course. However, the Over-run Areas are directly adjacent to the SPA and hydrological interactions at a small scale could occur. Hydrogeological Owenduff/Nephin Complex SPA is located within the same ground waterbody as the Main Wind Farm Development Site. The groundwater vulnerability at the Main Wind Farm Development Site is classed as Moderate (M). The groundwater vulnerability rating at the three Over-run Areas is Low (L). There are no identified karst features within a 2 km zone from the Main Wind Farm Development Site, the three Over-run Areas of the TDR and the GCR. Several clusters of karst features were noted along the nodes of the TDR. There is no Group Water Scheme (GWS) and Public Water Supply (PWS) within a 2 km radius of the Main Wind Farm Development Site, the Over-run Areas or the GCR. Eight water supply schemes are located along the TDR route, six GWS and two PWS. Furthermore, **Chapter 7** of the associated EIAR does not identify any significant groundwater interactions. Therefore, there is no realistic hydrogeological connection for potential effects to the SPA. Furthermore, the SCIs are not groundwater sensitive. Ecological Golden plover and merlin were recorded in flight within 500 m of the main development area of the wind farm. Breeding golden plover have a core foraging range of 3 km. The SPA is located 7.6 km away from the collision risk area of the main wind farm area and therefore is outside the core foraging range for golden plover and so no realistic ecological connection to the breeding SPA population of golden plover exists. Breeding merlin have a core foraging range of 5 km. There is no clear literature focused on the winter ranging behaviours of Merlin however, a study found that the mean winter range for	

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			merlin was approximately 8 km (Warkentin and Oliphant, 1990)[26]. Although it is noted the details of this study are not analogous to the context of the Proposed Project and the ranging behaviours are likely less than this, this is taken as a guide. As the SPA is located 7.6 km away from the main development area of the wind farm and given that the SPA is designated for its permanent population of merlin, there could be a potential ecological connection between the Main Wind Farm Development Site and the SPA, particularly for wintering merlin.	
Blacksod Bay/Broad Haven SPA 004037	700 from the Main Wind Farm Development Site and construction works will be further still. 1.4 km from the closest Over-run Area (Over-run Area 1).	Red-throated diver (Gavia stellata) [A001] (wintering) Great Northern diver (Gavia immer) [A003] (wintering) Slavonian grebe (Podiceps auritus) [A007] (wintering) Light-bellied brent goose (Branta bernicla hrota) [A046] (wintering) Common scoter (Melanitta nigra) [A065] (wintering) Red-breasted merganser (Mergus serrator) [A069] (wintering) Ringed plover (Charadrius hiaticula) [A137] (wintering) Sanderling (Calidris alba) [A144] (breeding) Dunlin (Calidris alpina) [A149] (wintering) Bar-tailed godwit (Limosa lapponica) [A157] (wintering)	Hydrological A study of the watercourses confirms there is hydrological connectivity as a result of two streams Bridgetown River which flows into Blacksod Bay – thus connected to the same SPA. as Blacksod Bay/Broad Haven SAC. Hydrogeological The SPA is located in the same ground waterbody (IE_WE_G_0057, Belmullet) and same sub-catchment (Glencastle_SC_010) as the Main Wind Farm Development Site and therefore they are hydrogeologically connected. Ecological Curlew was recorded within 500 m of the Main Wind Farm Development Site but not in flight. Curlew was also recorded during bioacoustic monitoring. The core winter foraging range for curlew is approximately 500 m (Mander et al. 2022)[27]. Therefore, the potential ecological connection is that the wintering curlew population of the SPA may fly across the Main Wind Development Site. The remaining SCIs were not recorded within the Main Wind Farm Development Site or 500 m buffer during passage surveys and no ecological connection is likely. The closest	Yes

[26] Warkentin, I. G., & Oliphant, L. W. (1990). Habitat use and foraging behaviour of urban Merlins (*Falco columbarius*) in winter. *Journal of Zoology (London)*, 221(4), 539–563.
[27] Mander et al. (2022). Individual, sexual and temporal variation in the winter home range sizes of GPS tagged Eurasian Curlews (Humber Estuary). Bird Study. Volume 69. Pages 39-52

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
		Curlew (Numenius arquata) [A160] (wintering) Sandwich tern (Sterna sandvicensis) [A191] (breeding) Wetland and Waterbirds [A999]	infrastructure is at least 700 m distant. Goodship and Furness (2022) also state that the majority of waders are not disturbed beyond 500 m. As there is forestry in between the SPA and Main Wind Development Site, the disturbing activities (construction at the main wind farm area) will be screened from any SPA birds. As a result, likely significant disturbance effects on SPA birds can be excluded.	
Carrowmore Lake SPA 004052	1.6 km NE of Over-run Area 3 but 5.9 km NE from the Main Wind Farm Development Site	Sandwich tern (Sterna sandvicensis) [A191] (breeding)	Hydrological & Hydrogeological No hydrological or hydrogeological connectivity. Ecological No sandwich terns were recorded during the surveys in the passage season or breeding seasons. Sandwich tern no longer breed within the SPA and the colony is thought to have moved to an island in Broad Haven Bay. The conservation objective of this species is to restore the population. Sandwich tern typically forages at sea and breeds on beaches and so would not use the Proposed Development Site because of the unsuitability of the habitat for breeding or foraging. Any movement would predominantly be between Carrowmore Lake/Dereens island and the sea via the shortest route northwest to Broad Haven Bay, which is located away from the Proposed Development Site. Therefore, there are no sources for impacts with pathways for potential effects to the SPA	No
Mullet Peninsula SPA 004227	9.6 km NW from the Main Wind Farm Development Site	Corncrake (*Crex crex*) [A122] (breeding)	Hydrological & Hydrogeological No hydrological or hydrogeological connectivity as this is a coastal/marine SPA connected to a different river catchment and groundwater body. Ecological No corncrake were recorded during surveys. These included extensive passage surveys and bioacoustic monitoring. Therefore, there is no ecological connection to the SPA.	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
Doogort Machair SPA 004235	11.1 km SW from the Main Wind Farm Development Site	Dunlin (*Calidris alpina schinzii*) [A466] (breeding)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a coastal/marine SPA connected to a different river catchment and groundwater body. Ecological Dunlin was not recorded during any flight activity survey or during the extensive suite of passage surveys (including bioacoustic surveys). This species was recorded during winter surveys at coastal locations nearby. The Proposed Development Site is not on a direct migratory line from the SPA to the wintering grounds as the Proposed Development Site located to the north and west of the SPA, and the breeding population grounds winters in southern Europe and Africa. Therefore, there is no ecological connection.	No
Termoncarragh Lake and Annagh Machair SPA 004093	13.3 km NW from the Main Wind Farm Development Site	Whooper swan (Cygnus cygnus) [A038] (wintering) Barnacle goose (Branta leucopsis) [A045] (wintering) Corncrake (Crex crex) [A122] (breeding) Lapwing (Vanellus vanellus) [A142] (breeding) Chough (Pyrrhocorax pyrrhocorax) [A346] (wintering) Greenland white-fronted goose (Anser albifrons flavirostris) [A395] (wintering) Dunlin (Calidris alpina schinzii) [A466] (breeding) Wetland and Waterbirds [A999]	Hydrological & Hydrogeological No hydrological or hydrogeological connectivity as this is partly a marine SPA connected to a different river catchment and groundwater body. Ecological Whooper swan was recorded in flight within 500 m of the Main Wind Farm Development Site. The core winter foraging range of whooper swan is less than 5 km and the SPA is approximately 13.3 km away. Therefore, it is unlikely any realistic ecological connectivity to the SPA population exists. Barnacle goose, lapwing and Greenland white-fronted goose were recorded during bioacoustic monitoring. Barnacle goose and Greenland white-fronted goose were also recorded in flight. As a precaution, lapwing was also assumed to be in flight to provide the worst-case scenario and ensure all potential impacts are considered appropriately. The core winter foraging range of barnacle goose is 15 km and the core winter foraging range for Greenland white-fronted goose is 5 – 8 km. Acoustic monitoring shows presence but not regular use. As the SPA is located approximately 13.3 km	Yes

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			away, there is ecological connectivity for barnacle goose but not Greenland white-fronted goose. No corncrake were recorded during surveys. This included extensive passage and bioacoustic surveys and therefore there is no ecological connection to the SPA population. A study in Italy found lapwing have home ranges of c. 56 ha during the breeding season and stay within 207 +/- 153 m from their nests. This equates to a core foraging range of approximately 400-450 m in the breeding season[28], indicating that no realistic ecological connection to the breeding population for this SPA is present. Dunlin was not recorded during any surveys within 500 m of the Main Wind Development Site , although this species was recorded during winter surveys at coastal locations nearby. Collectively, this suggests there is no realistic ecological connection to the breeding population from this SPA.	
Inishglora and Inishkeeragh SPA 004084	14.4 km NW from the Main Wind Farm Development Site	Storm petrel (Hydrobates pelagicus) [A014] (breeding) Cormorant (Phalacrocorax carbo) [A017] (breeding) Shag (Phalacrocorax aristotelis) [A018] (breeding) Barnacle goose (Branta leucopsis) [A045] (wintering) Lesser black-backed gull (Larus fuscus) [A183] (breeding) Herring gull (Larus argentatus) [A184] (breeding) Arctic tern (Sterna paradisaea) [A194] (breeding)	Hydrological & Hydrogeological No hydrological or hydrogeological connectivity as this SPA is composed of several islands. Ecological Cormorant, lesser black-backed gull and herring gull were recorded in flight within 500 m of the Main Wind Farm Development Site. Furthermore, barnacle goose was recorded in flight during bioacoustic monitoring. The core foraging range for breeding cormorant is 33.9 km, 236 km for breeding lesser black-backed gull and 85.6 km for breeding herring gull[29]. These ranges are greater than the distance of the SPA from the Main Wind Farm Development and therefore, there is potential ecological connectivity.	Yes

[28] Cevenini *et al* (2025) Habitat selection of the threatened Northern lapwing (*Vanellus vanellus*) breeding in an intensive agroecosystem. European Journal of Wildlife Research. 71:30
[29] https://www.nature.scot/doc/guidance-note-3-guidance-support-offshore-wind-applications-marine-birds-identifying-theoretical Accessed 10/11/2025

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			The core winter foraging range for barnacle goose is 15 km. As the SPA is 14.4 km away there is potential ecological connectivity. The remaining SCIs were not recorded within the Main Wind Farm Development Site or 500 m buffer and so there is no potential ecological connectivity present. Storm petrel and shag are marine/coastal species and do not occur on or near the Proposed Development Site .	
Duvillaun Islands SPA 004111	15.3 km SW of the Main Wind Farm Development Site	Fulmar (Fulmarus glacialis) [A009] (breeding) Storm petrel (Hydrobates pelagicus) [A014] (breeding) Barnacle goose (Branta leucopsis) [A045] (breeding)	Hydrological & Hydrogeological No hydrological or hydrogeological connectivity as this SPA is composed of several marine islands. Ecological Barnacle goose was recorded in flight during bioacoustic monitoring. The core winter foraging range for barnacle goose is 15 km The SPA is approximately 15.3 km away from the Main Wind Farm Development Site. Therefore, taking a precautionary approach, barnacle goose recorded at the Main Wind Farm Development Site may be linked to the SPA population. The remaining SCIs were not recorded within the Main Wind Farm Development Site or 500 m buffer. Fulmar and storm petrel are pelagic/coastal species and the habitat on the Main Wind Farm Development Site is not suitable. Therefore, no connectivity.	Yes
Inishkea Islands SPA 004004	16.4 km W from the Main Wind Farm Development Site	Shag (Phalacrocorax aristotelis) [A018] (breeding) Barnacle goose (Branta leucopsis) [A045] (wintering) Ringed plover (Charadrius hiaticula) [A137] (wintering & breeding) Sanderling (Calidris alba) [A144] (wintering)	Hydrological & Hydrogeological No hydrological or hydrogeological connectivity as this SPA is composed of several islands. Ecological Common gull and herring gull were recorded in flight within 500 m of the Main Wind Farm Development Site where collision risk was assessed. In addition, barnacle goose was recorded in flight during bioacoustic monitoring.	Yes

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
		Purple sandpiper (Calidris maritima) [A148] (wintering) Turnstone (Arenaria interpres) [A169] (wintering) Common gull (Larus canus) [A182] (breeding) Herring gull (Larus argentatus) [A184] (wintering) Arctic tern (Sterna paradisaea) [A194] (breeding) Little tern (Sterna albifrons) [A195] (breeding) Dunlin (Calidris alpina schinzii) [A466] (breeding & wintering)	The core foraging distances of common gull and herring gull are 50 km and 85.6 km[30], respectively. As the SPA is approximately 16.4 km distant there is potential ecological connectivity with regards to these two bird species. The core winter foraging range for barnacle goose is 15 km (NatureScot, 2016), which is less than the separation distance between the SPA and Main Wind Farm Development Site . However, it is likely that the birds at this SPA are from the same population as at Termoncarragh Lake and Annagh Macahir SPA (10.5 km distance between the two SPAs) so the population is linked to that of another SPA that is within foraging distances of the Proposed Development Site. Therefore, there is potential indirect ecological connectivity to the Inishkea Island SPA population of barnacle geese. The remaining SCIs were not recorded within the Main Wind Farm Development Site or 500 m buffer and so there is no ecological connectivity present.	
Lough Conn and Lough Cullin SPA 004228	17.1 km S from the Main Wind Farm Development Site	Common Scoter (Melanitta nigra) [A065] (breeding), Greenland White-fronted Goose (Anser albifrons flavirostris) [A395] (wintering), Tufted Duck (Aythya fuligula) [A061] (wintering), Wetland and Waterbirds [A999], Common Gull (Larus canus) [A182] (breeding)	Hydrological & Hydrogeological No hydrological or hydrogeological connectivity as this is a coastal/marine SPA connected to a different river catchment and groundwater body. Ecological Common gull were recorded in flight within 500 m of the Main Wind Farm Development Site where collision risk was assessed. Greenland white-fronted goose were recorded in flight during bioacoustic monitoring. The core foraging range for common gull is 50 km[21], and the core foraging range for Greenland white-fronted goose is 5 – 8 km. The SPA is located approximately 17.1 km away from the Main Wind Farm Development Site i.e. within the core foraging range for common gull but outside the core foraging range for Greenland	Yes

[30] https://www.nature.scot/doc/guidance-note-3-guidance-support-offshore-wind-applications-marine-birds-identifying-theoretical Accessed 10/11/2025

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
			white-fronted goose. Therefore, there is ecological connectivity for common gull but not Greenland white-fronted goose. The remaining SCIs were not recorded within the Main Wind Farm Development Site or 500 m buffer. Therefore, there is no connectivity for these other SCI species.	
Illanmaster SPA 004074	20.4 km NE from the Main Wind Farm Development Site	European storm petrel (Hydrobates pelagicus) [A014] (breeding)	Hydrological & Hydrogeological No hydrological or hydrogeological connectivity as this is a coastal/marine SPA connected to a different river catchment and groundwater body. Ecological Storm petrel was not recorded during any survey. This species is highly pelagic and the terrestrial location of the Proposed Project Site means the habitats on-site are not suitable for this species. Therefore, there is no connection to this SPA.	No
Killala Bay/Moy Estuary SPA 004036	22.7 km NE from the Main Wind Farm Development Site	Sanderling (Calidris alba) [A144] (wintering), Dunlin (Calidris alpina) [A149] (wintering), Curlew (Numenius arquata) [A160] (wintering), Ringed Plover (Charadrius hiaticula) [A137] (wintering), Bar-tailed Godwit (Limosa lapponica) [A157] (wintering), Redshank (Tringa totanus) [A162] (wintering), Wetland and Waterbirds [A999], Golden Plover (Pluvialis apricaria) [A140] (wintering), Grey Plover (Pluvialis squatarola) [A141] (wintering)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a coastal/marine SPA connected to a different river catchment and groundwater body. Ecological Golden plover were recorded in flight within 500 m of the Main Wind Farm Development Site. Curlew was also recorded during bioacoustic monitoring and during flight activity surveys (on the ground but not flying). The core winter foraging range for curlew is approximately 500 m (Mander et al. 2022). The core winter foraging range for golden plover is approximately 12 km (Gillings, Fuller and Sutherland, 2003). The SPA is located approximately 22.7 km from the Main Wind Farm Development Site, therefore there is no ecological connectivity.	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
Stags of Broad Haven SPA 004072	23.5 km W from the Main Wind Farm Development Site	Leach's Storm-petrel (Oceanodroma leucorhoa) [A015] (breeding), Storm Petrel (Hydrobates pelagicus) [A014] (breeding)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a coastal/marine SPA connected to a different river catchment and groundwater body. Ecological The SPA is a considerable distance from the Main Wind Farm Development Site. Furthermore, none of SCI species of the SPA were recorded during extensive bird surveys. These species are highly pelagic and the terrestrial location of the Main Wind Farm Development Site means the habitats on-site are not suitable. Therefore, there is no ecological connectivity to this SPA.	No
North-west Irish Sea SPA 004236	Approx. 240 km E from the Main Wind Farm Development Site	Red-throated diver (*Gavia stellata*) [A001] (wintering) Great northern diver (*Gavia immer*) [A003] (wintering) Fulmar (*Fulmarus glacialis*) [A009] (breeding and wintering) Manx shearwater (*Puffinus puffinus*) [A013] (breeding) Cormorant (*Phalacrocorax carbo*) [A017] (breeding) Shag (*Phalacrocorax aristotelis*) [A018] (breeding) Common scoter *(Melanitta nigra*) [A065] (wintering) Black-headed gull (*Chroicocephalus ridibundus*) [A179] (wintering) Common gull *(Larus canus*) [A182] (wintering) Lesser black-backed gull (*Larus fuscus*) [A183] (breeding)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a marine SPA connected to a different river catchment and groundwater body. Ecological The following species, which are SCI of this SPA, were recorded during surveys at the Main Wind Farm Development Site where collision risk was assessed: cormorant, kittiwake, black-headed gull, great black-backed gull, herring gull, lesser black-backed gull and common tern. The marine core foraging ranges of the aforementioned species during the breeding season are as follows; cormorant: 33.9 km kittiwake: 300.6 km black-headed gull: 18.5 km great black-backed gull: 73 km herring gull: 85.6 km lesser black backed gull 236 km common tern: 269 km.	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
		Herring gull (*Larus argentatus*) [A184] (breeding and wintering) Great black-backed gull (*Larus marinus*) [A187] (wintering) Kittiwake (*Rissa tridactyla*) [A188] (breeding and wintering) Roseate tern (Sterna dougallii) [A192] (breeding) Common tern (*Sterna hirundo*) [A193] (breeding) Arctic tern (*Sterna paradisaea*) [A194] (breeding) Guillemot (*Uria aalge*) [A199] (breeding and wintering) Razorbill (*Alca torda*) [A200] (breeding and wintering) Puffin (*Fratercula arctica*) [A204] (breeding) Little gull *(Hydrocoloeus minutus*) [A862] (wintering) Little tern (*Sternula albifrons*) [A885] (breeding)	The direct line distance of the SPA to the Main Wind Farm Development Site is approx. 240 km. Given the location of this SPA on the eastern coast of Ireland the marine distance is considerably greater than the direct line distance. Therefore, the marine distance between the Main Wind Farm Development Site and the SPA is greater than the marine core foraging range of any of the above-mentioned species. Hence, no ecological connection.	
Clare Island SPA 004136	Approx. 32 km S from the Main Wind Farm Development Site	Fulmar (*Fulmarus glacialis*) [A009] (breeding) Shag (*Phalacrocorax aristotelis*) [A018] (breeding) Common gull (*Larus canus*) [A182] (breeding) Kittiwake (*Rissa tridactyla*) [A188] (breeding) Guillemot (*Uria aalge*) [A199] (breeding) Razorbill (*Alca torda*) [A200] (breeding)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a marine SPA connected to a different river catchment and groundwater body. Ecological The following species, which are SCI of this SPA, were recorded during surveys at the Main Wind Farm Development Site: kittiwake and common gull. The marine core foraging ranges of these two species during the breeding season are as follows;	Yes

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
		Chough (*Pyrrhocorax pyrrhocorax*) [A346] (permanent)	Kittiwake: 300.6 km Common gull: 50 km The direct line distance of the SPA to the Main Wind Farm Development Site where collision risk was assessed is approx. 32 km. However, the marine distance is identified as greater than the direct line distance and is c.62 km. Therefore, the marine distance between the Main Wind Farm Development Site and the SPA is greater than the marine core foraging range of common gull. Therefore, with regards to common gull there is no ecological connectivity. One single kittiwake *Rissa tridactyla* was recorded during the 2023 spring passage season. Therefore, there is potential ecological connectivity for kittiwake, as summarised below. *Operating wind farm – collision – kittiwake*	
Inner Galway Bay SPA 004031	Approx 109 km S from the Main Wind Farm Development Site	Black-throated diver (*Gavia arctica*) [A002] (wintering) Great northern diver (*Gavia immer*) [A003] (wintering) Cormorant (*Phalacrocorax carbo*) [A017] (breeding) Grey heron (*Ardea cinerea*) [A028] Light-bellied brent goose (*Branta bernicla hrota*) [A046] (wintering) Teal (*Anas crecca*) [A052] (wintering) Red-breasted merganser (*Mergus serrato*r) [A069] (wintering) Ringed plover (*Charadrius hiaticula*) [A137] (wintering) Golden plover (*Pluvialis apricaria*) [A140] (wintering) Lapwing (*Vanellus vanellus*) [A142] (wintering)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a marine SPA connected to a different river catchment and groundwater body. Ecological The following species, which are SCIs of this SPA, were recorded during surveys at the Main Wind Farm Development Site: cormorant, golden plover, black-headed gull, common gull and common tern The marine core foraging ranges of the aforementioned species during the breeding season are as follows; cormorant: 33.9 km black-headed gull: 18.5 km golden plover: 12 km common gull: 50 km common tern: 269 km The direct line distance of the SPA to the Main Wind Farm Development Site is approx. 109 km; however, the marine distance between the Main Wind Farm Development Site is	Yes

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
		Dunlin (*Calidris alpina*) [A149] (wintering) Bar-tailed godwit (*Limosa lapponica*) [A157] (wintering) Curlew (*Numenius arquata*) [A160] (wintering) Redshank (*Tringa totanus*) [A162] (wintering) Turnstone (*Arenaria interpres*) [A169] (wintering) Black-headed gull (*Chroicocephalus ridibundus*) [A179] (wintering) Common gull (*Larus canus*) [A182] (wintering) Common tern (*Sterna hirundo*) [A193] (breeding) Wigeon (*Mareca penelope*) [A855] (wintering) Sandwich tern (*Thalasseus sandvicensis*) [A863] (breeding) Wetland and Waterbirds [A999]	considerably greater than this (c.200 km) and the marine core foraging range of cormorant, black-headed gull, golden plover and common gull. Therefore, there is no ecological connection for these species. However, there is potential ecological connectivity for common tern, as their marine core foraging range is greater than the marine distance between the Main Wind Farm Development Site and the SPA.	
Blasket Island SPA 004008	Approx. 224 km S from the Main Wind Farm Development Site	Fulmar (*Fulmarus glacialis*) [A009] (breeding) Manx shearwater (*Puffinus puffinus*) [A013] (breeding) Storm petrel (*Hydrobates pelagicus*) [A014] (breeding) Shag (*Phalacrocorax aristotelis*) [A018] (breeding) Lesser black-backed gull (*Larus fuscus*) [A183] (breeding) Herring gull (*Larus argentatus*) [A184] (breeding)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a marine SPA connected to a different river catchment and groundwater body. Ecological The following species, which are SCI of this SPA, were recorded during surveys at the Main Wind Farm Development Site was assessed: kittiwake, herring gull and lesser black-backed gull. The marine core foraging ranges of the aforementioned species are as follows; kittiwake: 300.6 km	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
		Kittiwake (*Rissa tridactyla*) [A188] (breeding) Arctic tern (*Sterna paradisaea*) [A194] (breeding) Razorbill (*Alca torda*) [A200] (breeding) Puffin (*Fratercula arctica*) [A204] (breeding) Chough (*Pyrrhocorax pyrrhocorax*) [A346] (breeding)	herring gull: 85.6 km lesser black backed gull: 236 km. The direct line distance of the SPA to the Main Wind Farm Development Site where collision risk was assessed is approx. 224 km. However, the marine distance is greater than the direct line distance. Therefore, the marine distance between the Main Wind Farm Development Site and the SPA is greater than the marine core foraging range of all the above-mentioned species. Hence, no ecological connection.	
South Dublin and River Tolka Estuary SPA 004024	Approx. 255 km SE from the Main Wind Farm Development Site	Light-bellied brent goose (*Branta bernicla hrota*) [A046] (wintering) Oystercatcher (*Haematopus ostralegus*) [A130] (wintering) Ringed plover (*Charadrius hiaticula*) [A137] (wintering) Grey plover (*Pluvialis squatarola*) [A141] (wintering) Knot (*Calidris canutus*) [A143] (wintering) Sanderling (*Calidris alba*) [A144] (wintering) Dunlin (*Calidris alpina*) [A149] (wintering) Bar-tailed godwit (*Limosa lapponica*) [A157] (wintering) Redshank (*Tringa totanus*) [A162] (wintering) Black-headed gull (*Chroicocephalus ridibundus*) [A179] (wintering) Roseate tern *(Sterna dougallii*) [A192] (concentration) Common tern (*Sterna hirundo*) [A193] (concentration)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a marine SPA connected to a different river catchment and groundwater body. Ecological The following species, which are SCI of this SPA, were recorded during surveys at the Main Wind Farm Development Site: black-headed gull and common tern. The marine core foraging ranges of the aforementioned species during the breeding season are as follows; black-headed gull: 18.5 km common tern: 269 km. The direct line distance of the SPA to the Main Wind Farm Development Site is approx. 255 km. Given the location of this SPA on the eastern coast of Ireland the marine distance is considerably greater than the direct line distance. Therefore, the marine distance between the Main Wind Farm Development Site and the SPA is identified as greater than the marine core foraging range of all the above-mentioned species, Hence, no ecological connection.	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
		Arctic tern (*Sterna paradisaea*) [A194] (concentration) Wetland and Waterbirds [A999]		
Rockabill SPA 004014	Approx. 257 km SE from the Main Wind Farm Development Site	Purple sandpiper (*Calidris maritima*) [A148] (breeding) Roseate tern (*Sterna dougallii*) [A192] (breeding) Common tern (*Sterna hirundo*) [A193] (breeding) Arctic tern (*Sterna paradisaea*) [A194] (breeding)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this SPA is entirely marine and therefore in a different catchment and groundwater body Ecological Common tern were recorded during surveys at the Main Wind Farm Development Site. The marine core foraging ranges of common tern is 269 km. The direct line distance of the SPA to the Main Wind Farm Development Site is approx. 257 km. Given the location of this SPA on the eastern coast of Ireland the marine distance is considerably greater than the direct line distance. No other SCI species were identified at the Main Wind Farm Development Site. Therefore, the marine distance between the Main Wind Farm Development Site and the SPA is identified as greater than the marine core foraging range of common tern. Hence, no ecological connection.	No
Lambay Island SPA 004069	Approx. 263 km SE from the Main Wind Farm Development Site	Fulmar (*Fulmarus glacialis*) [A009] (breeding) Cormorant (*Phalacrocorax carbo*) [A017] (breeding and wintering) Shag (Phalacrocorax aristotelis) [A018] Greylag goose (*Anser anser*) [A043] (wintering) Lesser black-backed gull (*Larus fuscus*) [A183] (breeding) Herring gull (*Larus argentatus*) [A184] Kittiwake *(Rissa tridactyla*) [A188] (breeding)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a marine SPA connected to a different river catchment and groundwater body. Ecological The following species, which are SCI of this SPA, were recorded during surveys at the Main Wind Farm Development Site: cormorant, kittiwake, herring gull and lesser black-backed gull. The marine core foraging ranges of the aforementioned species during the breeding season are as follows: cormorant: 33.9 km kittiwake: 300.6 km	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
		Guillemot (*Uria aalge*) [A199] (breeding) Razorbill (*Alca torda*) [A200] (breeding) Puffin (*Fratercula arctica*) [A204] (breeding)	herring gull: 85.6 km lesser black backed gull: 236 km. The direct line distance of the SPA to the Main Wind Farm Development Site is approx. 263 km. Given the location of this SPA on the eastern coast of Ireland the marine distance is considerably greater than the direct line distance. Therefore, the marine distance between the Main Wind Farm Development Site and the SPA is greater than the marine core foraging range of any of the above-mentioned species. Hence, no ecological connection.	
Ireland's Eye SPA 004117	Approx. 263 km SE from the Main Wind Farm Development Site	Cormorant (*Phalacrocorax carbo*) [A017] (breeding) Herring gull (*Larus argentatus*) [A184] (breeding) Kittiwake (*Rissa tridactyla*) [A188] (breeding) Guillemot (*Uria aalge*) [A199] (breeding) Razorbill (*Alca torda*) [A200] (breeding)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a marine SPA connected to a different river catchment and groundwater body. Ecological The following species, which are SCI of this SPA, were recorded during surveys at the Main Wind Farm Development Site: cormorant, kittiwake and herring gull. The marine core foraging ranges of the aforementioned species during the breeding season are as follows;: cormorant: 33.9 km kittiwake: 300.6 km herring gull: 85.6 km The direct line distance of the SPA to the Main Wind Farm Development Site is approx. 263 km. Given the location of this SPA on the eastern coast of Ireland the marine distance is considerably greater than the direct line distance. Therefore, the marine distance between the Main Wind Farm Development Site and the SPA is greater than the marine core foraging range of all of the above-mentioned species, Hence, no ecological connection.	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
Sovereign Island SPA 004124	Approx. 288 km S from the Main Wind Farm Development Site	Cormorant (*Phalacrocorax carbo*) [A017] (breeding)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a marine SPA connected to a different river catchment and groundwater body. Ecological Cormorant was recorded during surveys at the Main Wind Farm Development Site. The marine core foraging range of cormorant during the breeding season is 33.9 km. The direct line distance of the SPA to the Main Wind Farm Development Site is approx. 288 km. Therefore, the marine distance between the Main Wind Farm Development Site and the SPA is greater than the marine core foraging range of cormorant. Hence, no ecological connection.	No
Seas off Wexford SPA 004237	Approx. 300 km SE from the Main Wind Farm Development Site	Red-throated diver (*Gavia stellata*) [A001] (wintering) Fulmar (*Fulmarus glacialis*) [A009] (breeding) Manx shearwater (*Puffinus puffinus*) [A013] (breeding) Gannet (*Morus bassanus*) [A016] (breeding) Cormorant (*Phalacrocorax carbo*) [A017] (breeding and wintering) Shag (*Phalacrocorax aristotelis*) [A018] (breeding) Common scoter (*Melanitta nigra*) [A065] (wintering) Mediterranean gull (*Larus melanocephalus*) [A176] (breeding) Black-headed gull (*Chroicocephalus ridibundus*) [A179] (breeding) Lesser black-backed gull (*Larus fuscus*) [A183] (breeding)	Hydrology & Hydrogeology No hydrological or hydrogeological connectivity as this is a coastal/marine SPA connected to a different river catchment and groundwater body. Ecological The following species, which are SCI of this SPA, were recorded during surveys at the Main Wind Farm Development Site: cormorant, kittiwake and black-headed gull. The marine core foraging ranges of the aforementioned species during the breeding season are as follows: cormorant: 33.9 km kittiwake: 300.6 km black-headed gull: 18.5 km The direct line distance of the SPA to the Main Wind Farm Development Site is approx. 300 km. Given the location of this SPA on the eastern coast of Ireland the marine distance is considerably greater the direct line distance. Therefore, the marine distance between the Main Wind Farm Development Site and the SPA is greater than the marine core foraging	No

Site Name and Code	Distance (direct line) and Direction to Site	Qualifying Features[25]	Connections for Potential Effects (Source - Pathway – Receptor)	Further Consideration Needed (Yes/No)
		Herring gull (*Larus argentatus*) [A184] (breeding) Kittiwake (*Rissa tridactyla*) [A188] (breeding) Roseate tern (*Sterna dougallii*) [A192] (breeding) Common tern *(Sterna hirundo*) [A193] (breeding) Arctic tern (*Sterna paradisaea*) [A194] (breeding) Guillemot (*Uria aalge*) [A199] (breeding) Razorbill (*Alca torda*) [A200] (breeding) Puffin (*Fratercula arctica*) [A204] (breeding) Sandwich tern (*Thalasseus sandvicensis*) [A863] (breeding) Little tern (*Sternula albifrons*) [A885] (breeding)	range of any of the above-mentioned species. Hence, no ecological connection.	

3.4 Step 4 Assessment of potential for likely significant effects

3.4.1 For the Proposed Project 'Alone'

Table 3-1 identifies those European sites for which there are potential connections to the Proposed Project; **Table 3-1** details considerations of source-pathway-receptor linkages between the Proposed Project and qualifying features, and therefore where potential effects cannot be discounted at a screening level. Where there are potential effects - thus, there are sources with pathways identified to sensitive receptors - it is considered that there could be implications for the conservation objectives; therefore, further considerations are required regarding stage 2 AA alone.

Across the construction, operational and decommissioning phases, the Proposed Project has the potential to give rise to impacts including direct habitat disturbance or loss associated with infrastructure works; disturbance and displacement of qualifying species due to noise, visual presence and human activity; changes in surface water and groundwater quality or quantity arising from earthworks, drainage alteration or accidental spillages; temporary degradation of air quality due to dust and construction traffic; and the introduction or spread of invasive non-native species. During operation, additional potential effects include collision risk to birds, displacement and barrier effects affecting bird movement and migration, disturbance during maintenance activities, and indirect effects on prey availability for raptors. These impact pathways form the basis for the AA of potential effects on the integrity of the European sites identified; namely:

- Mullet/Blacksod Bay Complex SAC 000470
- Bellacorick Bog Complex SAC 001922
- Owenduff/Nephin Complex SAC 000534
- Owenduff/Nephin Complex SPA 004098
- Blacksod Bay/Broad Haven SPA 004037
- Termoncarragh Lake and Annagh Machair SPA 004093
- Inishglora and Inishkeeragh SPA 004084
- Duvillaun Islands SPA 004111
- Inishkea Islands SPA 004004
- Lough Conn and Lough Cullin SPA 004228
- Clare Island SPA 004136
- Inner Galway Bay SPA 004031

Therefore, the potential effects to European Sites - following the initial SPR model associated with the construction and decommissioning phases of the Proposed Project are:

- Loss or Damage of habitats and flora during the construction/removal of infrastructure;
- Loss of habitats and reduction in home ranges of qualifying interest and species of SCI;
- Disturbance and displacement of QI species;
- Changes in hydrology and hydrogeology (water quality / quantity);
- Spread of invasive non-native species to European Sites;
- Disturbance of SCI bird species by noise, visual, human disturbance;

The potential impacts associated with the operational phase of the Proposed Project are:

- Mortality of birds through collisions with wind turbines for the period of operation;
- Disturbance and displacement of birds from the area around the wind turbines for the period of operation.
- Barrier effect, disruption of migratory or other routes used by birds due to avoidance of wind turbines.

3.4.2 For the Proposed Project 'In Combination'

As the Proposed Project has potential significant effects alone, there is the potential for other plans and projects, specifically any other land use changes, to also impact upon the designated features of these European sites. These include projects such as other operational windfarm projects – which are considered in detail in the NIS – specifically Section 4.4.4. Therefore, likely significant effects cannot be excluded for the European sites listed above when the Proposed Project is considered in combination with other plans and projects.

3.5 AA Screening Conclusion

Through an assessment of the Pathways for potential effects and an evaluation of the Sources for impacts, taking account of the processes involved and the distance of separation from European Sites, likely significant adverse effects on the qualifying interests, special conservation interest or the conservation objectives of the following European Sites cannot be excluded without further assessment or mitigation:

- Mullet/Blacksod Bay Complex SAC 000470
- Bellacorick Bog Complex SAC 001922
- Owenduff/Nephin Complex SAC 000534
- Owenduff/Nephin Complex SPA 004098
- Blacksod Bay/Broad Haven SPA 004037
- Termoncarragh Lake and Annagh Machair SPA 004093
- Inishglora and Inishkeeragh SPA 004084
- Duvillaun Islands SPA 004111
- Inishkea Islands SPA 004004
- Lough Conn and Lough Cullin SPA 004228
- Clare Island SPA 004136
- Inner Galway Bay SPA 004031

This information that is presented in this report will allow the Competent Authority to make their determination regarding the need for a Stage 2 Appropriate Assessment regarding likely significant effects on European Sites resulting from the proposed project, in accordance with and fulfilment of the requirements of Article 6 of the Habitats Directive and the implementing legislation

4.0 Stage 2: Appropriate Assessment

4.1 Step 1, Part 1: Information on the Proposed Project

The full project description is provided above in Section 2.0. Below is a concurrent summary along with details of the surveys undertaken – and subsequent data – to provide insight into the baseline environment to further support the discussion on potential ecological connectivity.

4.1.1 Ecology Surveys

Table 4-1 details all the surveys undertaken at the Main Wind Farm Development Site and Turbine Delivery Route Over-Run Areas.

Table 4-1: Surveys undertaken at the Main Wind Farm Development Site and Turbine Delivery Route Over-Run Areas

Survey	Brief description	Timing	Reference
Data Validity Extended habitat survey	A verification walkover and drive-through of the Main Wind Farm Development Site, grid connection route and turbine delivery route was completed to validate the data previously collected in July 2023 (see Extended habitat surveys below) and confirm that no material changes to baseline habitat conditions had occurred.	May 2025	CIEEM, 2019[31] CIEEM, 2017[32]
Extended habitat surveys	Initial Walkover/drive of Main Wind Farm Development Site, grid connection route and turbine delivery route.	July 2023	CIEEM, 2017[33]
Habitat surveys	Habitats within the Main Wind Farm Development Site were mapped according to the Fossitt classification system. Full details see **Appendix 4**.	September 2023	Fossitt, 2007[34] Smith, 2011[35]
	Annex I habitat condition assessment within the identified Peatland Habitats within the Main Wind Farm Development Site. Full details see **Appendix 4**.	November 2024 January 2026	Fossitt, 2007 Smith, 2011 Smith, G.F. & Crowley, W., 2020[36] Perrin *et al*., 2014[37]

[31] CIEEM (2019) *Advice Note: On the Lifespan of Ecological Reports & Surveys*. April 2019. Winchester: Chartered Institute of Ecology and Environmental Management.
[32] Chartered Institute of Ecology and Environmental Management (CIEEM). (2017, December). *Guidelines for Ecological Report Writing* (2nd ed.). Winchester, UK. Retrieved from CIEEM website
[33] Chartered Institute of Ecology and Environmental Management (CIEEM). (2017, December). *Guidelines for Ecological Report Writing* (2nd ed.). Winchester, UK. Retrieved from CIEEM website
[34] Fossitt, J.A. (2007) *A guide to habitats in Ireland*. Kilkenny: The Heritage Council.
[35] Smith, O. P. (2011). Best practice guidance for habitat survey and mapping. Ireland: The Heritage Council.
[36] Smith, G.F. & Crowley, W. (2020) *The habitats of cutover raised bog*. Irish Wildlife Manuals, No. 128. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Dublin.
[37] Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014) *Guidelines for a National Survey and Conservation Assessment of Upland Vegetation and Habitats in Ireland*. Version 2.0. Irish Wildlife Manuals, No. 79. Dublin: National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

Survey	Brief description	Timing	Reference
	Habitats within the Turbine Delivery route – notable the 3 Over-run Areas where works are proposed to take place that are not along the existing road network. This was undertaken following the Fossitt classification system. Full details see **Appendix 4.**	July 2025 January 2026	Fossitt, 2007 Smith, 2011
Bird surveys	Vantage point (VP) surveys undertaken at four locations Full details see **Appendix 2**	Breeding season 2021 Autumn passage season 2021 Non-breeding season 2021-22 Breeding season 2022 Autumn passage season 2022 Non-breeding season 2022-23 Passage season 2023 Breeding season 2023 Autumn passage season 2023 Non-breeding season 2023/24 Spring passage season 2024	NatureScot, 2025[38]
	Breeding bird surveys Full details see **Appendix 2**	May – June 2021 May – July 2022 April – August 2023	O'Brien and Smith (1992)[39]
	Breeding raptor surveys Full details see **Appendix 2**	May – June 2021 June 2022 March 2023 – July 2023	Hardy et al., 2013[40]
	Winter walkover surveys Full details see **Appendix 2**	October 2021 – February 2022 October 2022 – February 2023 October 2023 – January 2024	Bibby, 2000[41]
	Wintering waterbird surveys Full details see **Appendix 2**	October 2021 – March 2022 October 2022 – March 2023 October 2023 – March 2024	Irish Wetland Bird Survey Counter Manual (2025) NatureScot, 2025

[38] NatureScot (2025) *Pre-application guidance for onshore wind farms: requirements for bird survey data, including vantage point surveys*. Perth: NatureScot. Available at: https://www.nature.scot/doc/naturescot-pre-application-guidance-onshore-wind-farms
[39] O'Brien, M.G. & Smith, K.W. (1992). Changes in the status of waders breeding on wet lowland grasslands in England and Wales between 1982 and 1989. Bird Study, 39, pp. 165–176.
[40] Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2013) *Raptors: a field guide for surveys and monitoring*. (3rd edn). Edinburgh: The Stationery Office.
[41] Bibby, C.J., Burgess, N.D., Hill, D.A. and Mustoe, S. (2000). *Bird Census Techniques*. Academic Press. Harcourt Place, London, UK.

Survey	Brief description	Timing	Reference
	Hen harrier roost searches Full details see **Appendix 2**	October 2021 – January 2022 October 2022 – March 2023 January – February 2024	Hardy et al., 2009[42] O'Donoghue, 2019[43]
	Bioacoustic monitoring Full details see **Appendix 2**	March – April 2023 February – April 2024	Bird Survey & Assessment Steering Group. (2025)[44]
Terrestrial Mammal Survey	Searches within 150 m of any undertaken within the main Wind Farm Development Site These surveys were not undertaken at the Over-run Areas or along the TDR.	July 2022 November 2024	CIEEM, 2019[45] CIEEM, 2017[46]
Aquatic surveys	Aquatic and fisheries surveys were undertaken within the Main Wind Farm Development Site. Full details see **Appendix 3**	September 2023	Please refer to Triturus, 2023a and Triturus 2023b for methodology references

4.1.1.1 Limitations

The survey and assessment are subject to several limitations and uncertainties as set out below.

Habitat condition assessment

The blanket bog habitat condition assessment surveys were conducted in the sub- optimal period – however, vegetative identification was used, meaning the flowering heads were not needed to record the species. All species found on site were identified. Cryptic species such as orchids – which would be sub-terranean in this period were not possible to identify. However, given the habitat type and general condition of the Main Wind Farm Development Site this is not thought to be a significant limitation for the survey.

The Floral Protection Order (FPO) species which are likely to occur in peatland habitats are; Hammarbya paludosa (Bog orchid), Eriophorum gracile (Slender cottongrass) and Salix phylicifolia (Tea-leaved Willow). Bog orchid are restricted in their known range to the NW of Ireland and Slender cottongrass are more strongly associated with fen habitats. Willow species are identifiable all year. Therefore, there are no limitations associated with FPO species due to the timing of the surveys.

Bats

It was not possible to collect 10 no. consecutive nights of static bat data in suitable weather conditions during the summer deployment period for 2022 (06 – 19 July 2022) as weather on 07 July 2022 was non-compliant.

[42] Hardey, J., Etheridge, B. W. & Summers, R. W. (2009) '*Breeding ecology and nest-site monitoring of Hen Harrier (Circus cyaneus) in Britain and Ireland*', in Raptors: a field guide for surveys and monitoring (3rd edn), Edinburgh: The Stationery Office.
[43] O'Donoghue, B.G. (2019) *Hen Harrier Roost Types and Guidelines to Roost Watching*. Irish Hen Harrier Winter Survey. Available at: http://www.ihhws.ie/IHHWS
[44] Bird Survey & Assessment Steering Group. (2025). *Bird Survey Guidelines for assessing ecological impacts*, https://birdsurveyguidelines.org [13/05/2025].
[45] CIEEM (2019) *Advice Note: On the Lifespan of Ecological Reports & Surveys*. April 2019. Winchester: Chartered Institute of Ecology and Environmental Management.
[46] Chartered Institute of Ecology and Environmental Management (CIEEM). (2017, December). *Guidelines for Ecological Report Writing* (2nd ed.). Winchester, UK. Retrieved from CIEEM website

Two detector failures occurred during the 2023 autumn survey season, detector locations D.10 and D.12. In addition, one detector failure occurred during the 2024 summer survey season at location D.12. Overall, the combined survey approach and coverage over the 2022 and 2023 survey seasons, provides robust data giving a full insight into the use of the Main Wind Farm Development Site by bats. The survey methodologies employed are in line with the recommended guidelines (NatureScot, 2021[1917]),[17] and as such, this information can be appropriately used to assess the potential impacts of the Proposed Project on the local bat population.

Birds

A total of three breeding bird survey visits between 2021 and 2023 were not conducted in a single day. Specifically, one survey visit in 2022 was conducted over two consecutive days, two survey visits in 2023 were each conducted over three consecutive days and a further one survey visit in 2023 was conducted over three non-consecutive days.

The number of breeding walkover and dusk surveys recommended by NatureScot (2025) were not accomplished in the 2021 and 2022 breeding seasons.

The number of breeding raptor surveys recommended by NatureScot (2017 and 2025) were not accomplished in the 2021 and 2022 breeding seasons.1915. It is recommended by NatureScot 2017 and NatureScot 2017 that four visits are conducted to establish occupancy and the presence of a breeding pair. However, if there is no evidence of occupation on the first two visits, then further visits to that home range can be omitted. A total of two visits were conducted in 2021, despite the established occupancy of a pair of kestrel, and one visit in 2022. A total of four visits were conducted in 2023.

Access to the full ornithological survey area for walkover surveys could only be undertaken on lands where permission had been granted.

IWeBS data were used to assess county populations of wintering wildfowl (data from all IWeBS sites in County Mayo were collated); however, this is only available for wintering wildfowl and is not available for all birds or for the breeding season. Where detailed county-level species population data was absent, we have estimated county-level populations for Mayo by multiplying the Republic of Ireland (ROI) population totals by 0.07. This 0.07 figure is the land area taken up by the County of Mayo as a proportion of the ROI total land area. This assumes that species populations are evenly distributed, which may not be realistic; however, in the absence of detailed spatial data this is considered a reasonable approximation.

Despite the minor limitations mentioned above, it is considered that the surveys carried out in 2021, 2022 and 2023 provide sufficient data to identify any ornithological constraints and provide a robust data set for the purpose of an ornithological impact assessment for the Main Wind Farm Development Site.

Aquatic and Fisheries Surveys

Overall, none of the limitations outlined above for the habitat condition assessment, bat surveys and bird surveys are considered to significantly affect the validity of the data on which the assessment is based.

The three Over-run Areas were not surveyed. However, due to the temporary nature of the works, this is not identified to be a significant limitation. It is considered that the area surveyed provides sufficient data to identify any aquatic and/or fisheries constraints and provides a robust data set for impact assessment.

Overall, none of the limitations outlined above for the habitat condition assessment, bat surveys and bird surveys are considered to significantly affect the validity of the data on which the assessment is based.

4.1.1.2 Overview of Survey Results from the Main Wind Farm Development Site

The below are the key summary details of the survey results for the Main Wind Farm Development Site which are relevant to the AA Process; further details on the broader ecological context can be found in Chapter 5 of the associated EIAR. The Main Wind Farm Development Site and surrounding area is typical of this part of west Ireland and comprise a generally flat low-lying landscape with little in the way of undulation. Within the Main Wind Farm Development Site levels range from c. 19 m above ordnance datum (AOD) to 29 m AOD.

The desktop assessment demonstrated that there is only one area of lands present within the Main Wind Farm Development Site or 500 m from the boundary[47] that has been previously mapped as Annex I habitat. Specifically, Over-run Area 3 is part of the Article 17 mapped data which forms part of the national Favourable Reference Area for Annex I Blanket Bog. No other areas have been previously mapped as protected or important habitats. However, while no Annex I areas have been mapped, the assessment is that all peatland within the Main Wind Farm Development Site aligns with Annex I criteria. There is also no previously mapped possible ancient woodland (PAW) or semi-natural grasslands within or in the vicinity of the Main Wind Farm Development Site. There are no known semi-natural grasslands within the receiving environment as per the NPWS data set. Furthermore, there are no records of plant species of conservation concern within the hectad (F72) from the NBDC which the Main Wind Farm Development Site is within. Similarly, there were no floral protection orders or rare/protected bryophytes present in the NPWS datasets

Habitat contribution to ecological networks has been assessed by Parker et al. (2016).[48] Those areas that contribute most to ecological networks (i.e. those that contribute to three ecological networks) are considered to have the highest biodiversity value. Most of the land is consistent with the surrounding landscape which is dominated by lowland blanket bogs and scattered conifer plantations.

Habitat within the Main Wind Farm Development Site predominately consists of cutover lowland blanket bog (PB4) surrounded by conifer plantation. The bog is extensively drained, is subject to scrub encroachment and there is the pervasive presence of invasive species such as rhododendron (*Rhododendron ponticum*) and prickly heath (*Gaultheria mucronate*). Scrub (WS1), wet grassland (GS4), dry-humid acid grassland (GS3) and two small acid oligotrophic lakes (FL2) are also present. Several buildings, and associated artificial surfaces (BL3), are located to the west of the Main Wind Farm Development Site. Several small streams are present within the Main Wind Farm Development Site and along the boundaries. The L5252 road bisects the Main Wind Farm Development Site east to west.

Table 4-2: Habitats within the Proposed Development Site

Habitat	Description	Annex I
BL3 - Buildings and artificial surfaces	A public access road bisects the centre of the Main Wind Farm Development Site, running east-west.	No
ED3 - Recolonising bare ground	This habitat is represented by the numerous trackways that traverse the Main Wind Farm Development Site. Species recorded include *Agrostis capillaris*, *Plantago lanceolata*, *Lolium perenne*, *Jacobaea vulgaris*, *Bellis perennis*, and *Plantago major*.	No
FW1 - Eroding/upland rivers	Eroding/upland river (FW1) habitat is represented by a number of small streams that criss-cross and drain the Main Wind Farm Development Site. A few aquatic species were seen occurring in the streams, including *Fontinalis antipyretic*a,	No

[47] Ordnance Survey Ireland (OSi). (2023). GeoHive Map Viewer [Online geospatial data portal]. GeoHive, Tailte Éireann.
[48] Parker, N., Medcalf, K., Naumann, E.-K., & Haines-Young, R. (2016). *Place-based ecosystem service mapping and opportunities analysis: Linking habitat contributions to ecological networks* [Conference presentation]. NPWS Workshop on Ecosystem Service Mapping, Ireland.

Habitat	Description	Annex I
	Nasturtium officinale agg., and *Potamogeton polygonifolius*. The bryophytes Marchantia polymorpha and *Brachythecium rivulare* were also recorded on wet rocks and soil in and by the streams. It is important to note that the watercourses on site classify as FW1 according to the fossit system – however, they are lower order streams and do not classify as rivers nor do they align with the Annex I habitat criteria.	
FL8 – Other artificial lakes and ponds	Present at a few locations in the southern half of the Main Wind Farm Development Site. It mainly forms mosaics with other habitats on the pond margins, including transition mire and quaking bog (PF3) and reed and large sedge swamps (FS1).	No
FS1 - Reed and large sedge swamps	At one location at the southern end of the Main Wind Farm Development Site where it occurs in a mosaic with artificial lakes and ponds (FL8) and transition mire and quaking bog (PF3) habitats. This habitat is dominated by *Typha latifolia*.	No
GS3 - Dry-humid acid grassland	Occurs in a mosaic with wet grassland (GS4) along the river at the north-western end of the Main Wind Farm Development Site. Grass species recorded here include *Agrostis capillaris*, *Agrostis stolonifera*, and *Anthoxanthum odoratum.*	No
GS4 – Wet grassland	A common habitat at the Main Wind Farm Development Site, both on its own and in a mosaic with other habitats. There is a large more continuous area of this habitat at the southern end of the Main Wind Farm Development Site.	No
HD1 - Dense bracken	Dense bracken (HD1) is found along the eastern Main Wind Farm Development Site in a mosaic with scrub (WS1) and wet grassland (GS4).	No
PB3 - Lowland blanket bog	Mostly found in small patches around the Main Wind Farm Development Site's boundary, where drainage is less substantial. The dominant species present is *Schoenus nigricans*, an indicator species for this habitat.	Yes - 7130 (not priority)
PB4 - Cutover bog	This habitat represents most of the Main Wind Farm Development Site's interior. *Calluna vulgaris*, *Juncus effusus* and *Sphagnum* spp. are the dominant species present.	Yes – 7130 (not priority)
PF2 – Poor fen and flush	Present at the north-western end of the Main Wind Farm Development Site in a mosaic with wet grassland (GS4) and cutover bog (PB4) and blanket bog (PB3). The PF2 within these mosaics is dominated by *Sphagnum palustre, Juncus effusus, and Molinia caerulea.*	No
WD4 - Conifer plantation	Dominates the southern and western ends of the Main Wind Farm Development Site and is also found along most of the boundary. The dominant species are *Picea sitchensis* and *Pinus contorta*.	No
WS1 - Scrub	Present in isolated patches widely across the Main Wind Farm Development Site and often in a mosaic with other habitats such as wet grassland (GS4), cutover bog (PB4) and blanket bog (PB3). Characterised by the dominance of *Ulex europaeus* and *Salix cinerea subsp. Oleifolia*.	No

4.1.1.3 Habitats (including Annex I)

Habitat within the Main Wind Farm Development Site predominately consists of cutover lowland blanket bog (PB4) which aligns with Annex I low blanket bog [7130]. Due to the sparse coverage of sphagnum species, there is no area of the Main Wind Farm Development Site which is active and therefore no Priority Annex I habitat is present. Please see **Appendix 4** for more information. The bog is extensively drained, is subject to scrub encroachment and there is the pervasive presence of invasive species such as rhododendron and prickly heath. Scrub (WS1), wet grassland (GS4), dry-humid acid grassland (GS3) and two small acid oligotrophic lakes (FL2) are also present. Several small streams are present within the Main Wind Farm Development Site and along the boundaries.

Species (Annex I birds and Annex II others)

Three years of baseline bird survey effort was undertaken between 2021 and 2024 at the Main Wind Farm Development Site where collision risk is a source for impacts. The TDR works will be small scale temporary works that will not have long term effects – there are no collision risks associated with these works – therefore, it is identified that the potential effects from these works are not likely to have significant effects on birds. Please refer to **Table 4-1** for more details on survey methodology and timing. A total of 10 SCIs for which there is ecological connectivity were recorded during the baseline bird survey effort; namely, curlew, cormorant, lesser black-backed gull, kittiwake, herring gull, common gull, common tern, merlin and barnacle goose. All of these bird species were recorded within 500 m of the Main Wind Farm Development Site.

Otter was recorded during baseline ecology surveys. Otter signs were recorded on the Doolough Stream and Mhoing Mhór River which flow along the northern boundary of the Main Wind Farm Development Site. Otter signs were also recorded on the unnamed river flowing along the eastern boundary of the Main Wind Farm Development Site which could be part of an SAC population.

4.2 Step 1, Part 2 Information on European Sites

4.2.1 Mullet/Blacksod Bay Complex SAC

Mullet/Blacksod Bay Complex SAC has site specific conservation objectives (NPWS, 2014). These provide the definition of favourable conservation condition for the qualifying interests of the SAC, and state whether the qualifying interests are in favourable or unfavourable condition. Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included. These are summarised in Table 4-3.

Table 4-3: Conservation objectives for the qualifying interests of Mullet/Blacksod Bay Complex SAC (F=favourable, U=unfavourable, M=maintain, R=restore)

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Mudflats and sandflats not covered by seawater at low tide [1140]	Habitat area Community distribution	M/F
Large shallow inlets and bays [1160]	Habitat area Community extent Community structure: shoot density Community structure – merl Community structure - Serpula vermiculari Community distribution	M/F
Reefs [1170]	Habitat area Distribution Community Extent Community structure – Serpula vermiculari Community structure – reef community	M/F

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Salicornia and other annuals colonising mud and sand [1310]	Habitat area Habitat distribution Physical structure: sediment supply Physical structure: creeks and pans Physical structure: flooding regime Vegetation structure: zonation Vegetation structure: vegetation height Vegetation structure: vegetation cover Vegetation composition: typical species and subcommunities Vegetation structure: negative indicator species – Spartina anglica	M/F
Alkaline fens	Habitat area Habitat distribution Hydrological regime Peat formation Water quality: nutrients Vegetation composition: typical species Vegetation composition: trees and shrubs Physical structure: disturbed bare ground Physical structure: drainage	M/F
Otter Lutra lutra	Distribution Extent of terrestrial habitat Extent of marine habitat Extent of freshwater (river) habitat Extent of freshwater (lake/lagoon) habitat Couching sites and holts Fish biomass available Barriers to connectivity	M/F

4.2.2 Bellacorick Bog Complex SAC

Bellacorick Bog Complex SAC has site specific conservation objectives (NPWS, 2017) (**Table 4-4**). These provide clarity on the definition of favourable conservation condition for the qualifying interests of the SAC, and state whether the qualifying interests are favourable or unfavourable. Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included.

Table 4-4: Conservation objectives for the qualifying interests of Bellacorick Bog Complex SAC (F=favourable, U=unfavourable, M=maintain, R=restore)

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Alkaline fens	Habitat area Habitat distribution Ecosystem function: soil nutrients Ecosystem function: peat formation Ecosystem function: hydrology Ecosystem function: water quality Community diversity	R/U

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
	Vegetation composition: number of positive indicator species (brown mosses) Vegetation composition: number of positive indicator species (vascular plants) Vegetation composition: cover of positive indicator species Vegetation composition: negative indicator species Vegetation composition: non-native species Vegetation composition: native trees and shrubs Vegetation composition: soft rush and common reed cover Vegetation structure: height Physical structure: disturbed bare ground Physical structure: drainage Physical structure: tufa formations Indicators of local distinctiveness	

4.2.3 Owenduff/Nephin Complex SAC

Owenduff/Nephin Complex SAC has site specific conservation objectives (NPWS, 2017). These provide clarity on the definition of favourable conservation condition for the qualifying interests of the SAC, and state whether the qualifying interests are favourable or unfavourable. These are summarised in**Table 4-5**. Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included

Table 4-5: Conservation objectives for the qualifying interests of Owenduff/Nephin Complex SAC (F=favourable, U=unfavourable, M=maintain, R=restore)

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Otter *Lutra lutra*	Distribution Extent of terrestrial habitat Extent of freshwater (river) habitat Extent of freshwater (lake) habitat Couching sites and holts Fish biomass available Barriers to connectivity	M/F
Salmon *Salmo salar*	Distribution: extent of anadromy Adult spawning fish Salmon fry abundance Out-migrating smolt abundance Number and distribution of redds Water quality	M/F

4.2.4 Blacksod Bay/Broad Haven SPA

Blacksod Bay/Broad Haven SPA has site specific conservation objectives (NPWS, 2014). These provide clarity on the definition of favourable conservation condition for the qualifying interests of the SPA, and state whether the qualifying interests are favourable or unfavourable. The conservation objectives for the SCI species which have been identified previously to have an ecological connection are summarised in **Table 4-6**. Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included.

Table 4-6: Conservation objectives for the qualifying interests of Blacksod Bay/Broad Haven SPA (F=favourable, U=unfavourable, M=maintain, R=restore)

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Curlew *Numenius arquata*	Population trend Distribution	M/F
Wetlands	Habitat area	M/F

4.2.5 Owenduff/Nephin Complex SPA

Owenduff/Nephin Complex SPA has site specific conservation objectives (NPWS, 2025). These provide clarity on the definition of favourable conservation condition for the qualifying interests of the SPA, and state whether the qualifying interests are favourable or unfavourable. The conservation objectives for the SCI species which have been identified previously to have an ecological connection are summarised in **Table 4-7**.. Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included.

Table 4-7: Conservation objectives for the qualifying interests of Owenduff/Nephin Complex SPA (F=favourable, U=unfavourable, M=maintain, R=restore

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Merlin *Falco columbarius*	Population size Productivity rate Distribution: extent of available nesting options within the SPA Extent and condition of suitable open habitats for foraging Disturbance to breeding sites	R/U

4.2.6 Termoncarragh Lake and Annagh Machair SPA

Termoncarragh Lake and Annagh Machair SPA has site specific conservation objectives (NPWS, 2025). These provide clarity on the definition of favourable conservation condition for the qualifying interests of the SPA, and state whether the qualifying interests are favourable or unfavourable. The conservation objectives for the SCI species which have been identified previously to have an ecological connection are summarised in **Table 4-8**. Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included.

Table 4-8: Conservation objectives for the qualifying interests of Termoncarragh Lake and Annagh Machair SPA (F=favourable, U=unfavourable, M=maintain, R=restore)

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Barnacle goose *Branta leucopsis*	Winter population trend Winter spatial distribution Disturbance at wintering site Barriers to connectivity and site use Forage spatial distribution, extent and abundance Roost spatial distribution and extent Supporting habitat: area and quality	M/F

4.2.7 Inishglora and Inishkeeragh SPA

Inishglora and Inishkeeragh SPA has site specific conservation objectives (NPWS, 2025). These provide clarity on the definition of favourable conservation condition for the qualifying interests of the SPA, and state whether the qualifying interests are favourable or unfavourable. The conservation objectives for the SCI species which have been identified previously to have an ecological connection are summarised in **Table 4-9**. Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included.

Table 4-9: Conservation objectives for the qualifying interests of Inishglora and Inishkeeragh SPA (F=favourable, U=unfavourable, M=maintain, R=restore)

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Cormorant *Phalacrocorax carbo*	Breeding population size Productivity rate Distribution: extent of available nesting options within the SPA Forage spatial distribution, extent, abundance and availability Disturbance at the breeding site Disturbance at areas ecologically connected to the colony Barriers to connectivity	R/U
Lesser black-backed gull *Larus fuscus*	Breeding population size Productivity rate Distribution: extent of available nesting options within the SPA Forage spatial distribution, extent, abundance and availability Disturbance at the breeding site Disturbance at areas ecologically connected to the colony Barriers to connectivity	R/U
Herring gull *Larus argentatus*	Breeding population size Productivity rate Distribution: extent of available nesting options within the SPA Forage spatial distribution, extent, abundance and availability Disturbance at the breeding site Disturbance at areas ecologically connected to the colony Barriers to connectivity	R/U
Barnacle goose *Branta leucopsis*	Winter population trend Winter spatial distribution Disturbance at wintering site Barriers to connectivity and site use Forage spatial distribution, extent and abundance Roost spatial distribution and extent Supporting habitat: area and quality	M/F

4.2.8 Duvillaun Islands SPA

Duvillaun Islands SPA has site specific conservation objectives (NPWS, 2025). These provide clarity on the definition of favourable conservation condition for the qualifying interests of the

SPA, and state whether the qualifying interests are favourable or unfavourable. The conservation objectives for the SCI species which have been identified previously to have an ecological connection are summarised in **Table 4-10**. Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included.

Table 4-10: Conservation objectives for the qualifying interests of Duvillaun SPA (F=favourable, U=unfavourable, M=maintain, R=restore)

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Barnacle goose *Branta leucopsis*	Winter population trend Winter spatial distribution Disturbance at wintering site Barriers to connectivity and site use Forage spatial distribution, extent and abundance Roost spatial distribution and extent Supporting habitat: area and quality	M/F

4.2.9 Inishkea Islands SPA

Inishkea Islands SPA has site specific conservation objectives (NPWS, 2025). These provide clarity on the definition of favourable conservation condition for the qualifying interests of the SPA, and state whether the qualifying interests are favourable or unfavourable. The conservation objectives for the SCI species which have been identified previously to have an ecological connection are summarised in **Table 4-11.** Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included.

Table 4-11: Conservation objectives for the qualifying interests of Inishkea Islands SPA (F=favourable, U=unfavourable, M=maintain, R=restore)

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Common gull *Larus canus*	Breeding population size Productivity rate Distribution: extent of available nesting options within the SPA Forage spatial distribution, extent, abundance and availability Disturbance at the breeding site Disturbance at areas ecologically connected to the colony Barriers to connectivity	M/F
Herring gull *Larus argentatus*	Breeding population size Productivity rate Distribution: extent of available nesting options within the SPA Forage spatial distribution, extent, abundance and availability Disturbance at the breeding site Disturbance at areas ecologically connected to the colony connectivity	R/U
Barnacle goose *Branta leucopsis*	Winter population trend Winter spatial distribution Disturbance at wintering site	M/F

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
	Barriers to connectivity and site use Forage spatial distribution, extent and abundance Roost spatial distribution and extent Supporting habitat: area and quality	

4.2.10 Lough Conn and Lough Cullin SPA 004228

Lough Conn and Lough Cullin SPA has site specific conservation objectives (NPWS, 2025). These provide clarity on the definition of favourable conservation condition for the qualifying interests of the SPA, and state whether the qualifying interests are favourable or unfavourable. The conservation objectives for the SCI species which have been identified previously to have an ecological connection are summarised in **Table 4-12.** Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included.

Table 4-12: Conservation objectives for the qualifying interests of Lough Conn and Lough Cullin SPA (F=favourable, U=unfavourable, M=maintain, R=restore)

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Common gull *Larus canus*	Breeding population size Productivity rate Distribution: extent of available nesting options within the SPA Forage spatial distribution, extent, abundance and availability Disturbance at the breeding site Disturbance at areas ecologically connected to the colony Barriers to connectivity	M/F

4.2.11 Inner Galway Bay SPA

Inner Galway Bay SPA has site specific conservation objectives (NPWS, 2013). These provide clarity on the definition of favourable conservation condition for the qualifying interests of the SPA, and state whether the qualifying interests are favourable or unfavourable. The conservation objectives for the SCI species which have been identified previously to have an ecological connection are summarised in**Table 4-13**. Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included.

Table 4-13: Conservation objectives for the qualifying interests Inner Galway Bay SPA (F=favourable, U=unfavourable, M=maintain, R=restore)

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Common tern *Sterna hirundo*	Breeding population abundance: apparently occupied nests (AONs) Productivity rate: fledged young per breeding pair Distribution: breeding colonies Prey biomass available Barriers to connectivity Disturbance at breeding site	M/F

4.2.12 Clare Island SPA

Clare Island SPA has site specific conservation objectives (NPWS, 2025). These provide clarity on the definition of favourable conservation condition for the qualifying interests of the SPA, and state whether the qualifying interests are favourable or unfavourable. The conservation objectives for the SCI species which have been identified previously to have an ecological connection are summarised in**Table 4-14.** Only the Qualifying Interests identified for further assessment in **Table 3-1** for this European Site are included.

Table 4-14: Conservation objectives for the qualifying interests Clare Island SPA (F=favourable, U=unfavourable, M=maintain, R=restore)

Qualifying interest	Attributes defining conservation condition	Conservation condition and objective
Kittiwake *Rissa tridactyl*	Breeding population size Productivity rate Distribution: extent of available nesting options within the SPA Forage spatial distribution, extent, abundance and availability Disturbance at the breeding site Disturbance at areas ecologically connected to the colony Barriers to connectivity	R/U

4.3 Step 2, Part 1: Effects on European Sites ‘Alone’

This Step evaluates whether the Proposed Project, considered in isolation, could give rise to an adverse effect on the integrity of a European site in view of that site’s conservation objectives. The assessment draws directly on the source–pathway–receptor (SPR) model established during AA Screening, including the spatial and functional connectivity identified for each site. For all sites with a linkage connection, we examine the specific qualifying features, relevant impact pathways, and the Proposed Project’s potential to undermine the conservation objectives for the habitats and species for which those sites are designated that have the identified connectivity as per the screening. Each pathway is assessed using the best scientific information, considering magnitude, duration, reversibility and the likelihood of adverse effects.

Table 4-15: Effects on European Sites Alone

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
Mullet/Blacksod Bay Complex SAC 000470	Mudflats and sandflats not covered by seawater at low tide [1140] Large shallow inlets and bays [1160] Reefs [1170] Salicornia and other annuals colonising mud and sand [1310] Alkaline fens [7230] *Lutra lutra* (Otter) [1355]	Loss or damage of habitat There will be no loss or damage to the habitats in the SAC as it does not fall within the Main Wind Farm Development Site. Loss of habitats and reduction in home ranges of QI/SCI species The Doolough Stream, Mhoing Mhór River, and unnamed river flowing along the eastern boundary of the Main Wind Farm Development Site, along which otter signs have been recorded, are beyond the boundary of the Main Wind Farm Development Site. No loss of habitat or reduction in home range of otter will occur. Disturbance/displacement of QI species As otter are recorded present in the absence of mitigation, activities undertaken during the construction/ decommissioning of the Proposed Project could result in disturbance/ displacement and/or reduction in foraging opportunities for this species. otter could be disturbed by works taking place near to watercourses within the Main Wind Farm Development Site which could result in temporary displacement of otter from the site and nearby during the construction period. Changes in water quality/quantity During construction, decommissioning, and to a lesser extent, during operation (in the form of routine maintenance) of the Proposed Project there is potential for the release of suspended solids, nutrients, and other pollutants, (such as hydrocarbons, contaminated waste-water, and cement-based products). All impacts outlined above have the potential to adversely affect the integrity of the site but only with respect to the QIs with hydrological sensitivities (Mudflats and sandflats not covered by seawater at low tide; Large shallow inlets and bays, Reefs, Salicornia and other annuals colonising mud and sand, alkaline fens and otter) if run-off from the Main Wind Farm Development Site reaches the SAC. The pathway is identified by the surface water network downstream. Suspended solids could reduce water clarity reducing the ability of plants to photosynthesize, resulting in die back. The increased availability of nutrients can lead to algal blooms (eutrophication) which can also limit light penetration, reducing growth and causing the death of plants. Hydrocarbon pollution affects leaf biochemistry, leading to decline in productivity and die back of vegetation (Arellano *et al*., 2015).

[49] The QF crossed out are the ones that were identified in the screening to not have potential effects from the Proposed Project due to the outcome of the SPR model.

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		Release of suspended solids could occur when soil is disturbed during construction and/or decommissioning works, especially during periods of heavy rainfall. Suspended solid pollution could reduce water quality and smother spawning beds of fish species, leading to negative effects on fish populations, in turn impacting prey availability for otter. Even at low levels of hydrocarbon pollution, bio-accumulation can occur, leading to suppressed immune systems, reduced metabolism and damage to gills (Austin, 2010). These impacts to fish would in turn negatively impact upon species that hunt them, including otter. During algal blooms, fish can die due to inflammation, mucus production and haemorrhaging gills, which impacts upon the species higher up in the food chain (Hallegraeff, 1992). When algal blooms eventually die, microbial decomposition severely depletes dissolved oxygen levels, creating a hypoxic environment that is unable to support most organisms, thus indirectly impacting upon otter. However, the period for potential release of suspended solids is likely to be temporary, occurring only during the construction and/or decommissioning works. During construction some of the works will require dry works areas within the Proposed Project. These are likely to interact with the water retained within the peatland habitats at the Main Wind Farm Development Site, this is an ombrotrophic system which means it is not groundwater fed however, there could be some small scale temporary interactions with groundwater that are not fully modelled or understood at this stage so there are unknown effects identified to water quality which may influence groundwater quality for a temporary period at very small scale sites during construction – therefore mitigation measures are required to address this risk. Alkaline fen are groundwater dependant terrestrial ecosystems sensitive to changes is water quantity. Hydrological interactions which may have links to groundwater in these habitats, even temporarily, would affect the vegetation composition, for example by facilitating colonisation of scrub within the peatlands, which would be difficult to reverse. Spread of Invasive Non-Native Species (INNS) There is the potential for construction and/or decommissioning activity to result in the importation or spread of INNS within the Main Wind Farm Development Site which may subsequently reach the SAC. Rhododendron and Prickly Heath were recorded during surveys within the Main Wind Farm Development Site. These species could be transported around the Main Wind Farm Development Site by construction machinery and potentially make their way into the SAC via the streams – the potential risk related to prickly heath is noted to be extremely low.
Bellacorick Bog Complex SAC 001922	Alkaline fens [7230]	Loss or damage of habitat There will be no loss or damage to the habitats in the SAC as it does not fall within the Main Wind Farm Development Site. Loss of habitats and reduction in home ranges of QI/SCI species

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		No QIs which are sensitive to Loss of habitats and reduction have been identified for this SAC with connectivity to the Main Wind Farm Development Site. Disturbance/displacement of QI species No QIs which are sensitive to disturbance or displacement have been identified for this SAC with connectivity to the Main Wind Farm Development Site.. Changes in water quality/quantity During construction, decommissioning, and to a lesser extent, during operation (in the form of routine maintenance) of the Proposed Project there is potential for the release of suspended solids, nutrients, and other pollutants, (such as hydrocarbons, contaminated waste-water, and cement-based products). All impacts outlined above have the potential to adversely affect the integrity of the site but only with respect to the QIs with hydrological sensitivities (alkaline) if run-off from the Main Wind Farm Development Site reaches the SAC. The pathway is identified to by the surface water network downstream. Suspended solids could reduce water clarity reducing the ability of plants to photosynthesize, resulting in die back. The increased availability of nutrients can lead to algal blooms (eutrophication) which can also limit light penetration, reducing growth and causing the death of plants. Hydrocarbon pollution affects leaf biochemistry, leading to decline in productivity and die back of vegetation (Arellano *et al*., 2015). Release of suspended solids could occur when soil is disturbed during construction and/or decommissioning works, especially during periods of heavy rainfall. However, the period for potential release of suspended solids is likely to be temporary, occurring only during the construction and/or decommissioning works. During construction some of the works will require dry works areas within the Proposed Project. These are likely to interact with the water retained within the peatland habitats at the Main Wind Farm Development Site, this is an ombrotrophic system which means it is not groundwater fed however, there could be some small scale temporary interactions with groundwater that are not fully modelled or understood at this stage so there are unknown effects identified to water quality which may influence groundwater quality for a temporary period at very small scale sites during construction – therefore mitigation measures are required to address this risk.. Alkaline fen are groundwater dependant terrestrial ecosystems sensitive to changes is water quantity. Hydrological interactions which may have links to groundwater in these habitats, even temporarily, would affect the vegetation composition, for example by facilitating colonisation of scrub within the peatlands, which would be difficult to reverse. Spread of Invasive Non-Native Species (INNS)

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		There is the potential for construction and/or decommissioning activity to result in the importation or spread of INNS within the Main Wind Farm Development Site which may subsequently reach the SAC. Rhododendron and Prickly Heath were recorded during surveys within the Main Wind Farm Development Site. These species could be transported around the Main Wind Farm Development Site by construction machinery and potentially make their way into the SAC via the streams – the potential risk related to prickly heath is noted to be extremely low.
Owenduff/Nephin Complex SAC 000534	*Salmo salar* (Salmon) [1106] *Lutra lutra* (Otter) [1355]	Loss or damage of habitat There will be no loss or physical damage to qualifying interest habitats within the SAC, as the SAC does not overlap with the Main Wind Farm Development Site and no works are proposed within its boundary. Loss of habitats and reduction in home ranges of QI/SCI species The Doolough Stream, Mhoing Mhór River, and the unnamed river along the eastern boundary of the Main Wind Farm Development Site—where otter activity has been recorded—lie outside the SAC boundary. No works are proposed within these watercourses, and therefore no loss of habitat or reduction in home range for otter within the SAC will occur. Disturbance or displacement of QI species Otter (Lutra lutra) has been recorded within the wider area. Construction and decommissioning activities undertaken in proximity to watercourses within the wind farm site could give rise to temporary disturbance or displacement of individuals using these features. Any such effects would be short-term, localised, and reversible, and would not affect the availability of suitable habitat or population viability within the SAC. Salmon are not likely to be functionally disturbed by the works as there will be no instream works and they are not sensitive to on land human activities that are not functionally connected to their watercourses. Changes in water quality or quantity Salmon is a QI of the SAC; however, the Main Wind Farm Development Site lies within a separate surface water catchment and there is no downstream hydrological connectivity to salmon-supporting watercourses within the SAC. Any potential water quality effects arising from construction or decommissioning activities would be confined to local catchments draining the wind farm site and would be subject to rapid dilution and attenuation. Accordingly, there is no plausible mechanism by which the Proposed Project could affect salmon migration, spawning or nursery habitats within the SAC. Spread of invasive non-native species (INNS)

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		The SAC is located approximately 7.7 km from the Main Wind Farm Development Site and is not hydrologically connected. In the absence of viable pathways, the spread of invasive non-native species to the SAC, either alone or in combination with other plans or projects, can be excluded.
Blacksod Bay/Broad Haven SPA 004037	Curlew (*Numenius arquata*) [A160] (wintering) Wetland and Waterbirds [A999]	Loss or damage of habitat No loss of habitat area; CO relates to extent only. Water quality effects, if any, would not result in habitat loss. Loss of habitats and reduction in home ranges of QI/SCI species None of the bird species of SCI for this SPA were recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard. Changes in water quality/quantity The conservation objective for wetland habitats within the SPA relates solely to the maintenance of habitat area, rather than habitat quality or trophic function. There is no mechanism by which the Proposed Project could result in loss or fragmentation of wetland habitat area. While a theoretical pathway linking water quality changes to food availability and subsequently to bird populations can be postulated, any potential releases of suspended solids or pollutants would be temporary, highly localised and subject to rapid dilution, dispersion and settlement within the receiving waters. Such effects would not be of sufficient magnitude, duration or spatial extent to alter prey availability at a scale relevant to SCI bird populations. Accordingly, this pathway is considered too remote to give rise to effects on the conservation objectives and can be excluded. Spread of INNS There is the potential for construction activity to result in the importation or spread of INSS within the Main Wind Farm Development Site which may subsequently reach the SAC. Rhododendron and Prickly Heath were recorded during surveys within the Main Wind Farm Development Site. These species could be transported around the Main Wind Farm Development Site by construction machinery and potentially make their way into the SAC via the streams. Disturbance and displacement of SCI bird species Curlew was recorded within 500 m of the Main Wind Farm Development Site but not in flight. Curlew was also recorded during bioacoustic monitoring. The core winter foraging range for curlew is

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		approximately 500 m (Mander et al. 2022)[50]. Therefore, the potential ecological connection is that the wintering curlew population of the SPA may fly across the Main Wind Farm Development Site and experience disturbance and/or displacement as a result of the Proposed Project. Curlew was recorded at low frequency during bioacoustic monitoring, indicating occasional passage through the wider area rather than regular use of the Main Wind Farm Development Site as breeding, wintering, roosting or core foraging habitat. As set out in **Table 3-1,** no SCI species exhibited sustained flight activity, repeated use, or spatial clustering within the wind farm footprint or 500 m buffer that would indicate functional reliance on the site. Displacement effects arise where wind farm development results in the loss or effective avoidance of habitat that contributes meaningfully to the conservation objectives of an SPA. In this case, the Proposed Project does not support habitat used by curlew in a way that contributes to it's distribution, population maintenance or supporting habitat within the SPA. Occasional passage movements do not constitute displacement, as alternative flight paths and habitat availability remain unrestricted at the landscape scale. Accordingly, even taking a precautionary approach and recognising seasonal passage activity, the Proposed Project would not result in displacement of curlew from functionally important SPA habitat, and adverse effects on site integrity via disturbance or displacement can be excluded. Mortality of birds through collisions with turbines Blacksod Bay/Broad Haven SPA is designated for a number of wetland and waterbird species. Of these species, only curlew was recorded flying within the Main Wind Farm Development Site or 500 m buffer area. Flight activity was very low level throughout the study period, with a single flock of two birds recorded during flight activity surveys in October 2022. Curlew was also recorded during bioacoustic monitoring making up 19% of total recordings with 313 records. There were no collisions for curlew predicted by the CRM (please refer to **Appendix 8** Collision Risk Model Results for more information) and so no adverse effects on the integrity of the site in this regard on curlew are predicted.

50 Mander et al. (2022). Individual, sexual and temporal variation in the winter home range sizes of GPS tagged Eurasian Curlews (Humber Estuary). Bird Study. Volume 69. Pages 39-52

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
Owenduff/Nephin Complex SPA 004098	Merlin (*Falco columbarius*) [A098] (permanent)	Loss or damage of habitat There will be no loss or damage to the habitats in the SPA as it does not fall within the Main Wind Farm Development Site. Loss of habitats and reduction in home ranges of QI/SCI species Merlin was not recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard. Changes in water quality/quantity Not applicable to this European Site as the no hydrologically sensitive species. Mortality of birds through collisions with turbines Owenduff/Nephin Complex SPA, situated approximately 7.6 km east of the Main Wind Farm Development Site, is designated for merlin. Five merlin flights were observed during VP surveys, including three observations during the non-breeding seasons and two during the spring passage seasons. There were no collisions predicted for merlin by the CRM (please refer to **Appendix 8** Collision Risk Model Results for more information) and so no adverse effects on the integrity of the site in this regard on merlin are predicted. Disturbance and displacement of SCI bird species Displacement effects arise where wind farm development results in the loss or effective avoidance of habitat that contributes meaningfully to the conservation objectives of an SPA. In this case, the Proposed Project does not support habitat used by merlin in a way that contributes to its distribution, population maintenance or supporting habitat within the SPA.
Termoncarragh Lake and Annagh Machair SPA 004093	Barnacle goose (*Branta leucopsis*) [A045] (wintering)	Loss or damage of habitat There will be no direct loss or damage to the wetland habitat as it does not fall within the area of the proposed works. Furthermore, there will be no indirect loss or damage as the Main Wind Farm Development Site and SPA are not hydrologically or hydrogeologically connected. Loss of habitats and reduction in home ranges of QI/SCI species Barnacle goose was not recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard. Changes in water quality/quantity There is no hydrological or hydrogeological connectivity between the Main Wind Farm Development Site and the SPA. Therefore, no adverse effects on the integrity of the site in this regard. Spread of INNS

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		No potential effect due to the spread of INNS due to lack of pathway for their spread to this SPA (as previously identified at screening stage). Disturbance and displacement of SCI bird species Displacement effects arise where wind farm development results in the loss or effective avoidance of habitat that contributes meaningfully to the conservation objectives of an SPA. In this case, the Proposed Project does not support habitat used by barnacle goose in a way that contributes to its distribution, population maintenance or supporting habitat within the SPA. Occasional passage movements do not constitute displacement, as alternative flight paths and habitat availability remain unrestricted at the landscape scale. Barnacle goose were not recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard during construction and operation. Mortality of birds through collisions with turbines Termoncarragh Lake and Annagh Machair SPA, situated approximately 13.3 km north-west of the Main Wind Farm Development Site, has the following SCI for which connectivity was identified; barnacle goose. This species was recorded flying through the Main Wind Farm Development Site or 500 m buffer and as such as is at risk of collision with the proposed turbines Barnacle goose: Recorded flight activity by barnacle goose was very low. A single recording of this species during bioacoustic monitoring was made at 02:30 am on 28 March 2024. This flight may have been as part of nocturnal migration. This level of flight activity (a single flight) is too low to qualify for conducting collision risk modelling on this species. Therefore, the number of collisions per year can be considered to be 0.
Inishglora and Inishkeeragh SPA 004084	Cormorant (*Phalacrocorax carbo*) [A017] (breeding) Barnacle goose (*Branta leucopsis*) [A045] (wintering) Lesser black-backed gull (*Larus fuscus*) [A183] (breeding) Herring gull (*Larus argentatus*) [A184] (breeding)	Loss or damage of habitat There will be no loss or damage to the habitats in the SPA as it does not fall within the Main Wind Farm Development Site. Loss of habitats and reduction in home ranges of/SCI species None of the bird species of SCI for this SPA were recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard. Spread of INNS No potential effect due to the spread of INNS due to lack of pathway for their spread to this SPA (as previously identified at screening stage). Disturbance and displacement of SCI bird species

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		None of the bird species of SCI for this SPA were recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard during construction and operation. SCI species associated with this SPA were recorded at low frequency during bioacoustic monitoring, indicating occasional passage through the wider area rather than regular use of the Main Wind Farm Development Site as breeding, wintering, roosting or core foraging habitat. As set out in **Table 3-1**, no SCI species exhibited sustained flight activity, repeated use, or spatial clustering within the wind farm footprint or 500 m buffer that would indicate functional reliance on the site. Displacement effects arise where wind farm development results in the loss or effective avoidance of habitat that contributes meaningfully to the conservation objectives of an SPA. In this case, the Proposed Project does not support habitat used by SCI species in a way that contributes to their distribution, population maintenance or supporting habitat within the SPA. Occasional passage movements do not constitute displacement, as alternative flight paths and habitat availability remain unrestricted at the landscape scale. Accordingly, even taking a precautionary approach and recognising seasonal passage activity, the Proposed Project would not result in displacement of SCI birds from functionally important SPA habitat, and adverse effects on site integrity via disturbance or displacement can be excluded. Changes in water quality/quantity Not applicable to this European Site as the qualifying features listed do not include any habitats. Mortality of birds through collisions with turbines Inishglora and Inishkeeragh SPA, situated approximately 14.4 km north-west of the Main Wind Farm Development Site, has the following SCI's for which there is connectivity; cormorant, lesser black-backed gull, herring gull and barnacle goose. All of these bird species were recorded flying through the Main Wind Farm Development Site or 500 m buffer and as such as are at risk of collision with the proposed turbines. CRM (please refer to **Appendix 8** Collision Risk Modelling Report for more detail) has been undertaken for cormorant, lesser black-backed gull and herring gull using data collected from flight activity surveys. Barnacle goose was recorded in flight via bioacoustic monitoring. Therefore, flight line data is not available for this species and as such can't be included in collision risk modelling. Cormorant A total of five cormorant observations were recorded during flight activity surveys. All records were of single birds during the non-breeding and the autumn passage seasons, with most flights associated with birds commuting along waterbodies. Using the data from the surveys, CRM has been completed which indicates that the Proposed Project could result in 0.02 collisions per year, or 1 bird every 42.86 years. The latest population figures for Inishglora and Inishkeeragh SPA is 114

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		birds. The predicted increase in annual mortality (taking into account the current level) on that size of population is 0.146%. Lesser black-backed gull Lesser black-backed gull was the most frequently recorded gull species with 82 observations. Flock size ranged from one to three birds, with typically observed flights involving one bird. Flight activity was considerably higher during the breeding seasons compared to the non-breeding seasons. The high frequency of flights recorded in summer, mainly located in the west, centre and south-west of the 500 m turbine buffer, suggests that there is likely breeding in the wider area. Using the data from the surveys, CRM has been completed which indicates that the Project could result in 0.15 - 0.18 collisions per year, or 1 bird every 5.5 – 6.5 years. The latest population figures for Inishglora and Inishkeeragh SPA is 132 birds. The predicted increase in annual mortality (taking into account the current level) on that size of population is 1.567% (worst-case). Herring gull A total of 63 herring gull observations were recorded during flight activity surveys. Flock size ranged from one to five birds. Flight activity was recorded during the breeding seasons. CRM indicates that the Proposed Project could result in 0.12 - 0.15 collisions per year, or 1 birds every 6.49 – 8.11 years. The predicted increase in annual mortality (taking into account the current level) on that size of population is 0.801% (worst-case). Barnacle goose Recorded flight activity by barnacle goose was very low. A single recording of this species during bioacoustic monitoring was made at 02:30 am on 28 March 2024. This flight may have been nocturnal migration. This level of flight activity (a single flight) is too low to qualify for conducting collision risk modelling on this species. Therefore, the number of collisions per year can be considered to be 0. While no quantitative estimate of collision risk was possible, it is effectively zero because only a single call was recorded during surveys.
Duvillaun Islands SPA 004111	Barnacle goose (*Branta leucopsis*) [A045] (breeding)	Loss or damage of habitat There will be no loss or damage to the habitats in the SPA as it does not fall within the Main Wind Farm Development Site. Loss of habitats and reduction in home ranges of QI/SCI species Barnacle goose was not recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard. Changes in water quality/quantity

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		Not applicable to this European Site as the qualifying features listed do not include any habitats. Spread of INNS No potential effect due to the spread of INNS due to lack of pathway for their spread to this SPA (as previously identified at screening stage). Disturbance and displacement of SCI bird species Barnacle goose were not recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard during construction, operation and decommissioning. Barnacle goose was recorded at low frequency during bioacoustic monitoring, indicating occasional passage through the wider area rather than regular use of the Main Wind Farm Development Site as wintering habitat. As set out in **Table 3-1**, barnacle goose did not exhibit sustained flight activity, repeated use, or spatial clustering within the wind farm footprint or 500 m buffer that would indicate functional reliance on the site. Displacement effects arise where wind farm development results in the loss or effective avoidance of habitat that contributes meaningfully to the conservation objectives of an SPA. In this case, the Proposed Project does not support habitat used by barnacle goose in a way that contributes to its distribution, population maintenance or supporting habitat within the SPA. Occasional passage movements do not constitute displacement, as alternative flight paths and habitat availability remain unrestricted at the landscape scale. Accordingly, even taking a precautionary approach and recognising seasonal passage activity, the Proposed Project would not result in displacement of barnacle goose from functionally important SPA habitat, and adverse effects on site integrity via disturbance or displacement can be excluded Mortality of birds through collisions with turbines Duvillaun Islands SPA, situated approximately 15.3 km south-west of the Main Wind Farm Development Site, is designated for fulmar, storm petrol and barnacle goose. Of these species, only barnacle goose is considered to have ecological connectivity. Recorded activity by barnacle goose was very low. A single recording of this species during bioacoustic monitoring was made at 02:30 am on 28 March 2024. This flight may have been nocturnal migration. This level of flight activity (a single flight) is too low to qualify for conducting collision risk modelling on this species. Therefore, the number of collisions per year can be considered to be 0. SCI species associated with this SPA were recorded at low frequency during bioacoustic monitoring, indicating occasional passage through the wider area rather than regular use of the Main Wind Farm Development Site as wintering habitat. As set out in **Table 3-1**, no SCI species exhibited sustained

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		flight activity, repeated use, or spatial clustering within the wind farm footprint or 500 m buffer that would indicate functional reliance on the site. Displacement effects arise where wind farm development results in the loss or effective avoidance of habitat that contributes meaningfully to the conservation objectives of an SPA. In this case, the Proposed Project does not support habitat used by SCI species in a way that contributes to their distribution, population maintenance or supporting habitat within the SPA. Occasional passage movements do not constitute displacement, as alternative flight paths and habitat availability remain unrestricted at the landscape scale. Accordingly, even taking a precautionary approach and recognising seasonal passage activity, the Proposed Project would not result in displacement of SCI birds from functionally important SPA habitat, and adverse effects on site integrity via disturbance or displacement can be excluded.
Inishkea Islands SPA 004004	Barnacle goose (*Branta leucopsis*) [A045] Common gull (*Larus canus*) [A182] Herring gull (*Larus argentatus*) [A184]	Loss or damage of habitat There will be no loss or damage to the habitats in the SPA as it does not fall within the Main Wind Farm Development Site. Loss of habitats and reduction in home ranges of QI/SCI species None of the bird species of SCI for this SPA were recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard. Changes in water quality/quantity Not applicable to this European Site as the qualifying features listed do not included any habitats. Spread of INNS No potential effect due to the spread of INNS due to lack of pathway for their spread to this SPA (as previously identified at screening stage). Disturbance and displacement of SCI bird species None of the bird species of SCI for this SPA were recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard during construction, operation and decommissioning. SCI species associated with this SPA were recorded at low frequency during bioacoustic monitoring, indicating occasional passage through the wider area rather than regular use of the Main Wind Farm Development Site as breeding, wintering, roosting or core foraging habitat. As set out in **Table 3-1**, no SCI species exhibited sustained flight activity, repeated use, or spatial clustering within the wind farm footprint or 500 m buffer that would indicate functional reliance on the site.

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		Displacement effects arise where wind farm development results in the loss or effective avoidance of habitat that contributes meaningfully to the conservation objectives of an SPA. In this case, the Proposed Project does not support habitat used by SCI species in a way that contributes to their distribution, population maintenance or supporting habitat within the SPA. Occasional passage movements do not constitute displacement, as alternative flight paths and habitat availability remain unrestricted at the landscape scale. Accordingly, even taking a precautionary approach and recognising seasonal passage activity, the Proposed Project would not result in displacement of SCI birds from functionally important SPA habitat, and adverse effects on site integrity via disturbance or displacement can be excluded. Accordingly, even taking a precautionary approach and recognising seasonal passage activity, the Proposed Project would not result in displacement of SCI birds from functionally important SPA habitat, and adverse effects on site integrity via disturbance or displacement can be excluded. Mortality of birds through collisions with turbines Inishkea Islands SPA, situated approximately 16.4 km west of the Main Wind Farm Development Site, is designated for a number of waterbird species. Barnacle goose, common gull and herring gull are considered to have ecological connectivity. Common gull Common gull was observed making a total of six flights through the Main Wind Farm Development Site. Flock size ranged between one to two birds. CRM indicates that the Proposed Project could result in 0.04 - 0.05 collisions per year, or 1 bird every 22.22 – 26.67 years. The predicted increase in annual mortality (taking into account the current level) on that size of population is 0.380% (worst-case). Herring gull A total of 63 herring gull observations were recorded during flight activity surveys. Flock size ranged from one to five birds. Flight activity was recorded during the breeding seasons. CRM indicates that the Proposed Project could result in 0.12 - 0.15 collisions per year, or 1 bird every 6.49 – 8.11 years. The predicted increase in annual mortality (taking into account the current level) on that size of population is 0.772% (worst-case). None of the other bird species of SCI for this SPA were recorded within the Main Wind Farm Development Site or 500 m buffer. Therefore, there are no adverse effects on the integrity of the site in this regard on these species. Barnacle goose Recorded flight activity by barnacle goose was very low. A single recording of this species during bioacoustic monitoring was made at 02:30 am on 28 March 2024. This flight may have been

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		nocturnal migration. This level of flight activity (a single flight) is too low to qualify for conducting collision risk modelling on this species. Therefore, the number of collisions per year can be considered to be 0.
Lough Conn and Lough Cullin SPA 004228	Greenland White-fronted Goose (*Anser albifrons flavirostris*) [A395] (wintering), Common Gull (*Larus canus*) [A182] (breeding) Wetland and Waterbirds [A999],	Loss or damage of habitat There will be no loss or damage to the habitats in the SPA as it does not fall within the Main Wind Farm Development Site. Loss of habitats and reduction in home ranges of QI/SCI species None of the bird species of SCI for this SPA were recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard. Changes in water quality/quantity The conservation objective for wetland habitats within the SPA relates solely to the maintenance of habitat area, rather than habitat quality or trophic function. There is no mechanism by which the Proposed Project could result in loss or fragmentation of wetland habitat area. While a theoretical pathway linking water quality changes to food availability and subsequently to bird populations can be postulated, any potential releases of suspended solids or pollutants would be temporary, highly localised and subject to rapid dilution, dispersion and settlement within the receiving waters. Such effects would not be of sufficient magnitude, duration or spatial extent to alter prey availability at a scale relevant to SCI bird populations. Accordingly, this pathway is considered too remote to give rise to effects on the conservation objectives and can be excluded. Spread of INNS No potential effect due to the spread of INNS due to lack of pathway for their spread to this SPA (as previously identified at screening stage). Disturbance and displacement of SCI bird species None of the bird species of SCI for this SPA were recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard during construction and operation. Greenland white-fronted goose was recorded at low frequency during bioacoustic monitoring, indicating occasional passage through the wider area rather than regular use of the Main Wind Farm Development Site as wintering, habitat. As set out in **Table 3-1**, no SCI species exhibited sustained flight activity, repeated use, or spatial clustering within the wind farm footprint or 500 m buffer that would indicate functional reliance on the site. Displacement effects arise where wind farm development results in the loss or effective avoidance of habitat that contributes meaningfully to the conservation objectives of an SPA. In this case, the

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		Proposed Project does not support habitat used by Greenland white-fronted goose in a way that contributes to its distribution, population maintenance or supporting habitat within the SPA. Occasional passage movements do not constitute displacement, as alternative flight paths and habitat availability remain unrestricted at the landscape scale. Accordingly, even taking a precautionary approach and recognising seasonal passage activity, the Proposed Project would not result in displacement of Greenland white-fronted goose from functionally important SPA habitat, and adverse effects on site integrity via disturbance or displacement can be excluded. Mortality birds through collisions with turbines Lough Conn and Lough Cullin SPA, situated approximately 16.4 km west of the Main Wind Farm Development Site, is designated for a number of waterbird species. Of these species, only common gull and Greenland White-fronted goose are considered to have ecological connectivity. Common gull Common gull was observed making a total of six flights through the Main Wind Farm Development Site. Flock size ranged between one to two birds. CRM (please refer to **Appendix 8** Collision Risk Model Results for more information) indicates that the Proposed Project could result in 0.05 collisions per year. With a current SPA population of 94 birds, this equates to a 0.38% increase in mortality relative to background mortality. As this increase is <1% it will not undermine the conservation objectives.
Inner Galway Bay SPA 004031	Common tern *(Sterna hirundo*) [A193]	Loss or damage of habitat There will be no loss or damage to the habitats in the SPA as it does not fall within the Main Wind Farm Development Site. Loss of habitats and reduction in home ranges of QI/SCI species None of the bird species of SCI for this SPA were recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard. Changes in water quality/quantity The conservation objective for wetland habitats within the SPA relates solely to the maintenance of habitat area, rather than habitat quality or trophic function. There is no mechanism by which the Proposed Project could result in loss or fragmentation of wetland habitat area. While a theoretical pathway linking water quality changes to food availability and subsequently to bird populations can be postulated, any potential releases of suspended solids or pollutants would be temporary, highly localised and subject to rapid dilution, dispersion and settlement within the receiving waters. Such effects would not be of sufficient magnitude, duration or spatial extent to alter prey availability at a

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		scale relevant to SCI bird populations. Accordingly, this pathway is considered too remote to give rise to effects on the conservation objectives and can be excluded. Spread of INNS No potential effect due to the spread of INNS due to lack of pathway for their spread to this SPA (as previously identified at screening stage). Disturbance and displacement of SCI bird species None of the bird species of SCI for this SPA were recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard during construction of operation. SCI species associated with this SPA were recorded at low frequency during bioacoustic monitoring, indicating occasional passage through the wider area rather than regular use of the Main Wind Farm Development Site as breeding, wintering, roosting or core foraging habitat. As set out in **Table 3-1**, no SCI species exhibited sustained flight activity, repeated use, or spatial clustering within the wind farm footprint or 500 m buffer that would indicate functional reliance on the site. Displacement effects arise where wind farm development results in the loss or effective avoidance of habitat that contributes meaningfully to the conservation objectives of an SPA. In this case, the Proposed Project does not support habitat used by SCI species in a way that contributes to their distribution, population maintenance or supporting habitat within the SPA. Occasional passage movements do not constitute displacement, as alternative flight paths and habitat availability remain unrestricted at the landscape scale. Accordingly, even taking a precautionary approach and recognising seasonal passage activity, the Proposed Project would not result in displacement of SCI birds from functionally important SPA habitat, and adverse effects on site integrity via disturbance or displacement can be excluded. Mortality of birds through collisions with turbines Inner Galway Bay SPA is situated approximately 109 km south of the Main Wind Farm Development Site. Of the SCI for which it is designated, only common tern is considered to have ecological connectivity. Common tern was observed making a total of two flights through the Main Wind Farm Development Site. All flights were of a single bird. CRM indicates that the Proposed Project could result in 0 collisions per year. Therefore, there would be no increase in annual mortality.
Clare Island SPA 004136	Kittiwake (*Rissa tridactyla*) [A188]	Loss or damage of habitat

Site Name and Code	Qualifying Features (Qualifying Interests and Special Conservation Interests)[49]	Potential Impacts
		There will be no loss or damage to the habitats in the SPA as it does not fall within the Main Wind Farm Development Site. Loss of habitats and reduction in home ranges of QI/SCI species None of the bird species of SCI for this SPA were recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard. Changes in water quality/quantity Not applicable to this European Site as habitat is not included in the list of Qualifying Features. Spread of INNS No potential effect due to the spread of INNS due to lack of pathway for their spread to this SPA (as previously identified at screening stage). Disturbance and displacement of SCI bird species Kittiwake were not recorded breeding or wintering within the Main Wind Farm Development Site or 500 m buffer. Therefore, no adverse effects on the integrity of the site in this regard during construction of operation. Mortality of birds through collisions with turbines Clare Island SPA is situated approximately 32 km south of the Main Wind Farm Development Site. Of the SCI for which it is designated only kittiwake is considered to have ecological connectivity. One single kittiwake was recorded during the 2023 spring passage season, CRM indicates that the Proposed Project could result in 0 collisions per year. Therefore, there would be no increase in annual mortality.

4.4 Step 2, Part 2: Effects on European sites 'In Combination'

4.4.1 Plans

The following development plans have been reviewed and taken into consideration:

- Regional Spatial and Economic Strategy 2020-2032 (RSES), and
- Mayo County Development Plan 2022 – 2028.

The review examined policies and objectives relating to designated sites for nature conservation, biodiversity, protected species, conservation of peatlands, sustainable land use and preservation of surface water quality.

Key policies and development allocations are summarised in **Table 4-16.**

Table 4-16: Assessment of relevant plans

Plan	Policies for the protection of European Sites	Development allocations with potential for in combination effects
Regional Spatial and Economic Strategy 2020-2031	**RPO 5.4** Encourage the prioritisation of Site-Specific Conservation Objectives (SSCO) for all sites of Conservation Value, designated in EU Directive (i.e. SACs, SPAs) to integrate with the development objectives of this Strategy. **RPO 5.5** Conserve and protect European sites and their integrity. **RPO 5.7** Ensure that all plans, projects and activities requiring consent arising from the RSES are subject to the relevant environmental assessment requirements including SEA, EIA and AA as appropriate.	Not applicable.
Mayo County Development Plan 2022-2028	**NEP 1** To support the protection, conservation and enhancement of the natural heritage and biodiversity of County Mayo, including the protection of the integrity of European sites, that form part of the Natura 2000 network, the protection of Natural Heritage Areas, proposed Natural Heritage Areas Ramsar Sites, Nature Reserves and Wild Fowl Sanctuaries (and other designated sites including any future designations). **NEO 14** To protect and enhance the ecological network throughout the county to improve the ecological coherence of the Natura 2000 network in accordance with Article 10 of the Habitats Directive.	No development allocations identified within the development plan were found to occur within the wider area surrounding the Main Wind Farm Development Site. However, the Plan provides a framework for land use developments and activities with potential for construction and operation source effects throughout the County.

4.4.2 Projects Connected to the Main Wind Farm Development Site

A desktop-based planning search spanning 10 years within a radius of 20 km of each of the European sites was undertaken. However, where applicable, this radius was extended to account for marine foraging ranges based on NatureScot guidance[51]. Sources consulted consisted of the EIA portal, An Coimisiún Pleanála (ACP formerly An Bord Pleanála [ABP]) and Mayo County Council planning portal.

[51] https://www.nature.scot/doc/guidance-note-3-guidance-support-offshore-wind-applications-marine-birds-identifying-theoretical Accessed 12/11/2025

This search captured operational developments, permitted developments, and live planning applications, representing the range of projects considered reasonably foreseeable in accordance with Article 6(3) of the EU Habitats Directive. Projects not yet submitted to the planning system or not defined within statutory planning frameworks are not considered reasonably foreseeable and cannot be meaningfully assessed.

The list was refined by eliminating all single homes from 2 km outside the red line boundary of the Main Wind Farm Development Site (on the basis that such developments are of a scale and nature that they do not give rise to significant in combination effects via the identified impact pathways, including disturbance, hydrological change, or traffic-related effects), and focused on planning applications of over 50 houses and planning applications which contained an EIAR or an NIS. This formed our in-combination long list of developments.

Further refinement was undertaken to ascertain developments within this list. This refinement was undertaken on a source–pathway–receptor basis to identify projects with a realistic potential to act in combination with the Proposed Project. These refinements included:

- All wind farms and grid cable route planning applications within 20 km of the Main Wind Farm Development Site where the planning status has been granted or to be determined;
- All infrastructural projects which are operational and utilising the same road networks that are proposed by the Proposed Project;
- All quarries within 2 km (reflecting the potential for localised hydrological and disturbance interactions);
- All Strategic Infrastructure and Strategic Housing Developments within 20 km where the same road network would be utilised; and
- All Strategic Housing Development and Large-Scale Residential Developments within 5 km.

This approach ensures that the in-combination assessment focuses on projects with a credible potential to contribute to cumulative effects, while applying a proportionate and evidence-based screening of developments that lack a viable impact pathway to the European sites.

There are a number of wind farm projects identified in the area surrounding the Main Wind Farm Development Site, the closest of which is the Bunnahowen Onshore Wind Farm 3.8 km northeast of the Main Wind Farm Development Site. Oweninny Wind Farm and Sheskin Onshore Wind Farm are 17 km and 20 km from the Main Wind Farm Development Site (respectively). In addition, an extension application for Sheskin South Wind Farm has also been submitted. Sceirde (Skerd) Rocks offshore Wind Farm off the coast of Galway is noted to have a capacity of 450 MW however, its status is currently ‘dormant’ and recently, Fuinneamh Sceirde Teoranta (FST) confirms that it will no longer proceed with the development of Sceirde Rocks Wind Farm. This site is over 126 km SW of the Main Wind Farm Development Site and therefore there are no cumulative impacts identified due to the distance between the sites combined with the fact the development will no longer proceed. All of these are detailed with their planning reference number in**Table 4-17**; with further breakdown of the environmental considerations below per project.

It is noted that the closest offshore wind turbine is a proposed single turbine at the Atlantic Marine Energy Test Site which is approximately 6 km NW of the Main Wind Farm Development Site with a potential capacity of 10 MW. This is a concept wind farm and is at the early stages of planning.

4.4.3 Potential Construction and Decommissioning Phase In-combination effects

The Main Wind Farm Development Site is located within a remote upland landscape dominated by blanket bog, forestry and peatland, with a very low density of other industrial or infrastructural development. A review of national planning databases confirms that there is minimal proposed and consented development within 2 km of the Main Wind Farm Development Site. Consequently, construction and decommissioning-phase activities are effectively isolated within the wider landscape, and there are no realistic pathways by which construction-related effects (including habitat loss, disturbance, hydrological change or pollution directly and indirectly with connectivity to European sites) could interact cumulatively with other plans or projects so as to give rise to adverse effects on European sites.

In-combination effects associated with other construction and decommissioning-phase impact factors, including habitat loss, reduction in home ranges, disturbance and displacement of qualifying species, spread of invasive non-native species, hydrogeological change and air quality effects, have been considered and excluded. These effects are either confined to the footprint of the Proposed Development, GCR and TDR, or do not extend beyond the site boundary, or arise solely from the Proposed Project with no plausible mechanism for interaction with other plans or projects. Accordingly, water quality effects represent the only credible pathway for construction-phase in-combination effects and are therefore the sole focus of the detailed assessment below.

There are no operational, consented or proposed projects with direct hydrological connectivity to the Proposed Project or the connected European sites. Although some hydrogeological connections are present, these are remote and weakly coupled, and therefore unlikely to give rise to any meaningful interaction with groundwater associated with the Proposed Project. This assessment was used to inform the NIS – and support the AA process.

The main sources of potential effects on water quality associated with the Proposed Project relate to on-site construction activities, including run-off from bare ground exposed during felling to create bat mitigation buffers and during the construction of turbine bases, hardstands, access tracks and on-site underground electrical cabling between turbines and the on-site substation. Any such effects are expected to be short-term, as disturbed areas will be reinstated and re-vegetated.

If infrastructure is poorly designed, engineered or constructed, increased runoff and sedimentation could occur from turbine hardstands and access tracks. Similarly, if reinstatement works associated with on-site cable trenches are not undertaken correctly, there could be a localised risk to adjacent watercourses and aquatic receptors. Service vehicles could also accidentally spill small volumes of hydrocarbons when accessing the operational Proposed Project.

Direct effects relevant to construction-phase in-combination assessment are confined to water quality–related interactions with watercourses. These include localised disturbance associated with the placement of culverts and watercourse crossings, which could, in the absence of mitigation, result in short-term increases in suspended solids, hydrocarbons or cement-based contaminants within watercourses inside the Main Wind Farm Development Site. Such effects could also arise from temporary diversion or modification of minor channels during construction, potentially affecting small areas of freshwater habitat.

The watercourses in the vicinity of the Proposed Project are typically heavily modified lowland channels draining blanket bog, or higher-gradient upland channels that are naturally prone to spate conditions. Elevated background siltation, primarily associated with peat escapement, was observed throughout much of the survey area, with eutrophication less evident. In the absence of mitigation, water-quality effects arising from the Proposed Project alone could have the potential to affect downstream designated sites (Bellacorick Bog Complex SAC,

Mullet/Blacksod Bay Complex SAC and Blacksod Bay/Broad Haven SPA) and aquatic receptors including otter and Atlantic salmon. The same pathway represents the only plausible mechanism by which in-combination effects could theoretically arise.

In theory, significant in-combination effects on water quality could arise where multiple hydrologically connected projects are constructed concurrently and without mitigation. However, no such circumstances apply in this case. There are no operational, consented or proposed projects with hydrological connectivity to the Main Wind Farm Development Site and European sites with hydrological connectivity, and any hydrogeological connections are remote and weakly coupled. Accordingly, construction-phase in-combination effects on water quality can be excluded

4.4.3.1 Potential Operational Phase In-combination effects

Operational impacts will occur because of the turbines, hardstands, access track and proposed Substation. As the GCR will be located underground, there will be no operational impacts due to underground cabling/ducting.

The proposed lifespan of the Proposed Project is 35 years, therefore for birds, the duration of effects is likely to be long-term. As the footprint of the Main Wind Farm Development Site is within a landscape highly modified by peatland habitats and forestry, some effects due to habitat loss are fully reversible – however, some infrastructure such as the turbine bases will be permanent - as most habitats due to be lost are in poor condition i.e. Cutover heavily drained peatlands and conifer plantations.

In the absence of mitigation, possible In-combination effects from the operational phase consist of:

- Loss of habitats and reduction in home ranges of qualifying interest and species of SCI;
- Disturbance and displacement of QI species;
- Disturbance of SCI bird species by noise, visual, human disturbance;

The potential impacts associated with the operational phase of the Proposed Project are:

- Mortality of birds through collisions with wind turbines for the period of operation;
- Disturbance and displacement of birds from the area around the wind turbines for the period of operation.
- Barrier effect, disruption of migratory or other routes used by birds due to avoidance of wind turbines.

A review of the national planning database and the surrounding land-use context confirms that there are no operational, consented or proposed developments in the wider area (please refer to Section 4.4.2 above for relevant distances), other than wind energy developments, that could give rise to operational in-combination effects relevant to European sites. In particular, there are no other projects with the potential to cause operational habitat loss, reduction in home ranges, disturbance, displacement or barrier effects for qualifying interest species or SCI birds. Accordingly, wind farms represent the only project type with a credible potential for operational in-combination effects, principally through collision risk, displacement or barrier effects for birds. Other potential operational impact sources can therefore be excluded.

There are **eight** no. onshore wind farm developments, specifically five operational wind farms (Oweninny Wind Farm (Phases 1 and 2), Bunnahowen Wind Farm, Sheskin Wind Farm, Lackan Wind Farm and Burtonport Harbour Single Turbine), one consented wind farm (Oweninny Wind Farm – Phase 3) and the consented extension to Sheskin Wind Farm (Sheskin South Wind Farm) and three decommissioned/non-operational (Bellacorick Wind Farm, Corvoderry Wind Farm and Dooleeg More Wind Farm) located in proximity to the

Proposed Project; however, only some have details of collision risk assessments undertaken, as summarised below.

4.4.3.2 Bunnahowen Wind Farm

Bunnahowen Wind Farm is a three-turbine wind farm located approximately 3.8 km northeast of the Main Wind Farm Development Site. It became operational in 2018 (Planning reference: 081997 and 0819970).

According to the EIAR written in 2008 no bird surveys were undertaken.

In terms of collision risk, no quantitative assessment was undertaken, so no quantitative cumulative collision risk assessment is possible.

Nonetheless, there is the potential for adverse in-combination effects to occur in combination with the Main Wind Farm Development Site for bird species that are present both at the Proposed Project and Bunnahowen – the species identified in our CRM are therefore considered.

4.4.3.3 Oweninny Windfarm

Oweninny Wind Farm (Phase 1 and 2) (Planning reference: ABP: PA0029) comprises a total of 60 wind turbines (29 in Phase 1 and 31 in Phase 2).

The EIAR for the project provides detail of the ecological context – particularly the suitability for bird species. It details that the site supports an important diversity of bird species that is characteristic of western blanket bog, wetland habitats and forest/scrub: 29 birds of conservation importance are present of which 21 are amber listed with many occurring in small numbers and on an occasional basis. The EIAR prepared for the project describes the wider ecological context of the site, including its suitability for a range of bird species associated with blanket bog, wetland and scrub habitats. While this information is relevant in establishing baseline ecological conditions, the Appropriate Assessment focuses specifically on those bird species that have been screened in to Stage 2, on the basis of potential effects on European sites. The overlapping species between the Proposed Development Site and the Oweninny project are:

- Greenland white-fronted goose (*Anser albifrons flavirostris*)
- Common gull (*Larus canus*)
- Merlin (*Falco columbarius*)

Accordingly, the Stage 2 assessment is confined to those SCI species for which pathways for effect have been identified and assessed in detail within this NIS, including species potentially susceptible to collision risk, disturbance, displacement or barrier effects in relation to relevant SPAs. Species not screened in to Stage 2, including hen harrier, are therefore not considered further in the context of the integrity assessment, as no plausible pathways for adverse effects on European sites have been identified for these receptors.

The ACP (formerly ABP) Inspectors report concluded the following:

> "*the likely residual effects of the project on flora and fauna would not be significant*".

The Oweninny Wind Farm is located approximately 17 km from the Main Wind Farm Development Site, placing it at the outer edge of the spatial scale at which cumulative effects might reasonably be considered. However, significant in-combination effects are not predicted as operational displacement of SCI bird species is not anticipated at the Main Wind Farm Development Site. Baseline surveys indicate that the site does not support important foraging, roosting or breeding habitat for SCI species, and usage by species such as common gull, Greenland white-fronted goose and merlin was low and infrequent. As such, the Proposed Development is not expected to result in displacement of these species from habitats of

importance. In the absence of displacement effects, there is no mechanism by which cumulative impacts could arise for species recorded at both sites.

4.4.3.4 Sheskin Wind Farm

Sheskin Wind Farm is an eight-turbine wind farm located approximately 20 km northeast of the Main Wind Farm Development Site. It became operational in 2023 (Planning reference: 15825).

Given the separation distance, there is no realistic potential for significant in-combination barrier effects or operational displacement upon IEF bird species.

According to the EIS written in 2015 to support the planning application, the following target SCI bird species, which are also considered in stage 2 of the current assessment, were recorded during flight activity surveys: Greenland white-fronted goose, cormorant, curlew, lesser black-backed gull and merlin. In terms of collision risk no quantitative assessment was undertaken, so no quantitative in-combination collision risk assessment is possible.

The EIS stated that:

> '*the risk of significant fatalities of birds at the operational wind farm is extremely low' and that 'very limited swan and geese activity has been recorded', which translated into 'a low risk of collision'*.

The chapter also stated

> "*However, despite the low risk there is potential and the impact could result in fatality*".

The NIS concluded:

> "*no significant adverse effects on Natura 2000 sites or Annex I bird species (including Greenland white-fronted goose, merlin and golden plover), subject to mitigation*".

Golden Plover are not identified as species with ecological connectivity to the Proposed Main Wind Farm Development Site. Therefore, there is the potential for significant in-combination effects due to collision to occur in combination with the Main Wind Farm Development Site for SCI bird species that are present both at the Main Wind Farm Development Site and Sheskin Wind Farm (cormorant, curlew, lesser black-backed gull and merlin).

4.4.3.5 Sheskin South Wind Farm

Sheskin South Wind Farm is a proposed 21-turbine extension to the operational Sheskin Wind Farm, located just over 20 km northeast (Planning reference: ABP: PA16.315933).

Given the separation distance, there is no realistic potential for significant in-combination barrier effects or operational displacement upon SCI bird species.

According to the EIAR written in 2023 by MKO to support the planning application, the following SCI target bird species, which are also considered in the current assessment, were recorded during flight activity surveys: merlin.

Collision risk modelling yielded the following predictions:

- Kestrel: 0.037 collisions/year (long-term slight negative effect);
- Merlin: 0.002 collisions/year (imperceptible effect); and
- Snipe: 0.037 collisions/year (long-term slight negative effect).

Of these three species Merlin is the only SCI species identified for the Main Wind Farm Development Site with collision risk identified in **Table 3-1**.

4.4.3.6 Lackan Wind Farm

Lackan Wind Farm is an operational three-turbine wind farm, located just over 53 km northeast (Planning reference: ABP PL21.203388). This application was for an extension of life application to keep the project powered.

Given the separation distance, there is no realistic potential for significant in-combination barrier effects or operational displacement upon SCI bird species which have been identified to have collision risk from the Proposed Development alone. Moreover, the primary reason significant in-combination effects are not predicted is that no operational displacement of SCI bird species is anticipated at the Main Wind Farm Development Site. In the absence of displacement effects, there is no mechanism by which cumulative impacts could arise for species recorded at both sites, including common gull, Greenland white-fronted goose and merlin.

The original documents were not available for the project but in the extension of like EIAR written in 2022 by Keohane Geological and Environmental Consultancy to support the planning application, the following target bird SCI species, which are also considered in the current assessment, were recorded during flight activity surveys: curlew, cormorant, brent goose, herring gull and lesser black-backed gull.

Carcass searches carried out from 2007 to 2022 found no evidence of collisions for any bird species.

Therefore, there is no potential for in-combination effects to occur in combination with the Main Wind Farm Development Site.

4.4.3.7 Burtonport Harbour Single Turbine

There is no planning information for this single turbine and no data available on whether any target bird SCI species were recorded in the vicinity of the same. Given the large separation distance between the turbine and Main Wind Farm Development Site (c. 131 km direct-line distance) and that it is only a single turbine, there is no potential for in-combination effects to occur in combination with the Proposed Development.

4.4.3.8 Bellacorick Wind Farm

Bellacorick Wind Farm is located on Oweninny Bog near Bellacorick, County Mayo, approximately 20 km east of the Proposed Development. It was Ireland's first commercial wind farm and comprised of 21 turbines. It is a decommissioned former operational development, with decommissioning finalised in January 2026. Therefore, no potential for in-combination effects.

4.4.3.9 Corvoderry Wind Farm

Corvoderry Wind Farm is a planning-consented wind farm development located on Oweninny Bog approximately 20 km east of the Proposed Development. Planning permission was granted under Mayo County Council Reg. Ref. 11/838 for 10 wind turbines. This permission expired in October 2022 and the project has not been constructed to date. It forms part of the Oweninny WF development detailed above instead.

4.4.3.10 Dooleeg More Wind Farm

Dooleeg Moore Wind Farm is a proposed single-turbine wind energy development located approximately 25 km southeast of the Main Wind Farm Development Site (Planning reference: Mayo County Council Reg. Ref. 092590). The development has not been constructed therefore is not operational. If constructed, given the large separation distance between the

turbine and Proposed Development (c. 25 km) and that it is only a single turbine, there would be no potential for in-combination effects to occur with the Proposed Development.

4.4.4 Projects with Pathways for In-Combination Effects Related to Collision Risk

Where collision risk has been analysed quantitatively, the number of collisions per year can be summed together to obtain an estimate of in-combination collision risk. This is the most usable approach for assessing in-combination collision risk and is recommended by NatureScot (2025)[52] guidance.

The approach of summing together the number of collisions is included in **Table 4-17** below for SCI birds present at the Main Wind Farm Development Site where collision risk modelling was done. It must be acknowledged that these in-combination estimates are likely to over-represent collision risk, as all flights within 500 m of the turbines were included. Similarly, assessment is based on adult rather than juvenile survival (lower survival rates mean that any deaths due to collision with turbines is likely to have less of an effect on a population) and so the realised risk to bird populations is likely to be less. Avoidance rates used are highly precautionary and the default 98% avoidance rate used (see **Appendix 8** Collision Risk Model Results) is not based on empirical evidence. Again, this is likely to produce an overestimate of true collision risk.

It is noted that the CRM had two other species (Common Kestrel and Snipe) identified, however, they are not SCI species and therefore not assessed as part of the AA process.

Any differences between the range of turbine permutations assessed will result in negligible changes to the direct in-combination collision effects assessment for SCI birds. This is because the differences in potential collision heights are very small.

A desktop planning review was undertaken covering the past 10 years within the largest core foraging range (inclusive of marine core foraging range, where applicable) of sensitive bird species of each European Site for which a potential pathway for collision risk has been identified. The identified projects are found in **Table 4-17** and the detailed considerations relative to each SPA is found in **Table 3-1**.

[52] Guidance - Assessing the cumulative impacts of onshore wind farms on birds | NatureScot Accessed 11/11/2025

Table 4-17: Projects with Pathways for In-Combination Effects Related to Collision Risk

Applicant / Development name	Planning Register Reference	Development description	Status
Bunnahown Wind Farm	Mayo County Council Reg. Ref. 081997 and amendments 18873	Wind farm consisting of 3 no. wind turbines and associated ancillary infrastructure	Operational
Sheskin Wind Farm (Phase 1)	Mayo County Council Reg. Ref. 15825	Wind farm consisting of 8 no. wind turbines and associated ancillary infrastructure	Operational
Sheskin South Wind Farm	An Bord Pleanála Case reference PA16.315933	Proposed wind farm consisting of 18 no. wind turbines and associated ancillary infrastructure	Granted permission March 2024
Lackan Wind Farm	Planning reference: ABP PL21.203388 Extension to life planning reference: ABP PL21.315917.	Wind farm consisting of 3 no. wind turbines and associated ancillary infrastructure	Operational
Burtonport Harbour Single Turbine	No planning reference available on Planning Portal.	Single turbine	Operational
Oweninny Wind Farm (Phase 1) and 2)	Mayo County Council Reg. Ref. 012542 and An Bord Pleanála Case reference PA16.PA0029	Wind farm consisting of 60 no. wind turbines and associated ancillary infrastructure	Operational
Oweninny Wind Farm (Phase 3)	An Bord Pleanála Case reference PA16.316178	Proposed wind farm extension consisting of 18 no. wind turbines and associated ancillary infrastructure	To be determined
Corvoderry Wind Farm	Mayo County Council Reg. Ref. 11/838	Consented wind farm consisting of 10 no. wind turbines and associated ancillary infrastructure	Permitted - Not Operational
Dooleeg More Wind Farm	Mayo County Council Reg. Ref. 092590	Single turbine	Permitted - Not Operational

Table 4-18: In-combination effects of collision risk for each of the SPAs identified with connectivity to the Proposed Development

European Site	SCIs identified within the Proposed Development CRM with Ecological Connectivity	Relevant Wind Farms Identified	CRM Calculations From Existing EIAR for the Relevant Wind Farm	In-combination Effects Calculation and Rational
Blacksod Bay/Broad Haven SPA 004037	Curlew (*Numenius arquata*) [A160]	None	Curlew – did not spend any time at collision heights so 0 collisions/year predicted.	None – core foraging range for winter curlew is c.500 m and there are no other wind farms within c.500 m of the SPA; no collisions predicted for Proposed Development; therefore, no in-combination collision risk above that predicted for Proposed Development possible.
Owenduff/Nephin Complex SPA 004098	Merlin (*Falco columbarius*) [A098]	Sheskin Wind Farm (Phase 1), Oweninny Wind Farm, Bellacorick Wind Farm, Corvoderry Wind Farm, Dooleg Moore Wind Farm	Merlin – 0 collisions / year	Merlin - none as no collisions predicted for Proposed Development alone, so no in-combination collision risk above that predicted for Proposed Development possible.
Termoncarragh Lake and Annagh Machair SPA 004093	Barnacle goose (Branta leucopsis) [A045]	Bunnahowen Wind Farm	Barnacle goose – no quantitative collision risk possible but very low observation rate indicates collision risk is 0 collisions/year.	Barnacle goose - none as no collisions predicted for Proposed Development alone, so no in-combination collision risk above that predicted for Proposed Development possible.
Inishglora and Inishkeeragh SPA 004084	Cormorant (Phalacrocorax carbo) [A017] Barnacle goose (Branta leucopsis) [A045] Lesser black-backed gull (Larus fuscus) [A183] Herring gull (Larus	Bunnahowen Wind Farm (for cormorant only) Lackan Wind Farm (lesser black-backed gull only) Burtonport Single Turbine (lesser black-backed gull only)	Cormorant – 0.02 collisions/year Barnacle goose – no quantitative collision risk possible but very low observation rate indicates collision risk is 0 collisions/year Lesser black-backed gull – 0.18 collisions/year Herring gull – 0.15 collisions/year	Cormorant – 0.02 collisions / year for the Proposed Development; no quantitative collision risk predicted for Bunnahowen Wind Farm and collisions assessed as 'extremely unlikely', so no in-combination collision risk above that predicted for Proposed Development. Barnacle goose – none as no collisions predicted for the Proposed Development alone, so no in-combination collision risk above that predicted for Proposed Development possible. Lesser black-backed gull – 0.15 – 0.18 collisions / year for the Proposed Development alone; no collisions recorded at operational Lackan Wind Farm during carcass searches, and Burtonport only a single turbine at considerable distance from Proposed Development; therefore, no in-combination collision risk above that predicted for Proposed Development.

European Site	SCIs identified within the Proposed Development CRM with Ecological Connectivity	Relevant Wind Farms Identified	CRM Calculations From Existing EIAR for the Relevant Wind Farm	In-combination Effects Calculation and Rational
	argentatus) [A184]			Herring gull – 0.12 – 0.15 collisions / year for the Proposed Development alone. No marine or coastal wind farms within marine core foraging distance from SPA therefore no in-combination collision risk.
Duvillaun Islands SPA 004111	Barnacle goose (Branta leucopsis) [A045]	Bunnahowen Wind Farm	Barnacle goose – no quantitative collision risk possible but very low observation rate suggests collision risk is 0 collisions/year	Barnacle goose - none as no collisions predicted for Proposed Development alone, so no in-combination collision risk above that predicted for Proposed Development possible.
Inishkea Islands SPA 004004	Common gull (Larus canus) [A182] Herring gull (Larus argentatus) [A184] Barnacle goose (Branta leucopsis) [A045]	None	Common gull – 0.05 collisions/year Herring gull – 0.15 collisions/year Barnacle goose – no quantitative collision risk possible but very low observation rate indicates collision risk is 0 collisions/year	Common gull - 0.04 – 0.05 collisions per year. No marine or coastal wind farms within marine core foraging distance from SPA therefore no in-combination collision risk. Herring gull – 0.12 – 0.15 collisions / year for the Proposed Development alone. No marine or coastal wind farms within marine core foraging distance from SPA therefore no in-combination collision risk. Barnacle goose - none as no collisions predicted for Proposed Development alone, so no in-combination collision risk above that predicted for Proposed Development possible.
Inner Galway Bay SPA	Common tern (Sterna hirundo) [A193]	Lackan Wind Farm (included on a precautionary basis)	Common tern– 0 collisions/year	Common tern - none as no collisions predicted for Proposed Development alone, so no in-combination collision risk above that predicted for Proposed Development possible.
Clare Island SPA	Kittiwake (*Rissa tridactyla*) [A188]	Lackan Wind Farm	Kittiwake– 0 collisions/year	Kittiwake - none as no collisions predicted for Proposed Development alone, so no in-combination collision risk above that predicted for Proposed Development possible.

4.5 Step 2, Part 3: Implications for the Conservation Objectives

The section summarises the conservation objectives of each of the European sites with pathways for potential effects and considers the sources for impacts regarding the conservation objectives of each QI and SCI individually regarding the project alone and in-combination with other plans and projects.

Risk ratings in **Table 4-18**. are assigned on an unmitigated and precautionary basis. Therefore, where a low, moderate or high risk is identified, mitigation is required to avoid any adverse effect on site integrity in view of the relevant conservation objectives; in this context, low risk denotes a limited but credible pathway for effect, moderate risk denotes a meaningful potential effect if unmanaged, and high risk denotes a likely material effect on conservation objectives without mitigation.

Table 4-19: Summary of the Implications for the Conservation Objectives

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
Mullet/Blacksod Bay Complex SAC 000470	0.07 km W	Maintain the: • Habitat area • Community distribution of Mudflats and sandflats not covered by **seawater at low tide [1140]**	**Low risk (if unmitigated):** There will be no direct habitat loss within the SAC. Potential effects identified in**Table 4-15**are limited to temporary and localised changes in water quality (e.g. suspended solids, nutrients or other contaminants) arising during construction or decommissioning, with pathways to the SAC via hydrological connectivity. Such effects would be short-term, spatially confined and subject to rapid dilution, dispersion and settlement within the receiving marine environment. There is risk to the integrity of the SAC if there are no water control measures implemented.	**Negligible or very low (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone.
		Maintain the: • Habitat area • Community extent • Community structure: shoot density • Community structure – merl • Community structure - Serpula vermiculari • Community distribution of **Large shallow inlets and bays [1160]**		
		Maintain the: • Habitat area • Distribution • Community Extent • Community structure – Serpula vermiculari • Community structure – reef community of **Reefs [1170]**		
		• Maintain the: • Habitat area		

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
		• Habitat distribution • Physical structure: sediment supply • Physical structure: creeks and pans • Physical structure: flooding regime • Vegetation structure: zonation • Vegetation structure: vegetation height • Vegetation structure: vegetation cover • Vegetation composition: typical species and subcommunities • Vegetation structure: negative indicator species – Spartina anglica of **Salicornia and other annuals colonising mud and sand**		
		Maintain the: • habitat area, and • habitat distribution of **Alkaline fen** within the SAC.	**No risk:** No works are proposed within the SAC, and there will be no direct loss, fragmentation, or physical alteration of qualifying habitats or supporting features within the designated site. Temporary and highly localised groundwater drawdown may occur during construction of turbine foundations outside the SAC boundary. However, any such drawdown will be limited in spatial extent, short in duration, and confined to the immediate construction footprint. There is no hydrological connectivity pathway capable of transmitting effects at a magnitude or	**No risk:** There are no operational, consented or other projects with direct hydrological connectivity to the Proposed Development Site. Although some hydrogeological connections are present, these are remote and weakly coupled, and therefore unlikely to give rise to any meaningful interaction with groundwater associated

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			duration sufficient to alter the structure, function, or distribution of the qualifying habitats within the SAC. Construction-phase dewatering will cease upon completion of foundation works, with groundwater levels expected to recover rapidly to baseline conditions. No permanent alteration of groundwater flow regimes, recharge rates, or catchment-scale hydrology will occur. On this basis, the Proposed Development will not adversely affect the integrity of the SAC, nor will it undermine the site's Conservation Objectives, including the maintenance of the extent, structure, function, and favourable conservation condition of the qualifying habitats.	with the Proposed Development Site.
		Maintain the: • hydrological regime, and • peat formation of **Alkaline fen**	**No risk:** No works are proposed within the SAC, and there will be no direct loss, fragmentation, or physical alteration of qualifying habitats or supporting features within the designated site. Temporary and highly localised groundwater drawdown may occur during construction of turbine foundations outside the SAC boundary. However, any such drawdown will be limited in spatial extent, short in duration, and confined to the immediate construction footprint. There is no hydrological connectivity pathway capable of transmitting effects at a magnitude or duration sufficient to alter the structure, function, or distribution of the qualifying habitats within the SAC. Construction-phase dewatering will cease upon completion of foundation works, with groundwater levels expected to recover rapidly to baseline conditions. No permanent alteration of groundwater flow regimes, recharge rates, or catchment-scale hydrology will occur. On this basis, the proposed development will not adversely affect the integrity of the SAC, nor will it	**No risk:** There are no operational, consented or other projects with direct hydrological connectivity to the Proposed Development Site. Although some hydrogeological connections are present, these are remote and weakly coupled, and therefore unlikely to give rise to any meaningful interaction with groundwater associated with the Proposed Development Site.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			undermine the site's Conservation Objectives, including the maintenance of the extent, structure, function, and favourable conservation condition of the qualifying habitats.	
		Maintain the: • water quality: nutrients of **Alkaline fen**	**Low risk (if unmitigated):** Unmitigated, the Proposed Development could release suspended sediment, nutrients and other pollutants into water courses hydrologically connected with the SAC resulting in a deterioration of water quality and increase in soil nutrients. Therefore, mitigation measures are required to further limit the risk to the water quality of the site.	**No risk:** There are no operational, consented or other projects with direct hydrological connectivity to the Proposed Development Site. Although some hydrogeological connections are present, these are remote and weakly coupled, and therefore unlikely to give rise to any meaningful interaction with groundwater associated with the Proposed Development Site.
		Maintain the: • vegetation composition: typical species, and • vegetation composition: trees and shrubs of **Alkaline fen**	**No risk:** There are no works proposed within the SAC and alkaline fen habitat was not recorded within the Main Wind Farm Development Site. There will be no works within this habitat and therefore no changes to vegetation composition because of the Proposed Development.	**No risk:** Given the absence of works within alkaline fen habitat and the lack of functional pathways, in-combination effects on vegetation composition can be excluded.
		Maintain the; • physical structure: disturbed bare ground, and • physical structure: drainage of **Alkaline fens.**	**No risk:** There are no works proposed within the SAC and alkaline fen habitats were not recorded within the Main Wind Farm Development Site.	**No risk:** Given the absence of works within alkaline fen habitat and the lack of functional pathways, in-combination

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
				effects on vegetation composition can be excluded.
		Maintain the; • distribution, • extent of terrestrial habitat, • extent of marine habitat, • extent of freshwater (river) habitat, • extent of freshwater (lake/lagoon) habitat, • couching sites and holts, • fish biomass available, and • barriers to connectivity for **otter.**	**Low risk (if unmitigated):** There will be no works within the SAC. However, otter signs were recorded along watercourses along the northern and eastern boundaries of the Main Wind Farm Development Site. There is the potential for construction/decommissioning activity to cause disturbance to the otters using these watercourses.	**Negligible or very low (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone.
Bellacorick Bog Complex SAC	0.05 km E	Maintain the: • habitat area, and • habitat distribution of **Alkaline fen** within the SAC.	**No risk:** No works are proposed within the SAC, and there will be no direct loss, fragmentation, or physical alteration of qualifying habitats or supporting features within the designated site. Temporary and highly localised groundwater drawdown may occur during construction of turbine foundations outside the SAC boundary. However, any such drawdown will be limited in spatial extent, short in duration, and confined to the immediate construction footprint. There is no hydrological connectivity pathway capable of transmitting effects at a magnitude or duration sufficient to alter the structure, function, or distribution of the qualifying habitats within the SAC. Construction-phase dewatering will cease upon completion of foundation works, with groundwater levels expected to recover rapidly to baseline conditions. No	**No risk:** There are no operational, consented or other projects with direct hydrological connectivity to the Proposed Development Site. Although some hydrogeological connections are present, these are remote and weakly coupled, and therefore unlikely to give rise to any meaningful interaction with groundwater associated with the Proposed Development Site.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			permanent alteration of groundwater flow regimes, recharge rates, or catchment-scale hydrology will occur. On this basis, the Proposed Development will not adversely affect the integrity of the SAC, nor will it undermine the site's Conservation Objectives, including the maintenance of the extent, structure, function, and favourable conservation condition of the qualifying habitats.	
		Maintain the: • hydrological regime, and peat formation of **Alkaline fen**	**No risk:** No works are proposed within the SAC, and there will be no direct loss, fragmentation, or physical alteration of qualifying habitats or supporting features within the designated site. Temporary and highly localised groundwater drawdown may occur during construction of turbine foundations outside the SAC boundary. However, any such drawdown will be limited in spatial extent, short in duration, and confined to the immediate construction footprint. There is no hydrological connectivity pathway capable of transmitting effects at a magnitude or duration sufficient to alter the structure, function, or distribution of the qualifying habitats within the SAC. Construction-phase dewatering will cease upon completion of foundation works, with groundwater levels expected to recover rapidly to baseline conditions. No permanent alteration of groundwater flow regimes, recharge rates, or catchment-scale hydrology will occur. On this basis, the proposed development will not adversely affect the integrity of the SAC, nor will it undermine the site's Conservation Objectives, including the maintenance of the extent, structure, function, and favourable conservation condition of the qualifying habitats.	**No risk:** There are no operational, consented or other projects with direct hydrological connectivity to the Proposed Development Site. Although some hydrogeological connections are present, these are remote and weakly coupled, and therefore unlikely to give rise to any meaningful interaction with groundwater associated with the Proposed Development Site.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
		Maintain the: • water quality: nutrients of **Alkaline fen**	**Low risk (if unmitigated):** Unmitigated, the Proposed Development could release suspended sediment, nutrients and other pollutants into water courses hydrologically connected with the SAC resulting in a deterioration of water quality and increase in soil nutrients. Therefore, mitigation measures are required to further limit the risk to the water quality of the site.	**Negligible or very low (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone.
		Maintain the: • vegetation composition: typical species, and • vegetation composition: trees and shrubs of **Alkaline fen**	**No risk:** There are no works proposed within the SAC and alkaline fen habitat was not recorded within the Main Wind Farm Development Site. There will be no works within this habitat and therefore no changes to vegetation composition because of the Proposed Development.	**No risk:** Given the absence of works within alkaline fen habitat and the lack of functional pathways, in-combination effects on vegetation composition can be excluded.
		Maintain the; • physical structure: disturbed bare ground, and • physical structure: drainage of **Alkaline fens.**	**No risk:** **There** are no works proposed within the SAC and alkaline fen habitats were not recorded within the Main Wind Farm Development Site.	**No risk:** Given the absence of works within alkaline fen habitat and the lack of functional pathways, in-combination effects on vegetation composition can be alone.
		Maintain the; • distribution, • extent of terrestrial habitat, • extent of marine habitat, • extent of freshwater (river) habitat, • extent of freshwater (lake/lagoon) habitat, • couching sites and holts,	**Low risk (if unmitigated):** There will be no works within the SAC. However, otter signs were recorded along watercourses along the northern and eastern boundaries of the Main Wind Farm Development Site. There is the potential for construction/decommissioning activity to cause disturbance to the otters using these watercourses.	**Negligible or very low (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
		• fish biomass available, and barriers to connectivity for **otter.**		
Owenduff/Nephin Complex SAC 000534	7.7 km SE	Maintain the; • distribution, • extent of terrestrial habitat, • extent of freshwater (river) habitat, • extent of freshwater (lake) habitat, • couching sites and holts, • fish biomass available, and • barriers to connectivity for **otter.**	**Low risk (if unmitigated):** There will be no works within the SAC. However, otter signs were recorded along watercourses along the northern and eastern boundaries of the Main Wind Farm Development Site. There is the potential for construction/decommissioning activity to cause disturbance to the otters using these watercourses.	**Negligible or very low (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone.
Blacksod Bay/Broad Haven SPA 004037	0.07 km W	Maintain the: • winter population trend; and • distribution of **curlew** within the SPA.	**No risk [collision risk]:** Curlew were recorded on the ground within 500 m of turbine locations; however, no curlew were recorded in flight within the collision risk envelope. Accordingly, collision risk for this species is zero. **Low risk [disturbance and displacement] (if unmitigated):** Low numbers of wintering curlew were recorded within the Main Wind Farm Development Site, and the SPA is located in close proximity. In the absence of mitigation, temporary disturbance or localised displacement could occur, with potential effects on fine-scale winter distribution. **No risk (barrier effect):** The Proposed Development is not of a scale or configuration that would present a barrier to curlew movement or connectivity within or between wintering areas.	**No risk [collision risk]:** Collision risk modelling predicts zero collisions, and no other operational, consented or proposed wind farms within the wider area present overlapping or additive risks in relation to collision, disturbance, displacement, habitat loss or barrier effects. Accordingly, there is no mechanism by which cumulative effects could arise, and the Proposed Development, alone or in combination with other plans or projects, will not undermine the conservation objectives or integrity of the SPA.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			Conclusion: While disturbance and displacement effects associated with the Proposed Development are characterised as low rather than absent, their limited magnitude and localised nature mean they will not undermine the winter population trend or spatial distribution of curlew within the SPA. Subject to mitigation, the integrity of the SPA will not be adversely affected.	**Negligible or very low [disturbance and displacement] (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone. **No risk [barrier effects]:** As there is no risk identified for the project alone regarding barrier effects there is no mechanism for in combination effects.
Owenduff/Nephin Complex SPA 004098	7.6 km E	Restore the: • population size; • productivity rate; • extent of available nesting options within the SPA; • extent and condition of suitable habitats for foraging; and • levels of disturbance to breeding sites of **merlin** within the SPA.	**No risk [collision risk]:** Collision risk modelling predicts 0 collisions/year for merlin for the Proposed Development alone. Accordingly, turbine-related mortality will not contribute to changes in adult survival or population size within the SPA. **Low risk [Habitat loss and foraging use] (if unmitigated)** Merlin were recorded within the Main Wind Farm Development Site, indicating that the site forms part of the wider foraging landscape available to the SPA population. The Proposed Development will result in the loss and modification of habitats that are used intermittently by merlin for foraging. Although the site does not represent core or regularly utilised foraging habitat, and recorded activity was low and sporadic, the loss of habitat gives rise to a plausible pathway for effect whereby reduced availability of	**No risk [collision risk]:** As no collision risk is predicted for the Proposed Development alone, there can be no in-combination collision risk for merlin possible. The same is true for productivity or nesting options / level of disturbance to breeding sites – as there are no effects predicted due to the Proposed Development alone, there can be no in-combination effects. **Negligible or very low [Habitat loss and foraging use] (if unmitigated)**

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			supporting foraging habitat could, in the absence of mitigation, influence population dynamics and breeding success (due to population dynamics at a landscape scale) within the SPA over the long term. Accordingly, measures are required to ensure that habitat loss and disturbance associated with the Proposed Development do not adversely affect the long-term viability of the SPA population. **No risk [Breeding and nesting]** No breeding merlin or nesting habitat were recorded within or adjacent to the Main Wind Farm Development Site. Therefore, there is no mechanism by which the Proposed Development could directly affect nesting availability, productivity rate or breeding success within the SPA. **Low risk [disturbance and displacement] (if unmitigated):** While the Proposed Development is located at a substantial distance from known breeding territories within the SPA, construction and operational activities could result in low-level disturbance within areas ecologically connected to the SPA population. In the absence of mitigation, this represents a plausible pathway for effect. Measures are therefore required to ensure that disturbance does not give rise to effects on breeding behaviour, foraging efficiency or productivity at the population level. **No risk [barrier effect]:** The Proposed Development is not of a scale or configuration that would present a barrier to curlew movement or connectivity within or between wintering areas**.** **Conclusion**	Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone. **No risk [Breeding and nesting]** No mechanism for effects to breeding from the project alone, therefore no in-combination effects. **Negligible or very low [disturbance and displacement] (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone. **No risk [barrier effects]:** As there is no risk identified for the project alone regarding barrier effects there is no mechanism for in combination effects.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			The Proposed Development will result in limited loss of habitat used by merlin within the wider foraging landscape. While these effects are not predicted to be significant in isolation, they represent plausible pathways for effect on the SPA population in the absence of mitigation. With the implementation of appropriate measures, it can be concluded beyond reasonable scientific doubt that the Proposed Development, alone, will not undermine the conservation objectives for merlin within the SPA and will not adversely affect the integrity of the site.	
Termoncarragh Lake and Annagh Machair SPA 004093	13.3 km NW	Maintain the: • winter population trend; • winter spatial distribution; • levels of disturbance; • lack of barriers to connectivity and site use; • spatial distribution, extent and abundance of foraging habitats; • spatial distribution and extent of roosts; and • area and quality of supporting habitat of **barnacle goose** within the SPA.	**No risk [collision risk]:** The modelled collision risk for barnacle goose associated with the Proposed Development is 0 collisions/year. Accordingly, there is no risk of collision-related mortality affecting the wintering population. **No risk [Winter population trend]** Given the absence of collision risk and the lack of regular or sustained use of the Main Wind Farm Development Site by barnacle goose, there is no plausible mechanism by which the Proposed Development could affect winter population size or trend. **No risk [Winter spatial distribution]** Barnacle geese were not recorded using the Main Wind Farm Development Site as a regular foraging or roosting area. Any flights recorded were infrequent and indicative of transit rather than functional site use. As a result, no changes to winter spatial distribution within the SPA are predicted. **No risk [Foraging habitat availability and quality]** The Main Wind Farm Development Site does not comprise key or regularly used foraging habitat for	**In-combination effects – No risk** No additional wind farms with predicted collision risk for barnacle goose are present. Accordingly, there is no potential for in-combination effects beyond those assessed for the Proposed Development alone. The same conclusions apply in respect of winter distribution, disturbance, displacement, barrier effects, foraging and roosting objectives.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			barnacle goose. Given the availability of extensive alternative foraging areas within the wider landscape and coastal environment, any localised avoidance or displacement at the wind farm would not result in a meaningful reduction in foraging opportunity or habitat availability. **No risk [Roosting]** No roosting sites for barnacle goose were identified within or adjacent to the Main Wind Farm Development Site. Therefore, no effects on the spatial distribution or extent of roosts are predicted. **Low risk [disturbance and displacement] (if unmitigated):** While occasional movements through the wider area cannot be excluded, the Proposed Development is not subject to regular or intensive use by barnacle goose. Any disturbance would be localised and transient, with no effect on wintering behaviour, distribution or habitat use at the SPA scale. **No risk [barrier effect]:** The Proposed Development is not of a scale or configuration that would present a barrier to curlew movement or connectivity within or between wintering areas The Proposed Development is not of a scale or configuration that would present a barrier to barnacle goose movements. Given the species' flight capability and the absence of reliance on the site, no effects on connectivity or site use are predicted.	
Inishglora and Inishkeeragh SPA 004084	14.4 km NW	Restore the: • breeding population size; • productivity rate; • extent of available nesting options;	**Low risk [Collision Risk] (if unmitigated)** The modelled collision risk for cormorant was 0.02 collisions/year (worst-case using the Nordex N163 candidate turbine). The current SPA breeding population is 114 birds. This equates to an increase in mortality of 0.15% relative to background mortality. As	**Negligible or very low [collision risk] (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
		• spatial distribution, extent and abundance of foraging habitats; • levels of disturbance at the breeding site; • levels of disturbance at areas ecologically connected to the colony; and • lack barriers to connectivity for **cormorant** within the SPA.	this increase is well below 1%, the risk of undermining the conservation objective related to breeding population size is low. While it cannot be confirmed that individuals recorded at the Main Wind Farm Development Site originate from the SPA population, the low collision risk remains precautionary and population-level effects can be excluded. **No risk [Breeding productivity and nesting]** No cormorant nests or breeding colonies were recorded within or adjacent to the Main Wind Farm Development Site. Consequently, there is no mechanism by which the Proposed Development could affect nesting availability, breeding success or productivity rate. Effects on breeding-related conservation objectives can therefore be excluded. **No risk [Foraging habitat (ex situ pathways)]** Cormorant were not recorded foraging within the Main Wind Farm Development Site, and the site does not comprise suitable or regularly utilised foraging habitat for the species. As a result, the Proposed Development cannot affect the spatial distribution, extent or quality of foraging habitats supporting the SPA population. Ex-situ effects on prey availability or foraging resources are therefore excluded. **No risk [Disturbance and displacement]** The Proposed Development is located at a substantial distance from the SPA breeding colony, and no disturbance-sensitive behaviours (e.g. breeding, roosting or repeated foraging) were recorded at or near the site. Accordingly, no disturbance effects at breeding sites or ecologically connected areas are predicted. **No risk [Barrier effects and connectivity]** The Proposed Development is not of sufficient scale or configuration to present a barrier to cormorant	other project sites adding to the risk to the CO due to the Proposed Development alone. **Other In-combination effects – No risk** No other operational, consented or proposed wind farms within the wider area present overlapping or additive risks in relation to collision, disturbance, displacement, habitat loss or barrier effects. Accordingly, there is no mechanism by which cumulative effects could arise, and the Proposed Development, alone or in combination with other plans or projects, will not undermine the conservation objectives or integrity of the SPA.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			movements between breeding, foraging or resting areas. Barrier effects can therefore be excluded. **Conclusion** While effects associated with the Proposed Development are characterised as low rather than absent (in relation to collision risk), their very limited magnitude, the absence of functional reliance on the site, and the lack of connectivity with the SPA breeding colony mean that population-level effects on breeding success or population viability are not predicted. The integrity of the SPA conservation objectives will not be undermined.	
		Maintain the: • winter population trend; • winter spatial distribution; • levels of disturbance; • lack of barriers to connectivity and site use; • spatial distribution, extent and abundance of foraging habitats; • spatial distribution and extent of roosts; and • area and quality of supporting habitat of **barnacle goose**.	**No risk [collision risk]:** The modelled collision risk for barnacle goose associated with the Proposed Development is 0 collisions/year. Accordingly, there is no risk of collision-related mortality affecting the wintering population. **No risk [Winter population trend]** Given the absence of collision risk and the lack of regular or sustained use of the Main Wind Farm Development Site by barnacle goose, there is no plausible mechanism by which the Proposed Development could affect winter population size or trend. **No risk [Winter spatial distribution]** Barnacle geese were not recorded using the Main Wind Farm Development Site as a regular foraging or roosting area. Any flights recorded were infrequent and indicative of transit rather than functional site use. As a result, no changes to winter spatial distribution within the SPA are predicted. **No risk [Foraging habitat availability and quality]**	**Negligible or very low [collision risk] (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone. **Other In-combination effects – No risk** No other operational, consented or proposed wind farms within the wider area present overlapping or additive risks in relation to collision, disturbance, displacement, habitat loss or barrier effects. Accordingly, there is no mechanism by which cumulative effects could arise,

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			The Main Wind Farm Development Site does not comprise key or regularly used foraging habitat for barnacle goose. Given the availability of extensive alternative foraging areas within the wider landscape and coastal environment, any localised avoidance or displacement at the wind farm would not result in a meaningful reduction in foraging opportunity or habitat availability. **No risk [Roosting habitat]** No roosting sites for barnacle goose were identified within or adjacent to the Main Wind Farm Development Site. Therefore, no effects on the spatial distribution or extent of roosts are predicted. **Low risk [Disturbance and displacement]** While occasional movements through the wider area cannot be excluded, the Proposed Development is not subject to regular or intensive use by barnacle goose. Any disturbance would be localised and transient, with no effect on wintering behaviour, distribution or habitat use at the SPA scale. **No risk [Barrier effects and connectivity]** The Proposed Development is not of a scale or configuration that would present a barrier to barnacle goose movements. Given the species' flight capability and the absence of reliance on the site, no effects on connectivity or site use are predicted.	and the Proposed Development Site, alone or in combination with other plans or projects, will not undermine the conservation objectives or integrity of the SPA.
		Restore the: • breeding population size; • productivity rate; • extent of available nesting options within the SPA;	**Low risk [Collision Risk] (if unmitigated)** The modelled collision risk for herring gull is 0.15 collisions/year (worst-case using the Nordex N163 candidate turbine). With a current SPA population of 156 birds, this equates to a 0.8% increase in mortality relative to background mortality. As this increase is	**Negligible or very low [collision risk] (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
		• spatial distribution, extent, abundance and availability of foraging habitat; • levels of disturbance at breeding sites; • levels of disturbance at areas ecologically connected to the colony; and • Lack of barriers to connectivity for **herring gull**	<1%, the risk of undermining the conservation objective relating to breeding population size is low. **No risk [Breeding and productivity]** No nests were recorded within or in proximity to the Main Wind Farm Development Site. Consequently, there is no mechanism by which the Proposed Development could affect breeding productivity, nesting success, or other breeding-related conservation objectives for the SPA population. **No risk [Foraging habitat and ex-situ supporting habitat]** The potential ex-situ pathway whereby effects at the wind farm could influence SPA population dynamics via loss or degradation of supporting foraging habitat has been considered and excluded. As set out in **Table 3-1**, the Main Wind Farm Development Site is not used as a key or regularly utilised foraging area by herring gull. Recorded flight activity was low and sporadic, indicating transit rather than functional reliance. Given the species' wide foraging range and the availability of extensive alternative foraging habitats within the wider landscape and marine environment, any localised avoidance or displacement at the wind farm would not result in a meaningful reduction in foraging opportunity. **No risk [Disturbance and displacement]** The Main Wind Farm Development Site does not support regular foraging, roosting or breeding use by herring gull. Any disturbance would therefore be localised and transient, with no plausible mechanism to affect SPA population distribution, productivity or viability. **No risk [Barrier effects and connectivity]** The Proposed Development is not of a scale or configuration that would present a barrier to herring gull	the risk to the CO due to the Proposed Development alone. **Other In-combination effects – No risk** No other operational, consented or proposed wind farms within the wider area present overlapping or additive risks in relation to collision, disturbance, displacement, habitat loss or barrier effects. Accordingly, there is no mechanism by which cumulative effects could arise, and the Proposed Development, alone or in combination with other plans or projects, will not undermine the conservation objectives or integrity of the SPA.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			movements. The species regularly traverses landscapes at much broader spatial scales, and no disruption to connectivity between breeding, foraging or roosting areas is predicted.	
		Restore the: • breeding population size; • productivity rate; • extent of available nesting options within the SPA; • spatial distribution, extent, abundance and availability of foraging habitat; • levels of disturbance at breeding sites; • levels of disturbance at areas ecologically connected to the colony; and • Lack of barriers to connectivity for **lesser black-backed gull**	**Low risk [Collision risk] (if unmitigated)** The modelled collision risk for lesser black-backed gull is 0.18 collisions/year (worst-case using the Nordex N163 candidate turbine). The current SPA breeding population is 132 birds. This equates to a 1.57% increase in mortality relative to background mortality. Although this exceeds 1%, the absolute magnitude of predicted mortality is very small and would represent only a marginal additional pressure on the SPA population. Recent population data indicate a substantial decline in the SPA breeding population (approximately 43% decline between 2020 and 2023; Harris et al., 2024). Under a 'do nothing' scenario, further population decline is expected irrespective of the Proposed Development. In this context, the predicted collision-related mortality would result in only a negligible increase in the rate of decline and would not hinder conservation or recovery measures. Accordingly, the risk of undermining the conservation objective relating to breeding population size is assessed as low. **No risk [Productivity rate]** No nests or breeding territories were recorded within or adjacent to the Main Wind Farm Development Site. Consequently, there is no mechanism by which the Proposed Development could affect breeding productivity, nesting success or chick survival. **No risk [Nesting options]** The Main Wind Farm Development Site does not provide nesting habitat for lesser black-backed gull, and	**Negligible or very low [collision risk] (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone. **Negligible or very low [Foraging habitat (extent, availability and use)] (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone. **Other In-combination effects – No risk** No other operational, consented or proposed wind farms within the wider area present overlapping or additive risks in relation to collision, disturbance, displacement, habitat loss or barrier effects.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			no nesting activity occurs within the wind farm footprint. Therefore, the extent or availability of nesting options within the SPA will not be affected. **Low risk [Foraging habitat (extent, availability and use)] (if unmitigated)** The Main Wind Farm Development Site is not a key or regularly utilised foraging area for lesser black-backed gull. Recorded flight activity was low and sporadic, consistent with transit rather than functional reliance. Given the species' wide foraging range and the availability of extensive alternative foraging habitat, any localised avoidance or displacement would not result in a meaningful reduction in foraging opportunity at the SPA population level. **No risk [Disturbance at breeding sites and ecologically connected areas]** The Proposed Development is located at a substantial distance from the SPA breeding colony. No pathways exist by which construction or operational activities could disturb breeding sites or ecologically connected areas. **No risk [Barrier effects and connectivity]** The Proposed Development is not of sufficient scale or configuration to act as a barrier to movement for lesser black-backed gull. No effects on connectivity between breeding, foraging or resting areas are predicted.	Accordingly, there is no mechanism by which cumulative effects could arise, and the Proposed Development Site, alone or in combination with other plans or projects, will not undermine the conservation objectives or integrity of the SPA.
Duvillaun Islands SPA 004111	15.3 km SW	Maintain the: • winter population trend; • winter spatial distribution; • levels of disturbance; • lack of barriers to connectivity and site use;	**Low risk [Collision risk] (if unmitigated)** The modelled collision risk for barnacle goose associated with the Proposed Development is 0 collisions/year. Accordingly, there is no risk of collision-related mortality affecting the wintering population. **No risk [Winter population trend]**	**Negligible or very low [collision risk] (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
		• spatial distribution, extent and abundance of foraging habitats; • spatial distribution and extent of roosts; and • area and quality of supporting habitat of **barnacle goose**.	Given the absence of collision risk and the lack of regular or sustained use of the Main Wind Farm Development Site by barnacle goose, there is no plausible mechanism by which the Proposed Development could affect winter population size or trend. **No risk [Winter spatial distribution]** Barnacle geese were not recorded using the Main Wind Farm Development Site as a regular foraging or roosting area. Any flights recorded were infrequent and indicative of transit rather than functional site use. As a result, no changes to winter spatial distribution within the SPA are predicted. **No risk [Foraging habitat availability and quality]** The Main Wind Farm Development Site does not comprise key or regularly used foraging habitat for barnacle goose. Given the availability of extensive alternative foraging areas within the wider landscape and coastal environment, any localised avoidance or displacement at the wind farm would not result in a meaningful reduction in foraging opportunity or habitat availability. **No risk [Roosting habitat]** No roosting sites for barnacle goose were identified within or adjacent to the Main Wind Farm Development Site. Therefore, no effects on the spatial distribution or extent of roosts are predicted. **No risk [Disturbance and displacement]** While occasional movements through the wider area cannot be excluded, the Proposed Development is not subject to regular or intensive use by barnacle goose. Any disturbance would be localised and transient, with no effect on wintering behaviour, distribution or habitat use at the SPA scale.	the risk to the CO due to the Proposed Development alone. **Other In-combination effects – No risk** No other operational, consented or proposed wind farms within the wider area present overlapping or additive risks in relation to collision, disturbance, displacement, habitat loss or barrier effects. Accordingly, there is no mechanism by which cumulative effects could arise, and the Proposed Development, alone or in combination with other plans or projects, will not undermine the conservation objectives or integrity of the SPA.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			No risk [Barrier effects and connectivity] The Proposed Development is not of a scale or configuration that would present a barrier to barnacle goose movements. Given the species' flight capability and the absence of reliance on the site, no effects on connectivity or site use are predicted.	
Inishkea Islands SPA 004004	16.4 km W	Maintain the: • breeding population size; • productivity rate; • extent of available nesting options within the SPA; • spatial distribution, extent, abundance and availability of foraging habitat; • levels of disturbance at breeding sites; • levels of disturbance at areas ecologically connected to the colony; and • Lack of barriers to connectivity for **common gull**	**Low risk [Collision risk] (if unmitigated)** The modelled collision risk for common gull is 0.05 collisions/year (worst-case using the Nordex N163 candidate turbine). With a current SPA population of 94 birds, this equates to a 0.38% increase in mortality relative to background mortality. As this increase is <1%, the risk of undermining the conservation objective relating to breeding population size is low. **No risk [Breeding and productivity]** No nests were recorded within or in proximity to the Main Wind Farm Development Site. Consequently, there is no mechanism by which the Proposed Development could affect breeding productivity, nesting success, or other breeding-related conservation objectives for the SPA population. **No risk [Foraging habitat and ex-situ supporting habitat]** The potential ex-situ pathway whereby effects at the wind farm could influence SPA population dynamics via loss or degradation of supporting foraging habitat has been considered and excluded. As set out in **Table 3-1**, the Main Wind Farm Development Site is not used as a key or regularly utilised foraging area by common gull, and recorded flight activity was low and sporadic, indicating transit rather than functional reliance. Given the wide foraging range of the species and the availability of extensive alternative foraging habitat within the wider landscape and marine environment,	**Negligible or very low [collision risk] (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone. **Other In-combination effects – No risk** No other operational, consented or proposed wind farms within the wider area present overlapping or additive risks in relation to collision, disturbance, displacement, habitat loss or barrier effects. Accordingly, there is no mechanism by which cumulative effects could arise, and the Proposed Development, alone or in combination with other plans or projects, will not undermine the conservation objectives or integrity of the SPA.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			any localised avoidance or displacement at the wind farm would not result in a meaningful reduction in foraging opportunity. **No risk [Disturbance and displacement]** The Main Wind Farm Development Site does not support regular foraging, roosting or breeding use by common gull. Any disturbance would therefore be localised and transient, with no plausible mechanism to affect SPA population distribution, productivity or viability. **No risk [Barrier effects and connectivity]** The Proposed Development is not of a scale or configuration that would present a barrier to common gull movements. The species routinely undertakes movements at much broader spatial scales, and no disruption to connectivity between breeding, foraging or roosting areas is predicted.	
		Restore the: • breeding population size; • productivity rate; • extent of available nesting options within the SPA; • spatial distribution, extent, abundance and availability of foraging habitat; • levels of disturbance at breeding sites; • levels of disturbance at areas ecologically connected to the colony; and • Lack of barriers to connectivity for **herring gull**	**Low risk [Collision risk] (if unmitigated)** The modelled collision risk for herring gull is 0.15 collisions/year (worst-case using the Nordex N163 candidate turbine). With a current SPA population of 156 birds, this equates to a 0.8% increase in mortality relative to background mortality. As this increase is <1%, the risk of undermining the conservation objective relating to breeding population size is low. **No risk [Breeding and productivity]** No nests were recorded within or in proximity to the Main Wind Farm Development Site. Consequently, there is no mechanism by which the Proposed Development could affect breeding productivity, nesting success, or other breeding-related conservation objectives for the SPA population.	**Negligible or very low [collision risk] (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone. **Other In-combination effects – No risk** No other operational, consented or proposed wind farms within the wider area present overlapping or additive risks in relation to collision, disturbance,

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			No risk [Foraging habitat and ex-situ supporting habitat] The potential ex-situ pathway whereby effects at the wind farm could influence SPA population dynamics via loss or degradation of supporting foraging habitat has been considered and excluded. As set out in **Table 3-1**, the Main Wind Farm Development Site is not used as a key or regularly utilised foraging area by herring gull. Recorded flight activity was low and sporadic, indicating transit rather than functional reliance. Given the species' wide foraging range and the availability of extensive alternative foraging habitats within the wider landscape and marine environment, any localised avoidance or displacement at the wind farm would not result in a meaningful reduction in foraging opportunity. **No risk [Disturbance and displacement]** The Main Wind Farm Development Site does not support regular foraging, roosting or breeding use by herring gull. Any disturbance would therefore be localised and transient, with no plausible mechanism to affect SPA population distribution, productivity or viability. **No risk [Barrier effects and connectivity]** The Proposed Development is not of a scale or configuration that would present a barrier to herring gull movements. The species regularly traverses landscapes at much broader spatial scales, and no disruption to connectivity between breeding, foraging or roosting areas is predicted.	displacement, habitat loss or barrier effects. Accordingly, there is no mechanism by which cumulative effects could arise, and the Proposed Development, alone or in combination with other plans or projects, will not undermine the conservation objectives or integrity of the SPA.
		Maintain the: • winter population trend; • winter spatial distribution; • levels of disturbance;	**No risk [Collision risk]** The modelled collision risk for barnacle goose associated with the Proposed Development is 0 collisions/year. Accordingly, there is no risk of collision-related mortality affecting the wintering population.	**In-combination effects – No risk** No additional wind farms with predicted collision risk for barnacle goose are present.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
		• lack of barriers to connectivity and site use; • spatial distribution, extent and abundance of foraging habitats; • spatial distribution and extent of roosts; and area and quality of supporting habitat of **barnacle goose**.	**No risk [Winter population trend]** Given the absence of collision risk and the lack of regular or sustained use of the Main Wind Farm Development Site by barnacle goose, there is no plausible mechanism by which the Proposed Development could affect winter population size or trend. **No risk [Winter spatial distribution]** Barnacle geese were not recorded using the Main Wind Farm Development Site as a regular foraging or roosting area. Any flights recorded were infrequent and indicative of transit rather than functional site use. As a result, no changes to winter spatial distribution within the SPA are predicted. **No risk [Foraging habitat availability and quality]** The Main Wind Farm Development Site does not comprise key or regularly used foraging habitat for barnacle goose. Given the availability of extensive alternative foraging areas within the wider landscape and coastal environment, any localised avoidance or displacement at the wind farm would not result in a meaningful reduction in foraging opportunity or habitat availability. **No risk [Roosting habitat]** No roosting sites for barnacle goose were identified within or adjacent to the Main Wind Farm Development Site. Therefore, no effects on the spatial distribution or extent of roosts are predicted. **No risk [Disturbance and displacement]** While occasional movements through the wider area cannot be excluded, the Proposed Development is not subject to regular or intensive use by barnacle goose. Any disturbance would be localised and transient, with	Accordingly, there is no potential for in-combination effects beyond those assessed for the Proposed Development alone. The same conclusions apply in respect of winter distribution, disturbance and displacement, barrier effects, foraging and roosting objectives.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			no effect on wintering behaviour, distribution or habitat use at the SPA scale. **No risk [Barrier effects and connectivity]** The Proposed Development is not of a scale or configuration that would present a barrier to barnacle goose movements. Given the species' flight capability and the absence of reliance on the site, no effects on connectivity or site use are predicted.	
Lough Conn and Lough Cullin SPA 004228	17.1 km S	Maintain the: • breeding population size; • productivity rate; • extent of available nesting options within the SPA; • spatial distribution, extent, abundance and availability of foraging habitat; • levels of disturbance at breeding sites; • levels of disturbance at areas ecologically connected to the colony; and • Lack of barriers to connectivity for **common gull**	**Low risk [Collision risk] (if unmitigated)** The modelled collision risk for common gull is 0.05 collisions/year (worst-case using the Nordex N163 candidate turbine). With a current SPA population of 94 birds, this equates to a 0.38% increase in mortality relative to background mortality. As this increase is <1%, the risk of undermining the conservation objective relating to breeding population size is low. **No risk [Breeding and productivity]** No nests were recorded within or in proximity to the Main Wind Farm Development Site. Consequently, there is no mechanism by which the Proposed Development could affect breeding productivity, nesting success, or other breeding-related conservation objectives for the SPA population. **No risk [Foraging habitat and ex-situ supporting habitat]** The Main Wind Farm Development Site does not comprise key or regularly used foraging habitat for common gull. Given the availability of extensive alternative foraging areas within the wider landscape and coastal environment, any localised avoidance or displacement at the wind farm would not result in a meaningful reduction in foraging opportunity or habitat availability.	**Negligible or very low [collision risk] (if unmitigated):** Negligible or very low risk of other construction and/or decommissioning works at other project sites adding to the risk to the CO due to the Proposed Development alone. **Other In-combination effects – No risk** No other operational, consented or proposed wind farms within the wider area present overlapping or additive risks in relation to collision, disturbance, displacement, habitat loss or barrier effects. Accordingly, there is no mechanism by which cumulative effects could arise, and the Proposed Development, alone or in combination with other plans or projects, will not undermine

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			No risk [Disturbance and displacement] The Main Wind Farm Development Site does not support regular foraging, roosting or breeding use by common gull. Any disturbance would therefore be localised and transient, with no plausible mechanism to affect SPA population distribution, productivity or viability. **No risk [Barrier effects and connectivity]** The Proposed Development is not of a scale or configuration that would present a barrier to common gull movements. The species routinely undertakes movements at much broader spatial scales, and no disruption to connectivity between breeding, foraging or roosting areas is predicted.	the conservation objectives or integrity of the SPA.
Inner Galway Bay SPA 004031	Approx 109 km S	Maintain the: • Breeding population abundance: apparently occupied nests (AONs) • Productivity rate: fledged young per breeding pair • Distribution: breeding colonies • Prey biomass available • Barriers to connectivity • Disturbance at breeding site of **common tern**	**No risk [Collision risk]** Common tern was observed making a total of two flights through the Main Wind Farm Development Site. All flights were of a single bird. CRM indicates that the Proposed Development could result in 0 collisions per year. Therefore, there would be no increase in annual mortality **No risk [Breeding and productivity]** No nests were recorded within or in proximity to the Main Wind Farm Development Site. Consequently, there is no mechanism by which the Proposed Development could affect breeding productivity, nesting success, or other breeding-related conservation objectives for the SPA population. **No risk [Foraging habitat and ex-situ supporting habitat]** The Main Wind Farm Development Site does not comprise key or regularly used foraging habitat for common tern. Given the availability of extensive alternative foraging areas within the wider landscape	**In-combination effects – No risk** No additional wind farms with predicted collision risk for common tern are present. Accordingly, there is no potential for in-combination effects beyond those assessed for the Proposed Development alone. The same conclusions apply in respect of foraging, disturbance and displacement, and barrier effects.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			and coastal environment, any localised avoidance or displacement **No risk [Disturbance and displacement]** The Main Wind Farm Development Site does not support regular foraging, roosting or breeding use by common tern. Any disturbance would therefore be localised and transient, with no plausible mechanism to affect SPA population distribution, productivity or viability. **No risk [Barrier effects and connectivity]** The Proposed Development is not of a scale or configuration that would present a barrier to common tern movements.	
Clare Island SPA 004136	Approx. 32 km S	Restore the: • Breeding population size • Productivity rate • Distribution: extent of available nesting options within the SPA • Forage spatial distribution, extent, abundance and availability • Disturbance at the breeding site • Disturbance at areas ecologically connected to the colony • Barriers to connectivity for **kittiwake**	**No risk [Collision risk]** CRM indicates that the Proposed Development could result in 0 collisions per year. Therefore, there would be no increase in annual mortality. **No risk [Breeding and productivity]** No nests were recorded within or in proximity to the Main Wind Farm Development Site. Consequently, there is no mechanism by which the Proposed Development could affect breeding productivity, nesting success, or other breeding-related conservation objectives for the SPA population. **No risk [Foraging habitat and ex-situ supporting habitat]** The Main Wind Farm Development Site does not comprise key or regularly used foraging habitat for kittiwake. Given the availability of extensive alternative foraging areas within the wider landscape and coastal environment, any localised avoidance or displacement **No risk [Disturbance and displacement]**	**In-combination effects – No risk** No additional wind farms with predicted collision risk for common tern are present. Accordingly, there is no potential for in-combination effects beyond those assessed for the Proposed Development alone. The same conclusions apply in respect of foraging, disturbance and displacement, and barrier effects.

Site Name and Code	Distance (direct line) and Direction to Site	Conservation Objective (summary) - all relate exclusively to within the SAC or SPA	Risk to the Conservation Objectives Due to the Proposed Development Alone	Risk to the Conservation Objectives In combination with other plans and projects
			The Main Wind Farm Development Site does not support regular foraging, roosting or breeding use by kittiwake. Any disturbance would therefore be localised and transient, with no plausible mechanism to affect SPA population distribution, productivity or viability. **No risk [Barrier effects and connectivity]** The Proposed Development is not of a scale or configuration that would present a barrier to kittiwake movements.	

4.6 Step 3: Effects on the Integrity of the European Sites

The detailed assessment of effects on European sites (summarised in **Table 4-15**) demonstrates that, for the majority of qualifying features and conservation objectives considered, the Proposed Project - both alone and in combination with other plans and projects - is associated with no risk or low to very low risk of adverse effects, due to the absence of direct habitat loss, limited spatial overlap, distance from designated sites, and the localised and temporary nature of potential impact pathways.

Notwithstanding this, a number of potential effect pathways are identified which, in the absence of mitigation, could give rise to low-level risks for certain conservation objectives. These relate primarily to:

- temporary disturbance of mobile qualifying features (notably otter and certain SPA bird species) during construction and decommissioning works;
- short-term, localised changes in water quality associated with construction and decommissioning activities in hydrologically connected catchments;
- the potential introduction or spread of invasive non-native species via construction activities; and
- collision risk, disturbance or barrier effects for selected SCI bird species during the operational phase.

While these effects are limited in magnitude, spatial extent and duration, and are not expected to result in habitat loss or population-level impacts, mitigation measures are required to avoid or further reduce these risks and to ensure that the conservation objectives of the relevant European sites are fully safeguarded.

Accordingly, the mitigation measures set out in **Section 4.7** have been designed to address these identified pathways and to provide certainty that the Proposed Project will not adversely affect the integrity of any European site, either alone or in combination with other plans and projects.

4.7 Step 4: Mitigation Measures

The Proposed Project incorporates a comprehensive suite of environmental mitigation measures, addressing a wide range of potential effects including habitat loss, species disturbance, and bat interactions. These measures are described in full within **Chapter 5: Biodiversity** of the accompanying EIAR and form an integral part of the overall project design and environmental management framework. None of these measures were considered at the Screening Stage.

However, for the purposes of this NIS, mitigation measures are considered only insofar as they are required to address potential effects that could give rise to adverse effects on the integrity of European sites or undermine their Conservation Objectives.

As set out in Sections 4.5 and 4.6, the detailed assessment demonstrates that many qualifying features and conservation objectives are not at risk due to the absence of direct habitat loss within European sites, limited spatial overlap, separation distances, and the localised and temporary nature of the sources for effects from the Proposed Project's activities. No mitigation is therefore required in respect of those pathways within the context of the AA.

The assessment has identified a limited number of potential effect pathways which, in the absence of mitigation, could give rise to low-level risk to the integrity of certain European sites (as stated in Section 4.6).

The mitigation measures presented in this section have therefore been designed specifically to address these pathways and to ensure that all relevant Conservation Objectives are fully safeguarded. The measures are preventative in nature, targeted to the identified risks, and are supported by established best practice guidance and expert ecological judgement. Details of the mitigation measures, their implementation, effectiveness, timescale and monitoring arrangements are provided in **Table 4-20**.

4.7.1 Mitigation Measures – Construction

Mitigation measures to prevent adverse effects on downstream European sites during construction are provided in full in this NIS as outlined below. These will ensure no deterioration in the quality of water entering the Bellacorick Bog Complex SAC, Mullet/Blacksod Bay Complex SAC and, Blacksod Bay/Broad Haven SPA (the only European sites identified with hydrological connectivity), and will ensure there will be no impacts on any the habitats to support the QIs and SCI species. The same is true for SCI, non-QI aquatic habitats and species. These measures are taken from **Chapter 7** of the accompanying EIAR and the CEMP (**Appendix 5** of this NIS).

The CEMP details a range of good practice measures that will be implemented to mitigate pollution prevention measures (as set out in Section 6 of the CEMP) and Drainage and Surface Water Management (as set out in Section 7 of the CEMP). These measures involve protocols related to environmental incident response plans, re-fuelling and spillage procedures, siltation avoidance measures etc. Including the maintenance and monitoring of silt traps etc.

The CEMP (**Appendix 5** of this NIS) has been developed for the Proposed Project to ensure adequate protection of the water environment. All personnel working on the Proposed Project will be responsible for the environmental control of their work and will perform their duties in accordance with the requirements and procedures of the CEMP. The measures that are relevant to this NIS are further detailed below.

4.7.1.1 Environmental Incident and Emergency Response Plan

The plan will provide:

- a summary of the key actions required as part of the Battery Safety Management Plan (BSMP);
- a summary of local environmental sensitivities, e.g. environmentally designated areas, protected species or habitats and high amenity areas;
- a description of the construction works and appropriate references to other environmental plans and construction method statements;
- an inventory of stored materials and emergency response spill kits;
- details on training requirements, evidence of training of site staff / plant operators in emergency response procedures including inclusion of EIERP training in site inductions and toolbox talks; and key staff contacts for environmental management and emergency response;
- detailed procedures to be taken in the event of an incident or emergency (including procedures for positioning and movement of plant) and identification of relevant personnel who will be responsible for implementing such procedures; and
- contact telephone numbers for emergency services and the EPA Pollution out-of-hours telephone number (0818 33 55 99).

4.7.1.2 Refuelling of Vehicles, Plant and Machinery

Refuelling will take place either:

- within the construction compound at a dedicated impermeable refuelling pad; or
- by mobile double-skinned bowsers located at least 50 m from watercourses, in accordance with OPW (2019) guidance.

Drainage from the compound will pass through oil interceptors prior to discharge.

Oils, greases, hydraulic fluids, hazardous substances and associated wastes will be stored under cover, over spill trays or within bunded containers in designated storage areas within the construction compounds. No fuel storage will occur outside the compounds.

Plant will be maintained in good operational order, with leaks recorded for attention. Absorbent pads and granules will be available in the event of accidental leaks or spillages.

The CEMP also states that:

- storage vessels will be regularly monitored and inspected;
- construction plant and equipment will be regularly maintained and serviced;
- an Environmental Incident and Emergency Response Plan (EIERP) will include contingency procedures for leaks and spills; and
- emergency spill response kits will be held onsite at strategic locations including refuelling areas and within plant.

4.7.1.3 Spillage and Chemical Storage

All fuels, oils, waste oils and other potential contaminants will be stored in secure, fit-for-purpose containers within bunded containment, in accordance with EPA guidance.

The refuelling pad will:

- have an impermeable base and bund with 110% capacity; and
- include sumps that do not drain directly to surface water drains.

Maintenance of mobile plant will only occur within construction compounds and in accordance with EPA guidance.

4.7.1.4 Storage of Materials

Stone stockpiles for tracks, compounds and hardstandings will be restricted to work areas. Temporary stockpiles will be located within pre-developed areas close to the working area.

Excavated material will be stored in low mounded stockpiles adjacent to access tracks, turbine areas and compounds, away from open drains.

4.7.1.5 Prevention of Mud and Debris on Public Roads

Wheel washing facilities and road sweepers will be provided as required to prevent mud and debris being transferred onto public roads.

Wheel wash facilities will:

- be located at site exits;
- be located at least 50 m from the nearest watercourse or surface water drain; and
- discharge runoff to the attenuation basin network.

Settled solids will be regularly removed and buried with silty fines collected from silt fences.

Open-backed lorries and tippers transporting material will be sheeted where required.

The CEMP also states that weather-responsive management will be implemented during periods of wet weather and high vehicle movement volumes.

4.7.1.6 Cement / Concrete

Ready-mixed concrete will be imported from an offsite source.

Bagged cement will:

- be stored within a soil-bunded area;
- be stored on pallets above ground level; and
- be covered with secured plastic sheeting.

Any spilled cement will be removed and disposed of offsite.

Concrete vehicle washing will only occur within designated washout facilities and not elsewhere onsite.

4.7.1.7 Silt

The CEMP identifies exposed soil, rock and access tracks as potential sources of silt-laden runoff.

It states that:

- no material will be discharged or disposed of directly into rivers, streams or drainage ditches; and
- measures to control silt entrainment in runoff are set out in Section 7.4 of the CEMP.

4.7.1.8 Waste and Litter

A licensed waste management contractor will be appointed prior to construction.

The contractor will:

- provide receptacles for waste streams, including domestic/canteen waste; and
- ensure regular emptying and collection of waste.

4.7.1.9 Hydrocarbon Contamination

Plant and machinery will be regularly maintained to minimise the potential for fuel or oil leaks and spillages.

Maintenance will be undertaken on absorbent spill pads and all machinery will be equipped with drip pans.

All fuels, oils and chemicals will be stored within secure bunded containment in the construction compound. Bunded areas will:

- have 110% storage capacity;
- have impervious walls and bases; and
- be underlain by an impermeable ground membrane layer.

4.7.1.10 Site Drainage

During the construction phase of the Proposed Project, measures, as detailed in **Sections 7 Drainage and Surface Water Management of the CEMP** will be adopted to prevent silt, chemicals and/or other contaminants from being washed into existing watercourses. Areas exposed due to the removal of vegetation are more susceptible to erosion during heavy rainfall so areas will be reinstated prior to heavy rainfall to minimise this effect.

This will include specific guidance in relation to drainage (and control of pollution to the water environment) around the following aspects of site infrastructure as outlined in the DoHLGH guidance “The Planning System and Flood Risk Management - Guidelines for Planning Authorities”:

- access routes,
- foundations, and
- hardstanding areas and new structures.

The appropriate methodologies to cover water control and the means of drainage from all hard surfaces and structures within the Proposed Project are described in the following sections.

4.7.1.11 Management of Sediment and Surface Waters

Techniques outlined in Section 7 of the CEMP (see **Appendix 5**) will be adopted for the management of sediment and surface water run-off generated during the construction phase of the Proposed Project.

A drainage system for the Proposed Development Site will be developed to comprise:

- The excavation of in channel rock drainage channels approx. 2 m in width and 275 mm in depth from the edge of the Proposed Development Site’s access tracks.
- Silt fence textile will be laid within the channel. The silt fence textile will be Hy-tex Terrastop premium or similar and will be fixed to the upslope side of the supporting slope within the main drainage channel.
- Support posts for silt fence support and for channel supports will be inserted at the edge of the drainage channel at 1,500 mm intervals.
- Silt fence textile will be anchored using clean drainage stone.

The proposed drainage system will be based on the following methods:

- The first method will involve protecting existing water quality by avoiding disturbance to natural drainage features, minimising any works in or around drainage features, and diverting clean surface runoff around excavations and construction areas.
- The second will involve collecting any drainage water from works areas that might carry silts or sediments, and to route them towards attenuation basins prior to controlled diffuse release over vegetated natural surfaces. To achieve this, shallow surface water drains will be excavated around areas of earthworks to prevent surface water runoff into the working area and thereby protect the wider water network from siltation.

The drainage design for the Proposed Development shall utilise the existing peat drains and drainage ditches.

Good practice construction techniques[53] will be adopted for the management of sediment and surface water run-off generated during the construction phase of the Proposed Development. Sustainable Drainage Systems (SuDS) will be used where applicable.

Drainage from the Site will include elements of SuDS design. SuDS replicate natural drainage patterns and have several benefits:

- SuDS will attenuate run-off, thus reducing peak flow and any flooding issues that might arise downstream;
- SuDS will treat run-off, which can reduce sediment and pollutant volumes in run-off before discharging back into the water environment; and

In addition, a wet weather protocol will be implemented by the PSCS to manage activities during periods of heavy and prolonged precipitation.

Heavy or prolonged rainfall during construction and operation may lead to sediment transport or vegetation causing blockage to infrastructure drainage channels or watercourse crossing structures. Regular monitoring and prompt maintenance of these assets will ensure that the drainage system continues to function as designed.

These measures prevent sediment release, hydrocarbon contamination, alkaline leachate from concrete, and altered hydrological pathways that could impact aquatic habitats, fish spawning areas, macroinvertebrate communities, peatland vegetation and downstream designated nature conservation sites.

4.7.1.12 Foul Drainage

Any waste that is generated during the Proposed Project's construction phase will be collected, separated and stored in dedicated receptacles at the temporary construction compounds during construction works. A fully authorised waste management contractor will be appointed prior to the commencement of construction works. This contractor will provide the appropriate receptacles for the collection of the various waste streams and ensure regular emptying and/or collection of these receptacles. Appropriate licensed waste facilities in the surrounding area will be used as part of Waste Management arrangements. Effluent and waste from onsite construction will be captured onsite in a foul holding tank and stored for offsite disposal by a licensed contractor.

4.7.1.13 Water Quality Monitoring

The CEMP includes a Water Quality Monitoring Plan (WQMP) to monitor and protect surface water and groundwater during construction. Monitoring will be undertaken weekly or monthly as required and will address risks including siltation, hydrocarbon contamination, concrete-

[53] CIRIA (2015). The SuDS Manual (C753). London: Construction Industry Research and Information Association (CIRIA).

related pollution, drainage issues and impacts from excavation and construction traffic. The WQMP includes monitoring of water chemistry, fish and macroinvertebrate communities upstream and downstream of works areas, alongside groundwater monitoring at installed standpipes. Monitoring will include visual inspections, laboratory analysis and comparison against baseline conditions and environmental quality standards. The ECoW will undertake regular inspections of watercourses, sediment controls and active work areas, maintain hydrological records and coordinate responses to any issues identified. Any pollution incident or deviation from expected water quality trends will trigger inspection, corrective action and reporting procedures under the Pollution Prevention and Incident Plan and EIERP.

With regard to the protection of the water environment the following risks will be addressed:

- siltation of watercourses;
- discolouration of raw water;
- potential pollution from construction traffic due to diesel spillage or similar;
- alteration of raw water quality resulting from imported track construction material;
- excavation and earthworks;
- use of large quantities of concrete; and
- construction compound and associated drainage/foul drainage and diesel spill issues.

The PSCS will compile a monitoring and maintenance plan for the drainage system and surface water runs for use by the ECoW which will as a minimum include:

- visual monitoring/inspections; and
- During site works, including water crossing construction works, the relevant drainage/surface water runs potentially being impacted by these works will be inspected daily by the ECoW while works are ongoing in this area.

4.7.1.14 Invasive Species

Any plant or equipment that may have worked in environments where invasive species are present (including but not restricted to rhododendron and prickly heath which were identified on site), will be suitably cleaned by high pressure hose, disinfected and dried before being used on site to prevent the spread of invasive species. A check-clean-dry protocol will be used to help spread crayfish plague.

Temporary fencing (paling with 25 mm mesh) will be erected around the required site works to delineate the works area and to minimise the potential for disturbance impacts outside of the works area. As no otter holts were identified within the Main Wind Farm Development Site, there is no specific mitigation required for the protection of this species in relation to relocation/construction of artificial dwellings.

Removal of brash and felled trees near to watercourses and drainage ditches will ensure that no significant acidification of downstream watercourses will occur.

A Habitat Management Plan (HMP) will be used to prevent the spread of invasive and non-native species and is included as part of the Peatland Restoration Plan (Appendix A) in **Appendix 7** of this NIS.

A pre-construction walkover survey of the works corridor will confirm the presence of any invasive/non-native species that may have escaped into the area since the baseline surveys were conducted.

4.7.1.15 Birds

To avoid widespread disturbance to birds, access will be restricted to the footprint of the proposed works corridor. Measures proposed above will prevent deterioration of water quality and adverse effects on any birds relying on downstream habitats.

The following will be implemented to reduce the possibility of damage and destruction (and disturbance to sensitive species) to occupied bird nests:

- clearance of woodlands and uncultivated vegetation i.e. trees and hedgerows (including vegetation removal for creation/maintenance of bat mitigation buffers), will be undertaken outside the main breeding season from March to September inclusive,
- if other site clearance and construction activities are required to take place during the main breeding bird season, pre-commencement confirmatory survey work will be undertaken to ensure that nest destruction and disturbance is avoided.
- once vegetation has been removed from the works corridor, these areas will be retained in a condition that limits suitability for nesting birds for the remainder of the construction phase e.g. cover for ground nesting species will be made unsuitable by cutting vegetation or tracking over with an excavator, and
- a suitably experienced ECoW will be employed for the duration of the construction period to make contractors aware of the ornithological sensitivities of the Proposed Project and to undertake surveys for nesting birds throughout the construction period, enforcing exclusion areas as required.

4.7.2 Mitigation Measures During Operational Phase

For the operational phase elements, the only mitigation measures required relate to long term water quality maintenance and collision risk/species displacement. The long-term impacts on habitats are discussed under construction phase mitigation measures with the long-term Habitat Management Plan included as part of the Peatland Restoration Plan (Appendix A) of **Appendix 7** of this NIS providing the 35-year long term active management strategy.

4.7.2.1 Designated Nature Conservation Sites, Fisheries and Aquatic Ecology

Maintenance of the Proposed Development drainage system will ensure the system is operating effectively and will be undertaken following the CIRIA C697 SuDS and Maintenance Manual. The following mitigation measures will be implemented:

- site access will be restricted by gates to prevent illegal dumping, use by off road vehicles etc., and
- as during construction, any stockpiled material will be within the temporary construction compounds or a minimum of 50 m from any surface water drainage.

This will prevent any negative effects on downstream aquatic receptors and designated sites..

4.7.2.2 Birds

Turbine curtailment

Turbine curtailment will be implemented for birds; this will also be supplemented by ongoing monitoring to ensure the curtailment is having the required impact avoidance regarding significant effect on bird populations.

Curtailment will be implemented via a system of adaptive management; where appropriate during ‘at-risk’ time periods and weather conditions, and as discussed and agreed with NPWS.

Curtailment for birds is different to curtailment for bats and would involve downtime of the actual turbine. Adaptive management options relating to turbine curtailment will include but are not limited to:

- Targeted curtailment during defined 'at risk' periods and conditions (e.g. low visibility such as fog) using turbine supervisory control and data acquisition (SCADA)-linked triggers informed by on-site weather/visibility sensors; and/or
- Automated detection-based curtailment using a validated camera / AI system to initiate turbine shutdown when the relevant species approach within a defined risk envelope.

It is possible that technological advances may have identified other options to reduce collision risk and any such measures would also be considered at that time, as appropriate.

The effectiveness of any adaptive measures will be reviewed against monitoring results and refined as necessary in agreement with NPWS.

It is important to reiterate that the implementation of curtailment will be amended further where the results of post-commissioning monitoring demonstrate a significant, adverse effect on SCI birds. This would be demonstrated via an assessment of recorded mortality in the light of changes in current conservation status at the time of the monitoring survey, indicating that the Proposed Project is contributing to the decline or hindering restoration efforts for the relevant species.

Consequently, with respect to all bird species, the Proposed Project would not be contrary to Ireland's obligations under the Birds Directive, Regional Policy Objective 7.22 (targets for, inter alia, protected species), nor the MCDP policies such as Policy NEP - 4 (To conserve and enhance the county's biodiversity and ecological connectivity identified areas of local biodiversity importance (Local Biodiversity Areas) in the town and villages in Mayo) and NEO – 4 (To protect and enhance biodiversity and ecological connectivity in County Mayo, including woodlands, trees, hedgerows, seminatural grasslands, rivers, streams, natural springs, wetlands, stone - walls, geological and geo-morphological systems, other landscape features and associated wildlife where these form part of the ecological network.).

4.7.3 Mitigation Measures During Decommissioning Phase

Mitigation measures for decommissioning will be the same as those for the construction phase, as described in **Section 4.7.1**. (with the exception of **Section 4.7.1.2**). However, the magnitude required will be less, as track and turbine installation will not be required. Monitoring

4.7.3.1 General Pre-Construction Confirmation Surveys

To prevent accidental disturbance to otter holts, an ecological confirmatory walkover survey will be undertaken prior to any construction activities within the development footprint to check that no new resting places have been established since the date of the previous survey.

Checks for nesting birds will be required for construction undertaken during the bird breeding season. If nests are recorded, ongoing monitoring and appropriate exclusion zones will be implemented to determine when and where works can proceed **Birds (Post-Construction)**

Based on current best-practice guidelines (SNH, 2009) and in accordance with EC Recommendation (C/2022/3219), a targeted range of flight activity surveys and collision monitoring (carcass searching) will be undertaken during the breeding and non-breeding seasons in years 1, 2 and 3 post construction, to monitor the rate of avian turbine collisions.[54] Six hours of survey per vantage point per month will be carried out for flight activity surveys

[54] Scottish Natural Heritage. (2009). *Monitoring the impact of onshore wind farms on birds*. SNH Guidance Document. Inverness: Scottish Natural Heritage.

and one round of carcass searches per turbine per month will be carried out. These surveys should be carried out by qualified ecologists. The results of each year of monitoring will be presented in a report that will be submitted to the competent authority and NPWS. After 3 years of post-construction monitoring surveys, consultation with NPWS and Mayo County Council will be undertaken to determine if further monitoring surveys or any further actions are required

Table 4-20: Summary of mitigation measures, implementation mechanisms, effectiveness, monitoring and reporting arrangements to avoid or reduce potential adverse effects on the integrity of European sites and their Conservation Objectives.

DESCRIPTION OF THE MEASURES, DETAILS ON IMPLEMENTATION, EFFECTIVENESS, MONITORING							
Effect identified in table 4-15 and the risks outlined in Table 4-18	European site potentially subject to effect	mitigation measures	how the measure will contribute to avoiding/reducing the effects on the integrity European sites	how it will be implemented and by whom	demonstrate its effectiveness (e.g. based on scientific evidence / expert rationale)	timescale of implementation, relative to the plan or project	proposed monitoring scheme and reporting requirements
Collision Risk	• Inishkeeragh SPA 004084 • Inishkea Islands SPA 004004 • Lough Conn and Lough Cullin SPA 004228	The mitigation measures outlined above in section 4.7 outline curtailment during operation.	Curtailment will directly reduce the risk of collision risk for qualifying bird species by temporarily stopping turbine operation during periods of elevated activity and highest collision susceptibility (e.g. low wind speeds, migration events, peak foraging periods, and/or seasonally sensitive times). By preventing turbine blade rotation at these high-risk times, the likelihood of individuals being struck is	Curtailment will be achieved by fitting weather detection sensors or cameras to the turbines, which will be linked to turbines via a supervisory control and data acquisition (SCADA) system. Thus, curtailment will only occur in foggy conditions during the 'at-risk' period for the relevant species. This will be implemented by the client.	This measure prevents the collision event from occurring rather than addressing impacts afterwards, it acts as an impact avoidance measure. Studies consistently show substantial reductions in mortality commonly in the order of ~40–70% for birds while requiring turbine shutdown for only a limited proportion of operating time. Please refer to Machado et al. 2024[55] for more information on turbine curtailment to mitigate collision risk for birds	Curtailment mitigation measure will be implemented during the operational phase. Post-commission monitoring will be implemented during the operational phase.	Post construction monitoring will be undertaken to ensure the effectiveness of the mitigation measures. This will be undertaken in collaboration with the NPWS. If monitoring indicates that collision rates exceed predicted levels for the SCI species, the curtailment regime will be refined in consultation with the Planning Authority and NPWS to ensure that significant effects are avoided.

[55] Machado, R., Nabo, P., Cardia, P., Moreira, P., Nicolau, P., & Repas-Goncalves, M. (2024). Bird Curtailment in Offshore Wind Farms: Application of curtailment in offshore wind farms at a sea basin level to mitigate collision risk for birds. Birdlife Europe and Central Asia and STRIX, Brussels, Belgium. Access online: Curtailment_Report_Digital_Spreads.pdf

DESCRIPTION OF THE MEASURES, DETAILS ON IMPLEMENTATION, EFFECTIVENESS, MONITORING							
Effect identified in table 4-15 and the risks outlined in Table 4-18	European site potentially subject to effect	mitigation measures	how the measure will contribute to avoiding/reducing the effects on the integrity European sites	how it will be implemented and by whom	demonstrate its effectiveness (e.g. based on scientific evidence / expert rationale)	timescale of implementation, relative to the plan or project	proposed monitoring scheme and reporting requirements
			substantially reduced.				
Introduction or spread of invasive non-native species	• Mullet/Blacksod Bay Complex SAC 000470 • Bellacorick Bog Complex SAC • Owenduff/Nephin Complex SAC 000534	The mitigation measures outlined above in section 4.7 outline mitigation of the spread/ introduction of invasive species during construction and decommissioning phases.	The Habitat Management Plan will control and, where feasible, eradicate invasive non-native plant species within and adjacent to the European site through biosecurity procedures, early detection surveys, and targeted removal (e.g. manual removal, appropriate treatment, and monitored follow-up).	The Environmental Manager / ECoW will monitor the implementation of the mitigation measures with regular reporting to client. Temporary fencing (paling with 25 mm mesh) will be erected around the required site works to delineate the works area and to minimise the potential for disturbance impacts outside of the works area.	The Habitat Management Plan represents a structured conservation management measure comprising survey, targeted control and monitoring. Guidance from the European Commission on the management of Natura 2000 sites[56] recognises planned invasive species control programmes as measures that prevent habitat deterioration and maintain ecological structure and function. Ecological research further demonstrates that sustained, monitored management programmes are significantly more effective than one-off removal in reducing invasive plant abundance and allowing recovery of native communities. By maintaining habitat composition and	For the duration of construction and decommissioning.	A Habitat Management Plan (HMP) will be used to prevent the spread of invasive and non-native species. Rhododendron and Prickly heath must not be spread during construction works. A pre-construction walkover survey of the works corridor will confirm the presence of any invasive/non-native species that may have escaped into the area since the baseline surveys were conducted.

[56] Commission Notice C (2018) 7621 final, Brussels, 21.11.2018. Access online: managing natura 2000 sites-KH0618414ENN.pdf

DESCRIPTION OF THE MEASURES, DETAILS ON IMPLEMENTATION, EFFECTIVENESS, MONITORING							
Effect identified in table 4-15 and the risks outlined in Table 4-18	European site potentially subject to effect	mitigation measures	how the measure will contribute to avoiding/reducing the effects on the integrity European sites	how it will be implemented and by whom	demonstrate its effectiveness (e.g. based on scientific evidence / expert rationale)	timescale of implementation, relative to the plan or project	proposed monitoring scheme and reporting requirements
					quality, the plan safeguards the favourable conservation condition of qualifying habitats and species and therefore protects the integrity of the European site.		
Changes in water quality	• Mullet/Blacksod Bay Complex SAC 000470 • Bellacorick Bog Complex SAC	The mitigation measures outlined above in section 4.7 outline mitigation of the changes in water quality.	These measures will prevent sediment and pollution runoff to the aquatic environment thereby blocking a pathway for effects on the downstream European sites	Measures will be implemented by the Contractor	EU Water Framework Directive (Directive 2000/60/EC) Water quality monitoring) will detect any deterioration in water quality arising from construction activities at an early stage, allowing works to cease and corrective measures to be implemented immediately. This prevents the release and downstream spread of silt, hydrocarbons, concrete leachate and other pollutants that could otherwise damage aquatic habitats and species. By maintaining water quality and preventing habitat degradation, the measure safeguards the ecological conditions required to support the qualifying	For the duration of construction and decommissioning.	The Environmental Manager and ECoW will monitor the implementation n of the mitigation measures with regular reporting to client.

DESCRIPTION OF THE MEASURES, DETAILS ON IMPLEMENTATION, EFFECTIVENESS, MONITORING							
Effect identified in table 4-15 and the risks outlined in Table 4-18	European site potentially subject to effect	mitigation measures	how the measure will contribute to avoiding/reducing the effects on the integrity European sites	how it will be implemented and by whom	demonstrate its effectiveness (e.g. based on scientific evidence / expert rationale)	timescale of implementation, relative to the plan or project	proposed monitoring scheme and reporting requirements
					interests of the European site. Accordingly, the conservation objectives and site integrity will not be adversely affected, either alone or in combination with other plans or projects.		
Disturbance of mobile qualifying features	• Mullet/Blacksod Bay Complex SAC 000470 • Bellacorick Bog Complex SAC • Owenduff/Nephin Complex SAC 000534 • Blacksod Bay/Broad	The mitigation measures outlined above in section 5.40 of the Biodiversity chapter of the EIAR outline the mitigation of disturbance of mobile qualifying features during	Works will follow best practice to minimise unnecessary noise and avoid lighting spill. Lighting will be shielded, directional and used only when required. Construction activity will be constrained where necessary to avoid sensitive periods for otter, birds (breeding, overwintering).	The ECoW will advise on timing to minimise disturbance to mammals, birds and aquatic fauna	Guidance from NatureScot recognises the effectiveness of these measures[57] [58] [59] during construction and decommissioning	For the duration of construction and decommissioning.	The Environmental Manager and ECoW will monitor the implementation n of the mitigation measures with regular reporting to client.

[57] NatureScot (2024) Standing advice for planning consultation – otters. Accessed online at: https://www.nature.scot/doc/standing-advice-planning-consultations-otters
[58] https://www.nature.scot/doc/bats-and-artificial-lighting
[59] https://www.nature.scot/doc/dealing-construction-and-breeding-birds

DESCRIPTION OF THE MEASURES, DETAILS ON IMPLEMENTATION, EFFECTIVENESS, MONITORING							
Effect identified in table 4-15 and the risks outlined in Table 4-18	European site potentially subject to effect	mitigation measures	how the measure will contribute to avoiding/reducing the effects on the integrity European sites	how it will be implemented and by whom	demonstrate its effectiveness (e.g. based on scientific evidence / expert rationale)	timescale of implementation, relative to the plan or project	proposed monitoring scheme and reporting requirements
	Haven SPA 004037 • Owenduff/Nephin Complex SPA 004098 • Inishglora and Inishkeeragh SPA 004084 • Inishkea Islands SPA 004004	construction and decommission.					

5.0 Conclusion

This report presents a detailed AA Screening and NIS, together with all supporting information, to inform the competent authority in making its own complete, precise and definitive findings in respect of the potential effects of the Proposed Project on the integrity of European sites.

The assessment has examined, based on best available scientific knowledge, those impact pathways identified as having the potential to affect conservation objectives, including disturbance, habitat loss or degradation, changes in hydrological and hydrogeological conditions, collision risk, displacement and barrier effects, both alone and in combination with other plans and projects.

The assessment demonstrates that, with the implementation of the mitigation measures identified in this report, the Proposed Project will not result in loss of habitat area, sustained deterioration of habitat condition, or population-level effects on qualifying interest species within any European site. Mitigation measures have been specifically designed to avoid or reduce effects associated with identified pathways.

On this basis, and subject to the competent authority's independent assessment, it is concluded that sufficient scientific certainty exists to determine without any reasonable doubt that the Proposed Project, either alone or in combination with other plans or projects, will not adversely affect the integrity of any European site, in view of their conservation objectives, and will not undermine the ability of those sites to maintain or restore their qualifying interests to favourable conservation condition.

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Site Synopses, Conservation Objectives and Standard Data Forms for European Sites: https://www.npws.ie/protected-sites

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FIGURES

Figure 1 Site Location

Figure 2 European Sites within 20 km

Figure 3 Hydrological Connections

Figure 4 Cumulative Assessment

Appendix 1 Site Location, European Sites within 20 km and Hydrological Connections

AA Screening and Natura Impact Statement

Muingmore Wind Farm

RWE Renewables Ireland Limited

SLR Project No.: 501.065301.00001

460000

480000

500000

840000

820000

N

LEGEND

- Proposed Development Site Boundary
- Bellacorick 110 kv Substation
- Proposed Grid Connection Route (Subject to Separate Planning Application)
- Proposed Over-run Area Location

Broadhaven Bay

Béal an Mhuirthead

Loch na Ceathrún Móire

OVER-RUN AREA 1

OVER-RUN AREA 3

OVER-RUN AREA 2

Blacksod Bay - Cuan an Fhóid Duibh

Achill Island - Acaill

Keel Beach

Wild Nephin National Park

N59

Clew Bay

Connac

0 10 20

Kilometres

RWE

SLR

MUINGMORE WIND FARM

NATURA IMPACT STATEMENT

PROPOSED DEVELOPMENT AND CABLE ROUTE

FIGURE 1

Scale 1:150,000 @ A3

Date MARCH 2026

402.064443.00001.0117.0 Proposed Development and GCR

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460000 470000 480000 490000 500000 510000

850000 840000 830000 820000 810000

N

Stags of Broad Haven SPA
Erris Head SAC
Illanmaster SPA
Termoncarragh Lake and Annagh Machair SPA
Broadhaven Bay SAC
Inishglora and Inishkeeragh SPA
Mullet Peninsula SPA
Glenamoy Bog Complex SAC
Killala Bay/Moy Estuary SPA
Carrowmore Lake SPA
Bellacorick Iron Flush SAC
Slieve Fyagh Bog SAC
West Connacht Coast SAC
OVER-RUN AREA 1
Knockmoyle/Sheskin Ramsar
Bellacorick Bog Complex SAC
Inishkea Islands SPA
Blacksod Bay/Broad Haven SPA
Carrowmore Lake Complex SAC
Inishkea Islands SAC
OVER-RUN AREA 3
Lough Dahybaun SAC
Duvillaun Islands SPA
Mullet/Blacksod Bay Complex SAC
Owenduff catchment Ramsar
Owenboy Ramsar
OVER-RUN AREA 2
River Moy SAC
Duvillaun Islands SAC
Blacksod Bay and Broadhaven Ramsar
Doogort Machair/Lough Doo SAC
Owenduff/Nephin Complex SAC
Lough Conn a Lough Cullin S
Doogort Machair SPA
Owenduff/Nephin Complex SPA
Achill Island - Acaill
Wild Nephin National Park
Newport River SAC
Achill Head SAC
Lough Gall Bog SAC
Bellacragher Saltmarsh SAC
Keel Machair/Menaun Cliffs SAC
Corraun Plateau SAC

N59

County Mayo

0 5 10
Kilometres

LEGEND

- Proposed Development Site Boundary
- Bellacorick 110 kv Substation
- Proposed Grid Connection Route (Subject to Separate Planning Application)
- Study Area (Proposed Development Site Boundary and Cable Route 20 km Buffer)
- Proposed Over-run Area Location

Ecological Designations

- Ramsar Wetland and Site Location
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)

Galway

RWE

SLR

MUINGMORE WINDFARM

NATURA IMPACT STATEMENT

EUROPEAN SITES WITHIN 20 KM OF THE PROPOSED DEVELOMENT AND CABLE ROUTE

FIGURE 2

Scale 1:200,000 @ A3

Date MARCH 2026

402.064443.00001.0118.0 European Sites within 20 km

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, USGS, Map data © OpenStreetMap contributors, Microsoft, Facebook, Google, Esri Community Maps contributors, Map layer by Esri. Copyright Government of Ireland. This dataset was created by National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs. This copyright material is licensed for re-use under the Creative Commons Attribution 4.0 International licence.

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474000 476000 478000 480000

824000

822000

L1205

Blacksod Bay/Broad Haven SPA

Mullet/Blacksod Bay Complex SAC

Blacksod Bay/Broad Haven SPA

Blacksod Bay/Broad Haven SPA

T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13

1 2 3

TCC1 TCC2

Gossala Cemetery

N

0 1 2

Kilometres

LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Site Access Location
- Proposed Met Mast Location
- Proposed New Access Track
- Proposed Upgraded Access Track
- Proposed Grid Connection Route (Subject to Separate Planning Application)
- Proposed Crane Pad
- Proposed Substation (Indicative Size and Location)
- Battery Energy Storage System (BESS) Compound (Indicative Size and Location)
- Proposed Temporary Construction Compound (TCC)
- Proposed Drainage Feature
- Proposed Attenuation Basin
- Watercourse
- Potential Hydrological Connection
- Waterbody

Ecological Designations

- Special Area of Conservation (SAC)
- Special Protection Area (SPA)

RWE

SLR

MUINGMORE WIND FARM

NATURA IMPACT STATEMENT

HYDROLOGICAL AND HYDROGEOLOGICAL CONNECTIONS

FIGURE 3

Scale 1:25,000 @ A3

Date MARCH 2026

402.064443.00001.0119.0 Hydrology Connections

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450000 460000 470000 480000 490000 500000

840000 830000 820000 810000

N

Broadhaven Bay

Béal an Mhuirthead

Loch na Ceathrún Móire

Blacksod Bay - Cuan an Fhóid Duibh

Achill Island - Acaill

Keel Beach

Wild Nephin National Park

N59

2021119

2019078

2023027

2022502

OVER-RUN AREA 1

OVER-RUN AREA 2

OVER-RUN AREA 3

0 5 10

Kilometres

LEGEND

Proposed Development Site Boundary

Study Area (Proposed Development Site Boundary 20 km Buffer)

Proposed Over-run Area Location

Environmental Impact Assessment Application (Development Type)

Agricultural

Hydrogen Production

Windfarm

Galway

RWE

SLR

MUINGMORE WIND FARM

NATURA IMPACT STATEMENT

CUMULATIVE ASSESSMENT

FIGURE 4

Scale 1:180,000 @ A3

Date MARCH 2026

402.064443.00001.0120.0 CAM

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, USGS, Map data © OpenStreetMap contributors, Microsoft, Facebook, Google, Esri Community Maps contributors, Map layer by Esri. Data provided by Dept of Housing, Local Government and Heritage under a Creative Commons 4.0

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Appendix 2 Bird Survey Reports

AA Screening and Natura Impact Statement

Muingmore Wind Farm

RWE Renewables Ireland Limited

SLR Project No.: 501.065301.00001

RWE

Ornithology Results Reports for Muingmore Wind Farm, Co. Mayo 2021-2024

EIAR Technical Appendix

Woodrow Ref: P00008408

Date: 05 December 2024

COMMERCIAL IN CONFIDENCE

woodrow
APEM Group

Client:	RWE
Project reference:	P00008408
Date of issue:	5 December 2024
Project Director:	Maeve Maher-McWilliams
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Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Approved by
1	19/06/2024	All	All	QA	EV
1	23/10/2024	All	All	QA	MMW
1	05/12/2024	All	All	Sign-off	MMW

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STATEMENT OF AUTHORITY

This report has been prepared on behalf of RWE by Woodrow Sustainable Solutions Limited, part of the APEM Group (APEM Group Woodrow). Ornithological surveys at the location of the proposed Muingmore Wind Farm were conducted by appropriately experienced surveyors as listed below. This report has been written by Julieta Pedrana, reviewed by Maeve Maher-McWilliams.

Julieta is a Senior Ecologist with APEM Group Woodrow. She has completed a BSc in Biological Science at the University of Mar del Plata, Argentina and a PhD in Conservation Biology at the University of Southern Patagonia, Argentina. From 2017 to 2023, Julieta worked as a Senior Scientist researcher at the National Council of Scientific Research from Argentina at the Department of Environmental Science, National Technological University, Argentina. The main themes of her research have been the application of GIS-based modelling in nature conservation focusing on the predictive models for species occurrence and habitat suitability. She regularly carries out ornithological surveys and compiles ornithological reports, including carrying out Collision Risk Modelling to inform wind farm planning.

This report has been approved by Maeve Maher-McWilliams, Associate Director Ecologist with APEM Group Woodrow. Maeve is an experienced ecologist and has worked for over twelve years on complex environmental impact assessments and mitigation strategies for development projects across Ireland, Northern Ireland, and Scotland. Maeve has been involved in projects across several sectors such as renewable energy; linear infrastructure; flood relief schemes and port developments; tourism and recreation; residential, pharmaceutical and data centre developments. She is proficient in ecological impact assessment and Appropriate Assessment. Maeve's specialism is ornithology.

As required by Charted Institute of Ecology and Environmental Management (CIEEM), all APEM Group Woodrow staff are required to abide by a strict code of professional conduct in all aspects of their work.

QUALIFICATIONS

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ORNITHOLOGICAL SURVEYORS

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1. OVERVIEW

Woodrow APEM Group (hereafter referred to as Woodrow) was commissioned by RWE to undertake ornithological survey work for the proposed Muingmore Wind Farm, Co. Mayo (hereafter referred to as the proposed development site). The proposed development site is for a 14-turbine wind farm, located in northwest Co. Mayo, north of Gweesalia and 1 km from Mullet/Blacksod Bay Complex Special Area of Conservation (SAC).

Survey work at the proposed development site commenced in April 2021. This report presents the methodologies and results of surveys undertaken at the proposed site between April 2021 and March 2024, and that comprise the Year 1, Year 2 and Year 3 surveys. Year 1 surveys were completed between April 2021 and March 2022, Year 2 surveys between April 2022 and March 2023 and Year 3 surveys between April 2023 and March 2024.

A summary of breeding season surveys undertaken included:

- Vantage point (VP) watches
- Breeding bird surveys including:
    - Lowland breeding wader surveys (O'Brien and Smith, 1992)
    - Dusk surveys for crepuscular species (Gilbert *et al*., 1998)
- Breeding raptor surveys

A summary of non-breeding season surveys undertaken included:

- VP watches
- Winter walkover surveys
- Wintering waterbird surveys
- Hen harrier roost searches

This results report is a factual report which presents the survey methodologies and results from Year 1, Year 2 and Year 3 ornithological surveys and includes a discussion on the most sensitive ornithological findings. The report provides the baseline ornithological information required to inform the ornithological impact assessment for the proposed development, and will form a Technical Appendix to the Environmental Impact Assessment Report (EIAR).

2. DESK STUDY

An initial desk-based study of the proposed development site and wider area was compiled to determine the appropriate surveys required to inform any potential for ornithological constraints. A preliminary assessment of avian habitat suitability and availability was undertaken using ortho-imagery and six-inch mapping, which was viewed using Bing Maps, Google Earth Pro, Google Maps, and Ordnance Survey Ireland – GeoHive.

The National Parks and Wildlife Service (NPWS) Designations Viewer was used to identify the location of sites designated for nature conservation, specifically Special Protection Areas (SPAs) and the bird species, Special Conservation Interests (SCIs), for which these sites have been designated. EPA Maps was used to investigate hydrological connectivity to sites designated for nature conservation. SPAs occurring within an indicative distance of 15 km from (or with a hydrological connection to) the proposed development site are listed in Table 1 and Figure 1.

Table 1: SPAs and Special Areas of Conservation (SACs) within 15 km of the proposed development site

Designated site	Distance to the proposed development site	Qualifying Interests/Special Conservation Interests
Special Protection Areas (SPAs)		
Blacksod Bay/Broad Haven SPA (Site code: 004037)	*c.* 1 km west and south	Red-throated diver (*Gavia stellata*) [A001] Great Northern diver (*Gavia immer*) [A003] Slavonian grebe (*Podiceps auritus*) [A007] Light-bellied brent goose (*Branta bernicla hrota*) [A046] Common scoter (*Melanitta nigra*) [A065] Red-breasted merganser (*Mergus serrator*) [A069] Ringed plover (*Charadrius hiaticula*) [A137] Sanderling (*Calidris alba*) [A144] Dunlin (*Calidris alpina*) [A149] Bar-tailed godwit (*Limosa lapponica*) [A157] Curlew (*Numenius arquata*) [A160] Sandwich tern (*Sterna sandvicensis*) [A191] Dunlin (*Calidris alpina schinzii*) [A466] Wetland and waterbirds [A999]
Carrowmore Lake SPA (Site code: 004052)	*c.* 6.5 km north-east	Sandwich tern (*Sterna sandvicensis*) [A191]
Owenduff/Nephin Complex SPA (Site code: 004098)	*c.* 7.5 km south-west	Merlin (*Falco columbarius*) [A098] Golden plover (*Pluvialis apricaria*) [A140]
Mullet Peninsula SPA (Site code: 004227)	*c.* 10.2 km north-west	Corncrake (*Crex crex*) [A122]
Doogort Machair SPA (Site code: 004235)	*c.* 11.5 km south-west	Dunlin (*Calidris alpina schinzii*) [A466]
Termoncarragh Lake and Annagh Machair SPA (Site code: 004093)	*c.* 13.3 km north-west	Whooper swan (*Cygnus cygnus*) [A038] Barnacle goose (*Branta leucopsis*) [A045] Corncrake (*Crex crex*) [A122] Lapwing (*Vanellus vanellus*) [A142] Chough (*Pyrrhocorax pyrrhocorax*) [A346] Greenland white-fronted goose (*Anser albifrons flavirostris*) [A395] Dunlin (*Calidris alpina schinzii*) [A466] Wetland and waterbirds [A999]
Inishglora and Inishkeeragh SPA (Site code: 004084)	*c.* 14.5 km north-west	Storm petrel (*Hydrobates pelagicus*) [A014] Cormorant (*Phalacrocorax carbo*) [A017] Shag (*Phalacrocorax aristotelis*) [A018] Barnacle goose (*Branta leucopsis*) [A045] Lesser black-backed gull (*Larus fuscus*) [A183] Herring gull (*Larus argentatus*) [A184] Arctic tern (*Sterna paradisaea*) [A194]
Special Areas of Conservation (SAC)		
Mullet/Blacksod Bay Complex SAC (Site code: 000470)	*c.* 1 km west	Mudflats and sandflats not covered by seawater at low tide [1140] Large shallow inlets and bays [1160] Reefs [1170] *Salicornia* and other annuals colonising mud and sand [1310] Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120]

Designated site	Distance to the proposed development site	Qualifying Interests/Special Conservation Interests
		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130] Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) [2150] Machairs (* in Ireland) [21A0] Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation [3150] Alkaline fens [7230] *Lutra lutra* (Otter) [1355] *Petalophyllum ralfsii* (Petalwort) [1395]
Carrowmore Lake Complex SAC (Site code: 000476)	*c.* 5.5 km north-east	Blanket bogs (* if active bog) [7130] Depressions on peat substrates of the Rhynchosporion [7150] *Saxifraga hirculus* (Marsh Saxifrage) [1528] *Hamatocaulis vernicosus* (Slender Green Feather-moss) [6216]
Broadhaven Bay SAC (Site code: 000472)	*c.* 6.5 km north	Mudflats and sandflats not covered by seawater at low tide [1140] Large shallow inlets and bays [1160] Reefs [1170] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Submerged or partially submerged sea caves [8330]
Owenduff/Nephin Complex SAC (Site code: 000534)	*c.* 7.5 km south-west	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3110] Natural dystrophic lakes and ponds [3160] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] Northern Atlantic wet heaths with *Erica tetralix* [4010] Alpine and Boreal heaths [4060] *Juniperus communis* formations on heaths or calcareous grasslands [5130] Blanket bogs (* if active bog) [7130] Transition mires and quaking bogs [7140] *Salmo salar* (Salmon) [1106 *Lutra lutra* (Otter) [1355] *Saxifraga hirculus* (Marsh Saxifrage) [1528] *Hamatocaulis vernicosus* (Slender Green Feathermoss) [6216]
Doogort Machair/Lough Doo SAC (Site code: 001497)	*c.* 9 km south-west	Machairs (* in Ireland) [21A0] *Petalophyllum ralfsii* (Petalwort) [1395]
Slieve Fyagh Bog SAC (Site code: 000542)	*c.* 11 km north-east	Blanket bogs (* if active bog) [7130]
Erris Head SAC (Site code: 001501)	*c.* 11 km north-west	Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] Alpine and Boreal heaths [4060]
Croaghaun/Slievemore SAC (Site code: 001955)	*c.* 12.5 km south-west	Northern Atlantic wet heaths with *Erica tetralix* [4010] European dry heaths [4030]

Designated site	Distance to the proposed development site	Qualifying Interests/Special Conservation Interests
		Alpine and Boreal heaths [4060] Blanket bogs (* if active bog) [7130] Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) [8110] Siliceous rocky slopes with chasmophytic vegetation [8220]
West Connacht Coast SAC (Site code: 002998)	*c.* 12.7 km west	*Tursiops truncatus* (Common Bottlenose Dolphin) [1349]
Glenamoy Bog Complex SAC (Site code: 000500)	*c.* 14 km north-east	Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] Machairs (* in Ireland) [21A0] Natural dystrophic lakes and ponds [3160] Northern Atlantic wet heaths with *Erica tetralix* [4010] *Juniperus communis* formations on heaths or calcareous grasslands [5130] Blanket bogs (* if active bog) [7130] Transition mires and quaking bogs [7140] Depressions on peat substrates of the Rhynchosporion [7150] *Salmo salar* (Salmon) [1106] *Petalophyllum ralfsii* (Petalwort) [1395] *Saxifraga hirculus* (Marsh Saxifrage) [1528] *Hamatocaulis vernicosus* (Slender Green Feather-moss) [6216]

Bird records from the last ten years for the 10 km national grid square, F72, encompassing the proposed development site were collated from the National Biodiversity Data Centre (NBDC) database, using the report function on Biodiversity Maps[1] (Balmer *et al*., 2013). Most of these records were based on the Bird Atlas 2007-11 (Balmer *et al*., 2013). A full list of records and their current conservation status from *Birds of Conservation Concern in Ireland 2020-2026* (BoCCI) (Gilbert *et al*., 2021) are listed in **Appendix I**. These records were reviewed to investigate target species potentially occurring within the proposed development site and wider area to inform survey design and identify any potential ornithological constraints. Target species generally focus on red and amber-listed BoCCI. Red-listed species are species of highest conservation concern where the population is rapidly declining in abundance or range, has experienced a historic rapid decline (without recovery) or is globally threatened. Amber-listed species are those with unfavourable European status, occur in internationally important numbers or are moderately declining in abundance or range. A species may also be amber-listed if a population occurs in very small numbers. These historical records and their conservation status (Gilbert *et al.,* 2021) are listed in **Appendix I**.

The NBDC mapping tool was also used to examine other relevant data sets including the BirdWatch Ireland bird sensitivity to wind energy layer as per Mc Guinness *et al.* (2015), though no data was found for the proposed development site.

1 Available at https://maps.biodiversityireland.ie/Map (Accessed: March 2024)

Based on the Scottish Natural Heritage (SNH, 2017) guidelines, migratory populations of wintering geese and swans are considered to be notably sensitive to wind farm developments. As such, to characterise the distribution of these populations, data from recent population monitoring reports have been reviewed, and included:

- Boland and Crowe (2008), Lewis *et al.* (2019a) and Burke *et al.* (2022) for greylag goose *Anser anser* and pink-footed goose *Anser brachyrhynchus* distribution
- Burke *et al.* (2021) for whooper swan *Cygnus cygnus* distribution
- Fox *et al.* (2021) for Greenland white-fronted goose *Anser albifrons flavirostris* distribution.

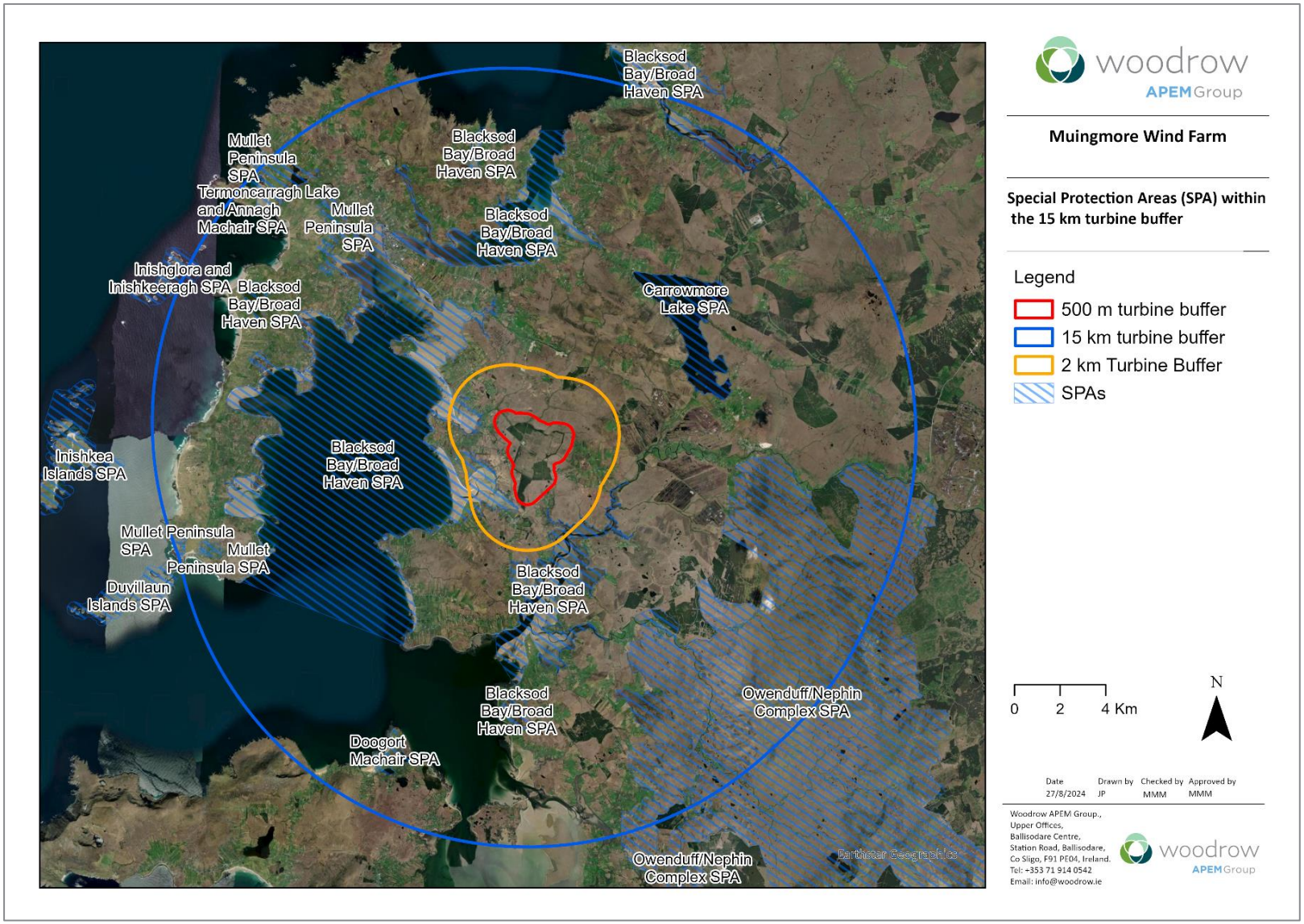

Figure 1: Special Protection Areas (SPAs) within the vicinity of the proposed development site

3. METHODOLOGY

Scottish Natural Heritage (SNH) (2017) guidelines provide recommended survey methodologies for the assessment of avian populations within and adjacent to proposed onshore wind farms. The survey methodologies utilised for ornithological surveys are outlined in the following sections and adhere to the relevant SNH guidance (SNH, 2017).

Two years of ornithological surveys are recommended by the SNH guidelines (SNH, 2017), unless it can be clearly demonstrated that a single year of data is sufficiently robust and appropriate for assessing the potential impacts of the proposal. For the proposed development, three years of ornithological surveys have been undertaken. This is to ensure there is no gap in data collection between the completion of surveys and the submission of a planning application.

3.1. VP watches

VP watches record flight line activity within the survey area, this is a 500 m buffer of the proposed turbine locations, to provide data on selected target species for assessing avian collision risk. Four

VPs were used to cover the proposed development site, and their locations are shown in

Figure **2**.

Target species are those identified as being at risk from displacement effects caused by wind farm developments or from collision with turbines. Target species for which flightline data was captured were as follows:

- Waders and wildfowl (ducks, geese and swans)
- Other waterbirds (including grebes, herons, rails, crakes and gulls)
- Raptors and owls
- Any species listed on Annex I of the Birds Directive, and
- Any species listed as red on the BoCCI (Gilbert *et al*., 2021).

VP watches involve the surveyor observing birds from a stationary position using binoculars and a telescope. In accordance with SNH guidelines (SNH, 2017), the viewshed of the VP is scanned at five-minute intervals. When a target species is seen, the surveyor estimates the height of the bird and its usage of the area by drawing its flight path on a map and noting its behaviour. Flight heights are estimated visually. Other data collected includes the number of birds, time of detection and duration

of flight, as well as sex and age class if determinable. A list of all non-target species encountered within the proposed development site is also compiled during watches, though priority is given to recording target species in the case of busier survey days. To limit observer fatigue, surveyors did not typically undertake VP watches of more than three hours in duration without a break, unless inclement periods of weather meant watches were paused for short durations until conditions improved.

The four selected VPs provide complete coverage (98.35%) of the 500 m turbine buffer of the proposed development, see **Appendix II** for the viewshed map. The VPs selected to cover this survey area are compliant with the SNH guidelines (SNH, 2017), which stipulate that viewsheds from VPs should not extend more than 2 km and that the angle of view should also not extend beyond an arc of 180 degrees. Based on viewsheds extending 2 km, some of the VP viewsheds overlap (see **Appendix II**). Given this overlap, it is acknowledged that the flight seconds reported cumulatively for all the VP watches will provide an overestimate of target species flight times. Conducting VP surveys simultaneously from VPs with overlapping viewsheds was avoided in order to avoid any duplicate records. In the rare case that VP watches were conducted simultaneously for VPs with overlapping viewsheds, surveyors would communicate with one another if a bird was seen flying to/from another viewshed so that the bird was recorded by only one surveyor at any one time. This overlap is also corrected in the collision risk modelling.

In compliance with SNH guidelines (SNH, 2017), for each VP a minimum of 36 hours of observation has been collected during the breeding season and non-breeding season, i.e. a minimum of 72 hours per VP per year. Survey hours completed at each VP location are provided in **Appendix III**.

In addition to the standard 36 hours of VP watches during the breeding and non-breeding seasons, an important consideration for the proposed development, given its location in the north-west of Ireland, is VP coverage during the spring (March to April) and autumn (September to October) passage seasons. Geese, swans and other waterfowl migrate to Ireland for the winter period arriving largely from Iceland, Greenland and Canada. For the Year 1 surveys at the proposed development site, investigative passage VP surveys were undertaken in September and October 2021 at each of the four VP locations lasting 1.5 hours each. In Year 2 and Year 3, a minimum of 18 hours of passage VP surveys were undertaken in the spring and autumn passage season at each of the four VP locations (See **Appendix III** for details). SNH guidelines (SNH, 2017) are not prescriptive on the number of hours required during the passage seasons but should be appropriate and adequate for the site and migration activity.

A summary of VP survey hours completed for each season is provided below.

Table 2: Number of VP watch survey hours during each season

Survey year	Season	VP1	VP2	VP3	VP4
Year 1	Breeding season 2021	38	36	36	36
	Autumn passage season 2021	4.5	4.5	4.5	4.5
	Non-breeding season 2021-22	36	38	36	36
Year 2	Breeding season 2022	36	36	39	36
	Autumn passage season 2022	18	18	18	18
	Non-breeding season 2022-23	36	36	36	36
	Spring passage season 2023	18	18.5	18	18
Year 3	Breeding season 2023	36	39	36	36

	Autumn passage season 2023	18	18	18	20.8
	Non-breeding season 2023-24	35.5	36	37	36
	Spring passage season 2024	21	18	18	18

3.2. Breeding bird surveys

The purpose of the breeding season walkovers, according to SNH guidelines (SNH, 2017), is to give a broad overview of bird activity in the survey area using a route which is representative of the important ornithological features and habitats present within the proposed development site (SNH, 2017). Breeding bird surveys aim to provide information on the distribution of breeding birds occurring within the proposed development site, highlighting the locations of potentially sensitive species which may present an ecological constraint. The survey area for breeding bird surveys included a 500 m buffer of the proposed turbine locations, shown at

Figure **2**. Walkovers surveys employed a variety of survey techniques depending on the habitat suitability and target species likely to be present.

Lowland breeding wader surveys followed the survey technique by O'Brien and Smith (1992). A minimum of three visits were undertaken in each breeding season between April and June. One visit may comprise one survey which covers the entire survey area or a number of surveys covering different areas of the survey area undertaken over consecutive days. An exception to this was in Year 2, during the 2022 breeding season, where one visit was completed over three consecutive dates. This visit was however supplemented with four dusk visits. Surveyors walked open habitats occurring within the survey area which extended to covering suitable habitats within 800 m of the proposed turbine locations for breeding curlew *Numenius arquata*. During these walkover surveys, all other bird species encountered were also noted, along with their behaviour to indicate breeding status. Observations were recorded using the ESRI application Survey123.

To record crepuscular species, such as breeding snipe, surveys running from dawn to three hours after or from late afternoon to dusk were employed to increase the chances of detecting breeding behaviour, including chipping, or drumming snipe (O'Brien & Smith, 1992). As for the above walkover surveys, one visit may comprise one survey which covers the entire survey area or a number of surveys covering different areas of the survey area undertaken over consecutive days. One dusk visit was completed during the 2021 breeding season, three dusk visits were completed during the 2022 breeding season and five dusk visits were completed during the 2023 breeding season. During dusk surveys, surveyors also listened for other crepuscular and nocturnal species, including woodcock and owls.

A summary of breeding bird surveys completed for each season is provided below. Survey dates, times and weather conditions of the walkover and dusk survey is provided in **Appendix IV.**

Table 3: Breeding bird survey visits during each season

Survey year	Season	Survey type	Survey dates
Year 1	Breeding season 2021	Walkover	12/05/2021
		Walkover	17/05/2021
		Walkover	15/06/2021
		Dusk	28/06/2021
Year 2	Breeding season 2022	Walkover	24/06/2022
		Walkover	25/06/2022
		Walkover	26/06/2022
		Dusk	16/05/2022
		Dusk	02/06/2022, 06/06/2022
		Dusk	19/07/2022
Year 3	Breeding season 2023	Walkover	06/04/2023, 07/04/2023, 11/04/2023
		Walkover	06/05/2023, 07/05/2023, 08/05/2023
		Walkover	11/06/2023, 12/06/2023, 13/06/2023
		Walkover	20/06/2023
		Dusk	06/04/2023, 08/04/2023
		Dusk	05/05/2023, 06/05/2023, 08/05/2023
		Dusk	05/06/2023
		Dusk	10/06/2023
		Dusk	09/08/2023

3.3. Breeding raptor surveys

SNH guidelines (SNH, 2017) recommend surveying the wider area (hinterland) for up to 2 km from the proposed turbines for most breeding raptor species, including hen harrier *Circus cyaneus* and merlin *Falco columbarius*. This can be extended if the proposed development site lies within the potential zone of influence SPAs (SNH, 2016). In this instance, the proposed development site is not near any SPAs designated for raptors and the 2 km survey area was considered appropriate, see Figure 3.

A combination of mini-VPs, as well as driven and walked transects were used to search potential nesting habitats within the hinterland over the 2021, 2022 and 2023 breeding seasons. Survey methods for breeding raptors follow those outlined in Hardey *et al*. (2013). A total of two visits were carried out during the 2021 breeding season, one visit during the 2022 breeding season, and four visits during the 2023 breeding season. A summary of breeding raptor surveys completed for each season is provided below, and the survey dates, times and weather conditions are detailed in **Appendix V.**

Table 4: Breeding raptor survey visits during each season

Survey year	Season	Survey dates
Year 1	Breeding season 2021	31/05/2021
		01/06/2021
Year 2	Breeding season 2022	13/06/2022
Year 3	Breeding season 2023	28/03/2023
		09/04/2023, 10/04/2023
		11/06/2023, 12/06/2023, 13/06/2023, 14/06/2023
		11/07/2023

3.4. Winter walkover surveys

Winter walkover surveys aim to provide information on the distribution of birds wintering throughout the proposed development site and 500 m turbine buffer, highlighting the locations of sensitive species to be flagged as ecological constraints. Winter walkovers are important in providing context to VP watch data and facilitating validation of bird numbers utilising the proposed development site.

Winter walkovers of the proposed development site were undertaken during the Year 1 (non-breeding season 2021-22), Year 2 (non-breeding season 2022-23) and Year 3 (non-breeding season 2023-24) non-breeding seasons. Surveyors walked the survey area noting down all species encountered, ensuring to cover a sample of all habitats present. As such, winter walkovers provide useful information on the distribution of winter bird species within the proposed development site and how they are using each habitat type. A summary of breeding raptor surveys completed for each season is provided below, and the dates times and weather conditions are detailed in **Appendix VI.**

Table 5: Winter walkover survey visits during each season

Survey year	Season	Survey dates
Year 1	Non-breeding season 2021-22	28/10/2021, 31/10/2021
		11/01/2022, 12/01/2022

Survey year	Season	Survey dates
		23/02/2022, 28/02/2022
Year 2	Non-breeding season 2022-23	11/10/2022, 12/10/2022, 14/10/2022, 16/10/2022
		08/11/2022, 09/11/2022, 11/11/2022, 12/11/2022, 14/11/2022
		24/02/2023
Year 3	Non-breeding season 2023-24	15/10/2023, 16/10/2023
		07/11/2023, 08/11/2023
		11/01/2024, 18/01/2024

3.5. Wintering waterbird surveys

In assessing the impact of the proposed development site, it is important to provide contextual data on the numbers of waterbirds in the wider area relative to the usage of the proposed development site by these species. SNH guidelines (SNH, 2017) advise fortnightly monitoring of swan and geese foraging and roosting locations when occurring in the environs of the site (as detailed in Gilbert *et al*., 1998), and specifically where SPAs are designated for these species. Survey areas of up to 500 m from the proposed development site for foraging locations and up to 6 km from the site for roost locations are recommended, although this may be extended where high levels of activity are anticipated (Figure 3).

In Ireland, swan and goose distribution is not well documented beyond designated sites. In addition, many wintering waterbirds occur outside of SPAs. As such, the number of survey visits undertaken was subject to the level of waterbird activity recorded within the proposed development and wider area. The surveys were based on the approach employed by BirdWatch Ireland's Irish Wetland Bird Surveys (I-WeBS) and the survey area was extended up to 6 km from the proposed development to cover turloughs and loughs in the wider area which were considered suitable for foraging and roosting wintering waterbirds Figure 3.

SNH guidelines recommend that core foraging ranges of species should be examined to assess connectivity between the site and surrounding SPAs (SNH, 2016 and 2017). As detailed in Section 2, the closest SPA to the survey area is Blacksod Bay/Broad Haven SPA (site code: 004037), see Figure 1, which lies 1 km west. This site is of high ornithological importance for its excellent diversity of wintering waterbirds, including internationally important populations of great northern diver *Gavia immer* and light-bellied brent goose *Branta bernicla hrota*, and nationally important populations of nine other species. Of particular note is the usage of the site by over 20% of the all-Ireland populations of great northern diver and common scoter *Melanitta nigra*. It is also a nationally important breeding site for sandwich tern *Sterna sandvicensis* and dunlin *Calidris alpina*. Eight of the species that occur regularly are listed in Annex I of the EU Birds Directive, i.e. great northern diver, red-throated diver *Gavia stellata*, golden plover *Pluvialis apricaria*, bar-tailed godwit *Limosa lapponica*, sandwich tern, common tern *Sterna hirundo* and arctic tern *Sterna paradisaea.* Blacksod Bay and Broad Haven is a Ramsar Convention site.

To determine the density of use by wintering bird populations, and especially to identify any foraging or roosting sites for swans and geese, point count surveys (following those employed for I-

WebS) were undertaken to survey all publicly accessible/viewable bogs, ponds, canals, rivers and other wetland habitats within the wider area of the proposed wind farm, as shown at Figure 3.

A summary of wintering waterbird surveys completed for each season is provided below, and the dates times and weather conditions are detailed in **Appendix VII.** Surveys focussed on waterbirds, other target species, notably raptors, present during the surveys were also recorded.

Table 6: Wintering waterbird survey visits during each season

Survey year	Season	Survey dates
Year 1	Non-breeding season 2021-22	27/10/2021, 31/10/2021
		15/11/2021
		30/11/2021
		09/12/2021, 12/12/2021
		17/01/2022
		31/01/2022, 01/02/2022
		09/02/2022, 15/02/2022
		17/03/2022
Year 2	Non-breeding season 2022-23	15/10/2022
		12/11/2022, 17/11/2022
		06/12/2022, 08/12/2022, 09/12/2022, 11/12/2022
		21/01/2023, 22/01/2023, 25/01/2023
		20/02/2023, 23/02/2023
		04/03/2023, 06/03/2023
Year 3	Non-breeding season 2023-24	15/10/2023, 16/10/2023
		03/11/2023, 06/11/2023
		31/12/2023
		16/01/2024
		05/03/2024
		22/03/2024, 25/03/2024

3.6. Bioacoustic Monitoring

As mentioned under the VP watch methodology, the location of the proposed development site in the north-west of Ireland is an important consideration for the survey design to ensure surveys adequately cover migratory species. In addition, the proximity of Blacksod Bay/Broad Haven SPA and Carrowmore Lake SPA has been a consideration in determining the need for bioacoustic monitoring of night-time flights at the proposed development site. Due to these factors, it was deemed judicious to use bioacoustic monitoring equipment to supplement day-time VP watches which would not capture the occurrence of waterbird flights at night. Bioacoustic monitoring does not provide data on the abundance of species, however it does confirm the presence or absence of species.

In Year 2, two bioacoustic monitors, SongMeter-Minis, were deployed with an acoustic microphone set to record the bird calls. The deployment was made in the spring passage season between March and April 2023. In Year 3, three bioacoustic monitors were deployed during the spring passage season between February and April 2024. Monitoring was repeated at two locations with a third location added in Year 3. The bioacoustic monitor locations aimed to cover a geographical spread

across the survey area and to detect birds flying from the north, west and east where waterbodies and features potentially used by waterbirds exist in the wider area. The bioacoustic monitors were placed in open habitats to reduce any noise interference with trees or other structures. Detectors were set to record between 2 hours before sunset to 3 hours after sunset, and between 3 hours before sunrise to 2 hours after sunrise.

Table 7: Bioacoustic detector locations and deployment periods

Survey year	Season	Monitoring unit no.	Location	Deployment period
Year 2	Spring passage	WSS049	54.151324, -9.906162	13/03/2023-11/04/2023
		WSS045	54.136525, -9.892722	13/03/2023-11/04/2023
Year 3	Spring passage	WSS050	54.151324, -9.906162	13/02/2024 - 13/04/2024
		WSS042	54.136525, -9.892722	13/02/2024 - 13/04/2024
		WSS049	54.146473, -9.874215	13/02/2024 - 27/03/2024

Before analysis, sound classifiers were constructed for each target species (raptors and waterbirds), facilitating automated scanning of the data for calls specific to each species. Data analysis was undertaken by a suitably trained ecologist.

Across the two years of bioacoustic monitor there was a total of 1294hrs of sound data analysed using Kaleidoscope Pro. A cluster analysis was performed using the following settings for the target species: F(min) = 500Hz; F(max) = 5000Hz; Length(min) = 0.1s; Length(max) = 7.5s; and, Inter-syllable gap = 0.35s.

3.7. Hen harrier roost searches

SNH guidance (SNH, 2017) stipulates that surveying for communal raptor roosts, including those of hen harriers, roost sites within 2 km of a proposed development site should be identified (see Figure 3 for the survey areas).

With respect to the proposed development, the approach to surveying for hen harrier roosts was determined by two factors:

- Availability of potentially suitable roosting habitat in the vicinity of the proposed development, as described by Clarke and Watson (1990) and in the Irish national hen harrier winter roost survey guidelines (O'Donoghue, 2012 and 2019); and
- Hen harrier activity observed during VP watches, site walkovers and wider area surveys.

SNH (2017) defers to Hardey *et al*. (2013) for specific roost survey methodology, requiring surveyors to employ professional judgement in identifying and targeting potential roosts based on observed flight activity within or adjacent to the proposed development. Hardey *et al.* (2013) recommend locating birds in the late afternoon and then attempting to track them back to roosts. O'Donoghue (2019) notes that the best time to conduct a roost watch is at least 30 minutes before sunset until dark or 30 minutes before sunrise until at least 30 minutes after sunrise.

A total of four roost watches were carried out during the 2021-22 non-breeding season, 12 roost watches during the 2022-23 non-breeding season, and four during the 2023-24 non-breeding season. A summary of surveys completed for each season is provided below, and the dates, times and weather conditions are detailed in **Appendix VIII**.

Table 8: Hen harrier roost searches during each season

Survey year	Season	Survey dates
Year 1	Non-breeding season 2021-22	27/10/2021

Survey year	Season	Survey dates
		15/11/2021
		17/12/2021
		27/01/2022
Year 2	Non-breeding season 2022-23	12/10/2022
		14/10/2022
		19/10/2022
		09/11/2022
		13/11/2022
		14/11/2022
		21/01/2023
		29/01/2023
		30/01/2023
		23/02/2023
		02/03/2023
		05/03/2023
Year 3	Non-breeding season 2023-24	08/01/2024
		10/01/2024
		16/01/2024
		27/02/2024

3.8. Survey limitations

Survey limitations included the following:

- The number of breeding walkover and dusk surveys recommended by SNH (SNH, 2017) were not accomplished in the 2021 and 2022 breeding seasons
- The number of breeding raptor surveys recommended by SNH (SNH, 2017) were not accomplished in the 2021 and 2022 breeding seasons
- Access to the full ornithological survey area for walkover surveys could only be undertaken on lands where permission had been granted.
- During the Year 1 autumn passaging season, 4.5 hours per VP location were completed. These surveys were investigative to understand the usage of the area by migratory species. While SNH (2017) guidelines are not prescriptive, a greater survey effort will be undertaken in following passage seasons to gather more information.

Despite the limitations mentioned above, it is considered that the surveys carried out in Year 1, Year 2 and Year 3 provide sufficient data to identify any ornithological constraints and provide a robust data set for the purposed of an ornithological impact assessment for the proposed development.

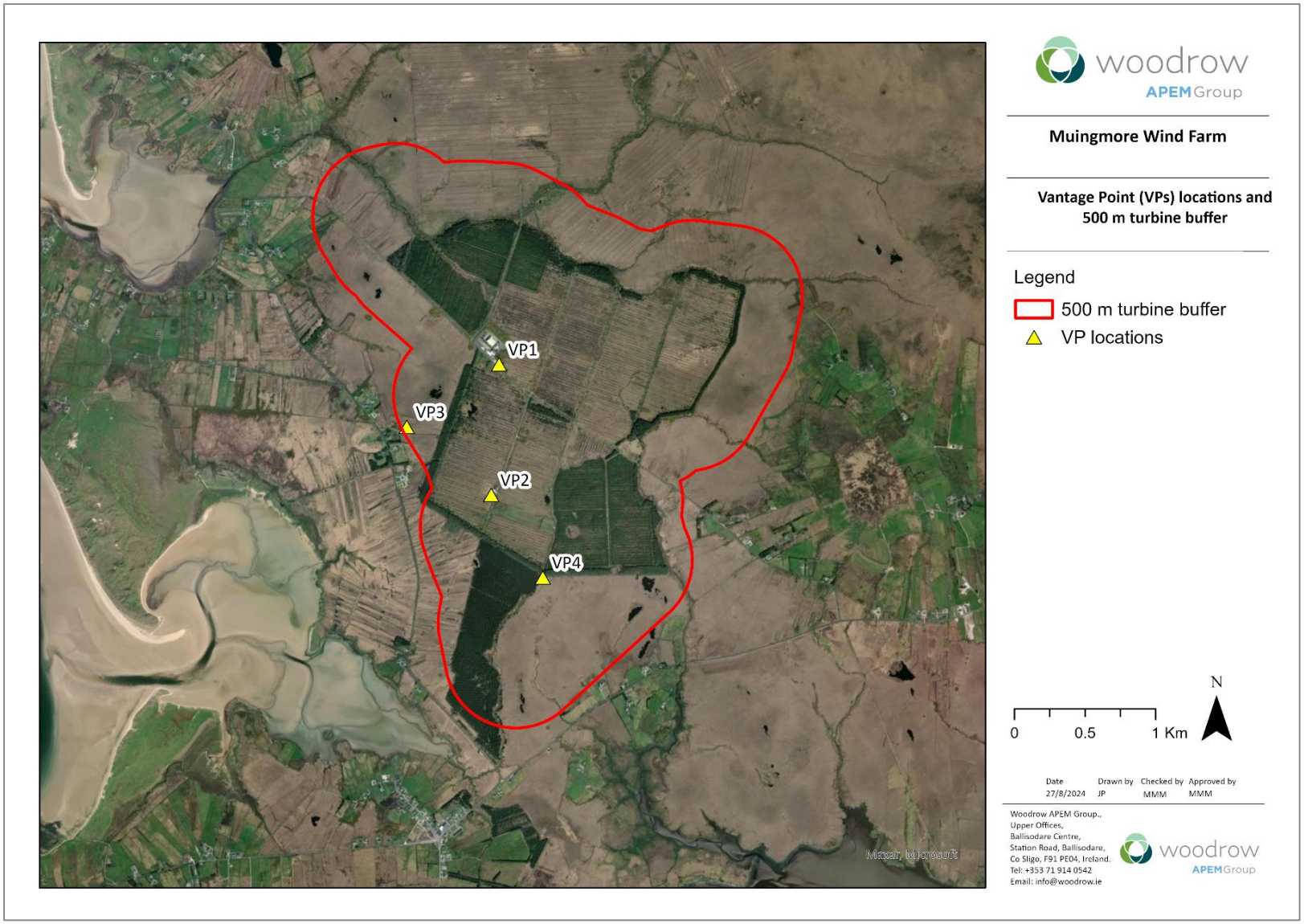

Figure 2: 500 m turbine buffer for VP watches, breeding bird surveys and winter walkover surveys

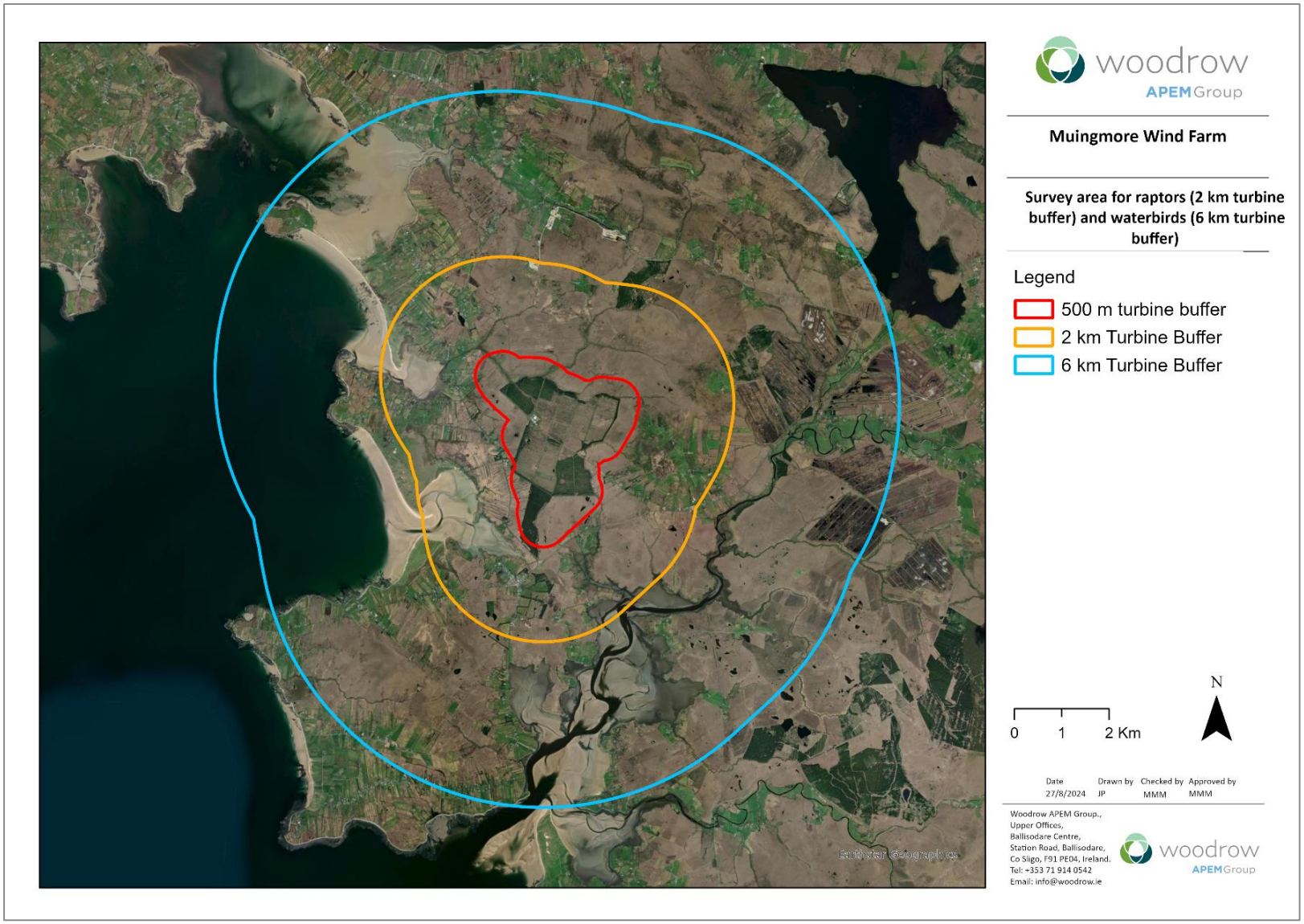

Figure 3: Survey area for breeding raptors and hen harrier roost searches (2 km turbine buffer) and for wintering waterbird surveys (6 km turbine buffer)

4. SURVEY RESULTS

4.1. VP watches

A total of 33 target species were recorded during VP watches over three years of surveys between April 2021 and March 2024. Flight times for target species recorded within the 500 m turbine buffer over three years of surveys are provided in

Table 9. Flightline maps are provided in **Appendix IX**, where individual flightlines shown on the maps can be cross-referenced via identification numbers to additional data on flight behaviour within attribute tables. To examine seasonal or annual variation in the occurrence of target species, the flight time data has been presented by the year:

- Year 1 - 2021 breeding season data (Table 10), 2021 autumn passage season data (Table 11), and 2021-22 non-breeding season data (Table 12)
- Year 2 - 2022 breeding season data (Table 13), 2022 autumn passage season data (Table 14), 2022-23 non-breeding season data (Table 15), and 2023 spring passage season data (Table 16)
- Year 3 - 2023 breeding season data (Table 17), the 2023 autumn passage season data (Table 18), 2023-24 non-breeding season data (Table 19) and 2024 spring passage season data (Table 20)

Flight time is split into time in different altitudinal levels to better understand the extent to which target species fly within the Collision Risk Zone (CRZ). The flight height range of the CRZ was defined as 10 to 150 m, a precautionary range based on the lowest minimum rotor swept height and highest tip height for the proposed turbine specifications.

A total of 11 species, which are highlighted in

Table 9, were identified as having flight times greater than 1,000 seconds within the CRZ. Generally, Collision Risk Modelling (CRM) is run for target species with a total aggregate flight time (i.e. number of individuals x flight time) of greater than 1,000 seconds within the CRZ, over a three-year study period. These species included:

- Four gull species (black-headed gull *Larus ridibundus*, great black-backed gull *Larus marinus*, herring gull *Larus argentatus*, and lesser black-backed gull *Larus fuscus*)
- Three raptor species (buzzard *Buteo buteo*, kestrel *Falco tinnunculus*, and sparrowhawk *Accipiter nisus*)
- Two wader species (snipe *Gallinago gallinago* and Wilson's phalarope *Phalaropus tricolor*), and
- Two other waterbird species (grey heron *Ardea cinerea* and greylag goose).

Table 9: Overall target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer between April 2021 and May 2024

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Black-headed gull	3	71	2,852	3,537	-	6,389
Buzzard	2	9	-	741	310-	1,051
Canada goose	1	1	-	50	-	50
Common gull	2	6	-	699	-	699

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Common tern	1	2	-	54	-	54
Cormorant	1	5	-	510	-	510
Curlew	2	1	-	-	-	-
Golden plover	3	1	-	36	-	36
Great black-backed gull	4	65	9	6,654	-	6,663
Greenshank	1	1	-	20	-	20
Grey heron	3	36	421	1,105	300	1,826
Greylag goose	17	1	-	4,335	-	4,335
Gull sp.	4	8	-	443	-	443
Hen harrier	1	9	850	265	-	1115
Herring gull	5	64	23	2,650	-	2,673
Hobby	1	3	50	240	-	290
Kestrel	4	192	864	14,977	2,060	17,901
Kittiwake	1	1	-	40	-	40
Lapwing	3	1	-	222	-	222
Lesser black-backed gull	5	91	306	8,452	-	8,758
Mallard	4	25	107	1070	-	1,177
Meadow pipit	7	7	70	78	-	148
Merlin	1	5	88	26	-	114
Mistle thrush	6	1	-	210	-	210
Peregrine	1	11	-	465	-	465
Pheasant	1	2	22	-	-	22
Raptor Sp.	1	1	-	30	-	30
Snipe	27	22	5	2,153	-	2,158
Sparrowhawk	2	80	756	5,588	-	6,359
Swift	1	1	-	12	-	12
Teal	5	3	40	87	-	127
Whimbrel	7	1	-	-	945	945
Whooper swan	5	3	-	1,125	-	1,125
Wilson's phalarope	18	1	-	1,080	-	1,080
Woodcock	1	4	14	21	-	35

Table 10: 2021 breeding season target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Black-headed gull	2	47	332	2,087	-	2,419
Buzzard	1	1	-	53	-	53
Common gull	2	1	-	580	-	580
Great black-backed gull	1	11	-	765	-	765
Grey heron	1	7	119	143	-	262
Herring gull	2	16	-	576	-	576
Kestrel	2	48	430	3,349	-	3,779

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Lesser black-backed gull	3	53	171	2,856	-	3,027
Mallard	1	4	44	46	-	90
Pheasant	1	1	12	-	-	12
Sparrowhawk	1	1	14	-	-	14
Teal	1	1	-	12	-	12

Table 11: 2021 autumn passage season target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Kestrel	1	1	-	134	-	134
Pheasant	1	1	10	-	-	10
Sparrowhawk	2	13	393	1,328	-	1,721

Table 12: 2021-22 non-breeding season target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Great black-backed gull	2	10	-	490	-	490
Grey heron	3	6	47	244	-	291
Kestrel	1	15	-	470	-	470
Lapwing	3	1	-	222	-	222
Merlin	1	1	-	26	-	26
Snipe	1	5	5	45	-	50
Sparrowhawk	2	23	15	963	-	978
Whooper swan	3	1	-	120	-	120
Woodcock	1	4	14	21	-	35

Table 13: 2022 breeding season target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Black-headed gull	3	6	-	510	-	510
Buzzard	2	6	-	938	-	938
Common tern	1	2	-	54	-	54
Great black-backed gull	2	10	-	360	-	360
Grey heron	1	7	10	180	180	370
Gull Sp.	4	7	-	418	-	418
Hen harrier	1	2	-	225	-	225
Herring gull	2	29	23	813	-	836
Hobby	1	3	50	240	-	290
Kestrel	4	32	-	5,632	700	6,332
Lesser black-backed gull	2	10	45	522	-	567
Mallard	2	8	-	278	-	278

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Meadow pipit	7	3	70	10	-	80
Raptor sp.	1	1	-	30	-	30
Sparrowhawk	1	1	-	30	-	30

Table 14: 2022 autumn passage season target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Black-headed gull	2	2	-	75	-	75
Cormorant	1	3	-	230	-	230
Curlew	2	1	-	-	-	-
Great black-backed gull	1	1	-	270	-	270
Grey heron	1	1	-	120	-	120
Herring gull	1	2	-	135	-	135
Kestrel	2	7	345	200	-	545
Peregrine	1	4	-	245	-	245
Snipe	27	4	-	1,475	-	1,475
Sparrowhawk	2	3	35	175	-	210

Table 15: 2022-23 non-breeding season target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Black-headed gull	1	1	-	25	-	25
Buzzard	1	2	-	60	-	60
Common gull	2	2	-	-	-	-
Cormorant	1	1	-	165	-	165
Great black-backed gull	3	8	-	1,985	-	1,985
Greenshank	1	1	-	20	-	20
Grey heron	1	2	120	40	-	160
Hen harrier	1	3	450	40	-	490
Kestrel	2	8	55	1,010	-	1,065
Lesser black-backed gull	2	1	-	250	-	250
Mallard	4	2	45	40	-	85
Merlin	1	1	30	-	-	30
Peregrine	1	4	-	145	-	145
Snipe	2	4	-	365	-	365
Sparrowhawk	2	12	110	1,575	-	1,685
Whooper swan	5	1	-	875	-	875
Wilson's phalarope	18	1	-	1,080	-	1,080

Table 16: 2023 spring passage season target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Cormorant	1	1	-	115	-	115
Great black-backed gull	4	10	-	1,484	-	1,484
Grey heron	1	6	125	215	-	340
Greylag goose	17	1	-	4,335	-	4,335
Hen harrier	1	1	160	-	-	160
Herring gull	1	2	-	95	-	95
Kestrel	2	12	-	760	-	760
Kittiwake	1	1	-	40	-	40
Lesser black-backed gull	3	2	90	75	-	165
Mallard	4	2	10	400	-	410
Merlin	1	2	23	-	-	23
Sparrowhawk	1	6	85	1,125	-	1,210
Teal	2	1	40	-	-	40

Table 17: 2023 breeding season target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10- 150 m	C >150 m	Total
Black-headed gull	2	13	2,520	696	-	3,216
Canada goose	1	1	-	50	-	50
Common gull	1	2	-	109	-	109
Golden plover	3	1	-	36	-	36
Great black-backed gull	2	10	-	1,025	-	1,025
Grey heron	1	2	-	45	-	45
Gull Sp.	1	1	-	25	-	25
Herring gull	5	12	-	891	-	891
Kestrel	2	39	-	3,474	-	3,474
Lesser black-backed gull	2	10	-	1,608	-	1,608
Mallard	2	2	-	40	-	40
Meadow pipit	4	4	-	68	-	68
Mistle thrush	6	1	-	210	-	210
Snipe	2	7	-	200	-	200
Sparrowhawk	1	13	60	200	-	260
Swift	1	1	-	12	-	12
Teal	5	1	-	75	-	75
Whimbrel	7	1	-	-	945	945

Table 18: 2023 autumn passage season target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Black-headed gull	1	1	-	20	-	20
Grey heron	1	1	-	15	-	15
Hen harrier	1	1	40	-	-	40

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Herring gull	1	2	-	95	-	95
Kestrel	1	5	5	105	-	110
Lesser black-backed gull	1	4	-	350	-	350
Snipe	2	2	-	68	-	68
Sparrowhawk	1	1	15	-	-	15

Table 19: 2023-24 non-breeding season target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Common gull	1	1	-	10	-	10
Great black-backed gull	2	3	-	275	-	275
Hen harrier	1	1	20	-	-	20
Kestrel	2	6	-	340	-	340
Lesser black-backed gull	1	1	-	30	-	30
Mallard	2	1	-	60	-	60
Merlin	1	1	35	-	-	35
Sparrowhawk	1	2	15	-	-	15

Table 20: 2024 spring passage season target species flight time, number of flights and the maximum number of individuals observed at any one time within the 500 m turbine buffer

Target species	Max no. birds	No. observations	Flight time (seconds) in height bands			
			A 0-10 m	B 10-150 m	C >150 m	Total
Black-headed gull	1	1	-	124	-	124
Great black-backed gull	1	2	9	-	-	9
Grey heron	1	4	-	223	-	223
Hen harrier	1	1	180	-	-	180
Herring gull	1	1	-	45	-	45
Kestrel	2	19	29	863	-	892
Lesser black-backed gull	5	10	-	2,761	-	2,761
Mallard	4	6	8	206	-	214
Peregrine	1	3	-	75	-	75
Sparrowhawk	1	5	29	192	-	221
Whooper swan	1	1	-	130	-	130

4.2. Breeding bird surveys

4.2.1. Breeding season 2021

Breeding bird walkovers including dusk surveys covering the proposed development site were undertaken between May and June 2021. A total of 38 different bird species were recorded during these surveys. Table 21 lists red and amber-listed species recorded, the number of individuals recorded and their breeding status within the 500 m turbine buffer. Figure 4 and Figure 5 show the

locations of red and amber-listed birds recorded during the 2021 breeding season, respectively. A list of all species recorded, including green-listed species, is provided in **Appendix X**.

Table 21: Summary of breeding bird walkover and dusk surveys carried out during the 2021 breeding season

Species	BTO code	No. individuals			BoCCI 2020-2026	Breeding status within 500 m turbine buffer
		Visit 1	Visit 2	Visit 3		
Kestrel	K	2	1	-	Red	A breeding pair of kestrels has been confirmed within the existing buildings in the central area of the site
Meadow pipit	MP	-	-	30	Red	Breeding in suitable habitats within the 500 m turbine buffer
Snipe	SN	2	1	-	Red	Snipe were recorded chipping and drumming to the north-west and south-east of the 500 m turbine buffer
Black-headed gull	BH	-		4	Amber	Not breeding within the 500 m turbine buffer
Goldcrest	GC	-	4	2	Amber	Breeding in suitable forestry habitat within the 500 m turbine buffer
Lesser black-backed gull	LB	1	5	-	Amber	Five observations were recorded in the central part of the site. One potential breeding territory within the 500 m turbine buffer
Mallard	MA	5	-	-	Amber	Likely breeding in a small waterbody in the west within the 500 m turbine buffer
Skylark	S	-	2	2	Amber	Breeding in suitable habitat within the 500 m turbine buffer
Starling	SG	2		-	Amber	One observation recorded near the buildings located in the central part of the site
Swallow	SL	2	3	-	Amber	Two observations were recorded in the north and central parts of the 500 m turbine buffer. Likely to breed in the north of the site where suitable habitats are present, although no nesting site is located
Teal	T	1	2	-	Amber	Two observations were recorded one in a small waterbody in the west and another in a small waterbody in the south within the 500 m turbine buffer. No breeding site was located
Willow warbler	WW	2	13	14	Amber	Breeding in suitable woodland and scrub habitat within the 500 m turbine buffer and wider area

4.2.2. Breeding season 2022

A total of 27 different bird species were recorded during the 2022 breeding bird surveys. Table 22 lists the species, the number of individuals recorded on each visit and the BoCCI conservation status following Gilbert *et al*. (2021). The breeding status of each species within the 500 m turbine buffer is also provided in this table. Figure 6 and Figure 7 show the locations of red and amber-listed birds recorded during the 2022 breeding bird surveys, respectively. A list of all species recorded, including green-listed species, is provided in **Appendix X**.

Table 22: Summary of breeding bird walkover and dusk surveys carried out during the 2022 breeding season

Species	BTO code	No. individuals	BoCCI 2020-2026	Breeding status within 500 m turbine buffer
		Visit 1		
Kestrel	K.	2	Red	A breeding pair of kestrel was confirmed in the central area of the site, as it was recorded in the previous breeding season
Meadow pipit	MP	45	Red	Breeding in suitable habitat within the 500 m turbine buffer
Snipe	SN	1	Red	Snipe were recorded chipping and drumming to the south-east of the 500 m turbine buffer
Black-headed gull	BH	6	Amber	Not breeding within the 500 m turbine buffer
Herring gull	HG	1	Amber	Not breeding within the 500 m turbine buffer
Lesser black-backed gull	LB	1	Amber	Not breeding within the 500 m turbine buffer
Skylark	S.	4	Amber	Breeding in suitable habitat within the 500 m turbine buffer
Starling	SG	12	Amber	One observation with 12 individuals was recorded in the north-east side of the site. No breeding behaviour was recorded
Swallow	SL	12	Amber	One observation with 12 individuals was recorded in the central part of the site. No breeding site was located
Willow warbler	WW	12	Amber	Breeding in suitable woodland and scrub habitat within the 500 m turbine buffer and wider area

4.2.3. Breeding season 2023

A total of 41 different bird species were recorded during the 2023 breeding bird surveys. Table 23 lists the species, the number of individuals recorded on each visit and the BoCCI conservation status following Gilbert *et al*. (2021). The breeding status of each species within the 500 m turbine buffer is also provided in this table. Figure 8 and Figure 9 show the locations of red and amber-listed birds recorded during the 2023 breeding bird surveys, respectively. A list of all species recorded, including green-listed species, is provided in **Appendix X**.

Table 23: Summary of breeding bird walkover and dusk surveys carried out during the 2023 breeding season

Species	BTO code	No. individuals				BoCCI 2020-2026	Breeding status within 500m turbine buffer
		Visit 1	Visit 2	Visit 3	Visit 4		
Kestrel	K.	-	-	4	-	Red	A breeding pair of kestrel was confirmed in the central area of the site, as it was recorded in the two previous breeding seasons
Meadow pipit	MP	56	26	38	18	Red	Breeding in suitable habitat within the 500 m turbine buffer
Snipe	SN	11	1	-	3	Red	Snipe were recorded chipping and drumming to south-east of the 500 m turbine buffer
Goldcrest	GC	19	28	28	8	Amber	Breeding in suitable forestry habitat within the 500 m turbine buffer, which is consistent with breeding territory locations recorded during the 2021 breeding season
House sparrow	HS	-	2	-	-	Amber	One observation with two individuals was recorded. No breeding behaviour was noted
Linnet	LI	-	-	2	-	Amber	One observation with two individuals was recorded. No breeding behaviour was noted
Mallard	MA	5	-	1	-	Amber	All flying individuals. No breeding site was recorded
Sand martin	SM	-	2	-	-	Amber	A couple was recorded feeding in a pasture in the north-west of the site. No breeding colonies were located
Skylark	S.	12	26	24	4	Amber	Breeding in suitable habitat within the 500 m turbine buffer
Starling	SG	6	-	-	-	Amber	Two observations with 6 and 4 individuals were recorded in the central part of the site. No breeding behaviour was recorded
Swallow	SL	2	18	7	3	Amber	Likely breeding in suitable structures in the central part of the site within the 500 m turbine buffer and wider area
Teal	T.	2	-	1	-	Amber	Two observations were recorded in a small waterbody in the south within the 500 m turbine buffer. No breeding site was located
Willow warbler	WW	25	53	48	4	Amber	Breeding in suitable woodland and scrub habitat within the 500 m turbine buffer and wider area

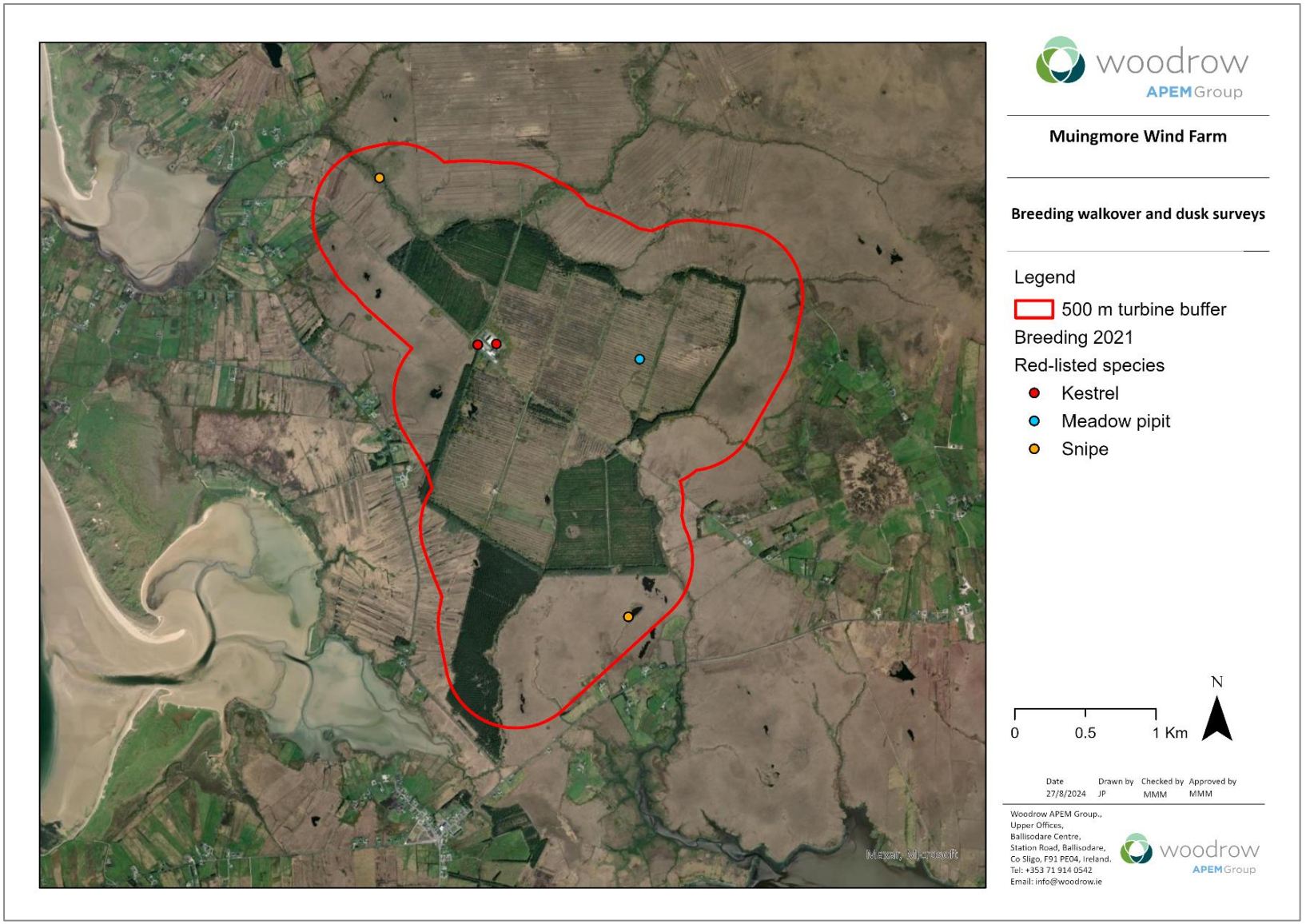

Figure 4: Red-listed species recorded during the 2021 breeding bird surveys within 500 m turbine buffer

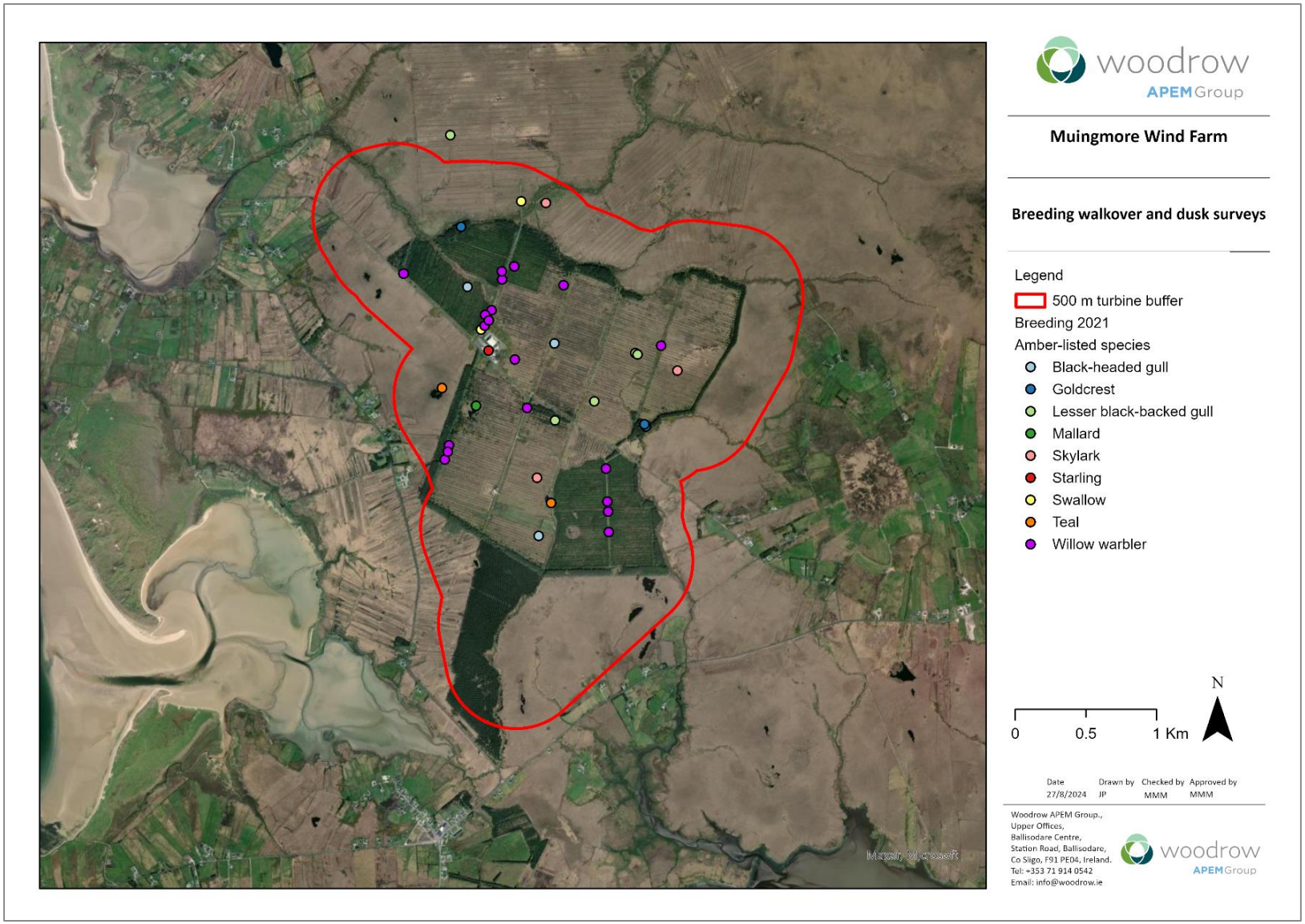

Figure 5: Amber-listed species recorded during the 2021 breeding bird surveys within 500 m turbine buffer

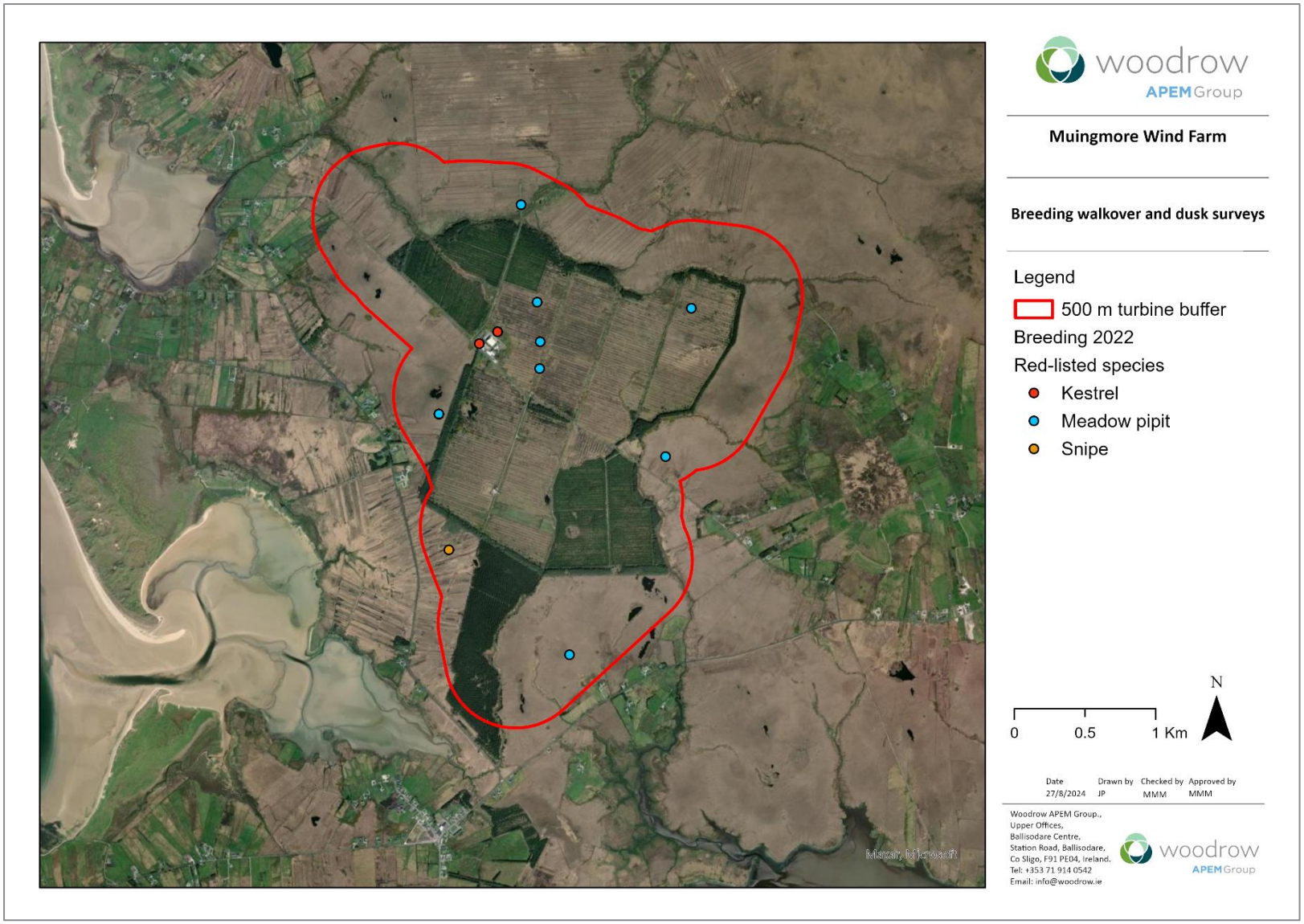

Figure 6: Red-listed species recorded during the 2022 breeding bird surveys within 500 m turbine buffer

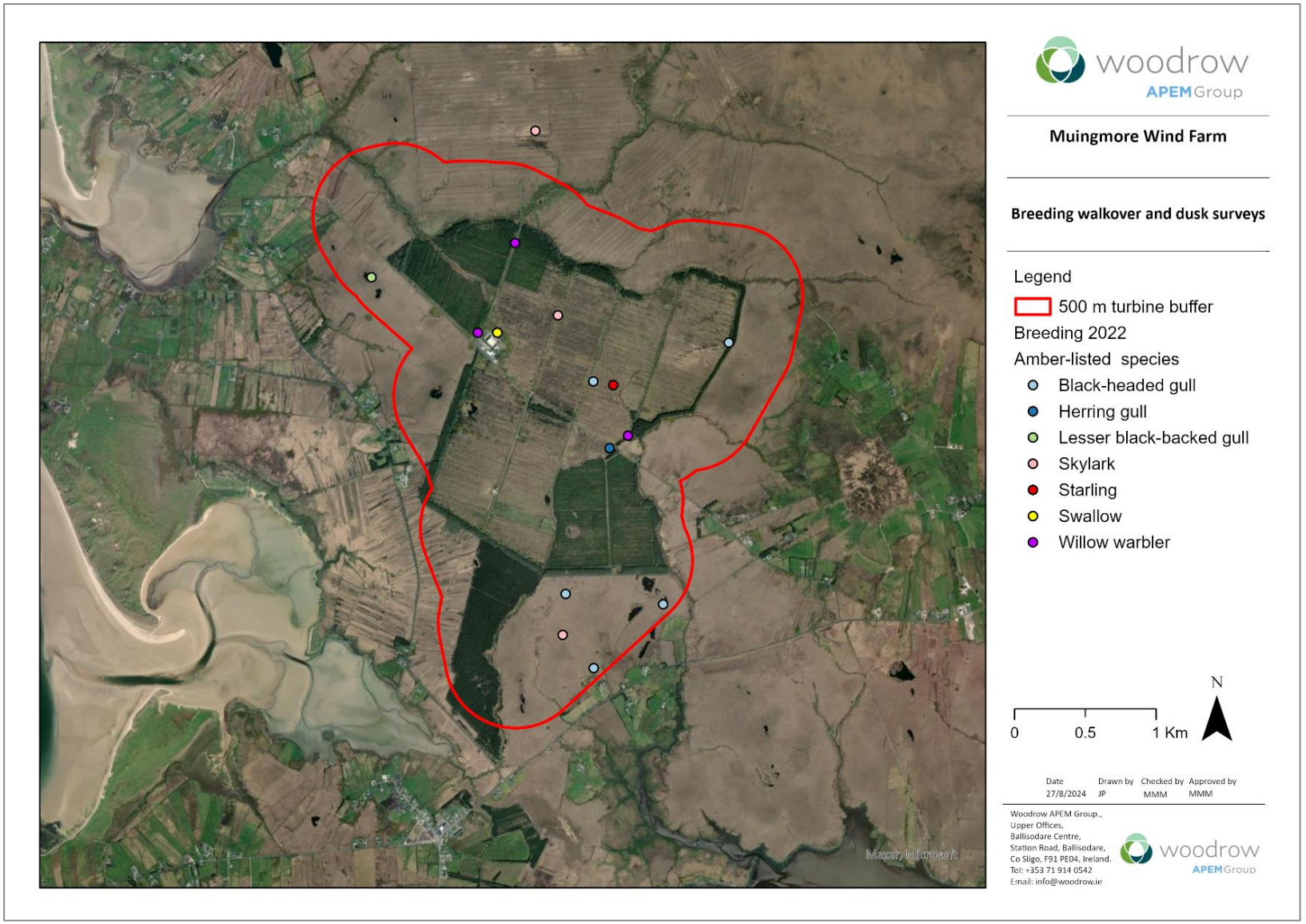

Figure 7: Amber-listed species recorded during the 2022 breeding bird surveys within 500 m turbine buffer

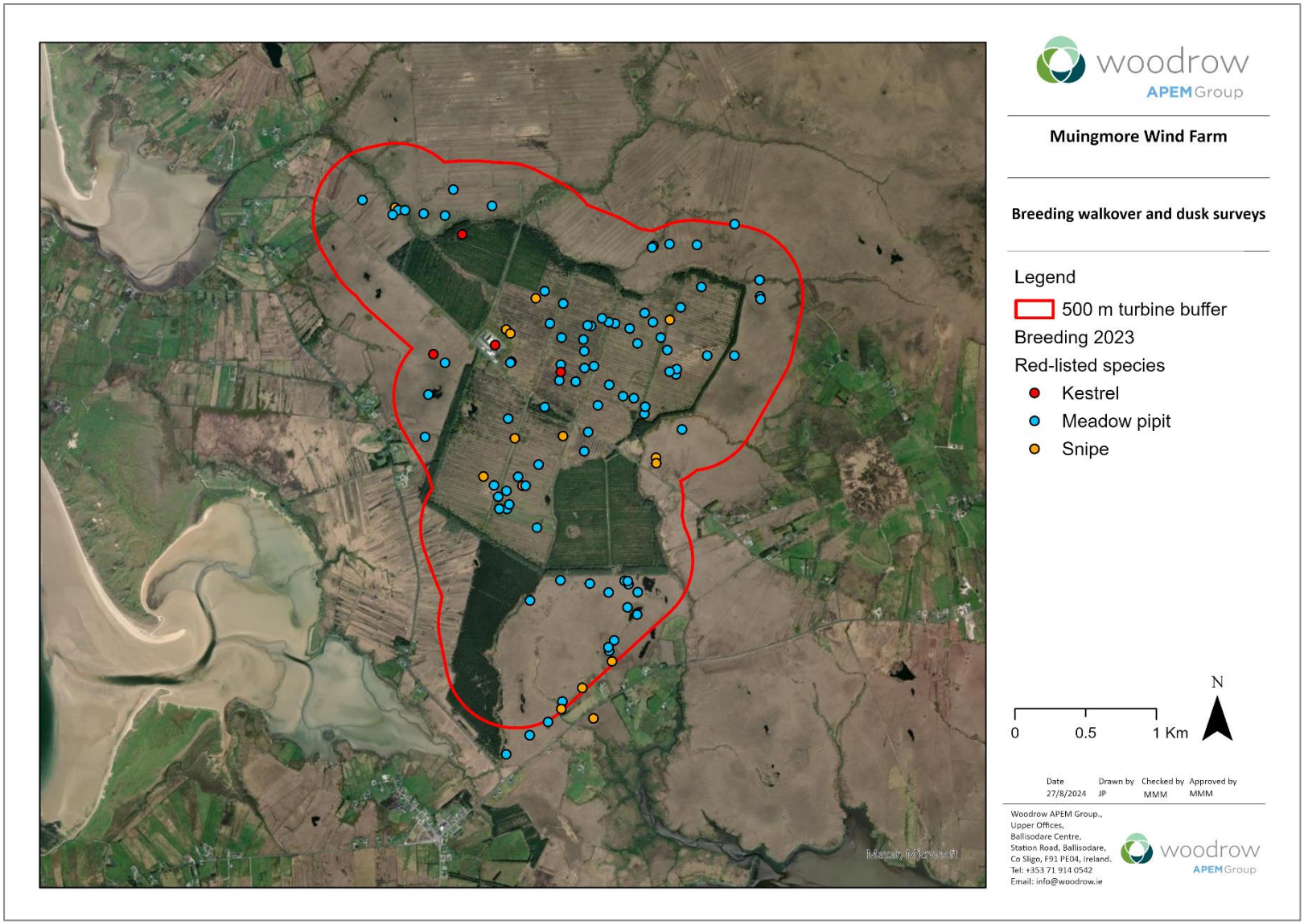

Figure 8: Red-listed species recorded during the 2023 breeding bird surveys within 500 m turbine buffer

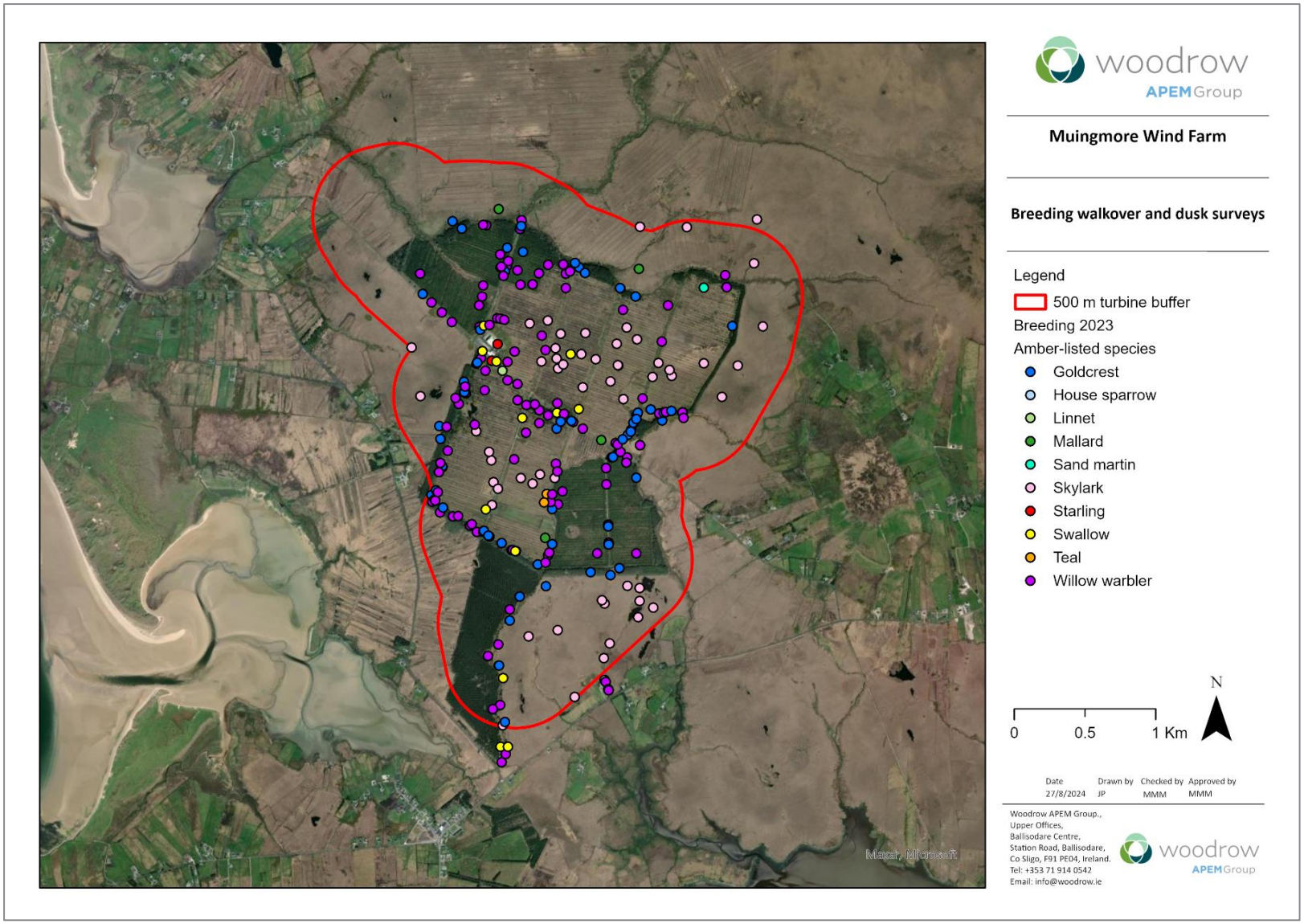

Figure 9: Amber-listed species recorded during the 2023 breeding bird surveys within 500 m turbine buffer

4.3. Breeding raptor surveys

Table 24, Table 25 and Table 26 show the number of raptor observations recorded during each breeding raptor survey date in the wider area for the 2021, 2022 and 2023 breeding seasons, respectively. The breeding status of each species within the 500 m turbine buffer is also provided in these tables. Figure 10, Figure 11 and Figure 12 show the locations of raptor species recorded during the 2021, 2022, and 2023 breeding raptor surveys, respectively.

No hen harrier, peregrine or merlin were recorded during the breeding raptor surveys within the 2 km turbine buffer. A breeding pair of kestrel have nested within the existing buildings in the central area of the site during the 2021, 2022 and 2023 breeding seasons.

Table 24: Summary of breeding raptor survey results for the 2021 breeding season

Species	BTO code	No. individuals		BoCCI 2020-2026	Breeding status within 500m turbine buffer
		Visit 1	Visit 2		
Kestrel	K.	1	8	Red	A breeding pair of kestrel was confirmed in the central area of the site

Table 25: Summary of breeding raptor survey results for the 2022 breeding season

Species	BTO code	No. individuals	BoCCI 2020-2026	Breeding status within 500m turbine buffer
		Visit 1		
Kestrel	K.	4	Red	A breeding pair of kestrel was confirmed in the central area of the site, as it was recorded in the previous breeding season

Table 26: Summary of breeding raptor survey results for the 2023 breeding season

Species	BTO code	No. individuals				BoCCI 2020-2026	Breeding status within 500m turbine buffer
		Visit 1	Visit 2	Visit 3	Visit 4		
Kestrel	K.	1	-	2	5	Red	A breeding pair of kestrel was confirmed in the central area of the site, as it was recorded in the two previous breeding seasons

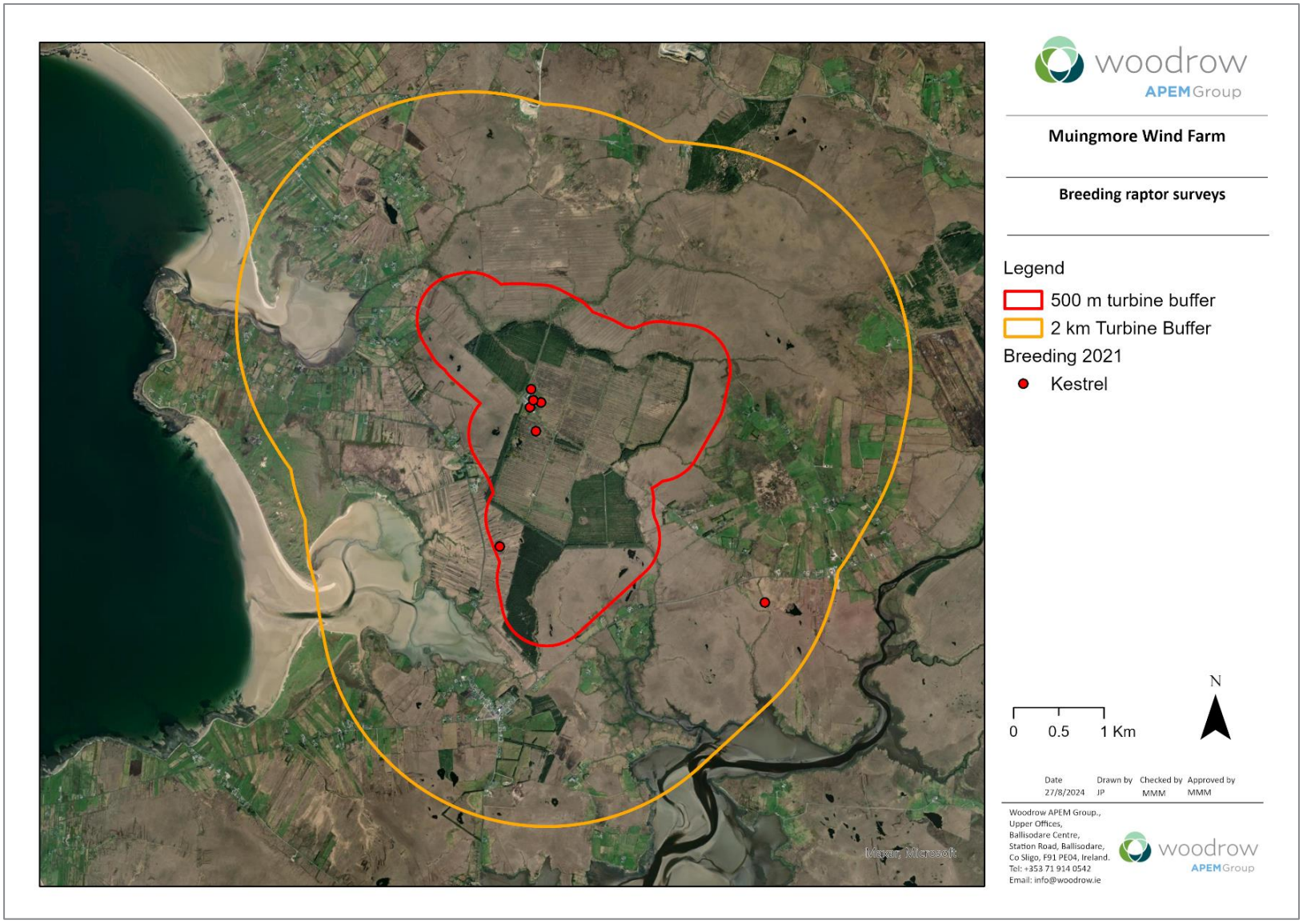

Figure 10: Raptor species recorded during the 2021 breeding raptor bird surveys within 2 km turbine buffer

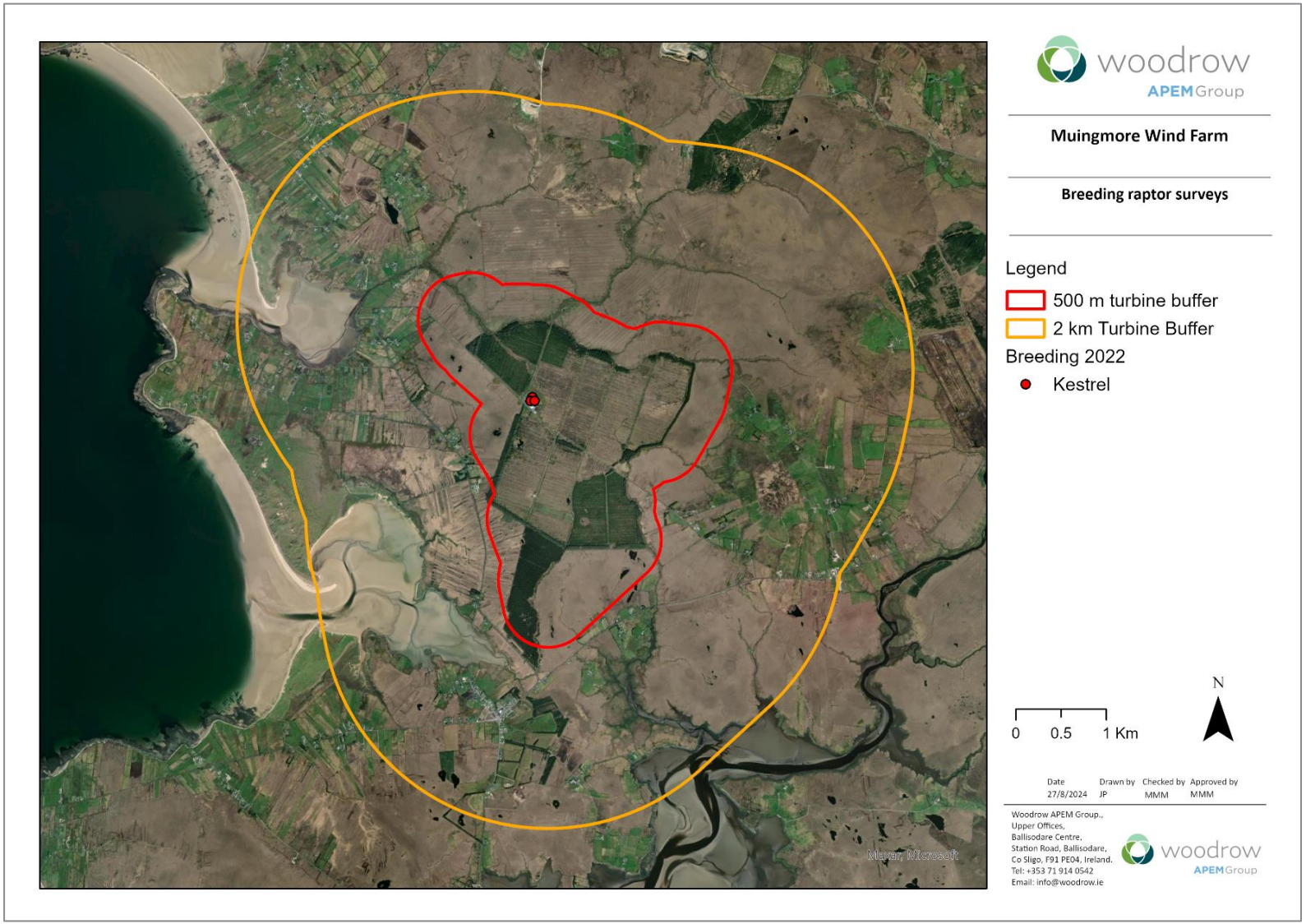

Figure 11: Raptor species recorded during the 2022 breeding raptor bird surveys within 2 km turbine buffer

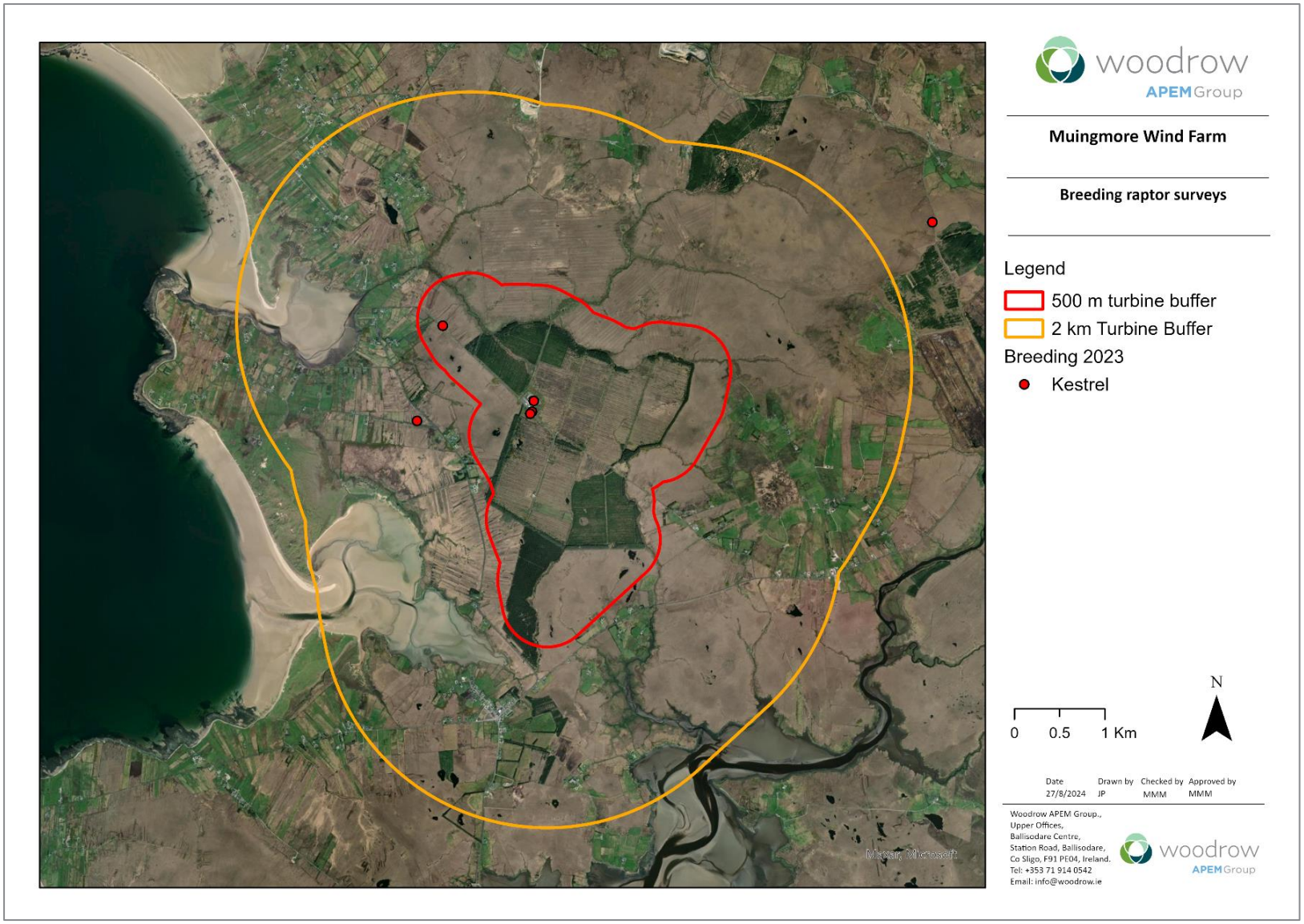

Figure 12: Raptor species recorded during the 2023 breeding raptor bird surveys within 2 km turbine buffer

4.4. Winter walkover surveys

4.4.1. Non-breeding season 2021-22

Winter walkover surveys covering the 500 m turbine buffer were undertaken on three visits during the 2021-22 non-breeding season. A total of 24 different bird species were recorded during the walkover surveys. Table 27 lists the red and amber-listed species, the number of individuals recorded on each visit and their location within the 500 m turbine buffer. Figure 13 and Figure 14 show the locations of red and amber-listed birds recorded during the 2020-21 non-breeding season, respectively. A list of all species recorded, including green-listed species, is provided in **Appendix XI.**

Table 27: Summary of winter walkover surveys carried out during the 2021-22 non-breeding season

Species	BTO code	Visit 1	Visit 2	Visit 3	BoCCI 2020-2026	Location within 500 m turbine buffer
Kestrel	K.	-	1	-	Red	An observation of a male kestrel flying near the buildings in the central part of the 500 m turbine buffer
Meadow pipit	MP	13	3	8	Red	Meadow pipit was the most frequently recorded species with 6 individuals flying from any one location. Observations were mainly distributed across the grassland habitats within the 500 m buffer
Snipe	SN	5	10	4	Red	Snipe were recorded in all visits with a maximum of two individuals from any one location. Observations were mainly distributed across bog habitats within the 500 m buffer
Woodcock	WK	-	5	1	Red	Small numbers of woodcock were recorded in the south-east and western section of the 500 m buffer
Goldcrest	GC	2	3	2	Amber	Observations were mainly distributed near forestry habitat within the 500 m turbine
Linnet	LI	5	5	1	Amber	Observations were spread within the 500 m turbine
Whooper swan	WS		12	-	Amber	In January 2022 a flock of 12 birds were recorded travelling over the south of the 500 m turbine buffer

4.4.2. Non-breeding season 2022-23

Winter walkover surveys covering the 500 m turbine buffer were undertaken on three visits during the 2022-23 non-breeding season. A total of 29 different bird species were recorded during the walkover surveys. Table 28 lists the red and amber-listed species, the number of individuals recorded on each visit and their location within the 500 m turbine buffer. Figure 15 and Figure 16

show the locations of red and amber-listed birds recorded during the 2022-23 non-breeding season, respectively. A list of all species recorded, including green-listed species, is provided in **Appendix XI.**

Table 28: Summary of winter walkover surveys carried out during the 2022-23 non-breeding season

Species	BTO code	Visit 1	Visit 2	Visit 3	BoCCI 2020-2026	Location within 500 m turbine buffer
Kestrel	K.	1	-	2	Red	One observation of a hunting juvenile was recorded in January over the north-east of the 500 m turbine buffer. Two observations of a hunting male were recorded during the same visit in February 2023 over the central proportion of the 500 m turbine buffer.
Meadow pipit	MP	117	93	28	Red	Meadow pipit was the most frequently recorded species with 25 individuals foraging from any one location. Observations were mainly distributed across the grassland habitats within the 500 m buffer
Redwing	RE	-	3	-	Red	One flock of three birds was observed during the visit in November 2022 over the north-east of the 500 m turbine buffer
Snipe	SN	12	20	3	Red	Observations were mainly distributed across bog habitats within the 500 m turbine buffer, and in wet grassland habitat over the central part of the 500 m buffer
Woodcock	WK	-	-	2	Red	Two observations were recorded during the same visit in February 2023 over the north-east of the 500 m turbine buffer
Black-headed gull	BH	-	2	-	Amber	Two individuals recorded on flying over the western section outside the 500 m turbine buffer.
Common gull	CM	-	1	-	Amber	One bird was recorded on flying over the western section outside the 500 m turbine buffer.
Goldcrest	GC	-	-	28	Amber	Observations were mainly distributed near forestry habitat within the 500 m turbine
Hen harrier	HH	-	-	2	Amber	Two observations of a hunting adult were recorded during the visit in January 2023 over the central and eastern portion of the 500 m turbine buffer
House sparrow	HS	3	-	-	Amber	One observation of three birds was observed during the visit in October 2022 over the south boundary of the 500 m turbine buffer

Species	BTO code	Visit 1	Visit 2	Visit 3	BoCCI 2020-2026	Location within 500 m turbine buffer
Linnet	LI	3	2	-	Amber	Two observations were recorded over the north-west and south of the 500 m turbine buffer

4.4.3. Non-breeding season 2023-24

Winter walkover surveys covering the 500 m turbine buffer were undertaken on three visits during the 2023-24 non-breeding season. A total of 37 different bird species were recorded during the walkover surveys. Table 29 lists the red and amber-listed species, the number of individuals recorded on each visit and their location within the 500 m turbine buffer. Figure 17 and Figure 18 show the locations of red and amber-listed birds recorded during the 2023-24 non-breeding season, respectively. A list of all species recorded, including green-listed species, is provided in **Appendix XI.**

Table 29: Summary of winter walkover surveys carried out during the 2023-24 non-breeding season

Species	BTO code	Visit 1	Visit 2	Visit 3	BoCCI 2020-2026	Location within 500 m turbine buffer
Grey wagtail	GL	1	1	-	Red	Two observations of one grey wagtail were recorded at the same location during two different visits over the southern section of the 500 m turbine buffer
Kestrel	K.	1	1	1	Red	One observation of an adult was recorded in October over the central section of the 500 m turbine buffer. Another observation of a hunting adult male was recorded during the visit in November 2023 near the buildings in the central part of the 500 m turbine buffer. A third observation was made in January 2024 of a male flying over the bog in the north-east of the 500 m turbine buffer
Meadow pipit	MP	56	57	16	Red	Meadow pipit was the most frequently recorded species with seven individuals flying from any one location. Observations were mainly distributed across the grassland habitats within the 500 m buffer
Redwing	RE	1	-	-	Red	One redwing was observed during the visit in October 2023 over the central section of the 500 m turbine buffer
Snipe	SN	15	17	11	Red	Observations were mainly distributed across bog habitats within the 500 m turbine buffer, and in wet grassland habitat over the central part of the 500 m buffer
Woodcock	WK	-	3	4	Red	Three observations were recorded during the visit in November 2023 over the central section of the 500 m buffer. Another three observations were recorded during the visit in January 2024

Species	BTO code	Visit 1	Visit 2	Visit 3	BoCCI 2020-2026	Location within 500 m turbine buffer
						over the south-east of the 500 m turbine buffer
Goldcrest	GC	78	-	5	Amber	Observations were mainly distributed near forestry habitat within the 500m turbine
Mallard	MA	-	-	2	Amber	An observation of two mallards was recorded in a small waterbody located in the west of the 500 m buffer
Teal	T.	-	5	-	Amber	An observation of five teal was recorded in a small waterbody located in the west of the 500 m buffer

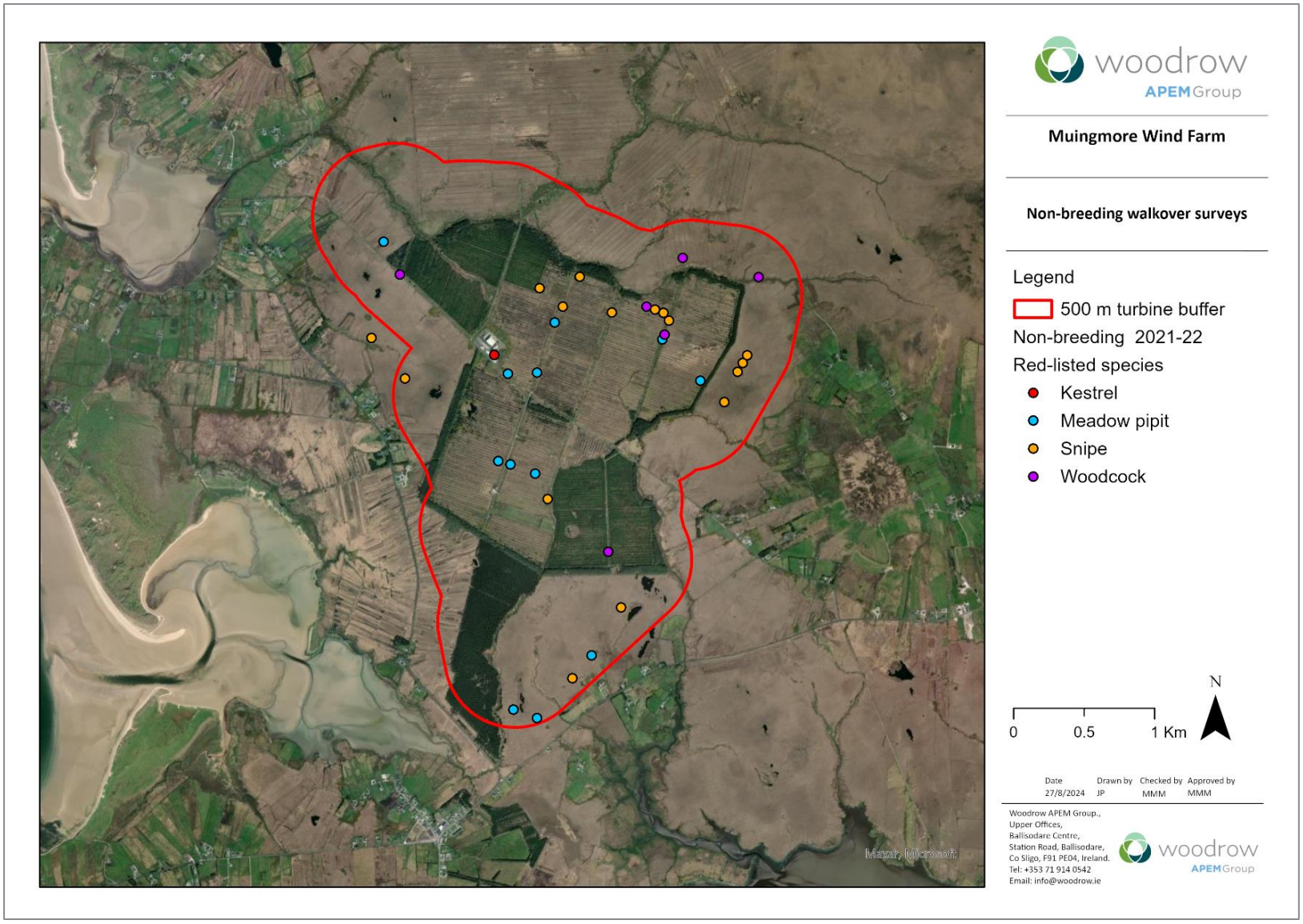

Figure 13: Red-listed species recorded during the 2021-22 non-breeding season bird surveys within 500 m turbine buffer

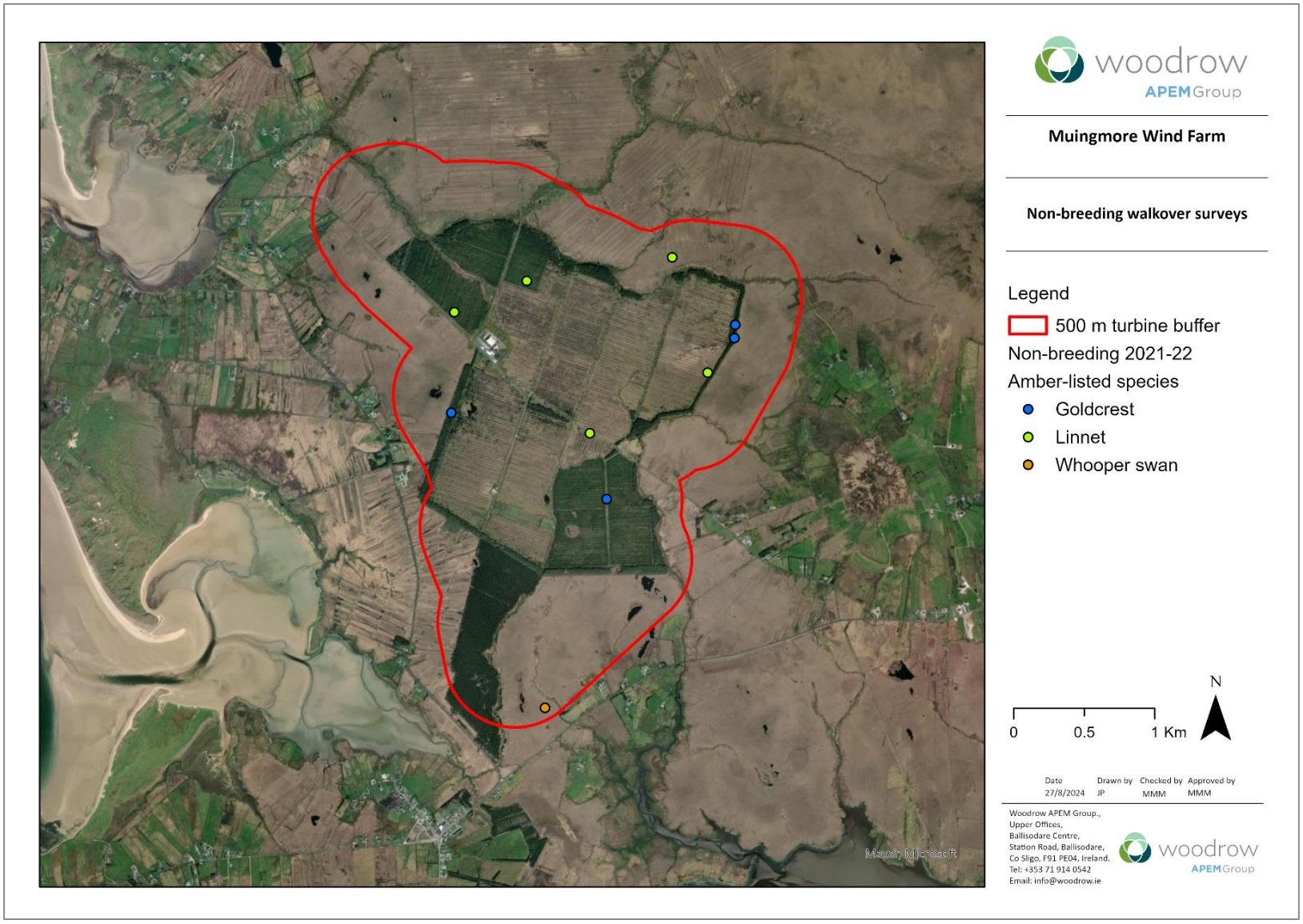

Figure 14: Amber-listed species recorded during the 2021-22 non-breeding season bird surveys within 500 m turbine buffer

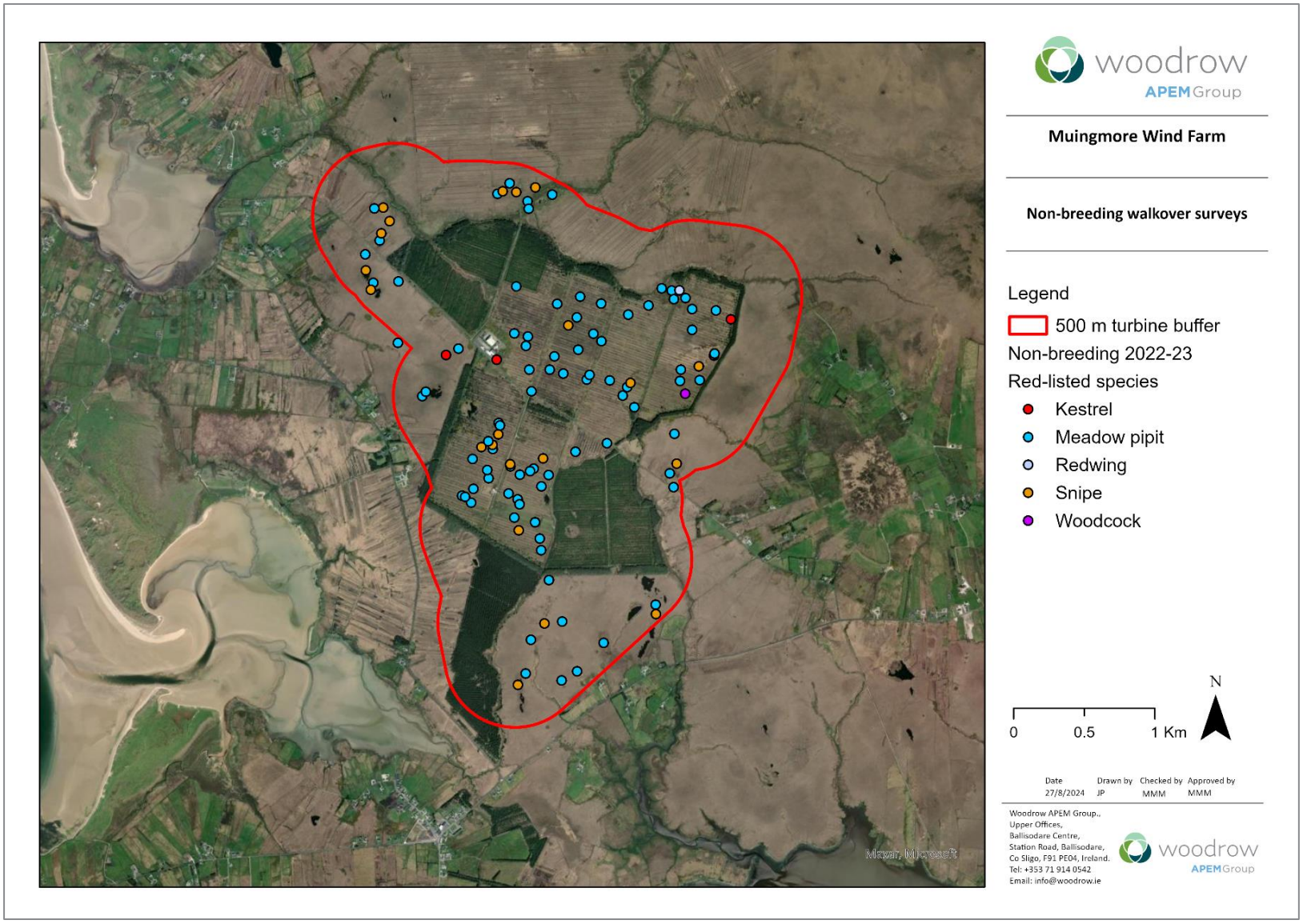

Figure 15: Red-listed species recorded during the 2022-23 non-breeding season bird surveys within 500 m turbine buffer

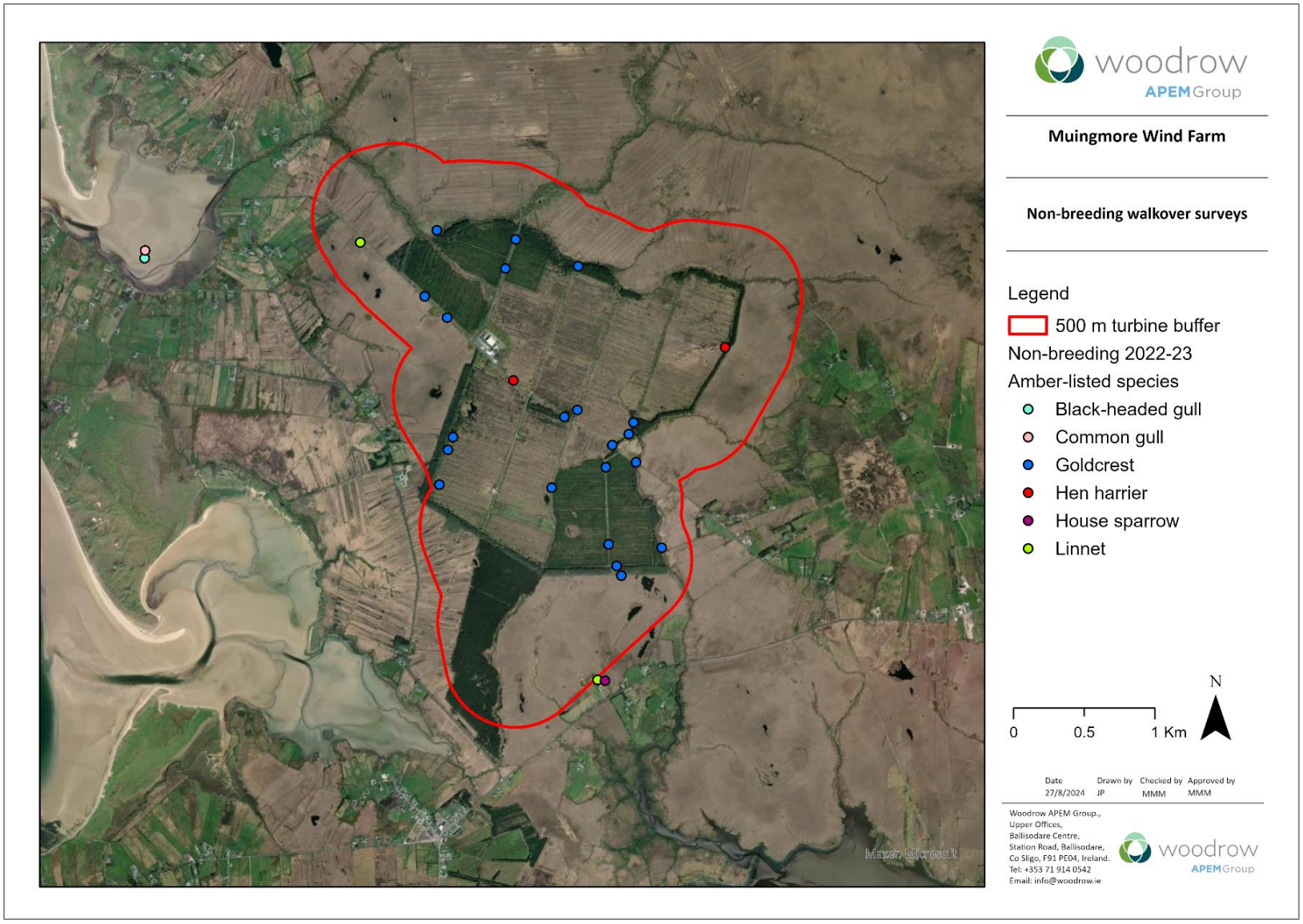

Figure 16: Amber-listed species recorded during the 2022-23 non-breeding season bird surveys within 500 m turbine buffer

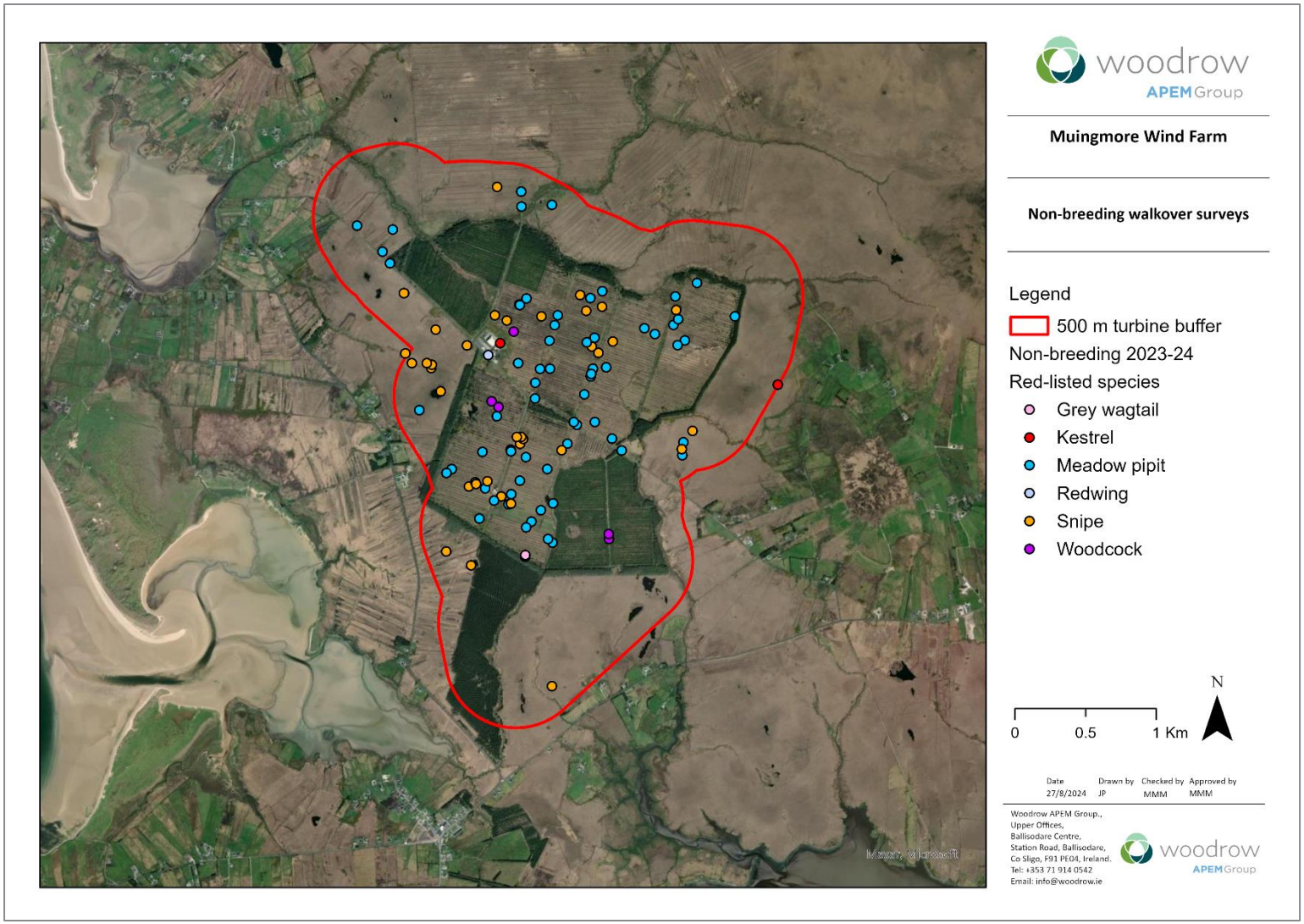

Figure 17: Red-listed species recorded during the 2023-24 non-breeding season bird surveys within 500 m turbine buffer

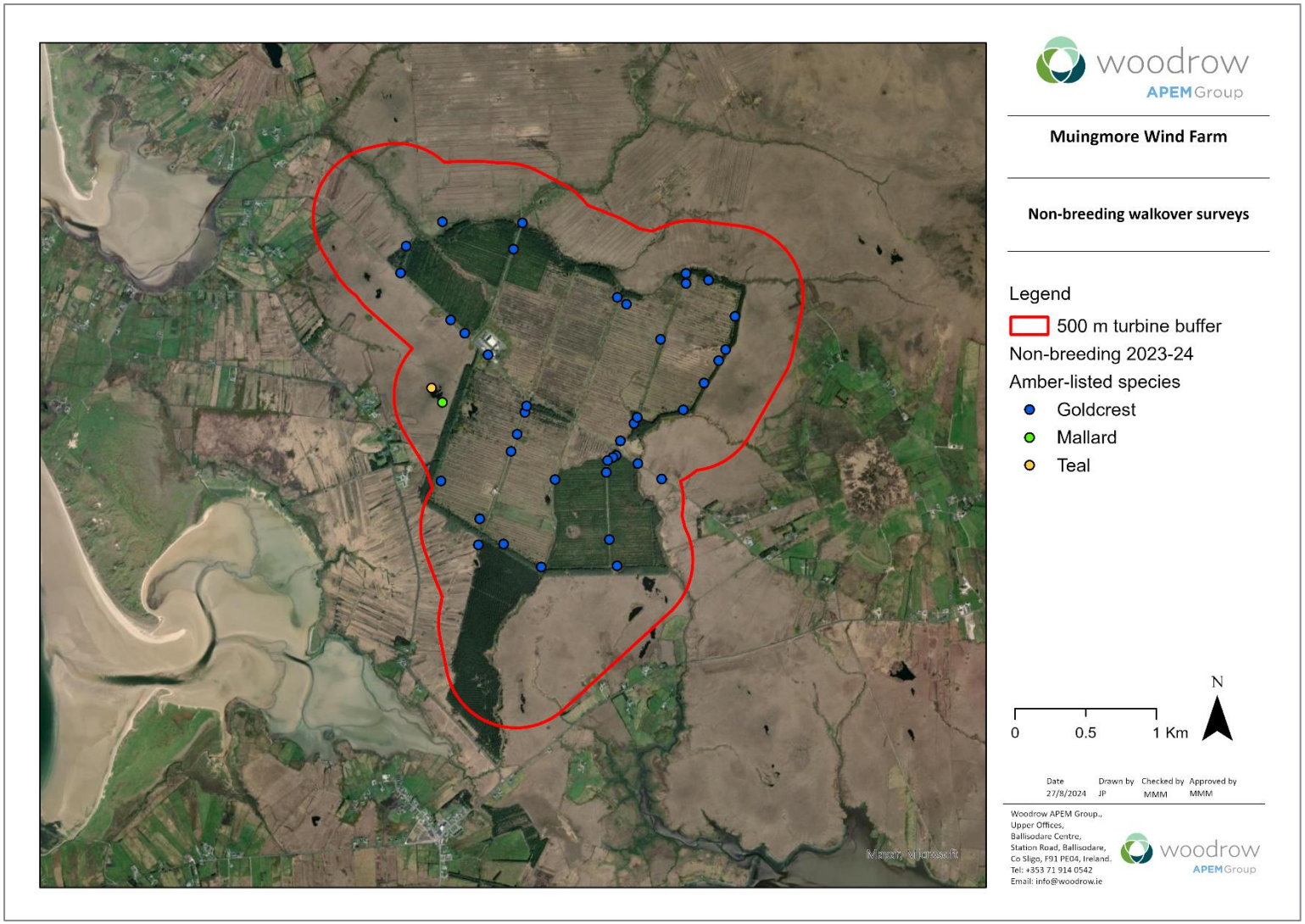

Figure 18: Amber-listed species recorded during the 2023-24 non-breeding season bird surveys within 500 m turbine buffer

4.5. Wintering waterbird surveys

4.5.1. Non-breeding season 2021-22

Table 30 lists the species and the number of waterbirds recorded on each visit to the wider area during the 2021-22 non-breeding season. From the survey results, a total of 40 waterbird species were recorded, shown in Table 30.

Muingmore
Wintering wat
Legend
500 m turbin
6 km Turbine
Non-breeding 202
Red-listed species
Bar-tailed go
Common sco
Curlew
Dunlin
Golden plove
Lapwing
Oystercatche
Redshank
Snipe
0 0.5 1 2 Km
Date 27/8/2024
Drawn by JP
Woodrow APEM Group.,
Upper Offices,
Ballisodare Centre,
Station Road, Ballisodare,
Co Sligo, F91 PE04, Ireland.
Tel: +353 71 914 0542
Email: info@woodrow.ie

Figure 19 and

Figure 20 show the locations of red and amber-listed waterbirds recorded during the 2021-22 non-breeding season, respectively. Waterbird activity was higher on the west coast within the 6 km buffer, with most of the activity recorded along the Blacksod Bay/Broad Haven SPA. Gull activity was notably higher than any other species, including common gull *Larus canus*, Mediterranean gull *Ichthyaetus melanocephalus* and great black-backed. Black guillemot *Cepphus grylle* was also noted in the western part of the survey area.

During these surveys, two raptor species were recorded, a single merlin in Visit 7 and a single peregrine in Visit 6.

Concentrations of waterbirds as presented in the table below, and in Figure 19 and 20, were observed in coastal, estuarine and wetland habitats associated with the Blacksod Bay/Broad Haven SPA and Carrowmore Lake SPA.

Table 30: Summary of wider area wintering waterbird surveys carried out during the 2021-22 non-breeding season

Species	BTO code	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	Visit 7	Visit 8	BoCCI 2020-2026
Bar-tailed godwit	BA	165	200	259	133	-	116	326	83	Red
Common scoter	CX	-	-	-	-	-	-	20	-	Red
Curlew	CU	45	21	9	26	79	14	34	7	Red
Dunlin	DN	41	16	58	92	88	96	117	125	Red
Golden plover	GP	-	-	-	-	6	-	-	-	Red
Lapwing	L.	-	1		33	6	4	3	-	Red
Oystercatcher	OC	50	46	103	90	33	52	49	138	Red
Redshank	RK	8	13	20	43	21	29	6	2	Red
Snipe	SN	2	-	-	-	-	-	-	-	Red
Slavonian grebe	SZ	-	-	-	-	-	-	-	5	Red
Black guillemot	TY	-	4	-	3	79	-	8	-	Amber
Black-headed gull	BH	-	-	-	-	11	-	-	13	Amber
Brent goose	BG	-	196	133	243	34	-	155	8	Amber
Common gull	CM	-	-	-	4	18	-	72	36	Amber
Coot	CO	-	-	1	-	-	-	-	-	Amber
Cormorant	CA	2	2	3	3	2	2	9	1	Amber
Great northern diver	ND	-	1	-	2	6	-	2	-	Amber
Herring gull	HG	1	2	-	-	2	1	3	-	Amber
Lesser black-backed gull	LB	-	-	-	-	3	5	-	-	Amber
Mallard	MA	28	12	10	42	-	10	12	14	Amber
Mediterranean gull	MU	55	53	13	20	-	-	-	-	Amber
Red-breasted merganser	RM	-	13	12	20	6	-	2	2	Amber
Ringed plover	RP	60	96	48	31	-	47	124	42	Amber
Shelduck	SU	-	-	-	-	-		2	-	Amber
Teal	T.	3	12	4		-	2	-	-	Amber
Turnstone	TT	-	-	11	11	-	-	3	-	Amber
Whooper swan	WS	21	7	-	23	-	-	-	3	Amber
Wigeon	WN	2	-	8	14	36	22	4	2	Amber
Shelduck	SU	6	-	-	8	-	6	-	-	Amber
Teal	T.	16	3	2	30	-	12	-	14	Amber
Tufted duck	TU	-	-	89	95	-	68	-	27	Amber
Turnstone	TT	8	30	14	26	-	-	-	12	Amber
Whooper swan	WS	5	16	20	5	-	16	-	17	Amber
Wigeon	WN	4	15	75	20	-	32	-	35	Amber
Great black-backed gull	GB	5	-	12	9	3	3	9	11	Green
Greenshank	GK	2	-	1	5	3	1	2	7	Green
Grey heron	H	1	3	1	3	1	3	1	-	Green
Little egret	ET	-	-	-	-	-	-	2	-	Green
Little grebe	LG	-	-	-	-	-	1	-	-	Green
Sanderling	SS	-	76	83	93	6	-	55	-	Green

4.5.2. Non-breeding season 2022-23

Table 31 lists the species and the number of waterbirds recorded on each visit to the wider area during the 2022-23 non-breeding season. From the survey results, a total of 56 waterbird species were recorded (Table 31Table 30).

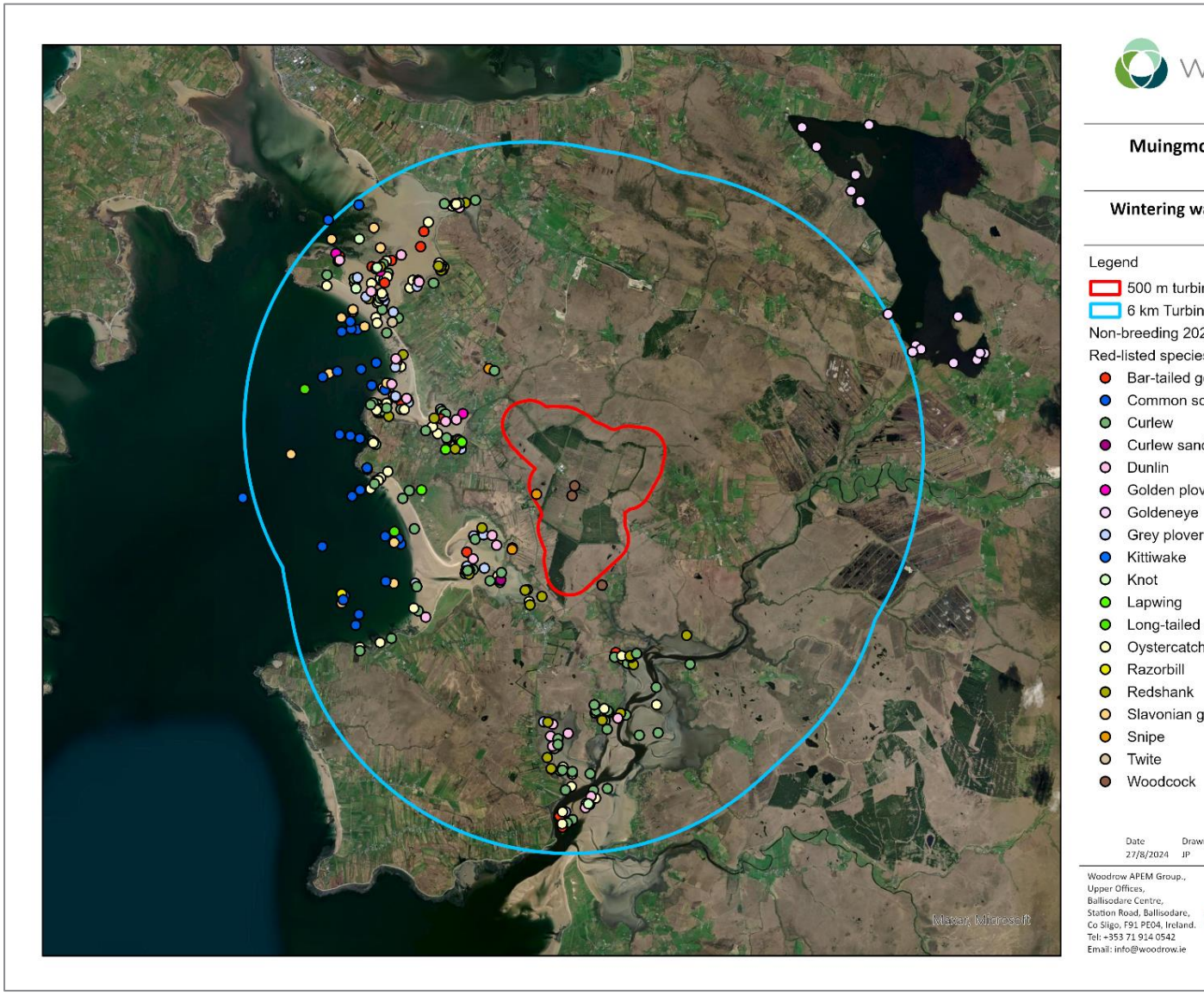

Figure 21 and

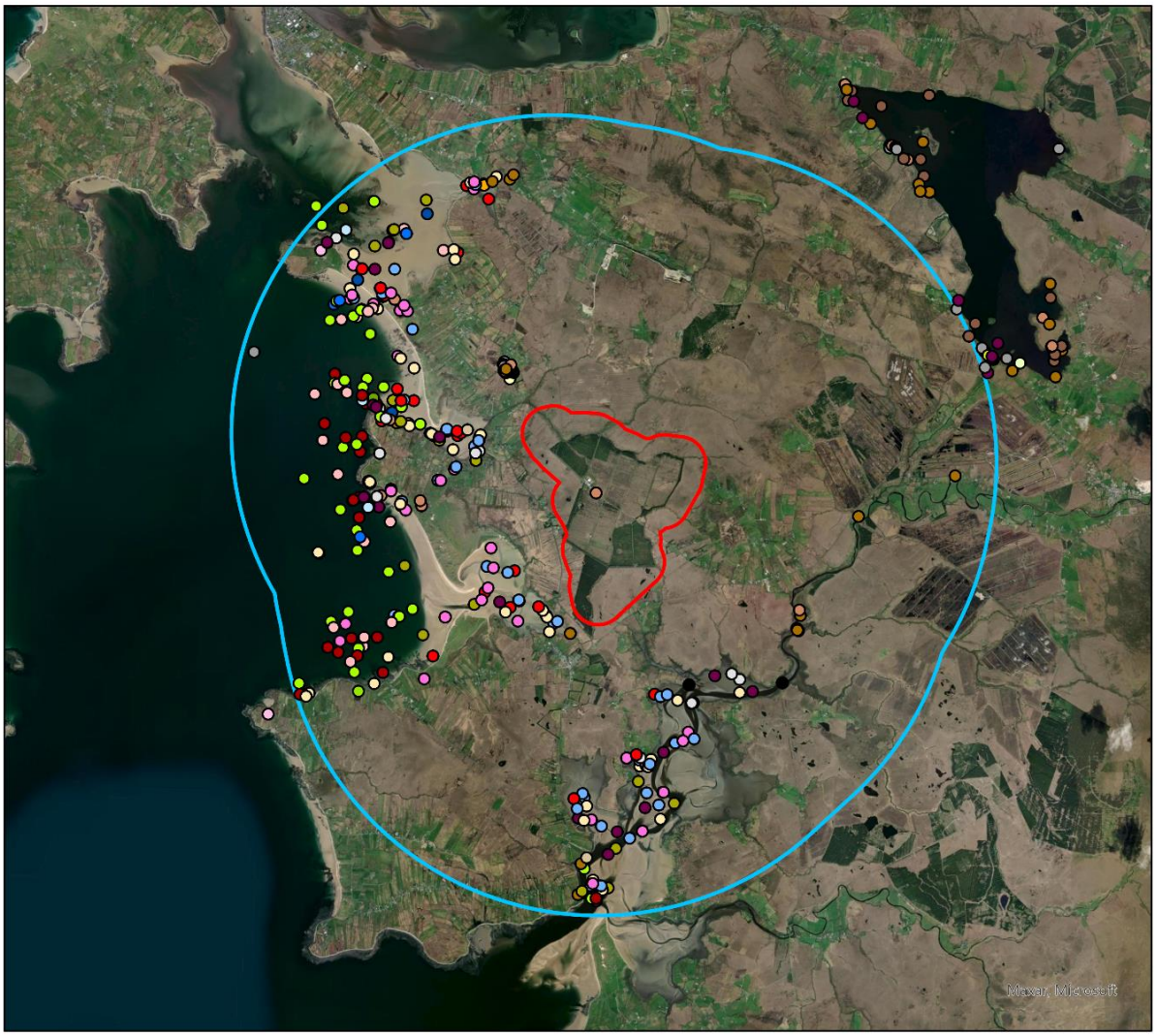

Figure 22 show the locations of red and amber-listed waterbirds recorded during the 2022-23 non-breeding season, respectively.

During these surveys, there was one observation of merlin and one observation of three chough *Pyrrhocorax pyrrhocorax* during Visit 1, with one observation of 33 twite *Linaria flavirostris* in Visit 6.

Concentrations of waterbirds as presented in the table below, and in Figure 21 and 22, were observed in coastal, estuarine and wetland habitats associated with the Blacksod Bay/Broad Haven SPA and Carrowmore Lake SPA.

Table 31: Summary of wider area wintering waterbird surveys carried out during the 2022-23 non-breeding season

Species	BTO code	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	BoCCI 2020-2026
Bar-tailed godwit	BA	114	743	755	226	710	762	Red
Common scoter	CX	109	188	111	281	103	349	Red
Curlew	CU	97	127	155	146	78	262	Red

Species	BTO code	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	BoCCI 2020-2026
Curlew sandpiper	CV	1	-	-	-	-	-	Red
Dunlin	DN	571	646	607	935	810	523	Red
Golden plover	GP	65	48	1	-	39	-	Red
Goldeneye	GN	-	-	8	10	4	14	Red
Grey plover	GV	87	53	52	68	65	155	Red
Kittiwake	KI	-	-	-	-	1	-	Red
Knot	KN	1	51	15	70	23	11	Red
Lapwing	L.	-	2	26	3	-	-	Red
Long-tailed duck	LN	-	1	-	-	-	2	Red
Oystercatcher	OC	100	38	176	151	93	136	Red
Razorbill	RA	-	-	-	-	-	1	Red
Redshank	RK	33	28	83	58	16	62	Red
Slavonian grebe	SZ	4	4	-	4	5	33	Red
Snipe	SN	5	-	1	-	-	1	Red
Woodcock	WK	-	-	-	3	-	1	Red
Black guillemot	TY	-	-	4	-	-	2	Amber
Black-headed gull	BH	91	64	15	11	-	37	Amber
Black-throated diver	BV	2	5	-	1	-	4	Amber
Brent goose	BG	-	-	28	-	77	-	Amber
Common gull	CM	18	123	16	78	8	84	Amber
Coot	CO	-	-	-	-	1	-	Amber
Cormorant	CA	9	8	3	15	22	19	Amber
Goosander	GD	-	-	-	-	-	2	Amber
Great northern diver	ND	5	54	34	53	43	129	Amber
Greylag goose	GJ	2	-	-	-	-	-	Amber
Guillemot (common)	GU	-	-	1	-	-	-	Amber
Herring gull	HG	23	17	22	10	31	126	Amber
Kingfisher	KF	-	-	1	-	-		Amber
Mallard	MA	13	35	26	45	17	29	Amber
Mute swan	MS	-	-	-	-	-	3	Amber
Red-breasted merganser	RM	23	33	58	25	20	66	Amber
Red-throated diver	RH	6	71	4	6	1	79	Amber
Ringed plover	RP	119	133	107	294	30	11	Amber
Shag	SA	3	38	6	27	9	47	Amber
Shelduck	SU	-	-	-	3	-	7	Amber
Teal	T.	-	20	60	67	9	28	Amber
Tufted duck	TU	-	42		61	56	60	Amber
Turnstone	TT	7	7	45	9	-	10	Amber
Whooper swan	WS	4	15	60	24	21	20	Amber
Wigeon	WN	13	44	10	22	48	31	Amber
Bufflehead	VH	-	2	-	-	-	-	Green
Glaucous gull	GZ	-	-	-	-	1	-	Green

Species	BTO code	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	BoCCI 2020-2026
Great black-backed gull	GB	22	9	6	13	18	33	Green
Greenshank	GK	11	13	13	15	10	9	Green
Grey heron	H	2	4	2	7	-	3	Green
Grey phalarope	PL	1	-	-	-	-	-	Green
Jack snipe	JS	-	-	1	-	-	-	Green
Light-bellied brent goose	PB	4	48	-	36	-	34	Green
Little egret	ET	-	2	4	2	2	1	Green
Little grebe	LG	-	-	-	-	2	2	Green
Moorhen	MH	17	2	3	1	-	4	Green
Ring-necked duck	NG	-	1		1	1	-	Green
Sanderling	SS	68	146	33	43	-	56	Green

4.5.3. Non-breeding season 2023-24

Table 32 lists the species and the number of waterbirds recorded on each visit to the wider area during the 2023-24 non-breeding season. From the survey results, a total of 40 waterbird species

were recorded (Table 32).

Figure 23 and Figure 24 show the locations of red and amber-listed waterbirds recorded during the 2023-24 non-breeding season, respectively.

During these surveys, there was four observations of kestrel, one observation of rock pipit *Anthus petrosus* and three observations of starling *Sturnus vulgaris.*

Concentrations of waterbirds as presented in the table below, and in Figure 23 and 24, were observed in coastal, estuarine and wetland habitats associated with the Blacksod Bay/Broad Haven SPA and Carrowmore Lake SPA.

Table 32: Summary of wider area wintering waterbird surveys carried out during the 2023-24 non-breeding season

Species	BTO code	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	BoCCI 2020-2026
Bar-tailed godwit	BA	467	551	28	333	450	1,422	Red
Common scoter	CX	70	12	-	-	35	58	Red
Curlew	CU	53	58	32	17	16	21	Red
Dunlin	DN	68	286	240	19	549	80	Red

Species	BTO code	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	BoCCI 2020-2026
Grey plover	GV	28	38	-	-	-	65	Red
Knot	KN	72	45	-	-	-	6	Red
Lapwing	L.	-	8	2	-	-	-	Red
Long-tailed duck	LN	-	-	-	-	-	1	Red
Oystercatcher	OC	139	46	22	72	134	39	Red
Redshank	RK	51	19	10	2	6	-	Red
Slavonian grebe	SZ	-	-	-	-	-	5	Red
Black guillemot	TY	-	2	-	-	-	-	Amber
Black-headed gull	BH	33	26	1	1	-	2	Amber
Black-throated diver	BV	1	-	-	-	-	-	Amber
Brent goose	BG	4	38	25	10	43	12	Amber
Common gull	CM	50	33	32	48	24	9	Amber
Cormorant	CA	2	-	3	1	10	-	Amber
Great crested grebe	GG	-	-		1	-	-	Amber
Great northern diver	ND	24	2	-	-	2	15	Amber
Herring gull	HG	37	2	12	8	16	40	Amber
Lesser black-backed gull	LB	-	-	-	-	6	32	Amber
Mallard	MA	21	16	37	36	6	-	Amber
Mute swan	MS	3	-	-	18	-	3	Amber
Red-breasted merganser	RM	63	95	-	3	5	9	Amber
Red-throated diver	RH	6	2	-	-	-	9	Amber
Ringed plover	RP	304	249	5	51	29	27	Amber
Shag	SA	-	-	-	-	-	1	Amber
Shelduck	SU	6	-	-	8	6	-	Amber
Teal	T.	16	3	2	30	12	14	Amber
Tufted duck	TU	-	-	89	95	68	27	Amber
Turnstone	TT	8	30	14	26	-	12	Amber
Whooper swan	WS	5	16	20	5	16	17	Amber
Wigeon	WN	4	15	75	20	32	35	Amber
Great black-backed gull	GB	11	-	4	1	4	1	Green
Greenshank	GK	4	5	1	1	22	-	Green
Grey heron	H.	4	-	1	2	-	-	Green
Little egret	ET	-	-	1	3	1	1	Green
Little grebe	LG	-	-	-	-	2		Green
Moorhen	MH	2	-	-	1	-	1	Green
Sanderling	SS	162	15	34	-	-	40	Green

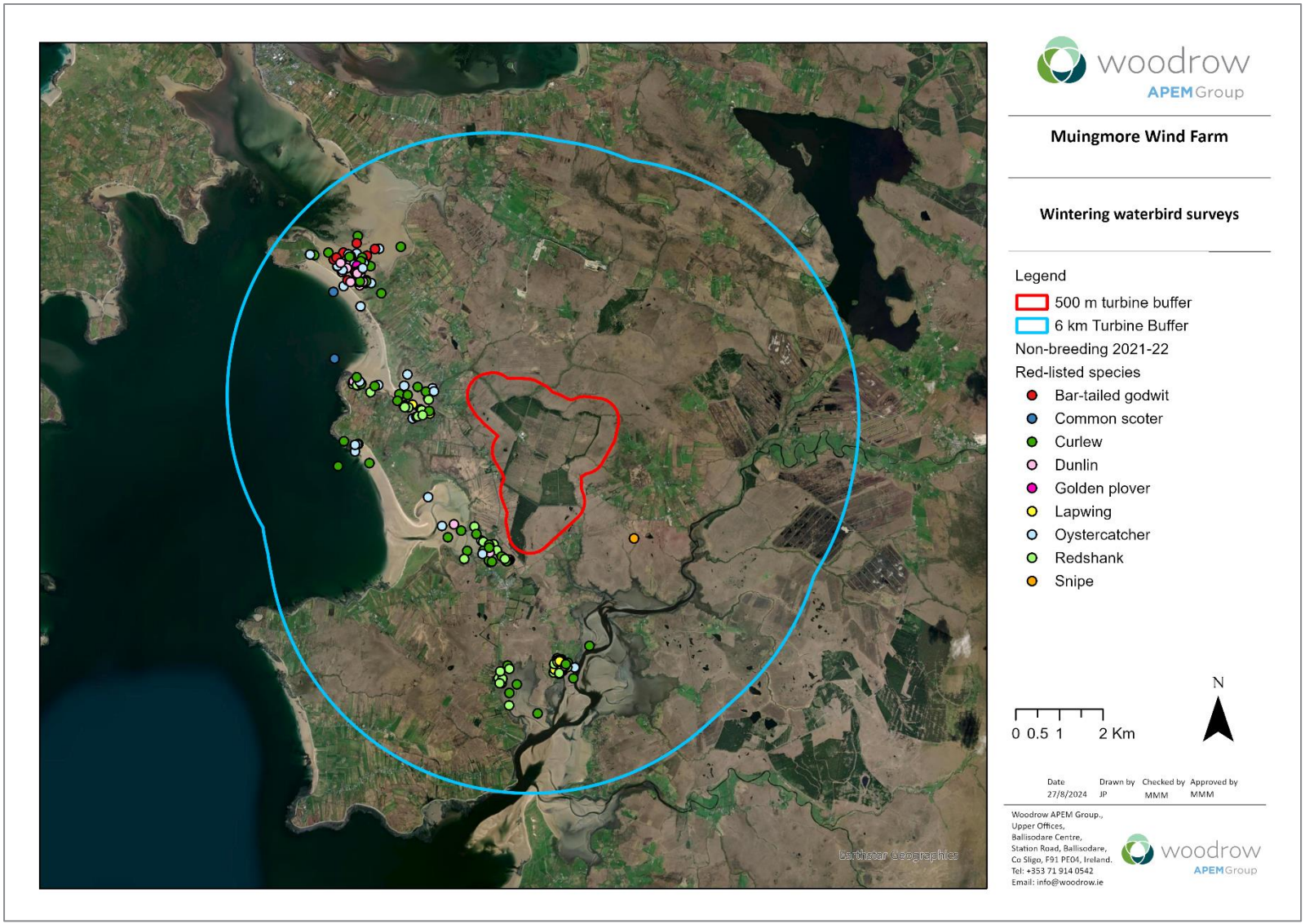

Figure 19: Red-listed species identified during waterbird surveys in the 2021-22 non-breeding season

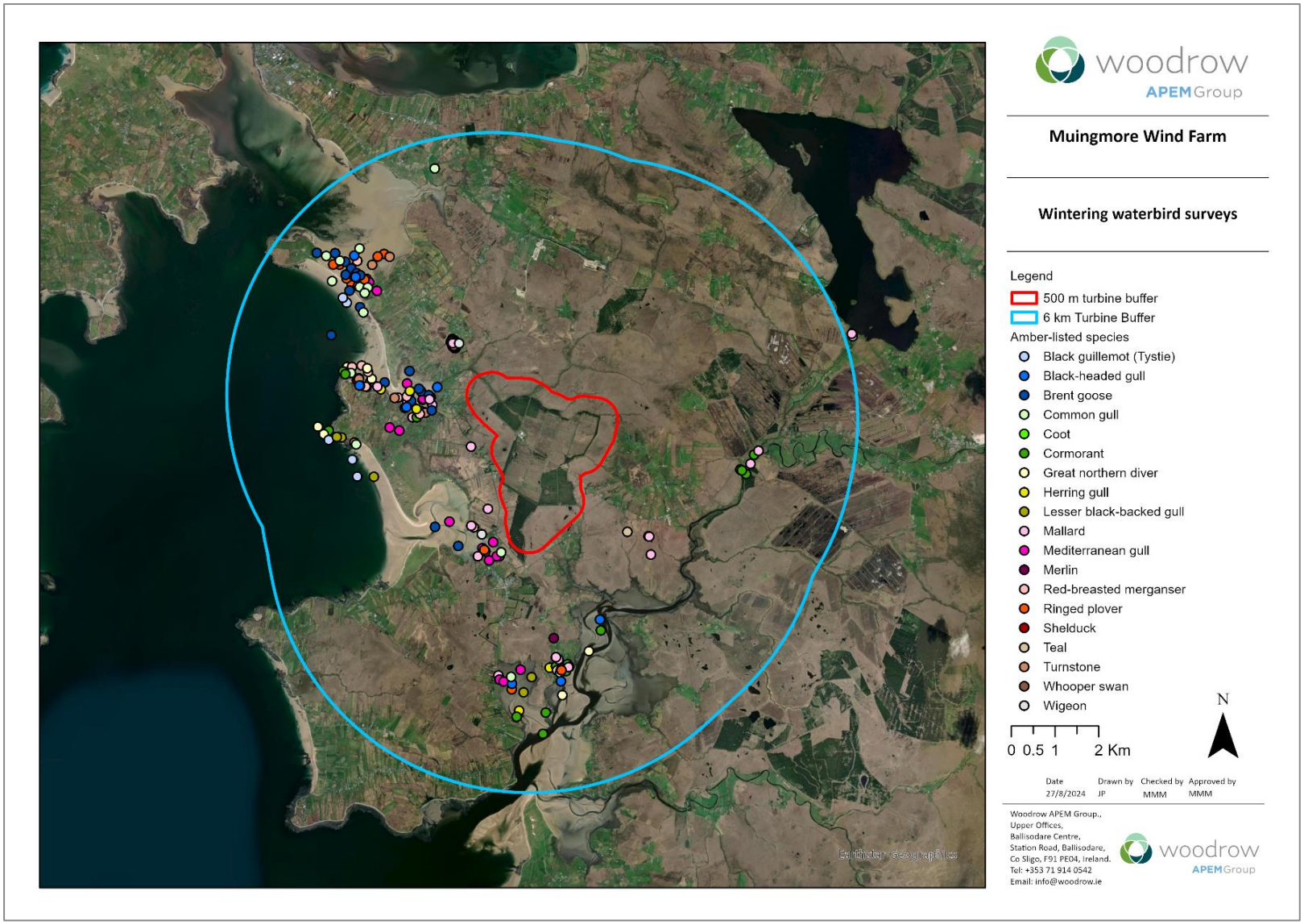

Figure 20: Amber-listed species identified during waterbird surveys in the 2021-22 non-breeding season

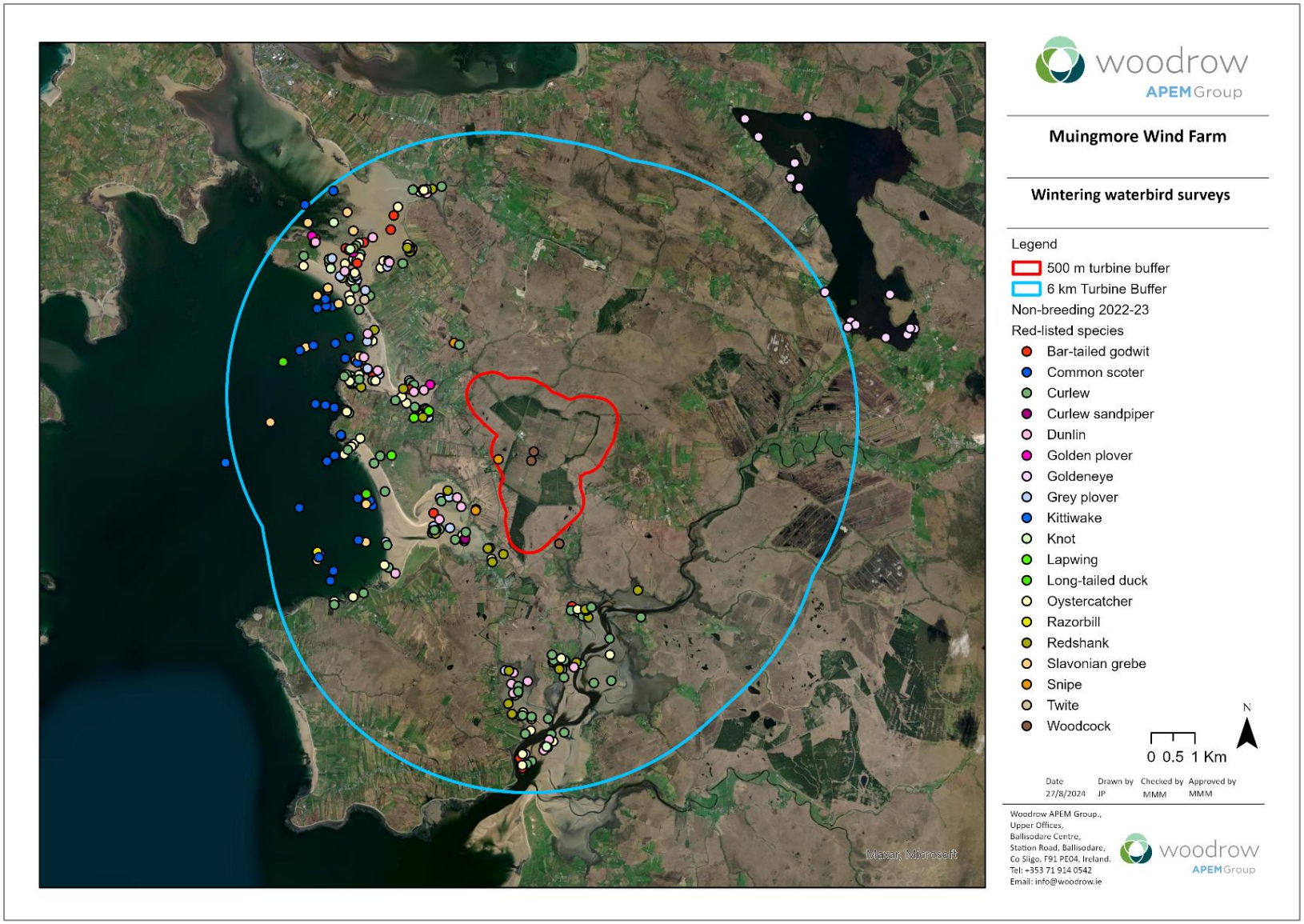

Figure 21: Red-listed species identified during waterbird surveys in the 2022-23 non-breeding season

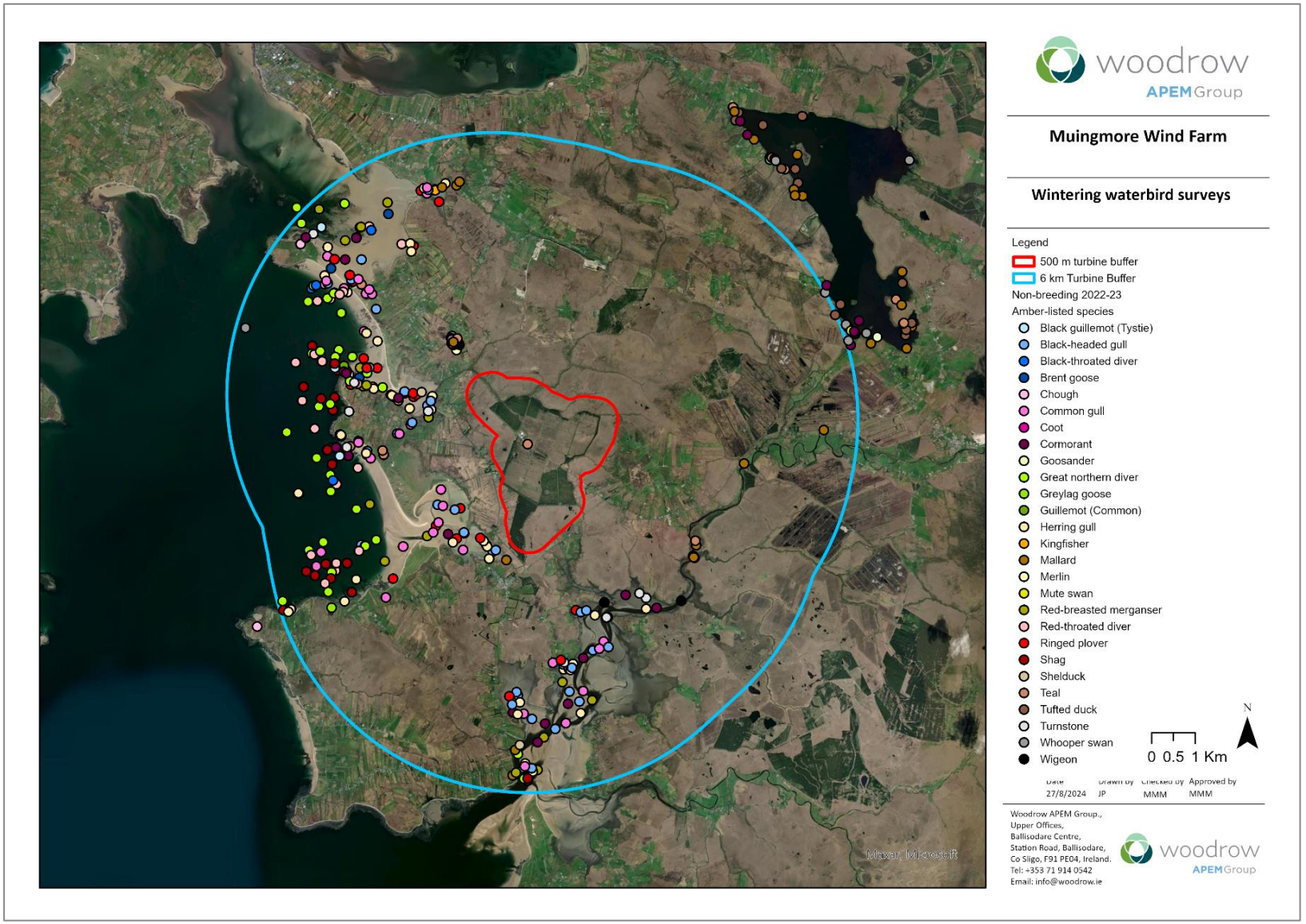

Figure 22: Amber-listed species identified during waterbird surveys in the 2022-23 non-breeding season

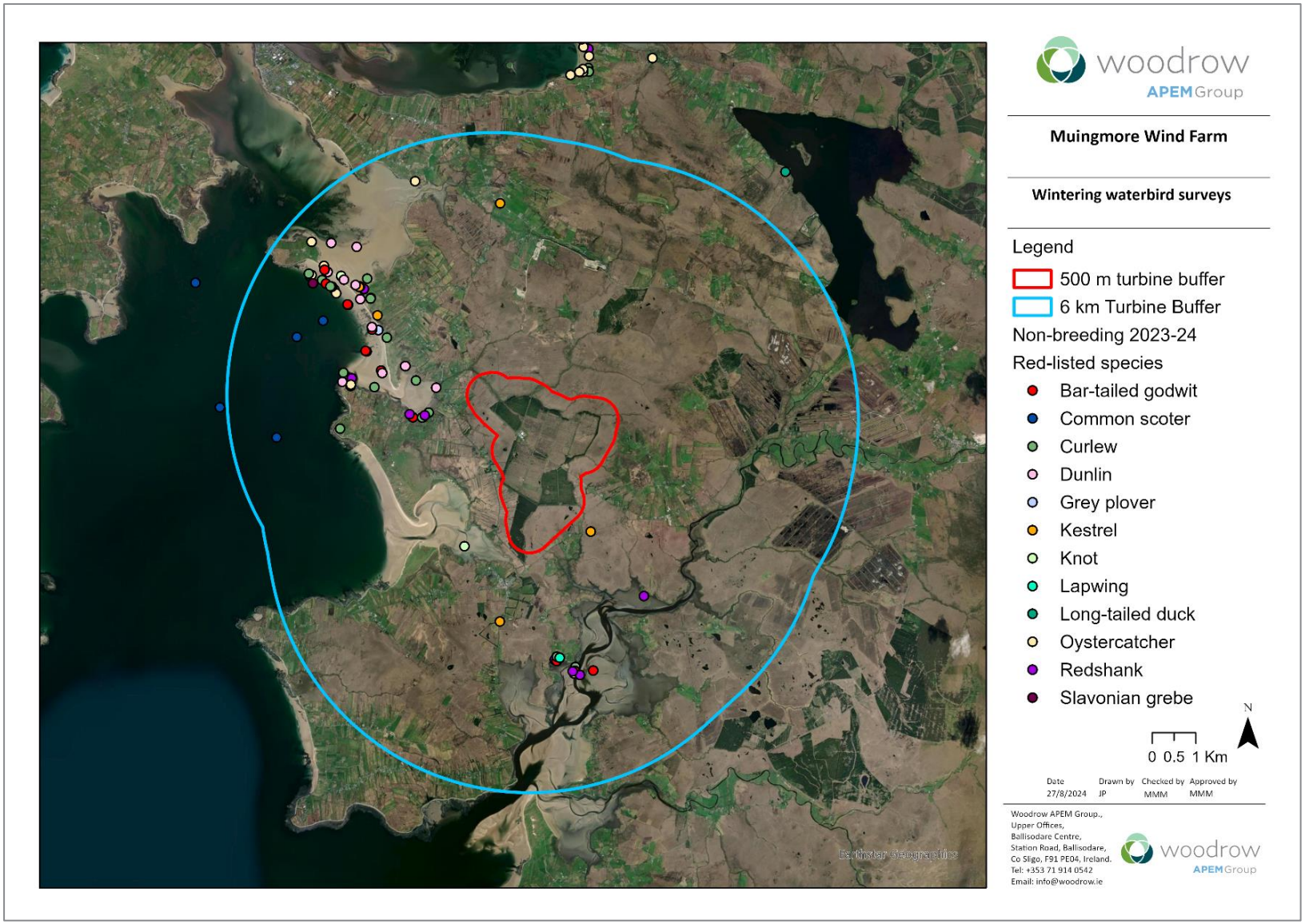

Figure 23: Red-listed species identified during waterbird surveys in the 2023-24 non-breeding season

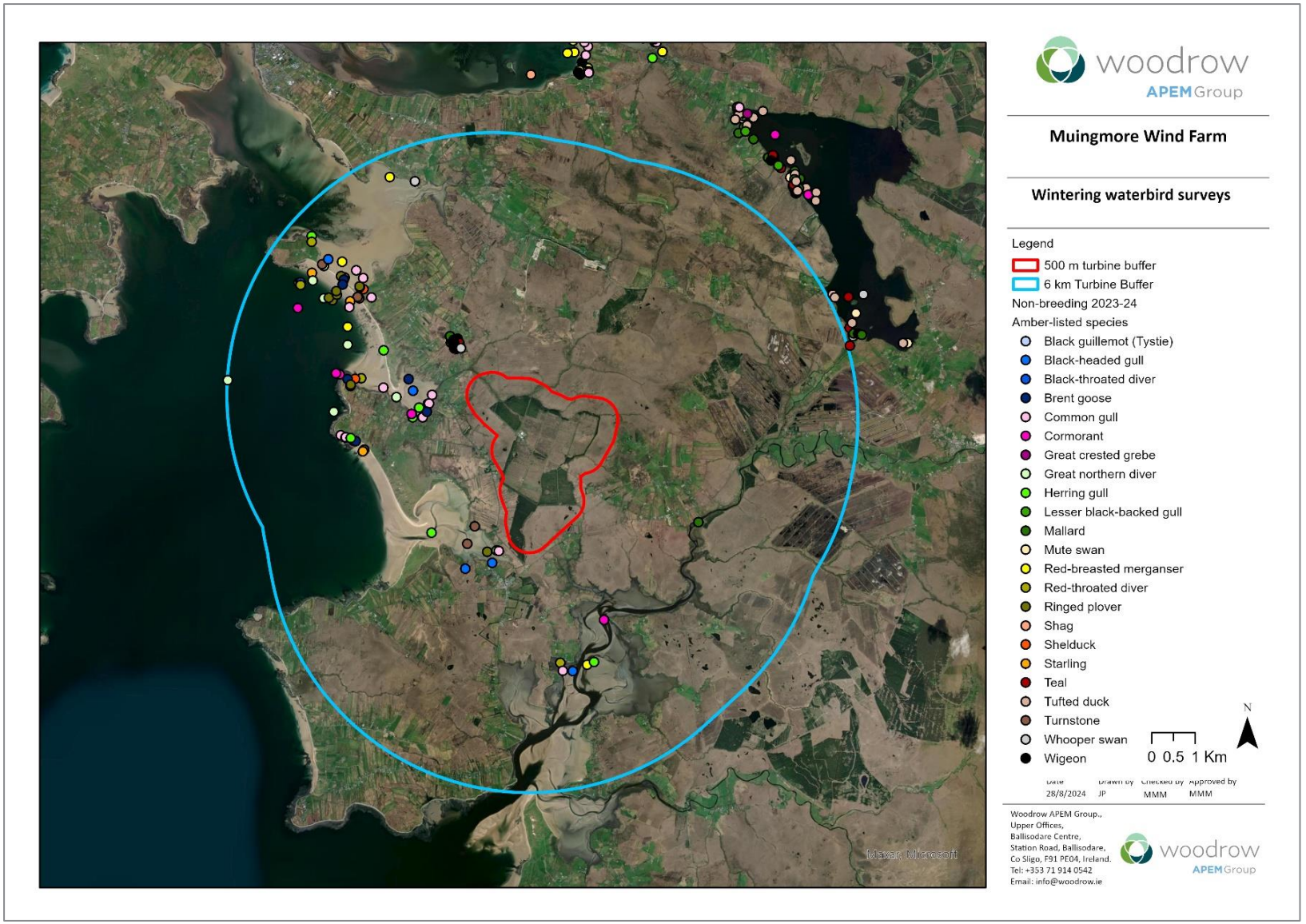

Figure 24: Amber-listed species identified during waterbird surveys in the 2023-24 non-breeding season

4.6. Bioacoustic Monitoring

No raptor species were recorded or identified during the bioacoustic monitoring. The most abundant target species was the snipe, making 78% of all the target detections, followed by the curlew (19%), while other species occasionally occurred in the recordings. Snipe produced three types of vocalisations: the snap in flight, the repetitive ground call (although sometimes in flight) and the tail drumming. Greenland white-fronted goose occurred as a flock in a single event, with multiple recordings, in the hour 10:00pm on 6 April 2023. Similarly, Barnacle goose occurred once, possibly nocturnal migration, with a single recording made at 02:30am on 28 March 2024. A range of passerine species were also identified in the recordings however were not the focus of the analysis and so are not listed here. Below is a summary of the species recorded in Table 33 and Table 34. Figure 25 presents the species recordings across all deployment periods. See **Appendix XII** a list of dates and times of each target species bioacoustic recordings.

Table 33: Overall account of target species recorded during two seasons of bioacoustic monitoring for frequency and abundance of recordings

Species	BTO code	Frequency	Abundance
Barnacle goose	BY	1	0.001
Curlew	CU	313	0.194
Grey heron	H.	1	0.001
Lapwing	L.	4	0.002
Mallard	MA	1	0.001
Moorhen	MH	7	0.004
Oystercatcher	OC	1	0.001
Snipe	SN	1255	0.779
Teal	T.	14	0.009
Greenland white-fronted goose	WG	15	0.009

Table 34: Target species for each bioacoustic monitoring deployment showing frequency and abundance of recordings

Year	Deployment dates	Monitoring unit no.	Species	BTO code	Frequency	Abundance
2	13-03-2023 to 27-03-2023	WSS045	Curlew	CU	8	0.005
	13-03-2023 to 27-03-2023	WSS045	Moorhen	MH	1	0.001
	13-03-2023 to 27-03-2023	WSS045	Snipe	SN	195	0.121
	13-03-2023 to 27-03-2023	WSS045	Teal	T.	4	0.002
	13-03-2023 to 27-03-2023	WSS049	Curlew	CU	10	0.006
	13-03-2023 to 27-03-2023	WSS049	Snipe	SN	243	0.151
	28-03-2023 to 11-04-2023	WSS045	Curlew	CU	26	0.016
	28-03-2023 to 11-04-2023	WSS045	Lapwing	L.	1	0.001
	28-03-2023 to 11-04-2023	WSS045	Mallard	MA	1	0.001
	28-03-2023 to 11-04-2023	WSS045	Moorhen	MH	5	0.003
	28-03-2023 to 11-04-2023	WSS045	Snipe	SN	102	0.063
	28-03-2023 to 11-04-2023	WSS045	Teal	T.	1	0.001
	28-03-2023 to 11-04-2023	WSS045	Greenland white-fronted goose	WG	15	0.009
	28-03-2023 to 11-04-2023	WSS049	Curlew	CU	16	0.010

Year	Deployment dates	Monitoring unit no.	Species	BTO code	Frequency	Abundance
	28-03-2023 to 11-04-2023	WSS049	Grey heron	H.	1	0.001
	28-03-2023 to 11-04-2023	WSS049	Snipe	SN	614	0.381
	28-03-2023 to 11-04-2023	WSS049	Teal	T.	4	0.002
3	13-02-2024 to 16-03-2024	WSS042	Curlew	CU	16	0.010
	13-02-2024 to 16-03-2024	WSS042	Lapwing	L.	1	0.001
	13-02-2024 to 16-03-2024	WSS042	Snipe	SN	19	0.012
	13-02-2024 to 16-03-2024	WSS042	Teal	T.	5	0.003
	13-02-2024 to 16-03-2024	WSS049	Curlew	CU	15	0.009
	13-02-2024 to 16-03-2024	WSS049	Snipe	SN	2	0.001
	17-03-2024 to 13-04-2024	WSS042	Curlew	CU	91	0.056
	17-03-2024 to 13-04-2024	WSS042	Moorhen	MH	1	0.001
	17-03-2024 to 13-04-2024	WSS042	Oystercatcher	OC	1	0.001
	17-03-2024 to 13-04-2024	WSS042	Snipe	SN	15	0.009
	17-03-2024 to 13-04-2024	WSS050	Barnacle goose	BY	1	0.001
	17-03-2024 to 13-04-2024	WSS050	Curlew	CU	81	0.050
	17-03-2024 to 13-04-2024	WSS050	Snipe	SN	64	0.040

4.7. Hen harrier roost searches

4.7.1. Non-breeding season 2021-22

No hen harrier roosts were identified during the hen harrier roost surveys undertaken in winter 2021-22. No hen harriers were noted during any of the surveys covering the proposed development site or in the wider area.

4.7.2. Non-breeding season 2022-23

No hen harrier roost or individual birds were recorded during the targeted hen harrier roost searches, and/or during other surveys undertaken over winter 2022-23 within or adjacent to the 500 m turbine buffer area.

4.7.3. Non-breeding season 2023-24

No hen harrier roosts, or individual birds, were recorded during the targeted hen harrier roost searches, and/or during other surveys undertaken over winter 2023-24 within or adjacent to the 500 m turbine buffer area.

5. DISCUSSION

5.1. Waterbirds

5.1.1. Swans, geese and ducks

Two whooper swan observations were recorded generating a total of 1,080 flight seconds over the three winter surveys, with 100% of the flight time occurring within the CRZ. Flock sizes recorded were between three and five birds. Given only two flights were observed, there is no emerging pattern that is suggestive of birds regularly travelling over the site on migration or between roost sites and foraging areas.

Of geese and ducks recorded during VP surveys, a single Canada goose *Branta canadensis* was recorded flying through the 500 m turbine buffer, generating a total of 50 flight seconds over the three-year surveys and a single greylag goose flock (17 individuals) was noted flying within the 500 m turbine buffer. Three teal *Anas crecca* flights were recorded flying through the 500 m turbine buffer equating to a total of 127 flight seconds, with 69% of the flight time occurring within the CRZ. A total of 19 mallard *Anas platyrhynchos* flights were recorded within the 500 m turbine buffer, equating to 963 flight seconds, with 90% of the flight time occurring within the CRZ. Flights were generally of one to four individuals. A potential breeding territory was identified in a small waterbody in the west part of the 500 m turbine buffer during the 2021 breeding season.

In the wider area, the high activity of waterbirds relates to the presence of the Blacksod Bay/Broad Haven SPA, which comprises of coastal and estuarine habitats in the northern part of Blacksod Bay within the 6 km turbine buffer. Carrowmore Lake SPA also holds concentrations of waterbirds recorded during the wider area waterbird surveys and is in an inland waterbody northwest of the proposed site and within the 6 km turbine buffer.

5.1.2. Waders

Eight wader species were recorded during VP watches over the three-year survey period, with the aggregated flight times for only two wader species, including snipe and Wilson´s phalarope, equating to more than 1,000 seconds within the CRZ. During VP surveys one observation of curlew (two individuals), golden plover (three individuals), greenshank *Tringa nebularia* (one individual), lapwing (three individuals), whimbrel *Numenius phaeopus* (seven individuals), and Wilson´s phalarope (18 individuals) were made.

A total of 22 snipe observations were recorded generating a total of 2,158 flight seconds, with 99% of the flights occurring within the CRZ. Flock size ranged from one to 27 birds with an average flock size of 2 birds. Flight activity was recorded during the non-breeding seasons with higher activity noted over the autumn passage season 2023 (1,475 flight seconds recorded), which cumulatively accounted for 70% of the flight time recorded. Additionally, 20% of the flight time recorded was noted during the non-breeding seasons and only 10% of the flight time recorded was identified during the 2023 breeding season. It is important to mention that snipe were recorded making displaying flights (drumming) around VP4 indicating breeding in this area.

Breeding bird surveys confirmed the presence of breeding snipe within the 500 m turbine buffer during both the 2019 and 2020 breeding seasons. Snipe were recorded chipping and drumming from wet grassland habitats to the north-west and south-east of the 500 m turbine buffer during the 2021 breeding season. Snipe were also considered to hold breeding territories in bog habitat in the south-east of the 500 m turbine buffer during the 2022 and 2023 breeding seasons.

A total of one Wilson's phalarope observation was recorded generating a total of 1,080 flight seconds, with 100% of the flights occurring within the CRZ. The flock comprised a total of 18 individuals.

A total of four woodcock *Scolopax rusticola* observations were recorded during the 2021-22 non-breeding season in the north and east of the 500 m turbine buffer. Woodcock were not recorded during the breeding season in any survey year.

With the exception of snipe, no other wader species were identified as breeding within the 500 m turbine buffer during the three-year survey period.

5.1.3. Gulls

Five species of gull were recorded during VP watches, including black-headed gull, common gull, great black-backed gull, herring gull, and lesser black-backed gull. Four of these species, black-headed gull, great black-backed gull, herring gull and lesser black-backed gull, generated aggregate flight time of more than 1,000 seconds within the CRZ.

Lesser black-backed gull was the most frequently recorded gull species with 82 observations generating a total of 6,142 seconds, with 95% of the seconds occurring within the CRZ. Flock size ranged from one to three birds, with typically observed flights involving one bird. Flight activity was considerably higher during the breeding seasons compared to the non-breeding seasons. The high frequency of flights recorded in summer, mainly located in the west, centre and south-west of the 500 m turbine buffer, suggests that there is likely breeding in the wider area.

The second most recorded gull species was black-headed gull with a total of 70 flights recorded equating to 6,265 flight seconds, with 55% of the seconds occurring within the CRZ. Flock size ranged from one to three birds, with typically observed flights involving one bird. More than 98% of the flights were recorded during the three breeding seasons. Black-headed gull have previously been recorded breeding on Derreens Island in Carrowmore Lake (NPWS, 2015).

A total of 63 great black-backed gull observations were recorded during VP watches over the three-year study period, totalling 6,654 flight seconds, all occurring within the CRZ. These records were widespread within the 500 m turbine buffer and within the different breeding and non-breeding seasons.

A total of 63 herring gull observations were recorded generating a total of 2,628 flight seconds, with 99% of the flights occurring within the CRZ. Flock size ranged from one to five birds. Flight activity was recorded during the breeding seasons.

One single kittiwake *Rissa tridactyla* was recorded during the 2023 spring passage season, which is a very unusual record in the area, and it is presumed to be a disoriented bird.

Surveys indicate that gulls commute across the site, with a suggestion that black-headed gull and lesser black-backed gull breed in the wider area however, the presence of breeding colonies in the wider area was not confirmed.

5.1.4. Other waterbirds

A total of five cormorant *Phalacrocorax carbo* observations were recorded generating 510 flight seconds, with 100% of the flight seconds recorded within the CRZ. All records were of single birds during the non-breeding and the autumn passage seasons, with most flights associated with birds commuting along waterbodies within the 500 m turbine buffer and in the wider area. During wider area wintering waterbird surveys, cormorant observations were associated with the Blacksod Bay/Broad Haven SPA, within the 6 km turbine buffer.

Overall, a total of 32 grey heron observations were recorded equating to 1,603 flight seconds, with 63% of the seconds occurring within the CRZ. All the records were of single birds with the majority of flights associated with birds commuting along waterbodies within the 500 m turbine buffer and in the wider area.

5.2. Raptors

Seven species of raptor were recorded during the VP surveys within the 500 m turbine buffer including buzzard, hen harrier, hobby *Falco subbuteo*, kestrel, merlin, peregrine, and sparrowhawk. Three raptor species, buzzard, kestrel and sparrowhawk, displayed a total aggregate flight time of more than 1,000 seconds within the CRZ over the three-year survey period.

Kestrel was the most active raptor species within the 500 m turbine buffer with 176 flights recorded which generated 16,849 flight seconds recorded, 90% occurring within the CRZ. Almost 70% of the flights observed were recorded during the breeding seasons. Breeding was confirmed during all three breeding seasons in the existing site. Kestrel is a red-listed species due to declining population numbers, with the national population somewhere between 9,918 and 17,393 pairs (Lewis *et al.*, 2019a).

No other raptor species were identified as breeding within the 500 m or the 2 km turbine buffer during surveys.

A total of 75 sparrowhawk observations were recorded during VP watches conducted over the three-year study period, generating 6,133 flight seconds, with 88% occurring within the CRZ. This species tends to fly relatively low (below rotor-swept height), especially when hunting. However, display flights and when commuting longer distances result in flight time within the CRZ. It is acknowledged that the application of CRMs to smaller, evasive species like sparrowhawk may not provide an accurate estimate of collision risk, as these species can be difficult to detect over the full extent of the viewsheds for VPs, due to diminutive size, cryptic nature and/or flight behaviour. While fatalities have been reported from Irish wind farm sites (Cullen and Williams, 2010), sparrowhawk is green-listed species in Ireland of least conservation concern and has a national population of 8,746 – 14,252 pairs (Lewis *et al.,* 2019a).

A total of nine buzzard sightings were recorded during VP watches over the three-year study period. Buzzard observations generated 1,051 flight seconds, with 100% occurring within the CRZ. Typically, single buzzards were recorded foraging, displaying or commuting through the 500 m turbine buffer, with occasionally up to two birds observed simultaneously. Increasingly, as post-construction monitoring programmes improve, buzzards are a species emerging as susceptible to collision with turbines. The buzzard population in Ireland has steadily increased over the last 20 years and is still expanding into new areas, seemingly only limited by the availability of nesting habitat, typically in

trees (Lusby, 2011, Balmer *et al.,* 2013). Although no population estimate is available for buzzards in Ireland, as indicated by the BoCCI green-list status of the species.

Eight hen harrier observations were recorded equating to 935 flight seconds, with 28% of the seconds occurring within the CRZ. Four of these observations were recorded during the non-breeding seasons, two observations during the breeding seasons, a single observation during the autumn passage season and another one during the spring passage season. These results, along with results of other wider area surveys including hen harrier roost watches, suggest that flights are not associated with breeding or winter roosting sites within the 2 km buffer.

A total of eight peregrine observations were recorded generating 390 flight seconds, with all the flight time occurring within the CRZ. Half of these observations were recorded during the autumn passage season and the other half during the non-breeding seasons. Typically, single birds were recorded hunting or travelling through the 500 m buffer, although on two occasions during the 2022 autumn passage season a pair was seen flying to the west and south-west of the 500 m turbine buffer. Considering the infrequency of flights over three years of surveys, the proposed development site does not represent a particularly important site for peregrine.

Five merlin flights were observed during VP surveys, including three observations during the non-breeding seasons and two during the spring passage seasons. While observations were infrequent, merlin appear to be using the lands within the proposed development site to over-winter or for commuting through the spring season.

Three hobby flights were recorded during VP watches in the 2022 breeding season. All records were observed on the same day (19 July 2022), including a single individual flying low over peatland in the west of the 500 m turbine buffer.

5.3. Other species of conservation concern

Meadow pipit, a red-listed passerine of conservation concern, was recorded during the three-year survey period. Meadow pipits were the most abundant and widespread passerine recorded during all breeding seasons, and breed within suitable open bog and grassland habitats within the 500 m turbine buffer. Eight amber-listed passerines of conservation concern were recorded during the three-year survey period and included goldcrest *Regulus regulus*, house sparrow *Passer domesticus*, linnet *Linaria cannabina*, skylark *Alauda arvensis*, willow warbler *Phylloscopus trochilus*, starling, sand martin *Riparia riparia* and swallow *Hirundo rustica*. Goldcrest were recorded breeding in suitable forestry habitat within the 500 m turbine buffer and this result was consistent during all breeding seasons. Suitable breeding habitats for swallows were identified in the existing buildings in the central part of the proposed development site. Willow warblers were recorded breeding in suitable woodlands and scrublands within the 500 m turbine buffer.

Populations of red and amber-listed passerines recorded within the proposed development site are not at risk from collisions with turbines but are sensitive to vegetation removal and disturbance.

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Appendix I - Historical records

Table I.1: NBDC bird records within 10km of the proposed site from the period 2011-22

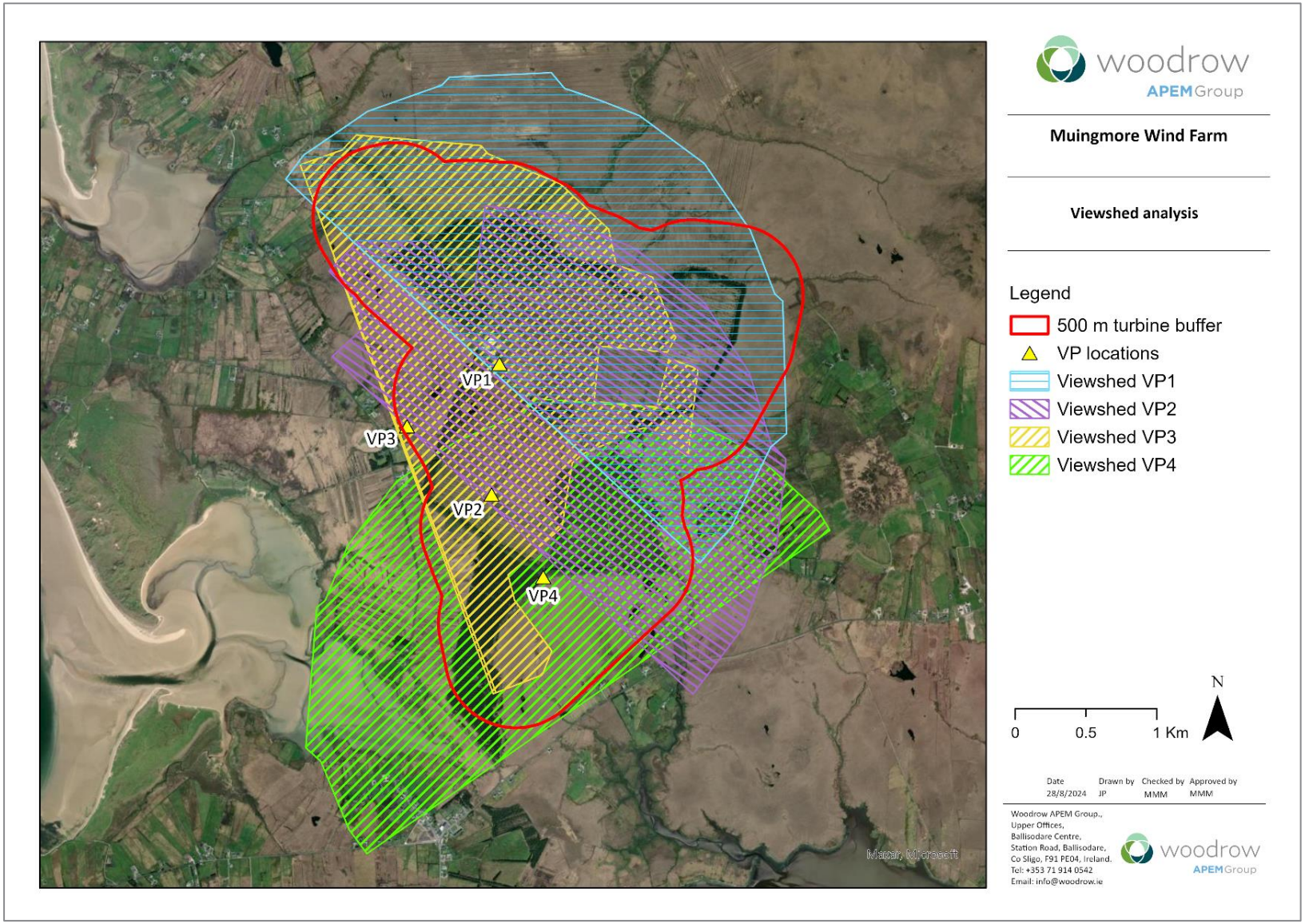
Common name	Scientific name	BoCCI 2020-2026	Count	Date
Red-listed species *are species of highest conservation concern where the population is rapidly declining in abundance or range, has experienced a historic rapid decline (without recovery) or is globally threatened.*				
Bar-tailed godwit	*Limosa lapponica*	Red [Win]	11	31/12/2011
Black-legged kittiwake	*Rissa tridactyla*	Red [Br]	4	15/05/2018
Common goldeneye	*Bucephala clangula*	Red [Win]	4	31/12/2011
Common kestrel	*Falco tinnunculus*	Red [Br]	21	04/08/2015
Common pochard	*Aythya ferina*	Red [Br. and Win]	4	31/12/2011
Common redshank	*Tringa totanus*	Red [Br. and Win]	22	31/12/2011
Common scoter	*Melanitta nigra*	Red [Br. and Win]	10	31/12/2011
Common snipe	*Gallinago gallinago*	Red [Br. and Win]	39	28/04/2018
Corn crake	*Crex crex*	Red [Br]	9	22/05/2018
Curlew sandpiper	*Calidris ferruginea*	Red [Passage]	1	24/02/2018
Dunlin	*Calidris alpina*	Red [Br. and Win]	14	31/12/2011
Eurasian curlew	*Numenius arquata*	Red [Br. and Win]	33	30/08/2020
Eurasian oystercatcher	*Haematopus ostralegus*	Red [Br. and Win]	29	10/07/2018
Eurasian woodcock	*Scolopax rusticola*	Red [Br]	10	31/12/2011
European golden plover	*Pluvialis apricaria*	Red [Br. and Win]	12	14/07/2021
European turtle dove	*Streptopelia turtur*	Red [Passage]	1	26/03/2018
Greater scaup	*Anas marila*	Red [Win]	4	31/12/2011
Grey plover	*Pluvialis squatarola*	Red [Win]	5	31/12/2011
Grey wagtail	*Motacilla cinerea*	Red [Br]	14	28/03/2019
Long-tailed duck	*Clangula hyemalis*	Red [Win]	5	31/12/2011
Meadow pipit	*Anthus pratensis*	Red [Br]	70	28/04/2018
Northern lapwing	*Vanellus vanellus*	Red [Br. and Win]	22	31/12/2011
Purple sandpiper	*Calidris maritima*	Red [Win]	3	31/12/2011
Red grouse	*Lagopus lagopus hibernicus*	Red [Br]	13	17/02/2020
Red knot	*Calidris canutus*	Red [Win]	5	31/12/2011
Redwing	*Turdus iliacus*	Red [Win]	13	31/12/2011
Slavonian grebe	*Podiceps auritus*	Red [Win]	6	31/12/2011
Twite	*Carduelis flavirostris*	Red [Br]	7	31/12/2011
Velvet scoter	*Melanitta fusca*	Red [Win]	1	31/12/2011
Amber-listed species *are those with unfavourable European status, occur in internationally important numbers, are moderately declining in abundance or range, or if the population occurs in very small numbers.*				
Arctic tern	*Sterna paradisaea*	Amber [Br]	3	31/12/2011
Barn swallow	*Hirundo rustica*	Amber [Br]	43	02/07/2018
Barnacle goose	*Branta leucopsis*	Amber [Win]	5	24/03/2018
Black guillemot	*Cepphus grylle*	Amber [Br]	8	31/12/2011
Black-headed gull	*Chroicocephalus ridibundus*	Amber [Br. and Win]	31	05/08/2018
Black-throated diver	*Gavia arctica*	Amber [Win]	2	31/12/2011
Brent goose (light-bellied)	*Branta bernicla hrota*	Amber [Win]	10	31/12/2011
Common guillemot	*Uria aalge*	Amber [Br]	18	31/12/2011

Common name	Scientific name	BoCCI 2020-2026	Count	Date
Common kingfisher	*Alcedo atthis*	Amber [Br]	4	31/12/2011
Common linnet	*Carduelis cannabina*	Amber [Br]	31	31/12/2011
Common sandpiper	*Actitis hypoleucos*	Amber [Br]	14	31/12/2011
Common shelduck	*Tadorna tadorna*	Amber [Br. and Win]	12	07/04/2018
Common starling	*Sturnus vulgaris*	Amber [Br]	53	27/03/2019
Common tern	*Sterna hirundo*	Amber [Br]	5	10/06/2018
Eurasian teal	*Anas crecca*	Amber [Br. and Win]	19	31/12/2011
Eurasian tree sparrow	*Passer montanus*	Amber [Br]	2	15/03/2018
Eurasian wigeon	*Anas penelope*	Amber [Br. and Win]	11	31/12/2011
European greenfinch	*Carduelis chloris*	Amber [Br]	23	31/12/2011
European shag	*Phalacrocorax aristotelis*	Amber [Br]	10	16/05/2018
Gadwall	*Anas strepera*	Amber [Br. and Win]	2	31/12/2011
Goldcrest	*Regulus regulus*	Amber [Br]	23	29/11/2017
Goosander	*Mergus merganser*	Amber [Br]	2	31/12/2011
Great cormorant	*Phalacrocorax carbo*	Amber [Br. and Win]	31	20/02/2018
Great northern diver	*Gavia immer*	Amber [Win]	16	31/12/2011
Greylag goose	*Anser anser*	Amber [Win]	7	31/12/2011
Hen harrier	*Circus cyaneus*	Amber [Br]	4	31/12/2011
Herring gull	*Larus argentatus*	Amber [Br. and Win]	30	15/05/2018
House martin	*Delichon urbicum*	Amber [Br]	7	31/12/2011
House sparrow	*Passer domesticus*	Amber [Br]	45	27/03/2019
Lesser black-backed gull	*Larus fuscus*	Amber [Br. and Win]	15	12/03/2018
Mallard	*Anas platyrhynchos*	Amber [Br. and Win]	42	31/12/2011
Merlin	*Falco columbarius*	Amber [Br]	13	30/07/2017
Mew gull	*Larus canus*	Amber [Br. and Win]	31	31/12/2011
Mute swan	*Cygnus olor*	Amber [Br. and Win]	5	31/12/2011
Northern gannet	*Morus bassanus*	Amber [Br]	5	31/12/2011
Northern pintail	*Anas acuta*	Amber [Win]	3	31/12/2011
Northern wheatear	*Oenanthe oenanthe*	Amber [Br]	28	13/05/2021
Red-billed chough	*Pyrrhocorax pyrrhocorax*	Amber [Br]	4	18/03/2018
Red-breasted merganser	*Mergus serrator*	Amber [Br. and Win]	22	31/12/2011
Red-throated diver	*Gavia stellata*	Amber [Br. and Win]	6	31/12/2011
Ringed plover	*Charadrius hiaticula*	Amber [Br]	30	07/04/2018
Ruddy turnstone	*Arenaria interpres*	Amber [Win]	14	15/03/2018
Sand martin	*Riparia riparia*	Amber [Br]	10	31/12/2011
Sandwich tern	*Sterna sandvicensis*	Amber [Br]	8	31/12/2011
Sky lark	*Alauda arvensis*	Amber [Br]	52	02/07/2018
Spotted flycatcher	*Muscicapa striata*	Amber [Br]	3	21/05/2011
Tufted duck	*Aythya fuligula*	Amber [Br. and Win]	11	31/12/2011
Whooper swan	*Cygnus cygnus*	Amber [Br. and Win]	8	31/12/2011
Willow warbler	*Phylloscopus trochilus*	Amber [Br]	25	28/04/2018
***Green-listed birds** are not considered threatened.*				
American golden plover	*Pluvialis dominica*	Green	7	30/09/2012

Common name	Scientific name	BoCCI 2020-2026	Count	Date
Black-billed magpie	*Pica pica*	Green	60	07/01/2018
Blackcap	*Sylvia atricapilla*	Green	2	31/12/2011
Blue tit	*Cyanistes caeruleus*	Green	38	29/03/2018
Brent goose	*Branta bernicla*	Green	13	31/12/2011
Carrion crow	*Corvus corone*	Green	5	27/03/2019
Chaffinch	*Fringilla coelebs*	Green	45	31/12/2011
Coal tit	*Periparus ater*	Green	27	26/03/2018
Common blackbird	*Turdus merula*	Green	68	27/03/2019
Common cuckoo	*Cuculus canorus*	Green	17	28/05/2018
Common grasshopper warbler	*Locustella naevia*	Green	14	28/04/2018
Common greenshank	*Tringa nebularia*	Green	12	18/03/2018
Common moorhen	*Gallinula chloropus*	Green	16	31/12/2011
Common pheasant	*Phasianus colchicus*	Green	3	31/12/2011
Common raven	*Corvus corax*	Green	17	27/05/2018
Common whitethroat	*Sylvia communis*	Green	4	31/12/2011
Common wood pigeon	*Columba palumbus*	Green	40	28/05/2018
Eurasian collared dove	*Streptopelia decaocto*	Green	11	31/12/2011
Eurasian jackdaw	*Corvus monedula*	Green	39	31/12/2011
Eurasian siskin	*Carduelis spinus*	Green	7	31/12/2011
Eurasian sparrowhawk	*Accipiter nisus*	Green	19	20/08/2018
European goldfinch	*Carduelis carduelis*	Green	18	31/12/2011
European robin	*Erithacus rubecula*	Green	64	27/03/2019
Fieldfare	*Turdus pilaris*	Green	10	27/03/2018
Great black-backed gull	*Larus marinus*	Green	16	31/12/2011
Great tit	*Parus major*	Green	16	31/12/2011
Greater white-fronted goose	*Anser albifrons*	Green	6	31/12/2011
Greenland white-fronted goose	*Anser albifrons flavirostris*	Green	4	31/12/2011
Green-winged teal	*Anas carolinensis*	Green	2	31/12/2011
Grey heron	*Ardea cinerea*	Green	23	22/05/2018
Hedge accentor	*Prunella modularis*	Green	41	31/12/2011
Hooded crow	*Corvus cornix*	Green	76	28/04/2018
Iceland gull	*Larus glaucoides*	Green	4	18/03/2018
Jack snipe	*Lymnocryptes minimus*	Green	2	31/12/2011
Lesser redpoll	*Carduelis flammea cabaret*	Green	23	28/04/2018
Little grebe	*Tachybaptus ruficollis*	Green	8	31/12/2011
Long-eared owl	*Asio otus*	Green	3	31/12/2011
Long-tailed tit	*Aegithalos caudatus*	Green	2	31/12/2011
Mistle thrush	*Turdus viscivorus*	Green	15	27/03/2019
Peregrine falcon	*Falco peregrinus*	Green	5	24/05/2018
Pied wagtail	*Motacilla alba yarrellii*	Green	2	05/01/2018
Pink-footed goose	*Anser brachyrhynchus*	Green	3	31/12/2011
Red-necked grebe	*Podiceps grisegena*	Green	3	31/12/2011
Reed bunting	*Emberiza schoeniclus*	Green	40	31/12/2011

Common name	Scientific name	BoCCI 2020-2026	Count	Date
Ring-necked duck	*Aythya collaris*	Green	3	31/12/2011
Rock pigeon	*Columba livia*	Green	3	31/12/2011
Rock pipit	*Anthus petrosus*	Green	17	31/12/2011
Rook	*Corvus frugilegus*	Green	16	31/12/2011
Sanderling	*Calidris alba*	Green	9	07/04/2018
Sedge warbler	*Acrocephalus schoenobaenus*	Green	24	31/12/2011
Snow bunting	*Plectrophenax nivalis*	Green	1	31/12/2011
Snow goose	*Anser caerulescens*	Green	4	31/12/2011
Song thrush	*Turdus philomelos*	Green	48	15/03/2018
Stonechat	*Saxicola torquata*	Green	50	31/12/2011
Water rail	*Rallus aquaticus*	Green	2	31/12/2011
White wagtail	*Motacilla alba*	Green	51	31/12/2011
White-rumped sandpiper	*Calidris fuscicollis*	Green	3	02/10/2012
White-throated dipper	*Cinclus cinclus*	Green	6	19/04/2016
Winter wren	*Troglodytes troglodytes*	Green	68	28/04/2018

Appendix II - VP viewshed analysis



Appendix III - VP watches effort tables

Table III.1: VP watch survey hours completed at the 500 m turbine buffer during the 2021 breeding season

Breeding season 2021				
Date	**VP1**	**VP2**	**VP3**	**VP4**
27/04/2021	3	3	-	-
28/04/2021	3	-	3	-
10/05/2021	-	3	3	-
08/06/2021	3	-	-	3
09/06/2021	-	3	3	
10/06/2021	3		-	3
17/06/2021	2	2	-	
21/06/2021	2		2	2
28/06/2021	2	2	2	
01/07/2021	-	6	-	-
12/07/2021	3	-	-	3
13/07/2021	2		2	2
14/07/2021	-	2	2	2
15/07/2021	3	-	3	-
19/07/2021	-	-	3	3
21/07/2021	-	3	2	-
22/07/2021	-		2	3
04/08/2021	-	3	3	
10/08/2021	-		3	3
2/08/2021	3	3	-	-
18/08/2021	-	-	-	6
23/08/2021	6	-	-	-
24/08/2021	-	3	-	3
25/08/2021	3	-	3	-
26/08/2021	-	3	-	3
Total hours	**38**	**36**	**36**	**36**

Table III.2: VP watch survey hours completed at the 500 m turbine buffer during the 2021 autumn passage season

Autumn passage season 2021				
Date	**VP1**	**VP2**	**VP3**	**VP4**
07/09/2021	-	1.5	-	1.5
09/09/2021	1.5	-	1.5	-
27/09/2021	1.5	-	1.5	-
28/09/2021	-	1.5	-	1.5
04/10/2021	1.5	-	1.5	-
05/10/2021	-	1.5		1.5
Total hours	**4.5**	**4.5**	**4.5**	**4.5**

Table III.3: VP watch survey hours completed at the 500 m turbine buffer during the 2021-22 non-breeding season

Non-breeding season 2021-22				
Date	**VP1**	**VP2**	**VP3**	**VP4**
13/10/2021	3	3	-	-
14/10/2021	-	-	3	3
20/10/2021	3	3	-	-
25/10/2021	-	-	3	3
19/11/2021	3	3	-	-
22/11/2021	-	3	3	-
24/11/2021	3	-	-	3
25/11/2021	-	-	3	3
29/11/2021	-	-	3	3
09/12/2021	3	-	-	-
16/12/2021	3	-	3	-
17/12/2021	-	3	3	-
10/01/2022	-	3	-	3
12/01/2022	-	-	-	3
18/01/2022	3	3	-	-
19/01/2022	3	3	-	-
27/01/2022	3	3	-	-
31/01/2022	-	-	6	-
01/02/2022	-	-	-	3
09/02/2022	3	-	-	-
17/02/2022	3	-	3	-
18/02/2022	-	-	-	3
21/02/2022	-	3	3	
23/02/2022	-		-	3
28/02/2022	-	3	-	-
01/03/2022	-		-	3
04/03/2022	-	2	-	-
09/03/2022	-	-	3	3
10/03/2022	3	3	-	-
Total hours	**36**	**38**	**36**	**36**

Table III.4: VP watch survey hours completed at the 500 m turbine buffer during the 2022 breeding season

Breeding season 2022				
Date	**VP1**	**VP2**	**VP3**	**VP4**
14/04/2022	3	3	-	-
15/04/2022	-	-	3	3
21/04/2022	-	3		3
27/04/2022	3	-	3	-
28/04/2022	-	3	-	3
04/05/2022	3	-	3	-
05/05/2022	-	3	-	3
17/05/2022	-	3	6	-
02/06/2022	-	-	3	-

Breeding season 2022				
Date	**VP1**	**VP2**	**VP3**	**VP4**
18/05/2022	6	-	-	-
25/06/2022	6	-	-	-
06/07/2022	3	-	-	-
19/07/2022	3	-	3	-
03/08/2022	3	3	-	-
09/08/2022	6	-	-	-
16/05/2022	-	6	-	-
24/06/2022	-	6	-	-
18/08/2022	-	6	-	-
13/06/2022	-	-	6	-
08/08/2022	-	-	6	-
15/05/2022	-	-	-	6
26/06/2022	-	-	-	6
27/07/2022	-	-	-	6
11/08/2022	-	-	6	-
29/08/2022	-	-	-	6
Total hours	**36**	**36**	**39**	**36**

Table III.5: VP watch survey hours completed at the 500 m turbine buffer during the 2022 autumn passage season

Autumn passage season 2022				
Date	**VP1**	**VP2**	**VP3**	**VP4**
12/09/2022	5	3	-	-
13/09/2022		6	-	2
11/10/2022	1	3	-	3
12/10/2022	-	3	1	-
14/10/2022		3		-
19/10/2022	-	-	3	-
14/09/2022	-	-	8	3
15/09/2022	-	-	1	1
10/10/2022	2	-	2	-
13/10/2022	3	-	3	3
11/09/2022	4	-	-	3
16/10/2022	-	-	-	3
17/10/2022	3	-	-	-
Total hours	**18**	**18**	**18**	**18**

Table III.6: VP watch survey hours completed at the 500 m turbine buffer during the 2022-23 non-breeding season

Non-breeding season 2022-23				
Date	**VP1**	**VP2**	**VP3**	**VP4**
19/10/2022	3	3	-	-
08/11/2022	3	3	-	-
10/11/2022	2		3	2
11/11/2022	2.5	3	-	-

Non-breeding season 2022-23				
Date	**VP1**	**VP2**	**VP3**	**VP4**
13/11/2022	1	-	1.5	
14/11/2022	1.5	-	-	3
17/11/2022	2	-	3	2
07/12/2022	5	-	-	-
08/12/2022	1	-	6	-
21/01/2023	3	-	1	6
25/01/2023	3	3	-	-
08/02/2023	3	3	-	-
21/02/2023	6	-	-	-
09/11/2022	-	3	-	-
15/11/2022	-	3	1.5	-
12/12/2022	-	6	-	-
30/01/2023	-	3	-	-
22/02/2023	-	6		-
20/10/2022	-	-	1	3
21/10/2022	-	-	2	-
07/11/2022	-	-	3	3
20/01/2023	-	-	2	-
29/01/2023	-	-	3	-
18/02/2023	-	-	5	-
19/02/2023	-	-	4	5
12/11/2022	-	-	-	1.5
11/12/2022	-	-		4.5
15/12/2022	-	-		2
20/02/2023	-	-		4
Total hours	**36**	**36**	**36**	**36**

Table III.7: VP watch survey hours completed at the 500 m turbine buffer during the 2023 spring passage season

Spring passage season 2023				
Date	**VP1**	**VP2**	**VP3**	**VP4**
01/03/2023	-	-	3	-
02/03/2023	3	4.5	-	-
03/03/2023	-	-	2.5	3
05/03/2023	1.5	-	3.5	-
06/03/2023	1.5	-	-	-
08/03/2023	-	-	-	3
04/04/2023	-	-	9	-
05/04/2023	-	-	-	8
06/04/2023	6	-	-	-
07/04/2023	6	-	-	
09/04/2023	-	-	-	4
10/04/2023	-	7	-	-
11/04/2023	-	7	-	-

Total hours	**18**	**18.5**	**18**	**18**

Table III.8: VP watch survey hours completed at the 500 m turbine buffer during the 2023 breeding season

Breeding season 2023				
Date	**VP1**	**VP2**	**VP3**	**VP4**
01/03/2023	3	-	-	3
04/03/2023	-	-	-	1.5
05/03/2023	-	2	-	-
06/03/2023	-	3	-	1.5
08/03/2023	-	3	-	-
09/03/2023	3	-	3	-
05/04/2023	-	-	3	-
04/05/2023	-	-	9	-
05/05/2023	-	-	-	9
06/05/2023	9	-	-	-
07/05/2023	-	6	-	-
08/05/2023	-	4	-	-
07/06/2023	-	-	9	-
08/06/2023	-	-	-	9
09/06/2023	9	-	-	-
10/06/2023	-	9	-	-
05/07/2023	3	3	-	-
06/07/2023	3	-	-	-
25/07/2023	-	2	3	3
26/07/2023	-	1	3	3
01/08/2023	3	-	6	-
02/08/2023	3	3	-	-
03/08/2023	-	3	-	3
09/08/2023	-	-	-	3
Total hours	**36**	**39**	**36**	**36**

Table III.9: VP watch survey hours completed at the 500 m turbine buffer during the 2023 autumn passage season

Autumn passage season 2023				
Date	**VP1**	**VP2**	**VP3**	**VP4**
02/09/2023	-	-	8	-
05/09/2023	-	-	-	6
06/09/2023	-	-	4	-
07/09/2023	9	-	-	-
12/09/2023	-	1	-	-
11/10/2023	-	-	6	-
13/10/2023	-	-	-	13.5
14/10/2023	9	-		1.25
17/10/2023	-	2.5	-	-
31/10/2023	-	9.5	-	-
03/11/2023	-	5	-	-

Total hours	**18**	**18**	**18**	**20.8**

Table III.10: VP watch survey hours completed at the 500 m turbine buffer during the 2023-24 non-breeding season

Non-breeding season 2023-24				
Date	**VP1**	**VP2**	**VP3**	**VP4**
04/09/2023	2	-	-	-
05/09/2023	-	-	-	3
06/09/2023	-	-	-	3
08/09/2023	1	10	-	-
12/09/2023	-	1	-	-
12/10/2023	-	-	5	-
15/10/2023	2.75	-	-	-
01/11/2023	9.5	-	-	-
02/11/2023	1.25	-	10	-
04/11/2023	-	-	3	-
05/11/2023	-	7	1	-
06/11/2023	1	-	-	-
23/11/2023	-	-	-	6
30/11/2023	-	-	-	6
13/12/2023	3	-	3	-
14/12/2023	3	-	3	-
15/12/2023	-	6	-	-
20/12/2023	-	-	-	-
08/01/2024	3	-	3	-
09/01/2024	3	-	3	-
12/01/2024	-	6	-	-
25/01/2024	-	-	-	6
19/02/2024	3	-	6	-
20/02/2024	-	-	-	6
27/02/2024	1	6	-	-
05/03/2024	2	-	-	-
Total hours	**35.5**	**36**	**37**	**36**

Table III.11: VP watch survey hours completed at the 500 m turbine buffer during the 2024 spring passage season

Spring passage season 2024				
Date	**VP1**	**VP2**	**VP3**	**VP4**
19/03/2024	-	-	9	-
20/03/2024	9	-	-	-
21/03/2024	-	-	-	9
22/03/2024	-	9	-	-
16/04/2024	6	3	-	-
17/04/2024	3	-	-	-
18/04/2024	-	-	3	-
22/04/2024	3	-	-	-

23/04/2024	-	-	3	-
24/04/2024	-	-	-	6
25/04/2024	-	3	-	-
15/05/2024	-	-	3	-
16/05/2024	-	3	-	-
20/05/2024	-	-	-	3
Total hours	**21**	**18**	**18**	**18**

Appendix IV - Breeding bird survey effort tables

Table IV.1: Dates, duration, surveyor and weather conditions for walkover surveys during breeding seasons

Season	Visit	Date	Start time	Duration	Surveyor	Wind force1 above[2]	Wind Dir	Cloud (oktas)[3]	Temp. (°C)	Rain
Breeding 2021	1	12/05/2021	11:17	6.50	PD	3	SW	5	14	None
Breeding 2021	1	17/05/2021	08:17	8.00	PD	3	NE	6	13	Light showers
Breeding 2021	2	15/06/2021	11:59	5.25	PD	6	W	8	14	Heavy shower
Breeding 2022	1	24/06/2022	12:00	2.50	EH	3	SW	8	14	Heavy shower
Breeding 2022	1	25/06/2022	09:00	6.00	CD	2	SW	8	15	Heavy shower
Breeding 2022	1	26/06/2022	09:15	3.00	EH	3	SW	7	15	Occasional heavy shower
Breeding 2023	1	06/04/2023	14:30	3.00	SM	2	W	2	12	None
Breeding 2023	1	07/04/2023	13:45	5.00	SM	5	S	5	9	Light showers
Breeding 2023	1	11/04/2023	14:15	3.25	SM	3	SW	6	8	Moderate showers
Breeding 2023	2	06/05/2023	05:30	1.25	SM	2	ENE	0	16	None
Breeding 2023	2	07/05/2023	12:26	2.25	SM	1	E	8	11	None
Breeding 2023	2	07/05/2023	15:21	0.50	SM	3	SM	1	12	None
Breeding 2023	2	08/05/2023	18:00	1.75	SM	1	E	8	11	None
Breeding 2023	3	11/06/2023	14:30	2.50	SM	2	E	6	18	None
Breeding 2023	3	12/06/2023	15:20	4.00	SM	2	E	6	18	None
Breeding 2023	3	12/06/2023	19:15	1.75	SM	2	E	6	18	None
Breeding 2023	3	13/06/2023	14:30	1.75	SM	3	E	5	16	None
Breeding 2023	3	13/06/2023	17:00	1.50	SM	3	E	5	16	None
Breeding 2023	4	20/06/2023	18:00	1.50	SM	1	S	0	18	None

Table IV.2: Dates, duration, surveyor and weather conditions for dusk surveys during breeding seasons

Season	Visit	Date	Start time	Duration	Surveyor	Wind force[2]	Wind Dir	Cloud (oktas)[3]	Temp. (°C)	Rain
Breeding 2021	1	28/06/2021	21:42	2.00	PD	3	S	4	14	None
Breeding 2022	1	16/05/2022	19:30	3.00	CD	5	S	1	17	None
Breeding 2022	2	02/06/2022	23:32	1.50	DL	2	E	2	17	None
Breeding 2022	2	06/06/2022	23:31	1.50	DL	3	E	7	16	None
Breeding 2022	3	19/07/2022	23:30	1.50	DL	2	S	6	17	None

[2] Wind force is measured using the Beaufort Scale (1-12)

[3] Cloud cover is measured using oktas (8/8)

Season	Visit	Date	Start time	Duration	Surveyor	Wind force[2]	Wind Dir	Cloud (oktas)[3]	Temp. (°C)	Rain
Breeding 2023	1	06/04/2023	18:15	1.00	SM	2	W	2	10	None
Breeding 2023	1	06/04/2023	20:20	0.50	SM	2	W	2	8	None
Breeding 2023	1	06/04/2023	20:55	1.00	SM	2	W	2	8	None
Breeding 2023	1	08/04/2023	18:17	1.00	SM	2	W	2	10	None
Breeding 2023	2	05/05/2023	21:15	1.00	SM	3	S	7	12	None
Breeding 2023	2	06/05/2023	21:15	1.00	SM	3	E	7	11	None
Breeding 2023	2	08/05/2023	21:15	1.00	SM	1	E	8	11	None
Breeding 2023	3	05/06/2023	21:50	2.00	SM	2	ENE	0	16	None
Breeding 2023	3	10/06/2023	21:20	1.50	SM	2	E	6	18	None
Breeding 2023	4	09/08/2023	21:00	2.00	DL	1	S	0	18	None

Appendix V - Breeding raptor survey effort table

Table V.1: Dates, duration, surveyor and weather conditions for breeding raptor surveys during breeding seasons

Season	Visit	Date	Start time	Duration	Surveyor	Wind Force[2]	Wind Dir	Cloud (oktas)[3]	Temp. (°C)	Rain
Breeding 2021	1	31/05/2021	12:55	4.00	PD	3	NE	8	16	None
Breeding 2021	2	01/06/2021	09:39	6.00	PD	2	SE	7	13	Showers
Breeding 2022	1	13/06/2022	11:45	2.50	DL	4	W-SW	5	14	None
Breeding 2023	1	28/03/2023	13:00	1.00	DL	4	S	8	10	Showers
Breeding 2023	2	09/04/2023	14:15	4.00	SM	4	S	8	10	Heavy shower
Breeding 2023	2	10/04/2023	12:10	1.00	SM	2	W	2	10	None
Breeding 2023	3	11/06/2023	17:30	2.00	SM	2	S	2	20	None
Breeding 2023	3	12/06/2023	12:25	3.50	SM	2	S	3	19	None
Breeding 2023	3	13/06/2023	13:15	1.00	SM	3	NE	2	18	None
Breeding 2023	3	14/06/2023	18:25	1.50	SM	3	NE	2	16	None
Breeding 2023	4	11/07/2023	14:45	3.00	DL	4	W	7	16	Showers
Breeding 2023	4	11/07/2023	18:00	3.00	DL	4	W	8	14	Showers

Appendix VI - Winter walkover survey effort table

Table VI.1: Dates, duration, surveyor and weather conditions for winter walkover surveys during non-breeding seasons

Season	Visit	Date	Start time	Duration	Surveyor	Wind Force[2]	Wind Dir	Cloud (oktas)[3]	Temp. (°C)	Rain
Non-breeding 2021-22	1	28/10/2021	07:15	6.00	DP	4	SE	8	12	None
Non-breeding 2021-22	1	31/10/2021	10:31	3.25	DP	4	SE/SW	8	10	Showers
Non-breeding 2021-22	2	11/01/2022	08:14	5.75	DP	4	SW	5	9	None
Non-breeding 2021-22	2	12/01/2022	11:15	3.00	DP	4	SW	6	8	None
Non-breeding 2021-22	3	23/02/2022	11:45	3.00	DP	6	SW	9	5	Showers
Non-breeding 2021-22	3	28/02/2022	11:55	3.00	DP	4	SW	4	10	Showers
Non-breeding 2022-23	1	11/10/2022	13:00	0.75	MH	4	S	8	14	None
Non-breeding 2022-23	1	12/10/2022	07:45	2.50	MH	2	W	6	13	None
Non-breeding 2022-23	1	14/10/2022	10:15	3.50	MH	3	SW	3	11	None
Non-breeding 2022-23	1	16/10/2022	07:35	5.00	MH	2	SE	7	10	None
Non-breeding 2022-23	2	08/11/2022	10:30	2.50	MH	3	SW	6	11	None
Non-breeding 2022-23	2	09/11/2022	12:50	2.00	MH	4	SW	8	12	Showers
Non-breeding 2022-23	2	11/11/2022	13:00	2.00	MH	3	SW	5	11	None
Non-breeding 2022-23	2	12/11/2022	10:30	2.00	MH	3	SW	7	12	None
Non-breeding 2022-23	2	14/11/2022	09:00	3.50	MH	3	SE	3	10	None
Non-breeding 2022-23	3	24/02/2023	12:15	6.00	SM	4	S	8	10	None
Non-breeding 2023-24	1	15/10/2023	11:00	3.25	SM	4	SE	3	12	None
Non-breeding 2023-24	1	16/10/2023	08:45	6.50	SM	4	E	4	14	None
Non-breeding 2023-24	2	07/11/2023	10:00	6.00	MH	6	S	5	10	Light showers
Non-breeding 2023-24	2	08/11/2023	10:15	4.00	MH	8	S	6	8	Moderate showers
Non-breeding 2023-24	3	11/01/2024	10:15	6.00	DL	2	E	3	6	None
Non-breeding 2023-24	3	18/01/2024	09:15	6.00	DL	3	NW	2	0	Light showers

Appendix VII - Wintering waterbird survey effort table

Table VII.1: Dates, duration, surveyor and weather conditions for wintering waterbird surveys during non-breeding seasons

Season	Visit	Date	Start time	Duration	Surveyor	Wind Force[2]	Wind Dir	Cloud (oktas)[3]	Temp. (°C)	Rain
Non-breeding 2021-22	1	27/10/2021	10:00	6.00	DP	5	S	8	14	None
Non-breeding 2021-22	1	31/10/2021	13:00	3.00	DP	7	NW	8	8	None
Non-breeding 2021-22	2	15/11/2021	10:30	4.50	DP	3	S	8	10	None
Non-breeding 2021-22	3	30/11/2021	08:30	5.00	DP	4	W/SW	8	10	Showers
Non-breeding 2021-22	4	09/12/2021	11:15	3.00	DP	5	W/SW	8	8	Showers
Non-breeding 2021-22	4	12/12/2021	09:00	5.00	DP	5	SE	8	9	Showers
Non-breeding 2021-22	5	17/01/2022	10:15	6.00	DP	1	E	1	4	None
Non-breeding 2021-22	6	31/01/2022	11:00	3.00	DP	5	SW	8	9	None
Non-breeding 2021-22	6	01/02/2022	11:30	3.00	DP	6	SW	8	10	Frequent showers
Non-breeding 2021-22	7	09/02/2022	12:00	3.00	DP	6	SW	7	6	Showers
Non-breeding 2021-22	7	15/02/2022	10:00	5.50	DP	5	SW	8	6	Showers
Non-breeding 2021-22	8	17/03/2022	08:10	6.00	DP	5	SW	6	12	Showers
Non-breeding 2022-23	1	15/10/2022	11:45	1.15	MH	5	SW	7	11	Frequent showers
Non-breeding 2022-23	2	12/11/2022	09:00	7.00	MH	3	SE	8	13	Light showers
Non-breeding 2022-23	2	17/11/2022	12:00	2.00	MH	3	SE	8	13	Light showers
Non-breeding 2022-23	3	06/12/2022	11:00	2.00	SM	3	NW	2	0	None
Non-breeding 2022-23	3	08/12/2022	10:30	5.00	SM	3	NW	2	0	None
Non-breeding 2022-23	3	09/12/2022	09:15	6.00	SM	3	NW	2	0	None
Non-breeding 2022-23	3	11/12/2022	08:10	4.00	SM	1	SE	3	2	Showers
Non-breeding 2022-23	4	21/01/2023	15:15	1.00	MH	2	SW	8	10	Light showers
Non-breeding 2022-23	4	22/01/2023	08:30	8.50	MH	2	SW	8	10	Light showers
Non-breeding 2022-23	4	25/01/2023	10:30	1.00	MH	2	SW	8	10	Light showers
Non-breeding 2022-23	5	20/02/2023	14:30	1.50	SM	3	SW	8	10	Light showers
Non-breeding 2022-23	5	23/02/2023	09:30	7.50	SM	3	NW	6	7	Light showers
Non-breeding 2022-23	6	04/03/2023	09:30	1.50	MH	1	NE	8	7	Light showers
Non-breeding 2022-23	6	06/03/2023	09:30	3.50	MH	2	NE	8	8	Light showers
Non-breeding 2023-24	1	15/10/2023	14:30	4.25	SM	4	E	4	12	None
Non-breeding 2023-24	1	16/10/2023	15:30	3.00	SM	4	E	4	14	None
Non-breeding 2023-24	2	03/11/2023	13:00	3.00	SM	6	NE	6	12	Showers
Non-breeding 2023-24	2	06/11/2023	11:30	2.00	SM	7	NW	6	12	Showers
Non-breeding 2023-24	3	31/12/2023	09:30	4.75	DL	6	NW	6	8	Showers
Non-breeding 2023-24	4	16/01/2024	10:30	5.00	DL	5	W	4	6	Showers
Non-breeding 2023-24	5	05/03/2024	12:30	5.00	DL	5	SW	3	10	None
Non-breeding 2023-24	6	22/03/2024	10:00	4.00	DL	4	W	3	10	None
Non-breeding 2023-24	6	25/03/2024	10:00	4.00	DL	4	W	6	8	None

APPENDIX VIII - HEN HARRIER ROOST SEARCHES EFFORT TABLE

Table VIII.1: Dates, duration, surveyor and weather conditions for hen harrier roost searches during non-breeding seasons

Season	Visit	Date	Start time	Duration	Surveyor	Wind force[2]	Wind Dir	Temp	Rain
Non-breeding 2021-22	1	27/10/2021	17:15	1.50	DP	4-6	S	Mild	Dry
Non-breeding 2021-22	2	15/11/2021	15:10	2.00	DP	0-3	S	Cool	Dry
Non-breeding 2021-22	3	17/12/2021	15:00	2.00	DP	0-3	SW	Cool	Dry
Non-breeding 2021-22	4	27/01/2022	16:10	2.00	DP	4-6	NW	Mild	Dry
Non-breeding 2022-23	1	12/10/2022	17:47	1.50	MH	0-3	W	Mild	Dry
Non-breeding 2022-23	2	14/10/2022	17:48	1.50	MH	4-6	SSW	Mild	Intermittent or Drizzle
Non-breeding 2022-23	3	19/10/2022	17:40	1.50	MH	4-6	E	Mild	Dry
Non-breeding 2022-23	4	09/11/2022	15:50	1.50	MH	4-6	SW	Mild	Intermittent or Drizzle
Non-breeding 2022-23	5	13/11/2022	16:00	1.50	MH	0-3	SSW	Mild	Dry
Non-breeding 2022-23	6	14/11/2022	15:45	1.50	MH	4-6	S	Cool	Intermittent or Drizzle
Non-breeding 2022-23	7	21/01/2023	15:52	1.50	MH	4-6	SSW	Mild	Intermittent or Drizzle
Non-breeding 2022-23	8	29/01/2023	16:05	1.50	MH	4-6	WSW	Mild	Intermittent or Drizzle
Non-breeding 2022-23	9	30/01/2023	16:15	1.50	MH	4-6	SW	Cool	Intermittent or Drizzle
Non-breeding 2022-23	10	23/02/2023	17:14	1.00	SLM	3	NW	Cool	Light Showers
Non-breeding 2022-23	11	02/03/2023	17:23	1.50	MH	0-3	NE	Cool	Dry
Non-breeding 2022-23	12	05/03/2023	17:25	1.50	MH	1-3	NW	Cool	Showers
Non-breeding 2023-24	1	08/01/2024	15:00	1.50	DL	4-6	SE	Cool	Dry
Non-breeding 2023-24	2	10/01/2024	15:50	1.50	DL	0-3	E	Cool	Dry
Non-breeding 2023-24	3	16/01/2024	16:05	1.50	DL	0-3	N	Cool	Dry
Non-breeding 2023-24	4	27/02/2024	17:30	1.50	DL	0-3	E	Cool	Dry

Appendix IX - VP data including flight line tables and maps for each target species

Table IX.1: VP watch data for common gull

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	4	22/07/2021	12:58	Common gull	2	10	B	580			Landed in field
2	4	10/11/2022	11:18	Common gull	2	10	B	5			Landed in field
3	4	17/11/2022	09:59	Common gull	1	25	B	5			
4	2	05/07/2023	15:14	Common gull	1	70	B	45			Flying
5	2	05/07/2023	17:30	Common gull	1	80	B	64			
6	3	09/01/2024	12:35	Common gull	1	15	B	10			

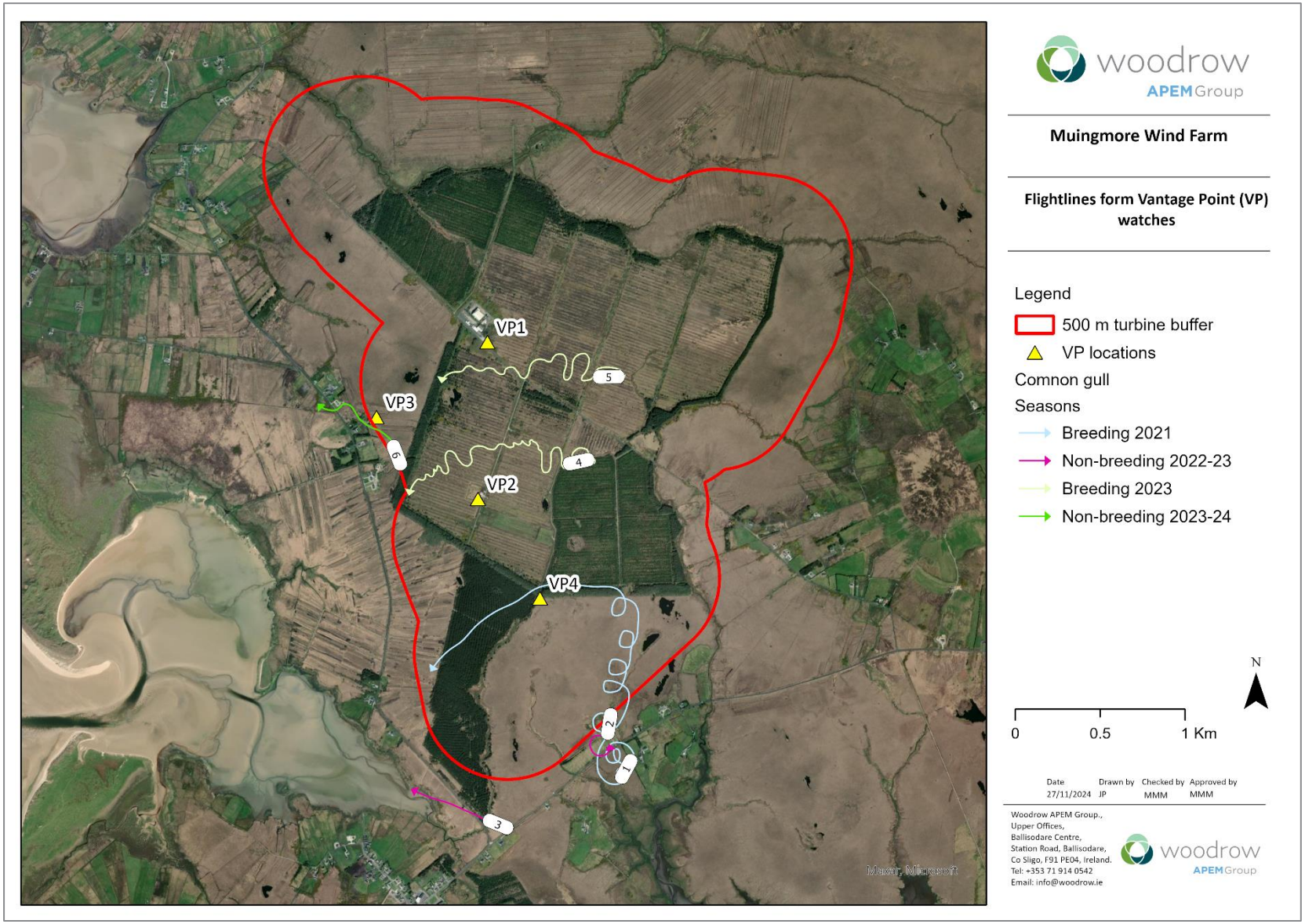


Figure IX.1: Common gull flightlines from VP watches

Table IX.2: VP watch data for black-headed gull

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	1	10/06/2021	11:50	Black-headed gull	1	5	A	56			
2	1	10/06/2021	13:05	Black-headed gull	1	30	B	56			
3	1	17/06/2021	12:33	Black-headed gull	1	30	B	21			Flying
4	1	17/06/2021	12:34	Black-headed gull	1	5	A	45			Took off flying then landed again
5	2	09/06/2021	14:50	Black-headed gull	1	20	B	63			
6	2	28/06/2021	16:35	Black-headed gull	2	30	B	190			
7	2	28/06/2021	16:56	Black-headed gull	1	20	B	109			
8	2	01/07/2021	14:11	Black-headed gull	1	30	B	39			
9	2	14/07/2021	10:44	Black-headed gull	1	30	B	87			
10	2	14/07/2021	12:15	Black-headed gull	1	30	B	121			Circled near small lake
11	3	09/06/2021	10:56	Black-headed gull	1	5	A	56			Headed towards the coast
12	3	09/06/2021	11:08	Black-headed gull	1	30	B	70			
13	3	09/06/2021	11:19	Black-headed gull	1	5	A	27			
14	3	09/06/2021	11:21	Black-headed gull	1	5	A	40			Flying above treeline
15	3	09/06/2021	11:30	Black-headed gull	1	5	A	9			Staying around a small lake
16	3	09/06/2021	11:53	Black-headed gull	1	15	B	37			
17	3	09/06/2021	12:47	Black-headed gull	2	25	B	80			Landed back in a small lake
18	3	09/06/2021	13:07	Black-headed gull	1	10	B	15			Came from a small lake
19	3	21/06/2021	11:02	Black-headed gull	1	30	B	81			
20	3	21/06/2021	11:04	Black-headed gull	1	30	B	5			Flew toward old factory
21	3	21/06/2021	11:12	Black-headed gull	1	20	B	70			
22	3	21/06/2021	11:20	Black-headed gull	1	20	B	33			
23	3	21/06/2021	11:22	Black-headed gull	1	20	B	32			
24	3	21/06/2021	11:45	Black-headed gull	1	10	B	10			
25	3	21/06/2021	11:51	Black-headed gull	1	10	B	90			
26	3	21/06/2021	12:05	Black-headed gull	1	10	B	31			
27	3	28/06/2021	14:18	Black-headed gull	1	30	B	53			

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
28	3	28/06/2021	14:54	Black-headed gull	1	30	B	115			
29	3	13/07/2021	09:41	Black-headed gull	1	20	B	24			Flying low over heather
30	4	08/06/2021	11:15	Black-headed gull	2	10	B	116			Heard calling and then flying
31	4	08/06/2021	11:16	Black-headed gull	1	10	B	32			
32	4	08/06/2021	11:48	Black-headed gull	1	30	B	44			
33	4	08/06/2021	12:35	Black-headed gull	1	10	B	11			
34	4	08/06/2021	13:26	Black-headed gull	1	10	B	42			
35	4	08/06/2021	13:35	Black-headed gull	1	30	B	34			
36	4	10/06/2021	14:03	Black-headed gull	1	10	B	15			
37	4	10/06/2021	14:12	Black-headed gull	1	10	B	46			
38	4	10/06/2021	14:59	Black-headed gull	1	50	B	48			Disappeared out of sight
39	4	10/06/2021	15:50	Black-headed gull	1	5	A	4			
40	4	10/06/2021	15:52	Black-headed gull	1	30	B	51			
41	4	10/06/2021	15:59	Black-headed gull	1	25	B	15			
42	4	10/06/2021	16:26	Black-headed gull	1	5	A	13			
43	4	21/06/2021	15:58	Black-headed gull	1	15	B	100			
44	4	21/06/2021	16:09	Black-headed gull	1	30	B	100			
45	4	21/06/2021	16:51	Black-headed gull	1	5	A	45			
46	4	21/06/2021	16:58	Black-headed gull	1	30	B	16			
47	4	14/07/2021	13:50	Black-headed gull	1	5	A	37			
48	1	06/07/2022	10:46	Black-headed gull	1	40	B	90			
49	1	06/07/2022	12:29	Black-headed gull	3	25	B	90			Disappeared behind tree line
50	2	16/05/2022	12:53	Black-headed gull	1	25	B	70			
51	3	17/05/2022	15:52	Black-headed gull	2	10	B	5			
52	4	26/06/2022	11:49	Black-headed gull	1	30	B	5			
53	4	26/06/2022	13:52	Black-headed gull	2	10	B	260			
54	4	11/10/2022	11:56	Black-headed gull	1	25	B	15			

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
55	4	16/10/2022	11:19	Black-headed gull	2	20	B	60			Dropped out of view
56	4	10/11/2022	11:29	Black-headed gull	1	12	B	25			
57	2	10/06/2023	11:24	Black-headed gull	1	20	B	40			
58	2	10/06/2023	17:25	Black-headed gull	1	12	B	70			
59	2	05/07/2023	15:42	Black-headed gull	1	80	B	51			
60	3	04/05/2023	13:10	Black-headed gull	1	30	B	90			
61	3	04/05/2023	17:45	Black-headed gull	1	15	B	110			Dropped behind pine belt
62	3	07/06/2023	16:21	Black-headed gull	1	20	B	65			
63	3	07/06/2023	17:36	Black-headed gull	1	20	B	25			
64	3	07/06/2023	18:21	Black-headed gull	1	25	B	45			
65	4	08/06/2023	12:59	Black-headed gull	1	10	B	35			
66	4	08/06/2023	17:49	Black-headed gull	1	10	B	45			
67	4	08/06/2023	18:51	Black-headed gull	2	3	A	2,520			Feeding over small pools NE
68	4	08/06/2023	18:58	Black-headed gull	1	35	B	70			Flew directly E
69	2	03/11/2023	11:07	Black-headed gull	1	15	B	20			
70	4	20/5/2024	17:02	Black-headed gull	1	20	B	124		Ad	Flying

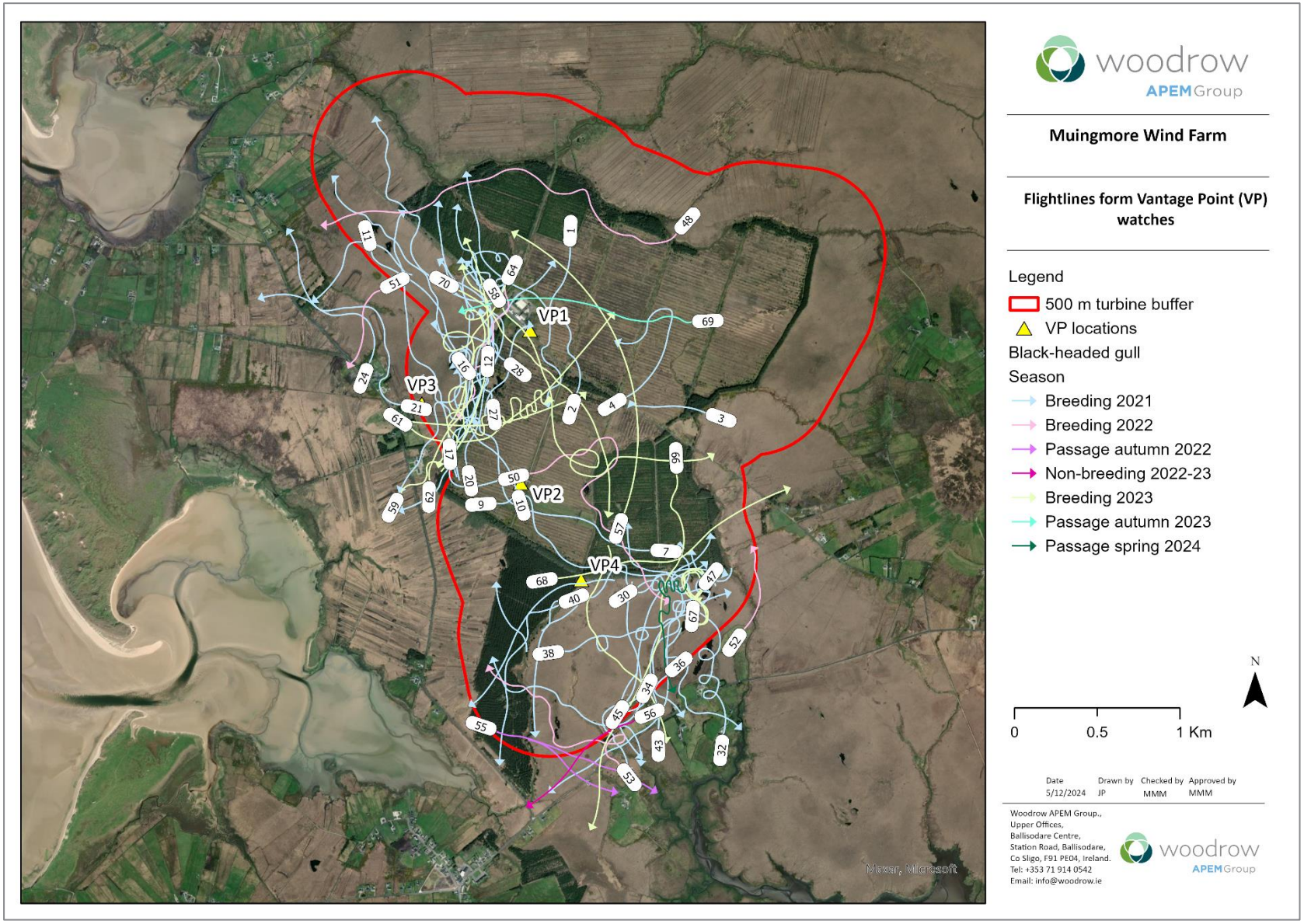


Figure IX.2: Black-headed gull flightlines from VP watches

Table IX.3: VP watch data for great black-backed gull

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
1	1	27/4/2021	15:58	Great black-backed gull	1	25	B	41			Flying
2	1	28/4/2021	16:13	Great black-backed gull	1	20	B	5			Flying
3	1	12/7/2021	15:04	Great black-backed gull	1	40	B	230			Circling
4	1	12/8/2021	10:53	Great black-backed gull	1	10	B	132			Flying
5	2	27/4/2021	12:49	Great black-backed gull	1	40	B	41			Flying
6	2	14/7/2021	11:07	Great black-backed gull	1	30	B	69			Flying
7	3	28/4/2021	11:50	Great black-backed gull	1	50	B	80			Flying
8	4	12/7/2021	11:34	Great black-backed gull	1	30	B	8			Circling
9	4	12/7/2021	11:40	Great black-backed gull	1	50	B	32			Circling
10	4	12/7/2021	12:10	Great black-backed gull	1	40	B	67			Flying
11	4	18/8/2021	16:23	Great black-backed gull	1	35	B	65			Flying
12	1	19/11/2021	8:44	Great black-backed gull	1	25	B	174		A	Commuting
13	1	19/1/2022	12:07	Great black-backed gull	1	35	B	92		J	Commuting
14	1	19/1/2022	12:49	Great black-backed gull	1	50	B	72		A	Commuting
15	3	17/2/2022	10:41	Great black-backed gull	2	40	B	20		A	Commuting
16	4	14/10/2021	9:59	Great black-backed gull	1	35	B	22			Commuting
17	4	24/11/2021	11:58	Great black-backed gull	1	20	B	5		A	Commuting
18	4	29/11/2021	12:08	Great black-backed gull	1	50	B	17		A	Commuting
19	4	12/1/2022	9:32	Great black-backed gull	1	40	B	40		A	Commuting
20	4	12/1/2022	11:12	Great black-backed gull	1	35	B	36		A	Commuting
21	4	23/2/2022	9:08	Great black-backed gull	1	25	B	17		A	Commuting
22	2	16/5/2022	11:09	Great black-backed gull	1	30	B	120		A	Commuting
23	2	18/8/2022	12:19	Great black-backed gull	1	25	B	97		A	Commuting
24	3	2/6/2022	18:20	Great black-backed gull	1	20	B	5		A	Commuting
25	3	13/6/2022	14:03	Great black-backed gull	1	20	B	35		A	Flying
26	3	8/8/2022	15:56	Great black-backed gull	1	10	B	30		A	Flying
27	4	21/4/2022	17:00	Great black-backed gull	2	50	B	4		A	Commuting

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
28	4	26/6/2022	14:30	Great black-backed gull	1	10	B	10		A	Flying
29	4	27/7/2022	16:15	Great black-backed gull	1	15	B	28		A	Commuting
30	4	27/7/2022	17:58	Great black-backed gull	1	10	B	4		A	Flying
31	4	29/8/2022	17:02	Great black-backed gull	1	23	B	40		A	Commuting
32	1	8/2/2023	13:46	Great black-backed gull	1	25	B	40		Ad	Flying
33	2	8/2/2023	10:35	Great black-backed gull	3	25	B	1440		Ad	Hunting
34	2	8/2/2023	10:52	Great black-backed gull	2	35	B	360		Ad	Gliding
35	2	8/2/2023	11:41	Great black-backed gull	1	20	B	0		Ad	Commuting
36	2	8/2/2023	12:29	Great black-backed gull	1	30	B	45		Ad	Gliding
37	2	8/2/2023	12:18	Great black-backed gull	2	35	B	0		Ad	Flying
38	3	19/2/2023	12:01	Great black-backed gull	1	25	B	35		Ad	Present
39	4	19/2/2023	15:11	Great black-backed gull	1	30	B	65		Ad	Present
40	2	12/10/2022	12:24	Great black-backed gull	1	60	B	270		J	Commuting
41	1	6/4/2023	11:04	Great black-backed gull	1	30	B	4		Ad	Present
42	1	7/4/2023	13:43	Great black-backed gull	1	12	B	105		Ad	Present
43	2	10/4/2023	13:31	Great black-backed gull	2	30	B	6		Ad	Present
44	2	10/4/2023	13:52	Great black-backed gull	1	20	B	4		Ad	Present
45	2	10/4/2023	14:26	Great black-backed gull	1	30	B	180		Ad	Present
46	2	10/4/2023	14:26	Great black-backed gull	1	25	B	20		Ad	Present
47	2	10/4/2023	18:03	Great black-backed gull	1	10	B	25		Ad	Present
48	3	4/4/2023	12:28	Great black-backed gull	1	12	B	15		Ad	Flying
49	4	5/4/2023	14:45	Great black-backed gull	4	25	B	1,000		Ad	Present
50	4	5/4/2023	18:04	Great black-backed gull	1	30	B	125		Ad	Flying
51	1	6/5/2023	15:18	Great black-backed gull	1	15	B	180		Ad	Present
52	2	5/3/2023	11:51	Great black-backed gull	1	80	B	195			Flying
53	2	7/5/2023	10:16	Great black-backed gull	1	15	B	45		Ad	Present
54	2	7/5/2023	12:15	Great black-backed gull	2	15	B	220		Ads	Present
55	3	4/5/2023	16:46	Great black-backed gull	2	80	B	240		Ads	Present

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
56	4	1/3/2023	9:11	Great black-backed gull	1	60	B	5		Ad	Flying
57	4	6/3/2023	17:57	Great black-backed gull	1	50	B	105			Flying
58	4	5/5/2023	15:59	Great black-backed gull	1	20	B	30		Ad	Present
59	4	9/8/2023	18:12	Great black-backed gull	1	60	B	10		Ad	Commuting
60	4	9/8/2023	18:48	Great black-backed gull	1	60	B	0		Ad	Commuting
61	1	1/11/2023	7:34	Great black-backed gull	1	25	B	25		Ad	Present
62	1	5/3/2024	11:33	Great black-backed gull	2	10	B	120		Ad	Feeding
63	1	5/3/2024	11:46	Great black-backed gull	2	10	B	130		Ad	Fly-land
64	4	21/3/2024	12:47	Great black-backed gull	1	2	A	4		Ad	Present
65	4	21/3/2024	15:03	Great black-backed gull	1	3	A	5		Ad	Present

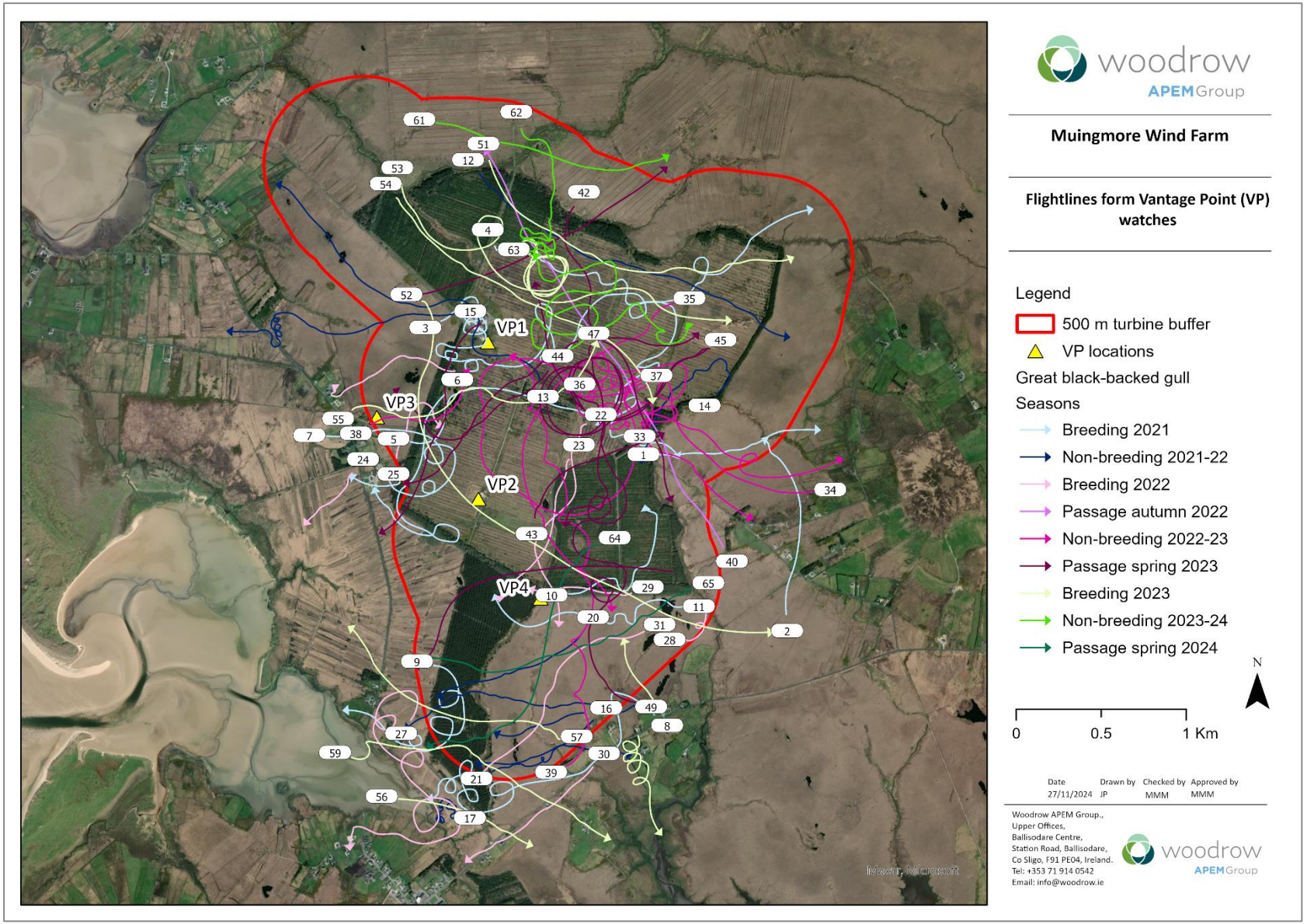


Figure IX.3: Great black-backed gull flightlines from VP watches

Table IX.4: VP watch data for lesser black-backed gull

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
1	1	27/4/2021	15:48	Lesser black-backed gull	2	70	B	30			Soaring
2	1	27/4/2021	16:08	Lesser black-backed gull	1	20	B	28			Flying
3	1	27/4/2021	16:53	Lesser black-backed gull	1	40	B	10			Flying
4	1	27/4/2021	17:05	Lesser black-backed gull	1	40	B	119			Flying
5	1	27/4/2021	17:19	Lesser black-backed gull	1	50	B	65			Soaring
6	1	28/4/2021	14:50	Lesser black-backed gull	1	60	B	62			Flying
7	1	28/4/2021	15:01	Lesser black-backed gull	1	60	B	20			Flying
8	1	28/4/2021	16:15	Lesser black-backed gull	1	50	B	30			Flying
9	1	28/4/2021	16:52	Lesser black-backed gull	1	40	B	63			Flying
10	1	8/6/2021	15:25	Lesser black-backed gull	1	20	B	81			Circling
11	1	8/6/2021	16:33	Lesser black-backed gull	1	20	B	38			Flying
12	1	10/6/2021	12:27	Lesser black-backed gull	2	80	B	98			Circling
13	1	10/6/2021	12:40	Lesser black-backed gull	1	70	B	37			Circling
14	1	17/6/2021	12:23	Lesser black-backed gull	1	10	B	109			Flying
15	1	17/6/2021	13:06	Lesser black-backed gull	1	30	B	85			Flying
16	1	12/7/2021	15:05	Lesser black-backed gull	1	30	B	133			Circling
17	1	12/8/2021	10:37	Lesser black-backed gull	1	25	B	57			Flying
18	1	12/8/2021	12:17	Lesser black-backed gull	1	5	A	29			Flying
19	2	10/5/2021	12:00	Lesser black-backed gull	3	40	B	126			Flying
20	2	9/6/2021	16:24	Lesser black-backed gull	1	30	B	24			Flying
21	2	9/6/2021	16:52	Lesser black-backed gull	1	10	B	96			Flying
22	2	9/6/2021	16:58	Lesser black-backed gull	3	30	B	285		Ad, Juv	Flying
23	2	17/6/2021	15:16	Lesser black-backed gull	1	30	B	87			Circling
24	2	1/7/2021	11:49	Lesser black-backed gull	1	40	B	63			Flying
25	2	14/7/2021	10:48	Lesser black-backed gull	1	5	A	78			Flying
26	3	28/4/2021	10:18	Lesser black-backed gull	1	25	B	140			Flying
27	3	10/5/2021	14:37	Lesser black-backed gull	1	25	B	66			Flying

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
28	3	10/5/2021	16:32	Lesser black-backed gull	2	30	B	6			Flying
29	3	21/6/2021	11:18	Lesser black-backed gull	1	5	A	28			Flying
30	3	14/7/2021	16:24	Lesser black-backed gull	1	30	B	14			Flying
31	3	15/7/2021	10:05	Lesser black-backed gull	1	40	B	55			Flying
32	3	15/7/2021	10:09	Lesser black-backed gull	1	20	B	5			Flying
33	3	15/7/2021	10:10	Lesser black-backed gull	1	20	B	5			Flying
34	3	15/7/2021	10:32	Lesser black-backed gull	1	20	B	5			Flying
35	3	15/7/2021	11:00	Lesser black-backed gull	1	30	B	196			Flying
36	3	19/7/2021	17:31	Lesser black-backed gull	1	35	B	45			Flying
37	3	21/7/2021	13:02	Lesser black-backed gull	1	20	B	2			Flying
38	3	10/8/2021	10:53	Lesser black-backed gull	1	15	B	5			Flying
39	3	10/8/2021	11:05	Lesser black-backed gull	1	5	A	19			Flying
40	3	10/8/2021	11:07	Lesser black-backed gull	1	5	A	17			Circling
41	4	8/6/2021	11:03	Lesser black-backed gull	1	50	B	35			Flying
42	4	8/6/2021	11:43	Lesser black-backed gull	1	40	B	31			Flying
43	4	8/6/2021	12:23	Lesser black-backed gull	1	50	B	70			Flying
44	4	8/6/2021	13:16	Lesser black-backed gull	1	30	B	41			Flying
45	4	10/6/2021	16:20	Lesser black-backed gull	1	40	B	33			circling
46	4	21/6/2021	17:08	Lesser black-backed gull	1	10	B	5			Flying
47	4	14/7/2021	13:56	Lesser black-backed gull	1	20	B	52			Flying
48	4	19/7/2021	14:42	Lesser black-backed gull	1	15	B	21			Flying
49	4	19/7/2021	15:41	Lesser black-backed gull	1	70	B	110			Circling
50	4	19/7/2021	15:46	Lesser black-backed gull	1	20	B	32			Flying
51	4	22/7/2021	12:23	Lesser black-backed gull	1	30	B	34			Flying
52	4	10/8/2021	14:07	Lesser black-backed gull	1	40	B	87			Flying
53	4	10/8/2021	14:07	Lesser black-backed gull	1	40	B	40			Flying
54	1	25/6/2022	11:50	Lesser black-backed gull	1	15	B	60		Ad	Flying
55	1	25/6/2022	11:55	Lesser black-backed gull	1	40	B	37		Ad	Flying

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
56	1	25/6/2022	14:15	Lesser black-backed gull	1	30	B	30		Ad	Flying
57	2	24/6/2022	15:10	Lesser black-backed gull	1	15	B	70		Ad	Commuting
58	3	27/4/2022	16:20	Lesser black-backed gull	2	100	B	5		Ad	Commuting
59	3	13/6/2022	13:03	Lesser black-backed gull	1	18	B	50		Ad	Gliding
60	3	13/6/2022	15:52	Lesser black-backed gull	1	20	B	20			Flying
61	3	13/6/2022	17:14	Lesser black-backed gull	1	20	B	15			Gliding
62	4	26/6/2022	13:47	Lesser black-backed gull	1	5	A	45		Ad	Flying
63	4	26/6/2022	15:21	Lesser black-backed gull	2	15	B	240		Ad	Commuting
64	1	25/1/2023	14:18	Lesser black-backed gull	2	40	B	250		Ad	Commuting
65	2	11/4/2023	18:49	Lesser black-backed gull	3	2	A	90		Ad	Present
66	4	9/4/2023	12:32	Lesser black-backed gull	3	30	B	75		Ad	Flying
67	1	9/6/2023	16:09	Lesser black-backed gull	2	40	B	8		Ad	Present
68	2	7/5/2023	13:01	Lesser black-backed gull	2	18	B	1,000		Ad	Present
69	2	7/5/2023	13:12	Lesser black-backed gull	1	25	B	90		Ad	Present
70	2	10/6/2023	17:01	Lesser black-backed gull	1	45	B	50		Ad	Present
71	3	4/5/2023	17:56	Lesser black-backed gull	1	10	B	30		Ad	Present
72	3	4/5/2023	17:58	Lesser black-backed gull	1	25	B	125		Ad	Present
73	3	7/6/2023	11:38	Lesser black-backed gull	1	10	B	10		Ad	Present
74	3	7/6/2023	11:46	Lesser black-backed gull	1	25	B	45		Ad	Present
75	3	7/6/2023	16:05	Lesser black-backed gull	2	30	B	80		Ad	Present
76	4	8/6/2023	17:02	Lesser black-backed gull	2	15	B	170		Ad	Present
77	1	7/9/2023	17:09	Lesser black-backed gull	1	20	B	45		Ad	Present
78	1	14/10/2023	12:21	Lesser black-backed gull	1	25	B	65		Ad	Flying
79	2	31/10/2023	16:01	Lesser black-backed gull	1	15	B	50		Ad	Present
80	4	5/9/2023	15:31	Lesser black-backed gull	1	15	B	190		Ad	Present
81	4	6/9/2023	13:22	Lesser black-backed gull	1	23	B	30		Ad	Present
82	1	16/4/2024	8:49	Lesser black-backed gull	2	30	B	74		Ad	Flying
83	1	16/4/2024	12:41	Lesser black-backed gull	1	30	B	136		Ad	Flying

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
84	1	16/4/2024	13:25	Lesser black-backed gull	1	80	B	379		Ad	Flying
85	1	22/4/2024	14:50	Lesser black-backed gull	2	30	B	186		Ad	Flying
86	2	16/4/2024	16:04	Lesser black-backed gull	2	20	B	442		Ad	Flying
87	2	17/4/2024	9:41	Lesser black-backed gull	2	40	B	188		Ad	Flying
88	2	17/4/2024	11:30	Lesser black-backed gull	1	30	B	54		Ad	Flying
89	3	18/4/2024	10:30	Lesser black-backed gull	5	30	B	980		Ad	Flying
90	1	22/4/2024	14:50	Lesser black-backed gull	2	30	B	186		Ad	Flying
91	3	23/4/2024	16:57	Lesser black-backed gull	1	40	B	79		Ad	Flying
92	2	25/4/2024	9:33	Lesser black-backed gull	3	50	B	243		Ad	Flying

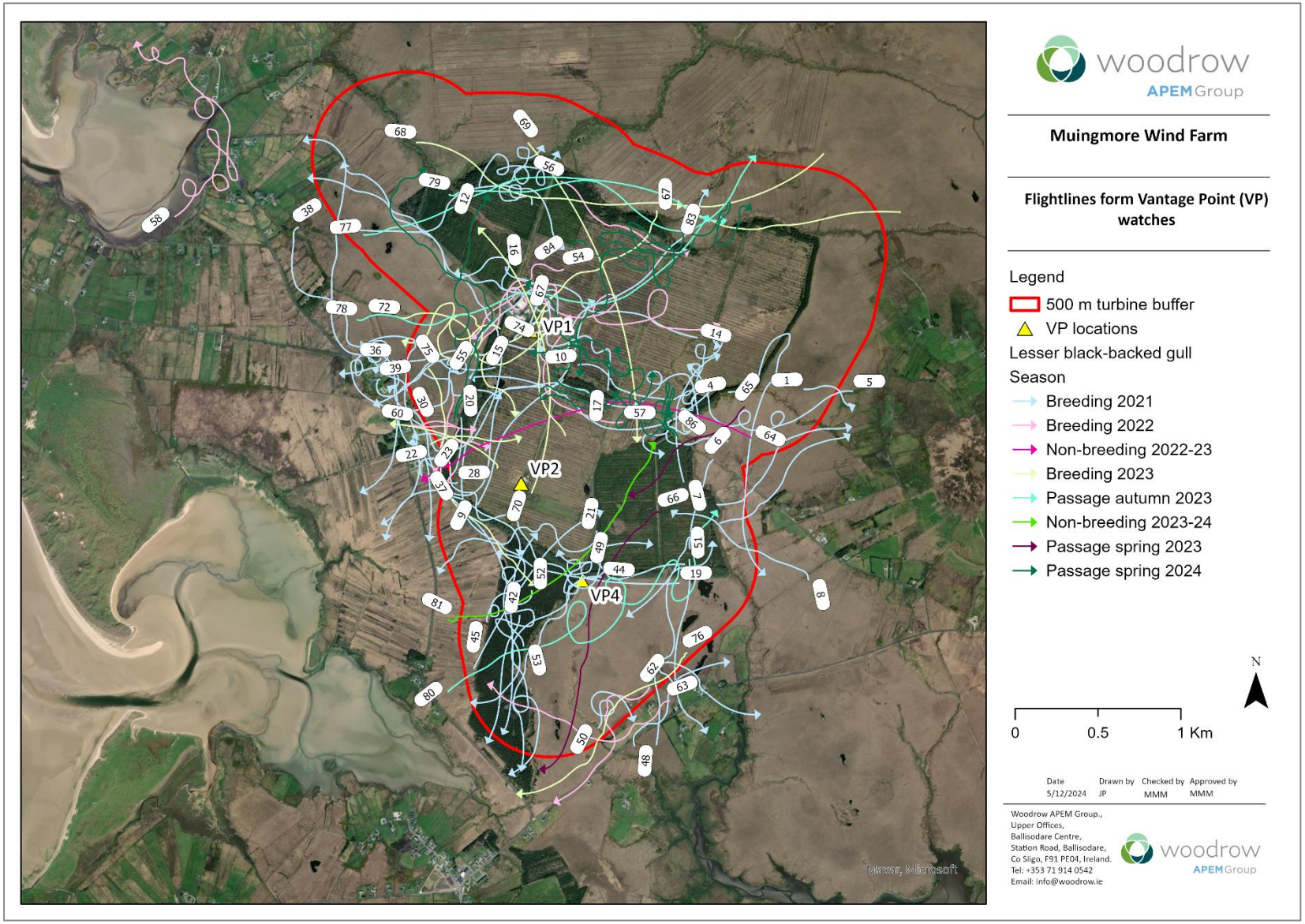


Figure IX.4: Lesser black-backed gull flightlines from VP watches

Table IX.5: VP watch data for herring gull

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
1	1	8/6/2021	16:32	Herring gull	1	30	B	9			Flying
2	2	9/6/2021	14:50	Herring gull	1	20	B	22			Flying
3	2	9/6/2021	15:15	Herring gull	1	25	B	56			Flying
4	2	1/7/2021	14:11	Herring gull	1	40	B	45			Circling
5	2	14/7/2021	10:49	Herring gull	1	30	B	49			Flying
6	2	14/7/2021	11:34	Herring gull	1	30	B	61			Flying
7	3	10/8/2021	11:18	Herring gull	1	10	B	6			Flying
8	4	8/6/2021	12:56	Herring gull	1	20	B	90			Flying
9	4	8/6/2021	13:02	Herring gull	1	30	B	21			Flying
10	4	10/6/2021	15:52	Herring gull	1	10	B	5			Flying
11	4	10/6/2021	16:16	Herring gull	1	25	B	12			Flying
12	4	10/6/2021	16:24	Herring gull	1	5	A	6			Flying
13	4	21/6/2021	15:55	Herring gull	1	5	A	6			Circling
14	4	21/6/2021	16:55	Herring gull	2	10	B	108			Flying
15	4	21/6/2021	16:58	Herring gull	2	10	B	98			Circling
16	4	21/6/2021	17:08	Herring gull	1	10	B	5			Flying
17	1	6/7/2022	10:19	Herring gull	1	50	B	135		A	Commuting
18	1	19/7/2022	14:13	Herring gull	1	40	B	80		A	Commuting
19	2	14/4/2022	17:42	Herring gull	1	50	B	36		J	Commuting
20	2	28/4/2022	15:46	Herring gull	1	100	B	5		J	Commuting
21	2	16/5/2022	12:20	Herring gull	1	40	B	100		J	Commuting
22	3	27/4/2022	14:45	Herring gull	1	15	B	10		A	Hunting
23	3	17/5/2022	14:46	Herring gull	1	5	A	5		A	Commuting
24	3	13/6/2022	12:10	Herring gull	1	10	B	10		A	Gliding
25	3	13/6/2022	14:26	Herring gull	2	20	B	110		A	Flying
26	3	13/6/2022	15:36	Herring gull	2	20	B	150			Flying
27	3	13/6/2022	17:09	Herring gull	1	7	A	18			Fly-land

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
28	3	19/7/2022	10:20	Herring gull	1	20	B	10		A	Commuting
29	3	19/7/2022	10:53	Herring gull	1	10	B	60		A	Commuting
30	3	8/8/2022	15:26	Herring gull	1	10	B	5		A	Fly-land
31	3	8/8/2022	15:26	Herring gull	1	0	-	-		A	Perched
32	3	8/8/2022	15:28	Herring gull	1	10	B	5		A	Fly-land
33	3	8/8/2022	15:28	Herring gull	1	0	-	-		A	Perched
34	3	8/8/2022	15:45	Herring gull	1	0	-	-		A	Perched
35	3	8/8/2022	16:01	Herring gull	1	10	B	10		A	Flying
36	3	8/8/2022	16:36	Herring gull	1	20	B	5		A	Flying
37	4	26/6/2022	12:19	Herring gull	1	35	B	60		A	Commuting
38	4	26/6/2022	12:47	Herring gull	1	5	A	2		A	Flying
39	4	27/7/2022	13:01	Herring gull	1	15	B	5		A	Commuting
40	4	27/7/2022	14:34	Herring gull	1	10	B	5		A	Flying
41	4	27/7/2022	15:00	Herring gull	1	10	B	2		A	Flying
42	4	27/7/2022	16:57	Herring gull	1	10	B	25		A	Flying
43	4	27/7/2022	16:58	Herring gull	1	10	B	5		A	Flying
44	4	27/7/2022	17:30	Herring gull	1	10	B	5		A	Flying
45	4	27/7/2022	18:50	Herring gull	1	50	B	40		A	Flying
46	3	19/10/2022	10:19	Herring gull	1	15	B	55		J	Commuting
47	4	13/10/2022	12:39	Herring gull	1	20	B	80		J	Commuting
48	4	8/3/2023	15:47	Herring gull	1	30	B	35			Flying
49	4	5/4/2023	14:46	Herring gull	1	40	B	60		Ad	Flying
50	3	25/7/2023	13:45	Herring gull	3	90	B	105			Flying
51	3	25/7/2023	13:49	Herring gull	1	90	B	17			Flying
52	3	25/7/2023	14:23	Herring gull	2	100	B	120			Flying
53	3	26/7/2023	14:21	Herring gull	5	80	B	115		Ad	Flying
54	3	1/8/2023	15:25	Herring gull	1	25	B	10		Ad	Commuting
55	4	8/6/2023	10:16	Herring gull	1	15	B	70		Ad	Present

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
56	4	8/6/2023	14:40	Herring gull	2	40	B	100		Ad	Present
57	4	25/7/2023	10:32	Herring gull	1	80	B	10		Ad	Flying
58	4	25/7/2023	10:52	Herring gull	2	50	B	50		Ad	Flying
59	4	25/7/2023	11:33	Herring gull	4	100	B	92		Ad	Flying
60	4	25/7/2023	11:54	Herring gull	5	90	B	185		Ad	Flying
61	4	26/7/2023	11:15	Herring gull	1	80	B	17			Flushed
62	2	3/11/2023	10:21	Herring gull	1	30	B	20		Ad	Flying
63	2	3/11/2023	10:22	Herring gull	1	25	B	75		Ad	Flying
64	2	22/3/2024	10:21	Herring gull	1	20	B	45		Ad	Present

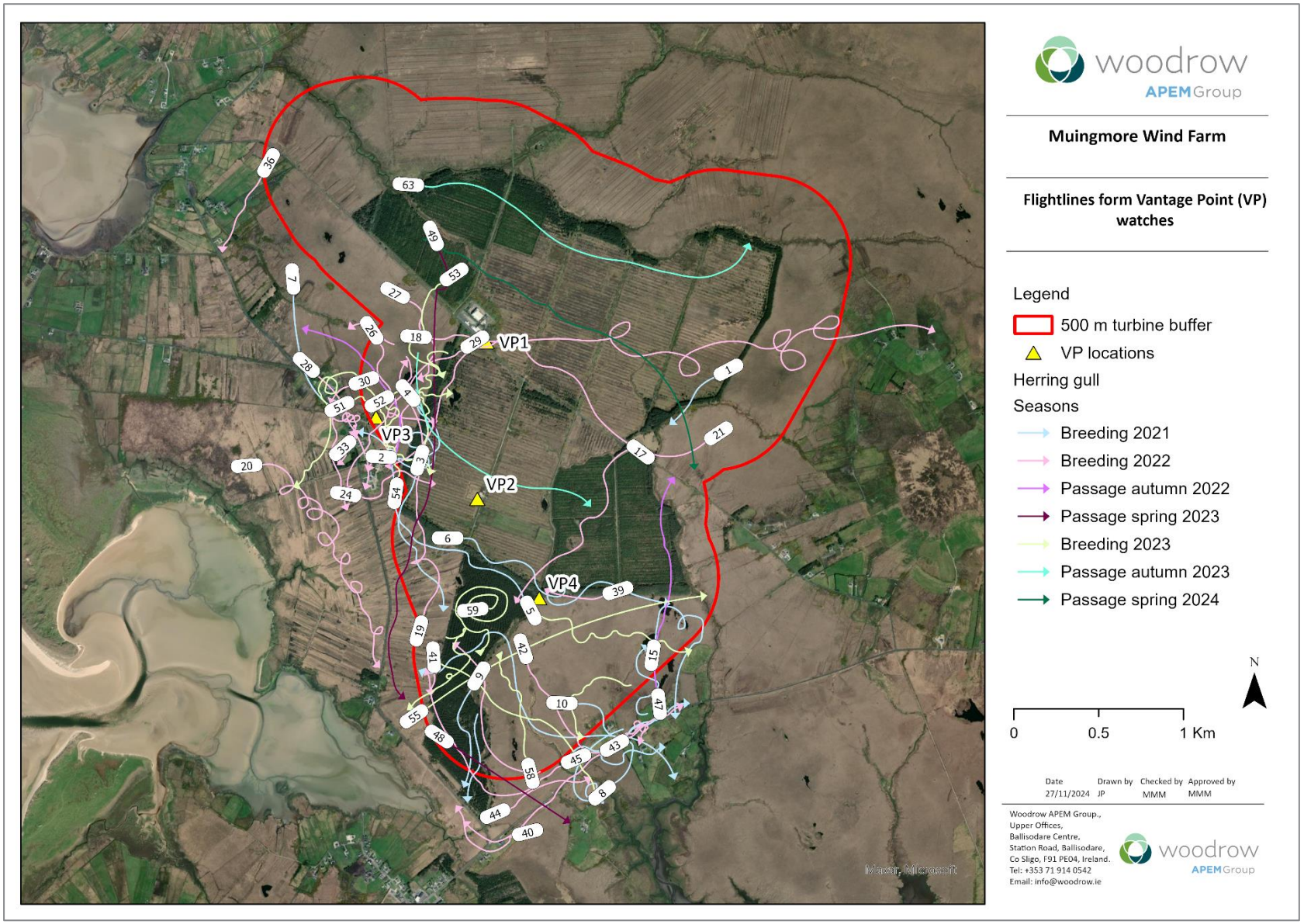


Figure IX.5: Herring gull flightlines from VP watches

Table IX.6: VP watch data for common tern

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	3	13/06/2022	15:38	Common tern	1	25	B	30			Flying
2	3	13/06/2022	17:37	Common tern	1	11	B	24			Flying

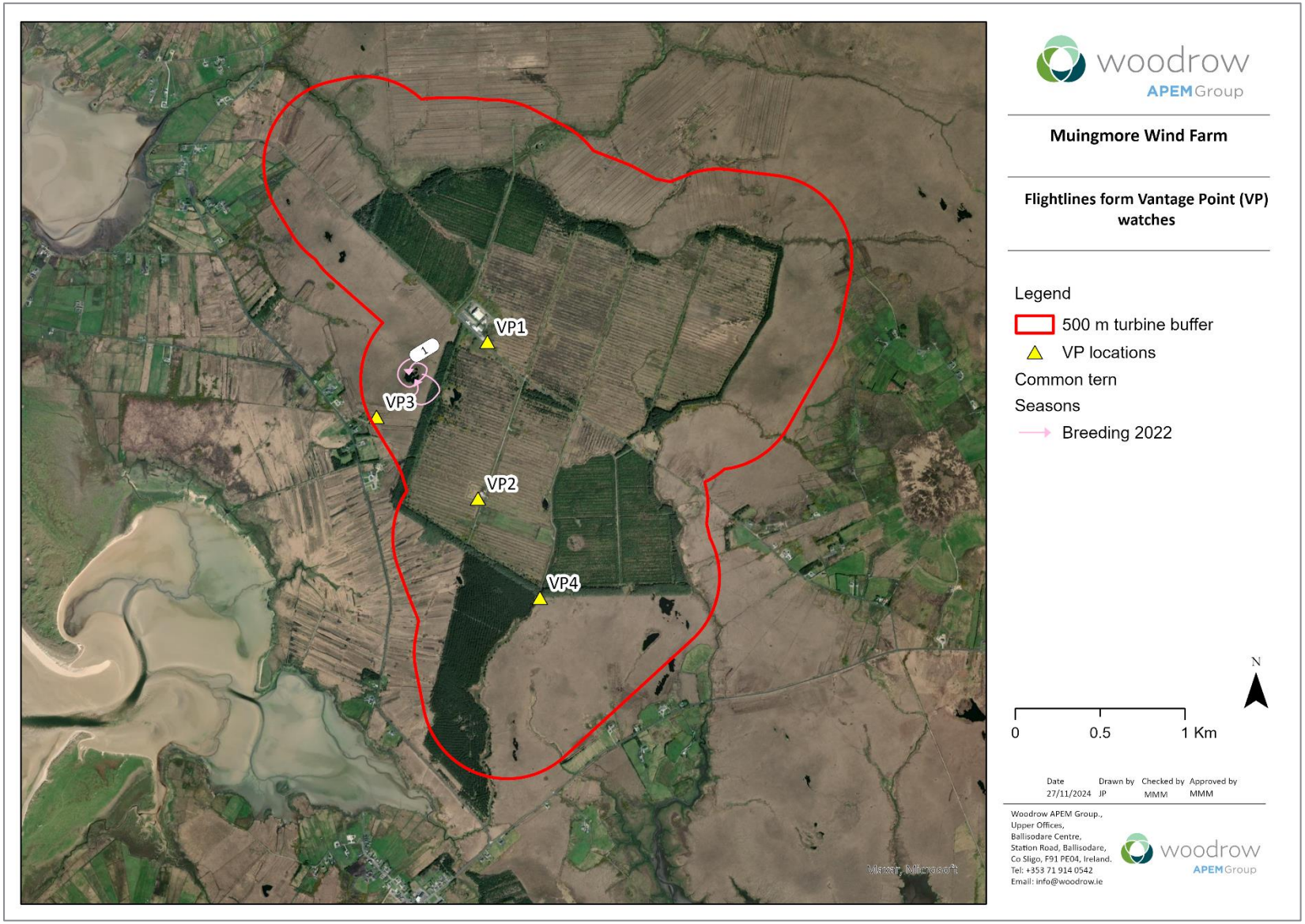


Figure IX.6: Common tern flightlines from VP watches

Table IX.7: VP watch data for cormorant

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	1	13/10/2022	10:20	Cormorant	1	35	B	160			Flying
2	2	25/01/2023	09:37	Cormorant	1	40	B	165			Flying
3	4	13/10/2022	13:13	Cormorant	1	50	B	45			Commuting
4	4	16/10/2022	08:22	Cormorant	1	40	B	25			Flying
5	3	05/03/2023	08:23	Cormorant	1	45	B	115			

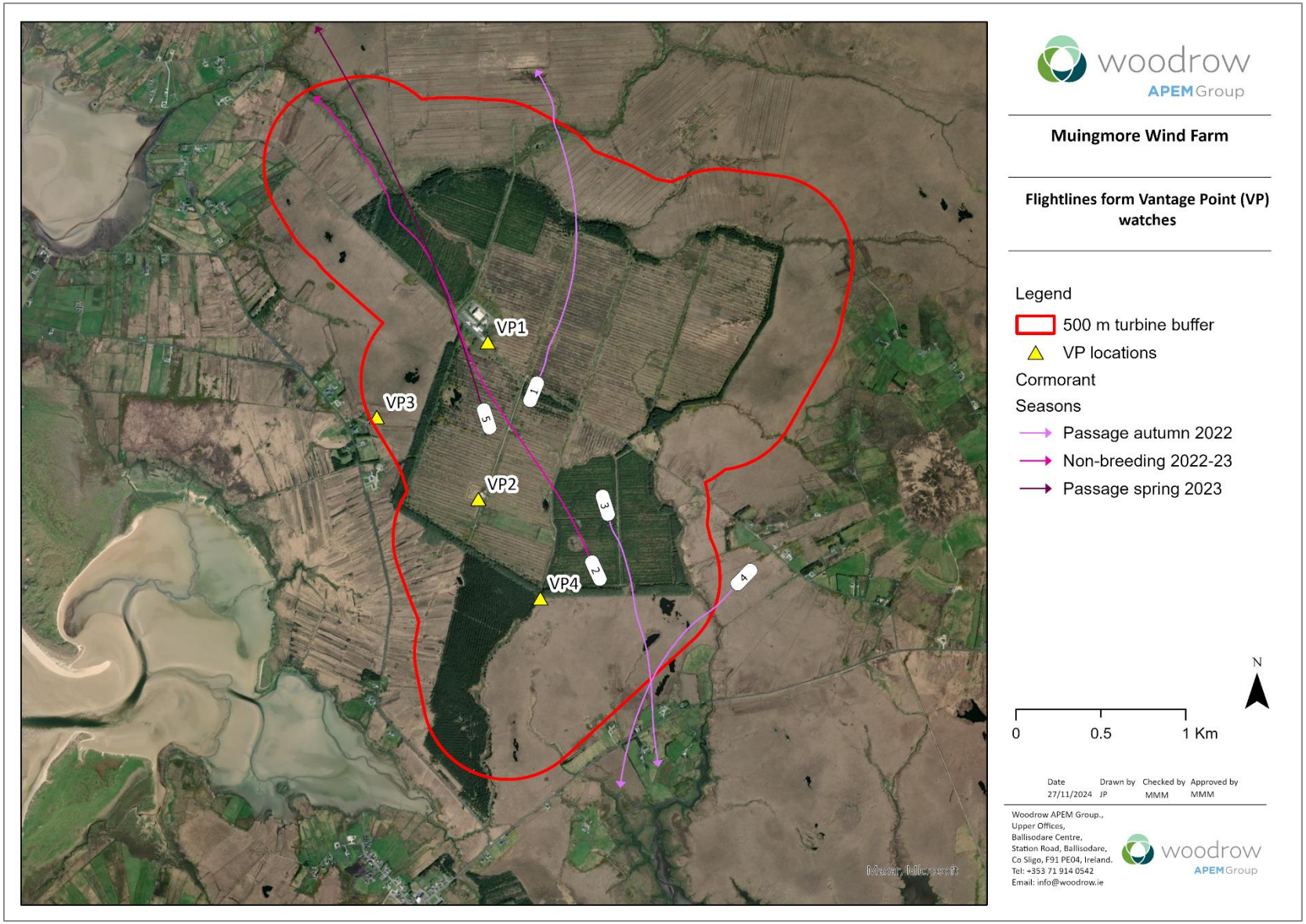


Figure IX.7: Cormorant flightlines from VP watches

Table IX.8: VP watch data for grey heron

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	1	21/06/2021	13:17	Grey heron	1	10	B	25			Feeding
2	1	21/06/2021	13:31	Grey heron	1	5	A	80			
3	1	28/06/2021	19:26	Grey heron	1	0	A	8			Flying
4	2	21/07/2021	10:39	Grey heron	1	15	B	60			Landed at small pond
5	2	21/07/2021	10:58	Grey heron	1	15	B	58			
6	4	10/06/2021	15:33	Grey heron	1	20	B	5			
7	4	18/08/2021	14:55	Grey heron	1	5	A	31			
8	2	21/02/2022	11:52	Grey heron	1	20	B	34			Commuting
9	2	21/02/2022	12:41	Grey heron	1	5	A	47			
10	2	21/02/2022	12:41	Grey heron	1	20	B	28			Flying
11	2	21/02/2022	13:15	Grey heron	3	15	B	108			Flying
12	3	14/10/2021	13:34	Grey heron	1	25	B	52			Commuting
13	3	25/11/2021	10:33	Grey heron	1	20	B	22			Commuting
14	1	14/04/2022	12:20	Grey heron	1	250	C	180			
15	1	03/08/2022	12:32	Grey heron	1	30	B	120			
16	2	18/08/2022	13:01	Grey heron	1	2	A	3			
17	2	18/08/2022	13:25	Grey heron	1	5	A	5			
18	3	19/07/2022	10:30	Grey heron	1	30	B	5			
19	4	05/05/2022	16:35	Grey heron	1	30	B	60			
20	4	27/07/2022	18:09	Grey heron	1	5	A	2			
21	1	11/11/2022	13:31	Grey heron	1	20	B	40			
22	2	22/02/2023	13:39	Grey heron	1	5	A	120			
23	2	13/09/2022	14:03	Grey heron	1	120	C	120			
24	2	02/03/2023	15:02	Grey heron	1	25	B	115			
25	3	05/03/2023	07:45	Grey heron	1	8	A	20			
26	3	05/03/2023	07:45	Grey heron	1	15	B	75			
27	3	05/03/2023	08:35	Grey heron	1	3	A	45			

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
28	3	05/03/2023	08:35	Grey heron	1	2	A	60			Commuting
29	4	08/03/2023	14:55	Grey heron	1	30	B	25			
30	4	06/03/2023	18:43	Grey heron	1	25	B	45			
31	4	03/08/2023	14:10	Grey heron	1	20	B	5			
32	2	03/11/2023	08:03	Grey heron	1	20	B	15			Commuting
33	1	16/4/2024	07:32	Grey heron	1	15	B	78		Ad	Flying
34	1	22/4/2024	16:09	Grey heron	1	30	B	67		Ad	Flying
35	4	24/4/2024	16:18	Grey heron	1	30	B	32		Ad	Flying
36	4	20/5/2024	15:58	Grey heron	1	30	B	46		Ad	Flying

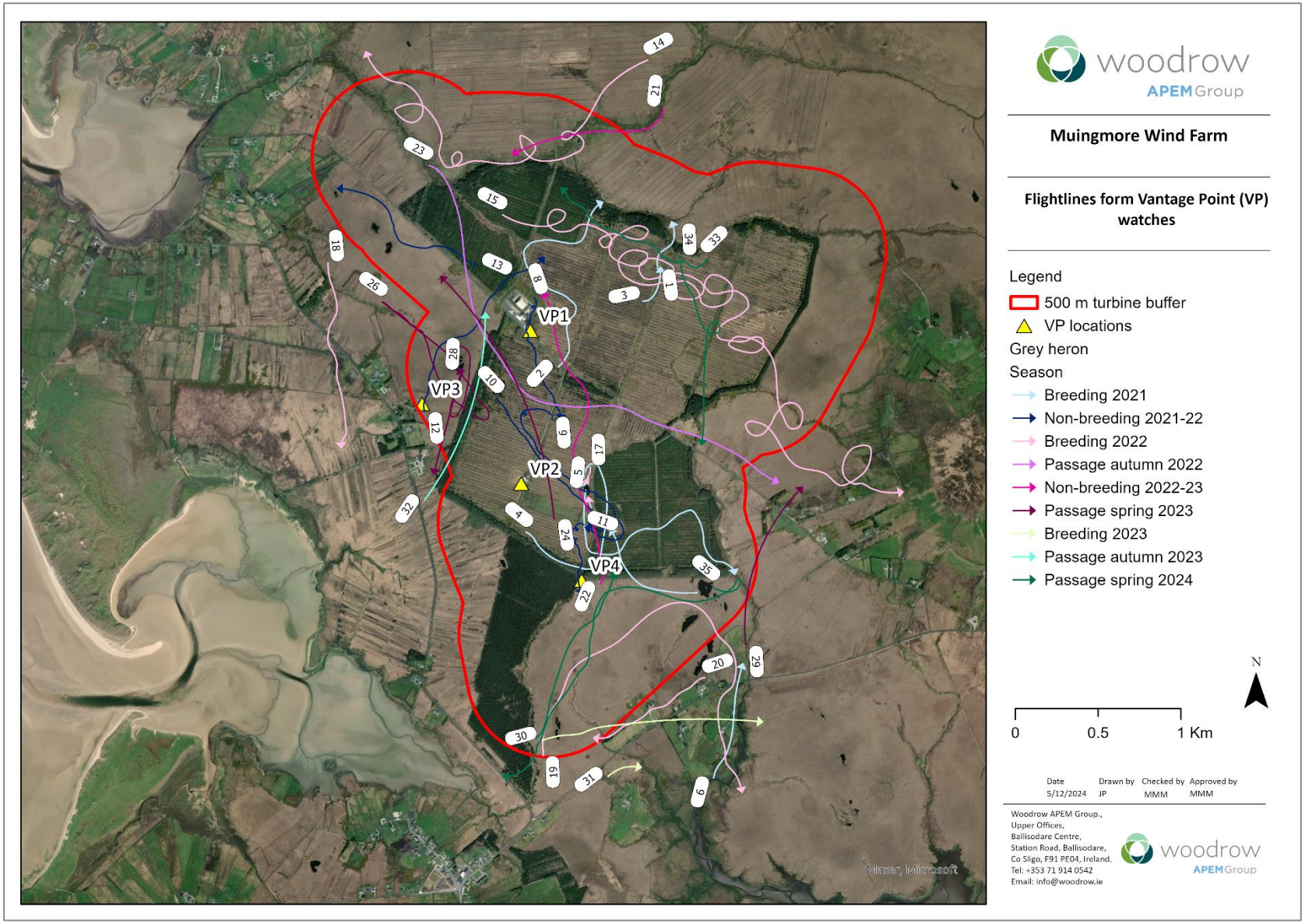


Figure IX.8: Grey heron flightlines from VP watches

Table IX.9: VP watch data for snipe

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	1	13/10/2021	10:04	Snipe	1	5	A	5			Commuting
2	2	13/10/2021	11:27	Snipe	1	10	B	5			Commuting
3	2	28/02/2022	08:25	Snipe	1	15	B	12			
4	2	28/02/2022	09:38	Snipe	1	15	B	16			Flying
5	3	14/10/2021	11:45	Snipe	1	10	B	12			
6	1	13/10/2022	08:55	Snipe	5	45	B	425			
7	2	11/11/2022	17:11	Snipe	2	45	B	90			
8	2	30/01/2023	13:05	Snipe	1	60	B	125			
9	3	10/10/2022	14:45	Snipe	27	25	B	540			
10	3	19/10/2022	09:54	Snipe	11	20	B	440			
11	4	20/10/2022	18:58	Snipe	2	40	B	110			
12	4	19/02/2023	16:54	Snipe	1	80	B	40			Flushed by kestrel
13	2	11/10/2022	09:23	Snipe	1	30	B	70			Landed
14	2	10/06/2023	17:28	Snipe	1	35	B	30			Displaying
15	3	25/07/2023	13:17	Snipe	2	60	B	16			
16	4	05/05/2023	11:27	Snipe	1	40	B	20			Drumming
17	4	05/05/2023	13:50	Snipe	2	50	B	90			Drumming
18	4	25/07/2023	11:00	Snipe	1	30	B	12			
19	4	26/07/2023	10:28	Snipe	1	70	B	23			
20	4	26/07/2023	11:10	Snipe	1	40	B	9			
21	1	14/10/2023	17:37	Snipe	2	60	B	60			
22	2	03/11/2023	09:15	Snipe	1	10	B	8			Flying

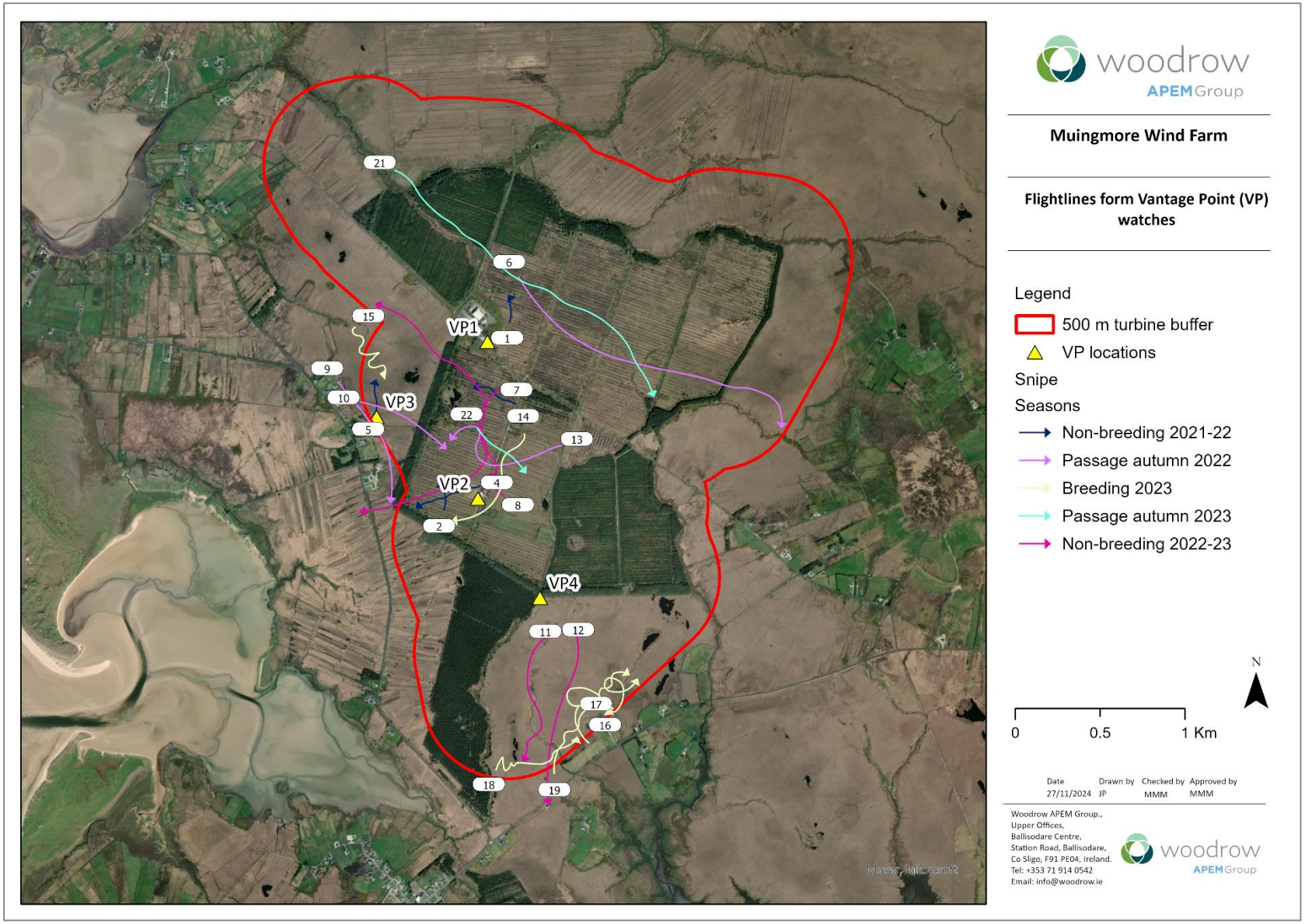


Figure IX.9: Snipe flightlines from VP watches

Table IX.10: VP watch data for other waders

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	1	24/11/2021	09:23	Lapwing	3	100	B	222			Commuting
2	1	19/01/2022	12:12	Woodcock	1	40	B	17			Flying
3	1	19/01/2022	12:12	Woodcock	1	30	B	4			
4	3	16/12/2021	13:41	Woodcock	1	1	A	9			Commuting
5	4	12/01/2022	08:15	Woodcock	1	1	A	5			
6	2	19/10/2022	15:58	Wilson's phalarope	18	80	B	1,080			
7	4	16/10/2022	10:19	Curlew	2	40	B	5			Dropped out of view
8	4	17/11/2022	08:14	Greenshank	1	50	B	20			Dropped out of view
9	4	25/07/2023	11:40	Golden plover	3	40	B	36			
10	2	07/05/2023	17:12	Whimbrel	7	150	C	945			

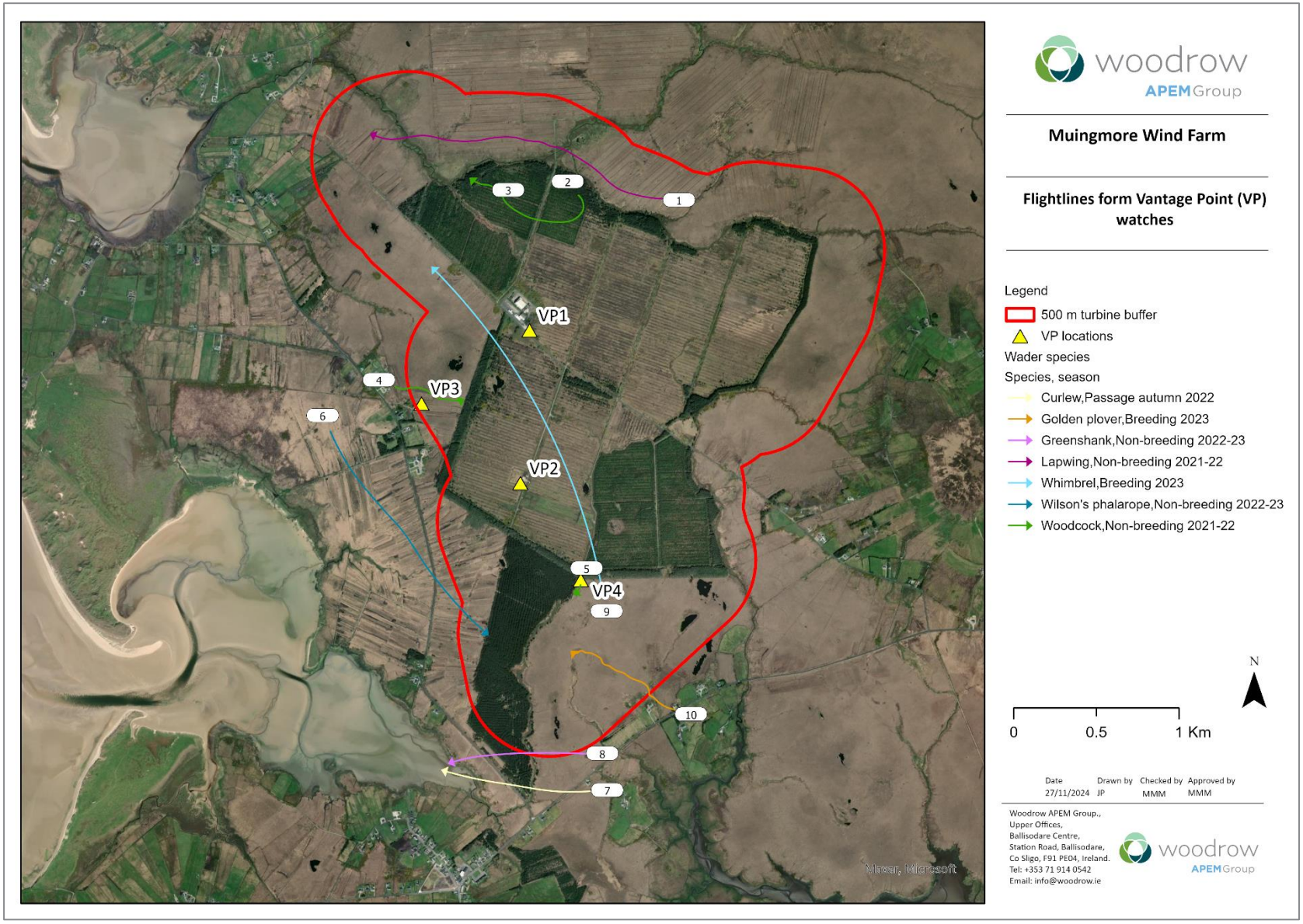


Figure IX.10: Waders flightlines from VP watches

Table IX.11: VP watch data for mallard

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
1	3	28/4/2021	11:17	Mallard	1	30	B	24	M		Flying
2	3	10/5/2021	15:12	Mallard	1	5	A	28	M		Flying
3	3	10/5/2021	16:33	Mallard	1	15	B	22	M		Flying
4	3	25/8/2021	14:58	Mallard	1	5	A	16	F		Flying
5	1	3/8/2022	11:46	Mallard	1	15	B	45		Ad	Commuting
6	3	27/4/2022	16:43	Mallard	2	15	B	50	M	Ad	Commuting
7	3	27/4/2022	17:05	Mallard	1	10	B	38	M	Ad	Commuting
8	3	17/5/2022	11:21	Mallard	1	15	B	5			Commuting
9	4	21/4/2022	17:25	Mallard	1	15	B	65	M	Ad	Commuting
10	4	5/5/2022	16:53	Mallard	1	10	B	40	F	Ad	Commuting
11	4	15/5/2022	20:32	Mallard	1	15	B	20	M	Ad	Commuting
12	4	15/5/2022	20:49	Mallard	1	45	B	20	M	Ad	Commuting
13	3	19/2/2023	12:32	Mallard	3	7	A	45	2M 1F		Displaying
14	4	12/11/2022	7:33	Mallard	4	25	B	40			Commuting
15	3	4/4/2023	18:10	Mallard	1	5	A	10	M	Ad	Present
16	4	5/4/2023	18:22	Mallard	4	35	B	400		Ad	Present
17	3	1/8/2023	13:05	Mallard	2	20	B	30			Commuting
18	3	1/8/2023	14:30	Mallard	1	15	B	10	F	Ad	Commuting
19	4	25/1/2024	10:39	Mallard	2	15	B	60			Flushed
20	2	17/4/2024	7:18	Mallard	4	10	B	40	M+F	Ad	Flying
21	2	17/4/2024	7:39	Mallard	4	25	B	112	M+F	Ad	Flying
22	3	18/4/2024	7:35	Mallard	2	5	A	8	M	Ad	Hunting
23	4	24/4/2024	12:08	Mallard	1	20	B	9	M	Ad	Flying
24	3	15/5/2024	19:38	Mallard	1	40	B	29	M	Ad	Flying
25	2	16/5/2024	19:43	Mallard	2	30	B	16	M	Ad	Flying

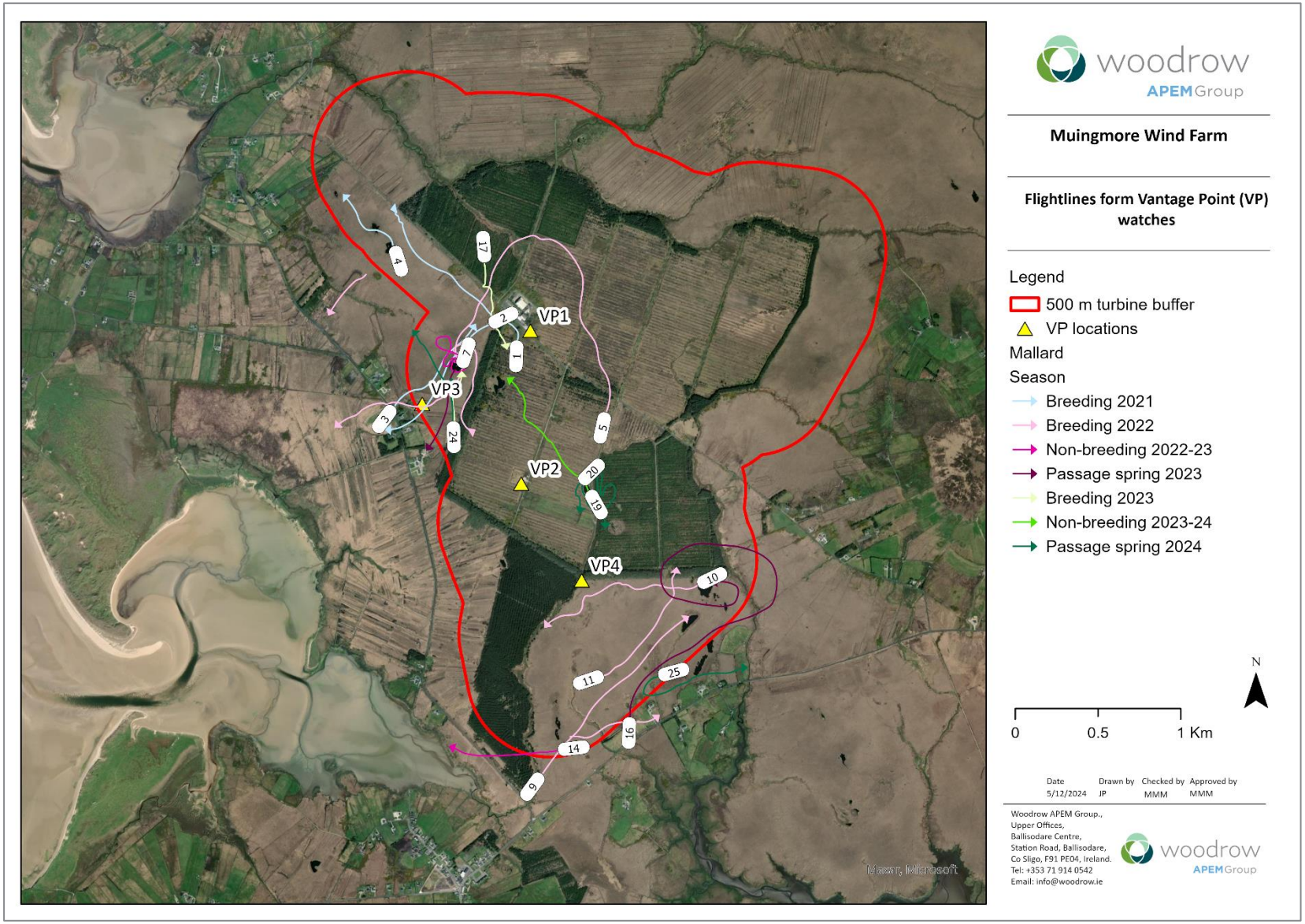


Figure IX.11: Mallard flightlines from VP watches

Table IX.12: VP watch data for teal

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	2	1/7/2021	13:24	Teal	1	10	B	12			Nesting
2	4	26/7/2023	11:30	Teal	5	80	B	75			
3	3	3/3/2023	17:19	Teal	2	2	A	40			Landed on pond

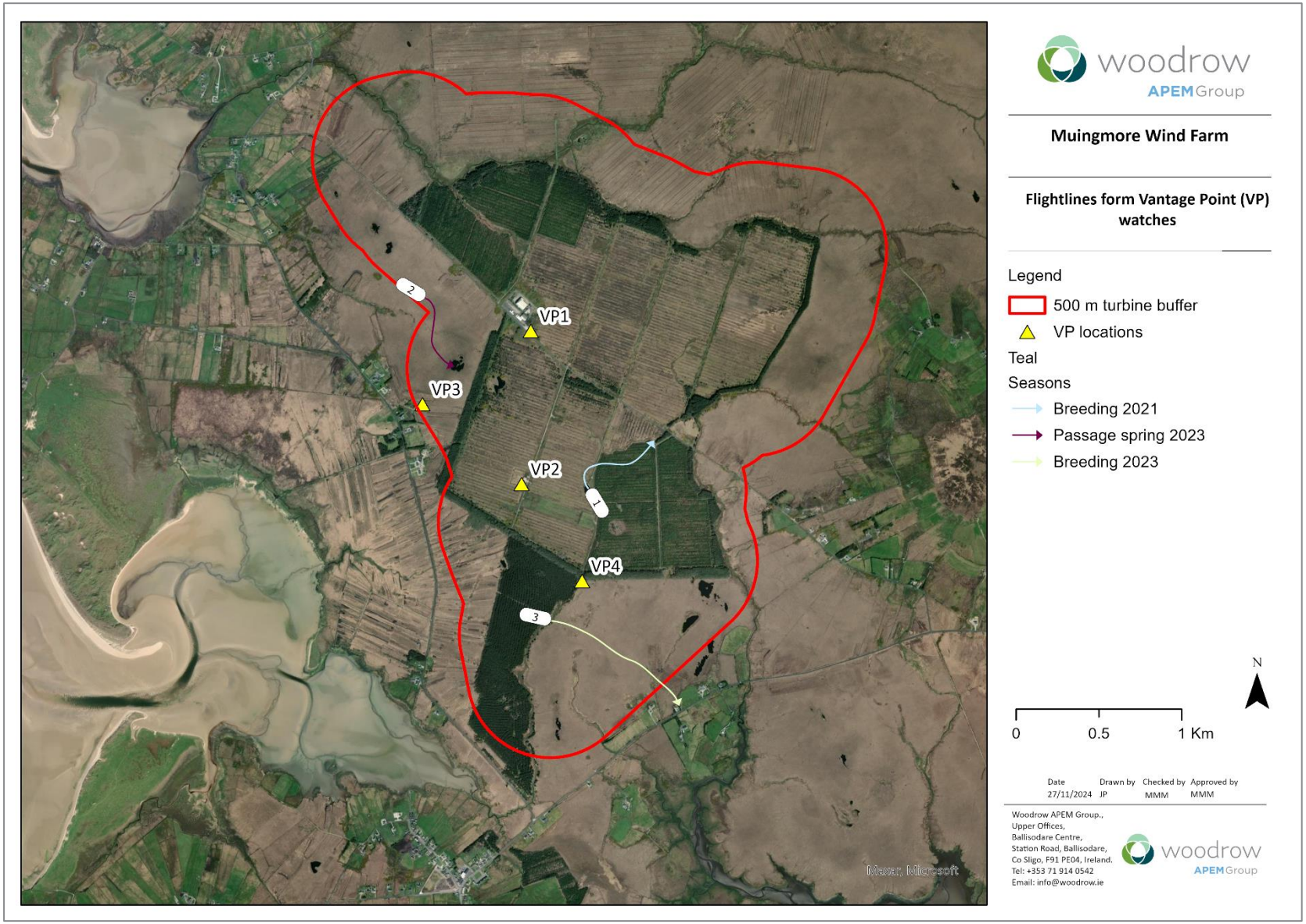


Figure IX.12: Teal flightlines from VP watches

Table IX.13: VP watch data for greylag goose, Canada goose and whooper swan

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	3	03/03/2023	17:40	Greylag goose	17	80	B	4,335			
2	3	07/06/2023	17:13	Canada goose	1	25	B	50			
3	3	17/12/2021	09:32	Whooper swan	3	25	B	120			Commuting
4	1	25/01/2023	11:39	Whooper swan	5	30	B	875		Ad, Juv	

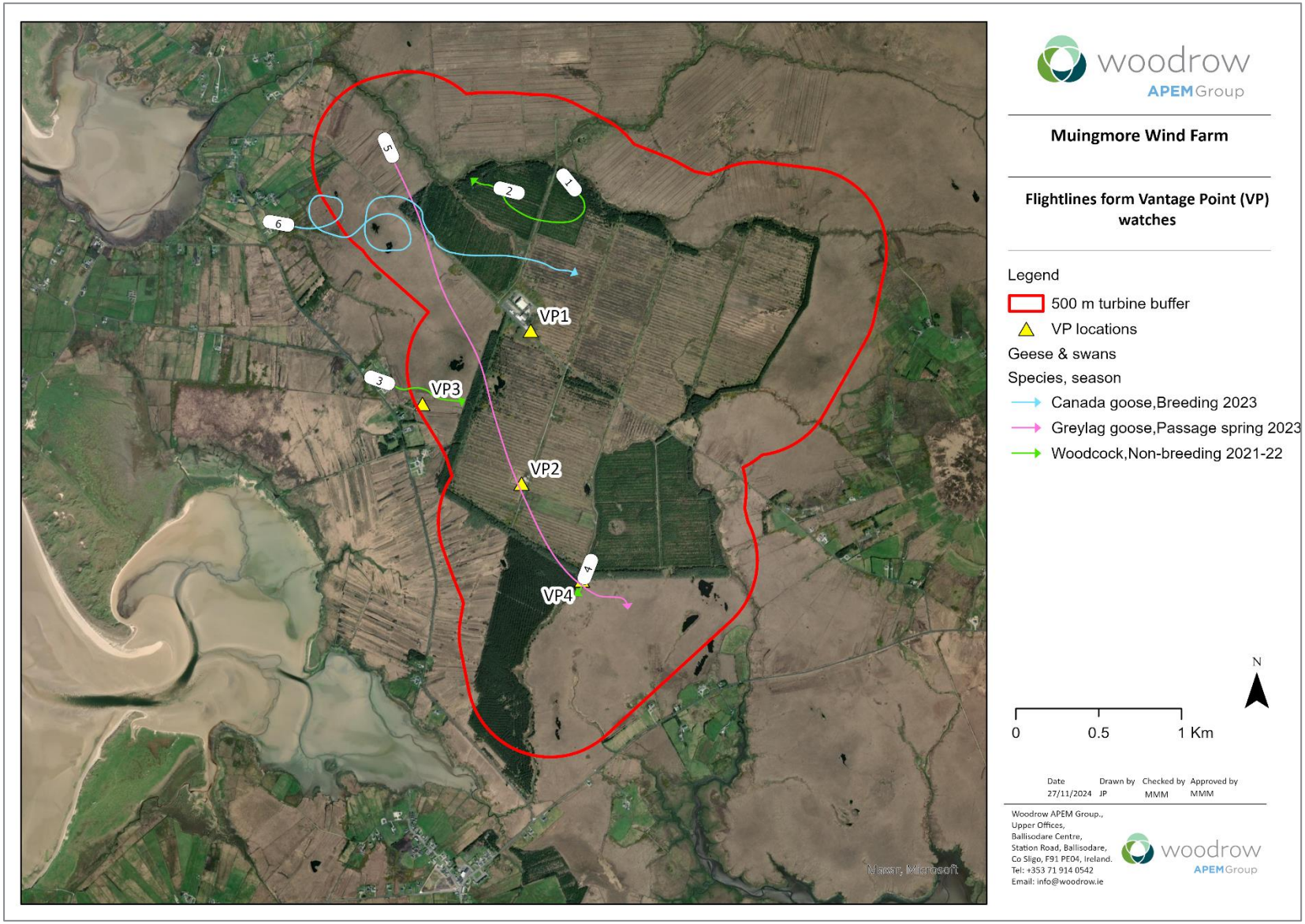


Figure IX.13: Greylag goose, Canada goose and whooper swan flightlines from VP watches

Table IX.14: VP watch data for kittiwake

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	2	10/04/2023	17:48	Kittiwake	1	15	B	40			Presume storm blown bird in, reorienting. Unusual record

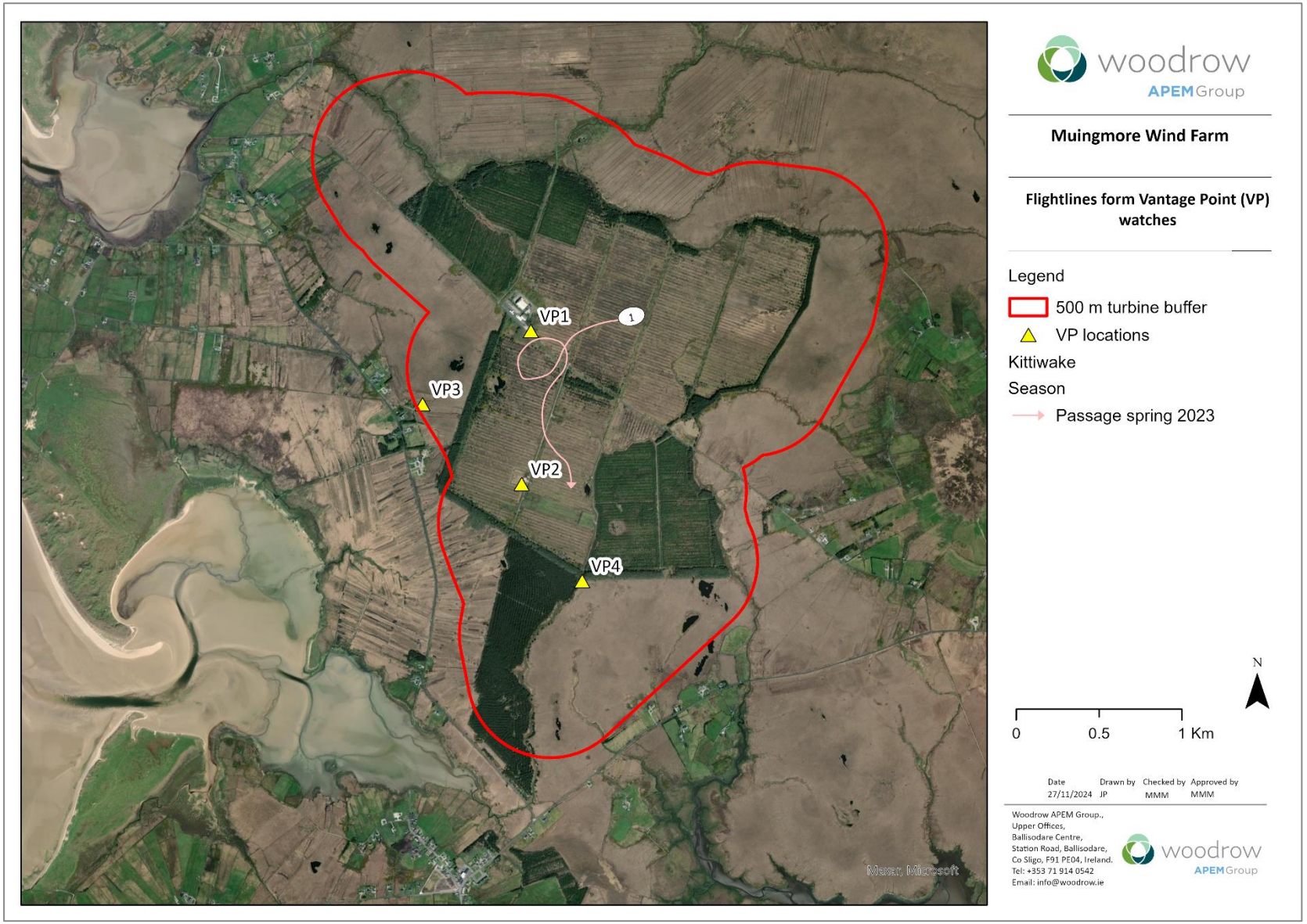


Figure IX.14: Kittiwake flightlines from VP watches

Table IX.15: VP watch data for buzzard

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	1	28/04/2021	15:48	Buzzard	1	100	B	53			
2	1	14/04/2022	12:10	Buzzard	1	-	-	-			Perched
3	1	09/08/2022	16:48	Buzzard	2	55	B	440			Pair circling up high
4	2	21/04/2022	11:50	Buzzard	1	35	B	68			
5	2	21/04/2022	12:50	Buzzard	1	40	B	120			Hunting
6	2	21/04/2022	12:52	Buzzard	1	150	C	310			
7	4	29/08/2022	11:41	Buzzard	2	50	B	5			
8	1	08/02/2023	16:05	Buzzard	1	15	B	20			Landed on bog
9	2	08/02/2023	12:21	Buzzard	1	25	B	40			

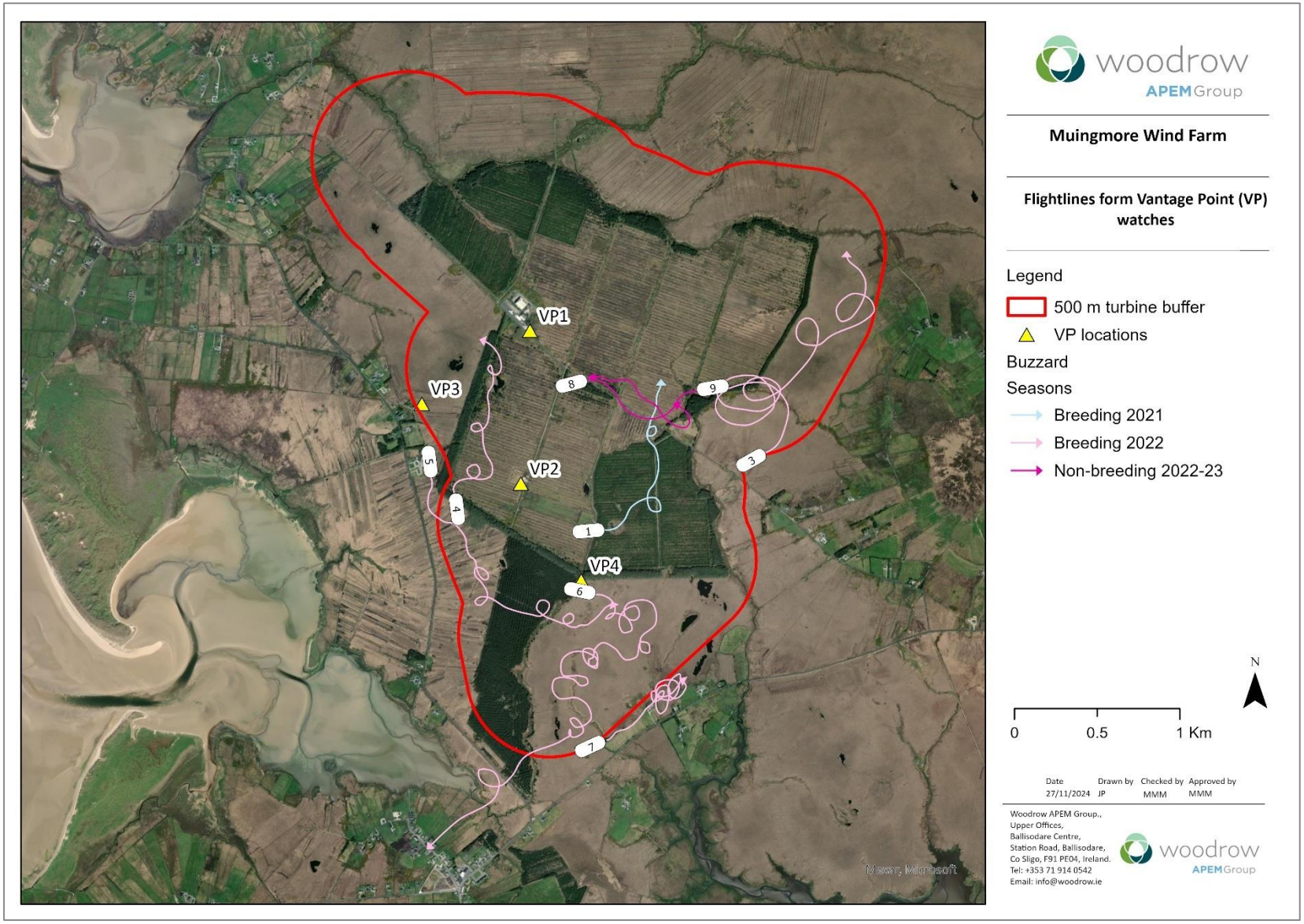


Figure IX.15: Buzzard flightlines from VP watches

Table IX.16: VP watch data for sparrowhawk

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
1	4	18/8/2021	13:29	Sparrowhawk	1	5	A	14	F		Flying
2	1	4/10/2021	11:05	Sparrowhawk	1	30	B	9	M		Perched
3	2	28/9/2021	9:18	Sparrowhawk	2	15	B	646	F	Juv	Hunting
4	2	28/9/2021	9:25	Sparrowhawk	2	0	A	374	F	Juv	Hunting
5	2	28/9/2021	9:32	Sparrowhawk	2	35	B	196	F	Juv	Calling
6	2	28/9/2021	9:43	Sparrowhawk	2	20	B	100	F	Juv	Hunting
7	2	28/9/2021	9:46	Sparrowhawk	2	20	B	36	F	Juv	Hunting
8	2	28/9/2021	10:28	Sparrowhawk	2	10	B	78	F	Juv	Hunting
9	2	28/9/2021	9:21	Sparrowhawk	1	10	B	34	M		Hunting
10	2	28/9/2021	9:35	Sparrowhawk	1	10	B	34	M		Hunting
11	2	5/10/2021	9:21	Sparrowhawk	1	20	B	24	M		Hunting
12	2	5/10/2021	10:21	Sparrowhawk	1	20	B	123	M		Flying
13	3	9/9/2021	12:45	Sparrowhawk	1	0	A	19	M		Perched
14	3	9/9/2021	13:22	Sparrowhawk	1	20	B	48	F		Flying
15	1	13/10/2021	7:45	Sparrowhawk	1	20	B	21	F	Ad	Commuting
16	1	13/10/2021	8:44	Sparrowhawk	1	25	B	12			Commuting
17	1	13/10/2021	9:52	Sparrowhawk	1	10	B	5	F	Ad	Hunting
18	1	20/10/2021	9:57	Sparrowhawk	1	15	B	216	F	Ad	Commuting
19	1	20/10/2021	10:26	Sparrowhawk	1	20	B	36	F	Ad	Hunting
20	1	9/12/2021	9:48	Sparrowhawk	1	20	B	31	F	Ad	Commuting
21	1	9/12/2021	9:49	Sparrowhawk	1	15	B	0	F	Ad	Perched
22	1	9/12/2021	9:51	Sparrowhawk	1	15	B	10	F	Ad	Commuting
23	1	18/1/2022	10:22	Sparrowhawk	1	25	B	171	F	Ad	Commuting
24	1	18/1/2022	10:38	Sparrowhawk	1	20	B	41	F	Ad	Commuting
25	1	19/1/2022	12:12	Sparrowhawk	1	30	B	15		Ad	Hunting
26	1	19/1/2022	12:13	Sparrowhawk	1	30	B	4		Ad	Hunting
27	1	27/1/2022	9:38	Sparrowhawk	1	20	B	17	F	Ad	Displaying

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
28	1	27/1/2022	9:39	Sparrowhawk	1	15	B	8	M	Ad	Commuting
29	1	27/1/2022	9:44	Sparrowhawk	1	25	B	31	F	Ad	Displaying
30	1	27/1/2022	9:45	Sparrowhawk	2	20	B	36	M + F	Ad	Displaying
31	1	27/1/2022	9:52	Sparrowhawk	2	20	B	44	F	Ad	Displaying
32	1	9/2/2022	10:44	Sparrowhawk	1	25	B	42	F	Ad	Displaying
33	2	22/11/2021	12:48	Sparrowhawk	1	5	A	15	F	Ad	Hunting
34	2	22/11/2021	12:57	Sparrowhawk	1	10	B	131	M	Juv	Hunting
35	2	21/2/2022	12:34	Sparrowhawk	1	20	B	37	F	Ad	Commuting
36	3	17/2/2022	10:32	Sparrowhawk	1	10	B	16	F	Ad	Hunting
37	3	9/3/2022	9:37	Sparrowhawk	1	10	B	39	F	Ad	Hunting
38	4	15/5/2022	20:42	Sparrowhawk	1	20	B	30		Ad	Commuting
39	1	19/10/2022	12:01	Sparrowhawk	2	35	B	870	M	Juv	Interacting
40	1	19/10/2022	12:34	Sparrowhawk	2	20	B	440	M	Juv	Mobbed
41	1	11/11/2022	12:09	Sparrowhawk	1	3	A	45	F		Hunting
42	2	15/11/2022	8:11	Sparrowhawk	1	2	A	35	F		Hunting
43	2	12/12/2022	11:41	Sparrowhawk	1	60	B	150	F		Circling
44	2	12/12/2022	14:37	Sparrowhawk	2	5	A	6	M		Flying
45	3	17/11/2022	10:29	Sparrowhawk	1	2	A	5	M	Juv	Perched
46	4	16/10/2022	10:33	Sparrowhawk	1	45	B	85	F		Soaring
47	4	20/10/2022	17:11	Sparrowhawk	1	30	B	80	F		Present
48	4	11/12/2022	14:54	Sparrowhawk	1	1	A	5	F	Ad	Present
49	4	11/12/2022	14:56	Sparrowhawk	1	1	A	4	F	Ad	Present
50	4	11/12/2022	15:04	Sparrowhawk	1	1	A	10	F	Ad	Present
51	4	21/1/2023	10:14	Sparrowhawk	1	25	B	35			Commuting
52	2	13/9/2022	14:07	Sparrowhawk	2	20	B	90	M + F		Present
53	2	14/10/2022	17:29	Sparrowhawk	1	3	A	35	F		Hunting
54	1	2/3/2023	11:14	Sparrowhawk	1	80	B	415	F		Displaying
55	1	2/3/2023	11:16	Sparrowhawk	1	60	B	265	M		Displaying

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
56	1	2/3/2023	12:48	Sparrowhawk	1	75	B	95	F		Displaying
57	1	6/3/2023	72:4	Sparrowhawk	1	2	A	35	M	Ad	Hunting
58	2	2/3/2023	9:34	Sparrowhawk	1	2	A	50	F		Hunting
59	4	8/3/2023	14:48	Sparrowhawk	1	45	B	350			Displaying
60	1	6/5/2023	11:37	Sparrowhawk	1	2	A	30	M		Present
61	2	8/3/2023	17:06	Sparrowhawk	1	25	B	55	F		Hunting
62	2	8/3/2023	17:50	Sparrowhawk	1	10	B	35	F		Hunting
63	2	10/6/2023	17:03	Sparrowhawk	1	2	A	5	M		Hunting
64	2	10/6/2023	17:05	Sparrowhawk	1	2	A	10	M		Present
65	2	25/7/2023	16:15	Sparrowhawk	1	40	B	10			Flying
66	2	25/7/2023	17:45	Sparrowhawk	1	50	B	22			Flying
67	3	25/7/2023	13:10	Sparrowhawk	1	70	B	35		Ad	Flying
68	3	25/7/2023	14:27	Sparrowhawk	1	70	B	10		Ad	Flying
69	3	26/7/2023	14:35	Sparrowhawk	1	70	B	11		Ad	Flying
70	3	26/7/2023	15:30	Sparrowhawk	1	100	B	10		Ad	Flying
71	4	5/5/2023	16:16	Sparrowhawk	1	3	A	15			Present
72	4	26/7/2023	11:40	Sparrowhawk	1	60	B	12			Flying
73	2	31/10/2023	10:03	Sparrowhawk	1	3	A	15	M	Ad	Present
74	2	15/12/2024	10:53	Sparrowhawk	1	2	A	5	M	Ad	Hunting
75	2	15/12/2024	10:54	Sparrowhawk	1	2	A	5	M	Ad	Hunting
76	1	16/4/2024	9:53	Sparrowhawk	1	2	A	29	F	Ad	Hunting
77	3	23/4/2024	17:28	Sparrowhawk	1	30	B	19	M	Ad	Provisioning
78	4	24/4/2024	10:07	Sparrowhawk	1	100	B	137	M	Ad	Hunting
79	4	24/4/2024	17:57	Sparrowhawk	1	20	B	13	M	Ad	Hunting
80	2	25/4/2024	7:11	Sparrowhawk	1	10	B	23	M	Ad	Hunting

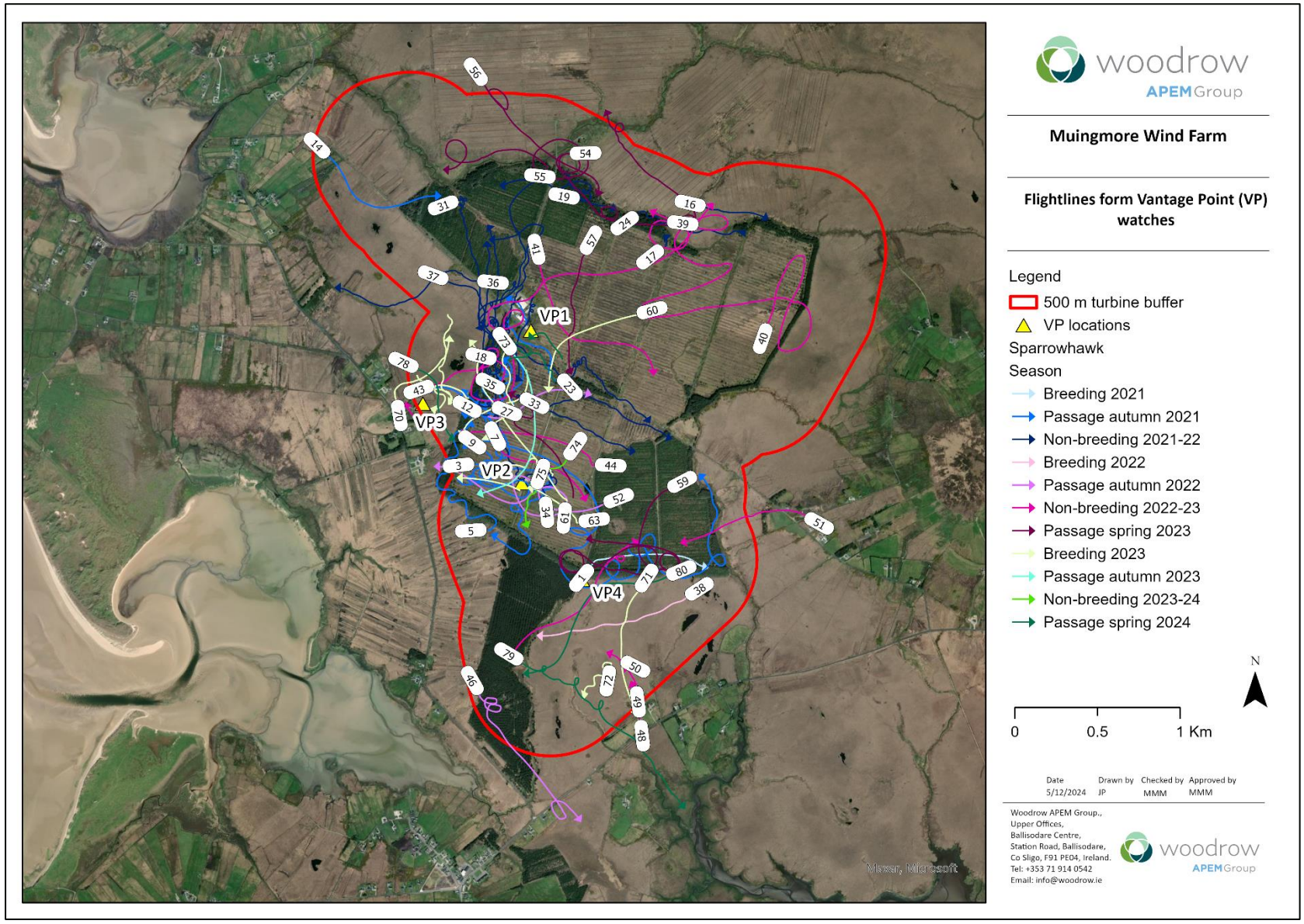


Figure IX.16: Sparrowhawk flightlines from VP watches

Table IX.17: VP watch data for kestrel during Year 1

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	1	28/04/2021	15:29	Kestrel	1	50	B	19			Flying
2	1	08/06/2021	15:04	Kestrel	1	20	B	38			Dove for prey
3	1	08/06/2021	17:10	Kestrel	2	15	B	46			
4	1	10/06/2021	10:41	Kestrel	1	15	B	6			Flying
5	1	10/06/2021	13:09	Kestrel	1	20	B	27			Returning to factory
6	1	17/06/2021	13:22	Kestrel	1	10	B	5			Calling and flying
7	1	17/06/2021	13:30	Kestrel	1	20	B	101			Flying in SE direction
8	1	17/06/2021	13:36	Kestrel	1	30	B	38			
9	1	17/06/2021	13:45	Kestrel	1	15	B	67			
10	1	17/06/2021	14:00	Kestrel	1	20	B	180			
11	1	21/06/2021	14:23	Kestrel	1	20	B	118			Landed between scrub out of sight
12	1	13/07/2021	10:46	Kestrel	1	20	B	27		Juv	
13	1	13/07/2021	10:49	Kestrel	1	30	B	88			
14	1	13/07/2021	10:49	Kestrel	1	10	B	41			Flushed
15	1	15/07/2021	15:05	Kestrel	1	30	B	17			Heard rook alarm call
16	2	27/04/2021	11:31	Kestrel	1	20	B	86			Flying low scanning for prey
17	2	27/04/2021	12:19	Kestrel	1	30	B	32			Hovering
18	2	27/04/2021	13:39	Kestrel	1	20	B	26			Low over young forestry plantation
19	2	09/06/2021	16:25	Kestrel	1	30	B	169	M	Ad	Flying from the nest in old factory
20	2	09/06/2021	16:25	Kestrel	1	30	B	38	F	Ad	Returning to nest at old factory
21	2	24/08/2021	12:02	Kestrel	1	35	B	317			
22	3	28/04/2021	09:46	Kestrel	1	35	B	5			Dropped slowly to ground
23	3	28/04/2021	10:00	Kestrel	1	50	B	10			Dove to ground for prey
24	3	28/04/2021	10:04	Kestrel	1	40	B	73			Hunting
25	3	28/04/2021	10:54	Kestrel	1	25	B	12			Appeared over the treeline
26	3	28/04/2021	11:06	Kestrel	1	60	B	560			
27	3	28/04/2021	11:06	Kestrel	1	60	B	89			

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
28	3	28/04/2021	11:30	Kestrel	1	40	B	18			
29	3	28/04/2021	11:38	Kestrel	1	50	B	87			
30	3	28/04/2021	12:12	Kestrel	1	25	B	225			
31	3	10/05/2021	14:30	Kestrel	1	2	A	21			
32	3	10/05/2021	14:45	Kestrel	1	20	B	10			Flying
33	3	10/05/2021	15:43	Kestrel	1	20	B	12			Altered flight direction around the observer
34	3	21/06/2021	10:54	Kestrel	1	20	B	47			
35	3	28/06/2021	14:21	Kestrel	1	0	A	12			
36	3	25/08/2021	12:51	Kestrel	1	40	B	197			Flew into the line of conifer trees
37	3	25/08/2021	12:52	Kestrel	1	30	B	39			Perched at the edge of young conifer forestry
38	3	25/08/2021	13:24	Kestrel	1	35	B	74			Gradually gained altitude
39	4	08/06/2021	11:59	Kestrel	1	35	B	13			
40	4	10/08/2021	13:50	Kestrel	1	20	B	70			
41	4	10/08/2021	13:53	Kestrel	1	25	B	137			Foraging
42	4	10/08/2021	13:51	Kestrel	1	5	A	37			
43	4	10/08/2021	13:54	Kestrel	1	25	B	94			Alarm called then flew east out of sight
44	4	10/08/2021	15:24	Kestrel	1	5	A	360			
45	4	18/08/2021	12:26	Kestrel	1	20	B	12			Flying back to field, circled then landed
46	4	24/08/2021	17:11	Kestrel	1	25	B	20			Came from small lake
47	4	26/08/2021	16:07	Kestrel	1	40	B	55			
48	4	26/08/2021	16:34	Kestrel	1	15	B	9			Flying from perch on conifer branch
49	1	20/10/2021	07:52	Kestrel	1	15	B	12			Flying north-west
50	1	24/11/2021	10:39	Kestrel	1	-	-	-			Perched upon dead tree. Viewed until end of count
51	1	27/01/2022	10:31	Kestrel	1	15	B	42			Calling out and moving east
52	1	27/01/2022	10:32	Kestrel	1	30	B	29			Circling and flying
53	1	27/01/2022	10:32	Kestrel	1	30	B	11			
54	1	27/01/2022	10:33	Kestrel	1	-	-	-			Perched at 5m until VP count finished

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
55	1	17/02/2022	15:17	Kestrel	1	10	B	7			Flying west
56	1	17/02/2022	15:17	Kestrel	1	-	-	-			Perched at 5m until end of count.
57	1	10/03/2022	09:53	Kestrel	1	15	B	137			Commuting west
58	1	10/03/2022	10:39	Kestrel	1	15	B	92			
59	3	14/10/2021	12:21	Kestrel	1	15	B	7	M	Juv	Flying
60	3	22/11/2021	09:28	Kestrel	1	25	B	42			Commuting and hunting
61	3	29/11/2021	09:32	Kestrel	1	20	B	22	M		Commuting
62	3	09/03/2022	08:49	Kestrel	1	20	B	22			Commuting
63	4	25/10/2021	13:09	Kestrel	1	50	B	47			Circling

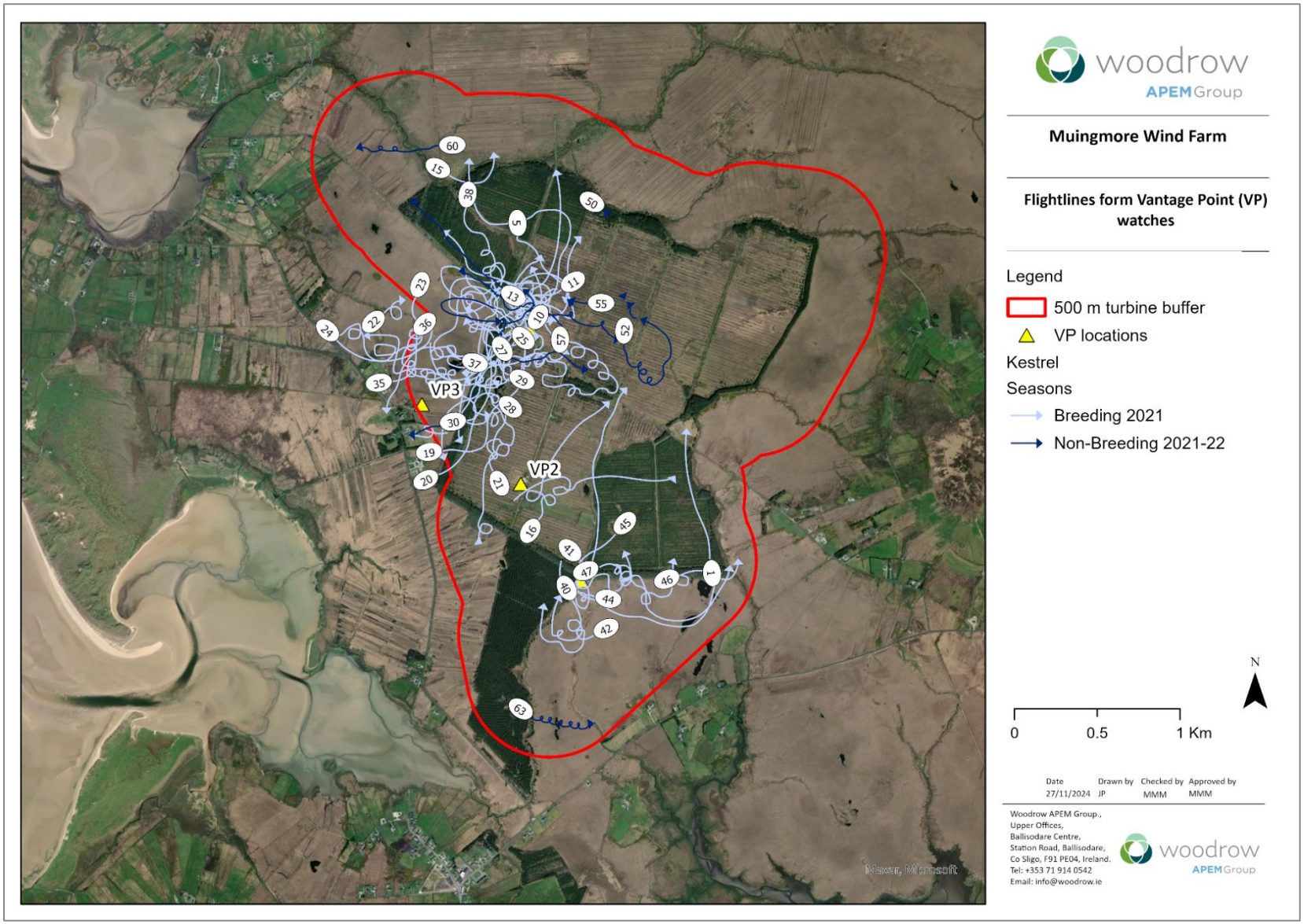


Figure IX.17: Kestrel flightlines from VP watches (Year 1)

Table IX.18: VP watch data for kestrel during Year 2

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
1	1	27/4/2022	10:35	Kestrel	1	10	B	5		A	Commuting
2	1	4/5/2022	16:28	Kestrel	1	10	B	15	M	A	Hunting
3	1	4/5/2022	16:35	Kestrel	1	10	B	10	M	A	Hunting
4	1	4/5/2022	17:20	Kestrel	1	40	B	120	M	A	Hunting
5	1	4/5/2022	17:25	Kestrel	1	20	B	20	M	A	Commuting
6	1	4/5/2022	18:10	Kestrel	1	15	B	10		A	Commuting
7	1	4/5/2022	18:20	Kestrel	2	30	B	480	M + F	A	Hunting
8	1	25/6/2022	10:40	Kestrel	1	10	B	20	F	A	Flying
9	1	25/6/2022	10:55	Kestrel	2	20	B	70	M + F	A	Hunting
10	1	25/6/2022	11:05	Kestrel	1	20	B	20	F	A	Hunting
11	1	25/6/2022	11:38	Kestrel	1	10	B	15	F	A	Flying
12	1	25/6/2022	14:20	Kestrel	1	10	B	40	F	A	Flying
13	1	25/6/2022	15:40	Kestrel	1	20	B	58	F	A	Hunting
14	1	6/7/2022	10:54	Kestrel	1	25	B	40	F	A	Flying
15	1	6/7/2022	11:48	Kestrel	4	20	B	120	M + F	2A 2J	Feeding
16	2	21/4/2022	12:30	Kestrel	1	25	B	180		A	Hunting
17	2	21/4/2022	13:35	Kestrel	1	30	B	300		A	Hunting
18	2	28/4/2022	15:16	Kestrel	2	150	C	760	M + F	A	Courtship
19	2	28/4/2022	15:55	Kestrel	2	120	C	600	M + F	A	Courtship
20	2	28/4/2022	16:14	Kestrel	2	100	B	280	M + F	A	Courtship
21	2	28/4/2022	16:25	Kestrel	2	180	C	700	M + F	A	Courtship
22	2	28/4/2022	16:59	Kestrel	2	100	B	10	M + F	A	Courtship
23	2	28/4/2022	17:10	Kestrel	2	100	B	700	M + F	A	Courtship
24	2	3/8/2022	15:22	Kestrel	2	20	B	720			Hunting
25	2	18/8/2022	11:39	Kestrel	1	20	B	140			Hunting
26	2	18/8/2022	16:22	Kestrel	1	40	B	4			Hunting
27	3	27/4/2022	16:35	Kestrel	1	25	B	65		A	Commuting

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
28	3	13/6/2022	14:20	Kestrel	2	18	B	20	M + F	A	Mobbing
29	3	19/7/2022	10:40	Kestrel	1	25	B	200	F	A	Mobbing
30	4	26/6/2022	11:50	Kestrel	1	25	B	20		A	Hunting
31	1	11/9/2022	17:05	Kestrel	1	15	B	20	M	A	Calling
32	1	10/10/2022	11:53	Kestrel	2	8	A	330			Interacting
33	1	13/10/2022	7:52	Kestrel	1	10	B	30		J	Commuting
34	1	19/10/2022	13:22	Kestrel	1	15	B	65			Hunting
35	1	25/1/2023	12:26	Kestrel	1	30	B	140	F	A	Hunting
36	1	25/1/2023	12:31	Kestrel	2	75	B	540	M	A	Displaying
37	1	25/1/2023	12:36	Kestrel	1	50	B	40	M	A	Commuting
38	1	25/1/2023	12:36	Kestrel	1	75	B	200	F	A	Hunting
39	1	25/1/2023	12:47	Kestrel	1	2	A	30	M	A	Commuting
40	1	25/1/2023	13:45	Kestrel	1	5	A	25	M	A	Commuting
41	3	14/9/2022	17:03	Kestrel	1	5	A	10	M	A	Hunting
42	3	14/9/2022	17:05	Kestrel	1	5	A	5	M	A	Flying
43	3	10/10/2022	15:22	Kestrel	1	20	B	35			Commuting
44	3	19/10/2022	9:18	Kestrel	1	20	B	115			Hunting
45	4	21/1/2023	8:27	Kestrel	1	15	B	25			Commuting
46	1	5/3/2023	13:55	Kestrel	1	10	B	65	M	Ad	Flying
47	1	6/3/2023	7:17	Kestrel	1	10	B	20	M	Ad	Mobbing
48	1	6/3/2023	7:31	Kestrel	1	10	B	40	F		Mobbing
49	1	6/4/2023	12:58	Kestrel	2	20	B	60	M+F		Mobbing
50	1	6/4/2023	14:34	Kestrel	2	15	B	50	M+F		Mobbing
51	1	6/4/2023	14:53	Kestrel	2	20	B	60	M+F		Circling
52	1	7/4/2023	12:56	Kestrel	1	15	B	10	F		Present
53	2	2/3/2023	7:21	Kestrel	1	25	B	65			Flying
54	2	2/3/2023	7:21	Kestrel	2	20	B	90	M+F	Ad	Mobbing

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
55	2	10/4/2023	15:31	Kestrel	1	20	B	25			Present
56	3	3/3/2023	17:53	Kestrel	1	10	B	10	F		Flying
57	3	5/3/2023	15:29	Kestrel	1	20	B	265	F		Hunting
58	1	25/6/2022	11:00	Kestrel	1	-	-	-		J	Perched
59	1	6/7/2022	10:56	Kestrel	1	15	B	-		J	Flying

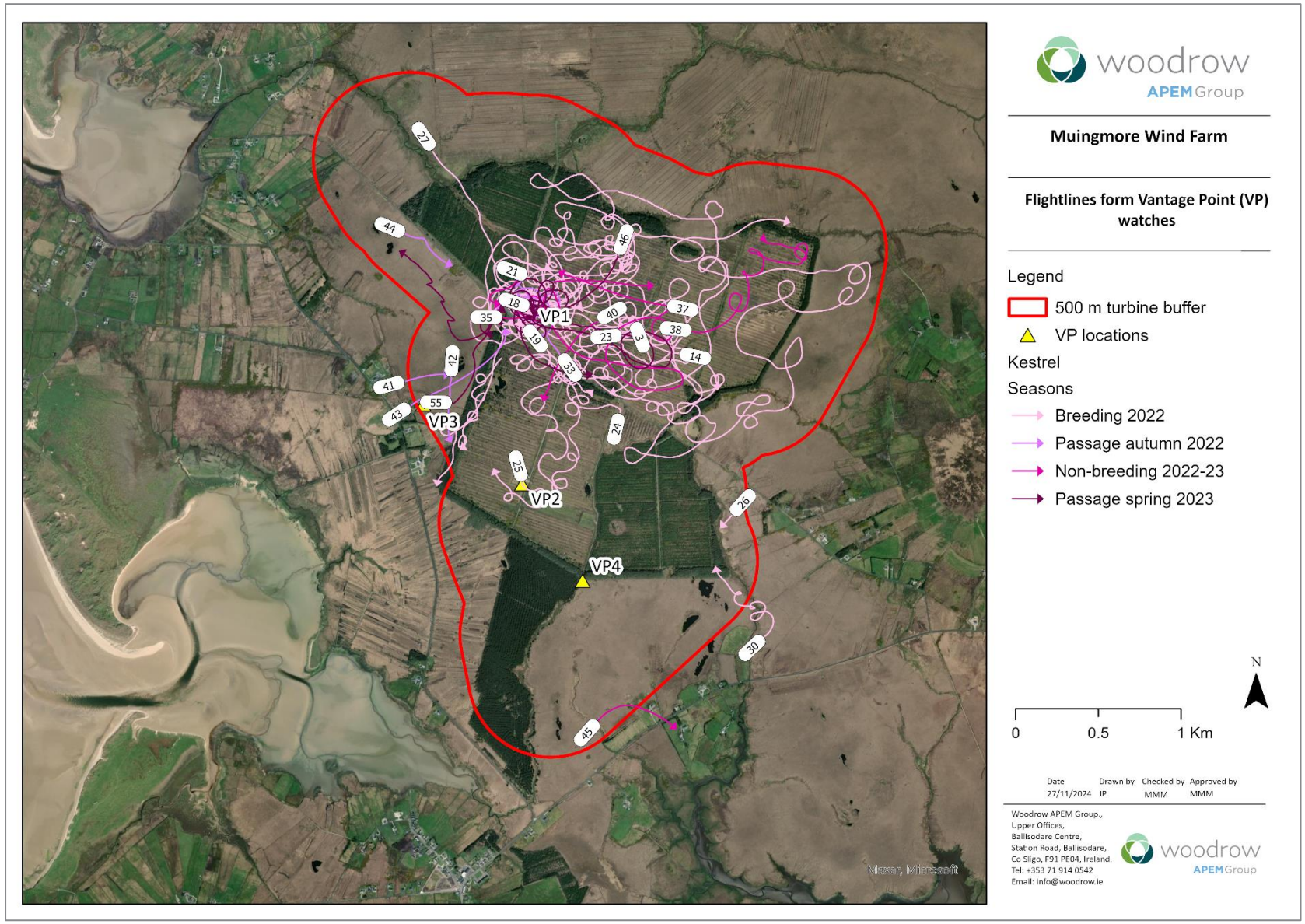


Figure IX.18: Kestrel flightlines from VP watches (Year 2)

Table IX.19: VP watch data for kestrel during Year 3

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
1	1	1/3/2023	17:13	Kestrel	2	10	B	390	M+F	Ad	Displaying
2	1	1/3/2023	18:03	Kestrel	1	20	B	40	M	Ad	Flying
3	1	1/3/2023	18:30	Kestrel	1	20	B	25	F	Ad	Flying
4	1	9/3/2023	8:08	Kestrel	1	20	B	135	M	Ad	Displaying
5	1	9/3/2023	8:12	Kestrel	2	15	B	200	M+F		Displaying
6	1	9/3/2023	8:14	Kestrel	2	50	B	80	M+F		Flying
7	1	9/3/2023	8:48	Kestrel	1	15	B	85	M		Hunting
8	1	6/5/2023	9:51	Kestrel	1	20	B	20	F		Present
9	1	6/5/2023	12:30	Kestrel	1	100	B	150	F		Present
10	1	6/5/2023	12:30	Kestrel	1	100	B	150	F		Present
11	1	9/6/2023	12:15	Kestrel	1	40	B	120	F	Ad	Present
12	1	9/6/2023	12:17	Kestrel	1	90	B	70	F	Ad	Present
13	1	9/6/2023	13:02	Kestrel	1	10	B	8	M	Ad	Present
14	1	9/6/2023	13:19	Kestrel	1	50	B	180	M	Ad	Flying
15	1	9/6/2023	13:19	Kestrel	1	50	B	180	M	Ad	Flying
16	1	9/6/2023	16:20	Kestrel	1	12	B	150	M	Ad	Flying
17	1	9/6/2023	16:23	Kestrel	1	30	B	40	M	Ad	Flying
18	1	9/6/2023	16:25	Kestrel	1	10	B	20		Ad	Hunting
19	1	9/6/2023	18:51	Kestrel	1	30	B	40		Ad	Present
20	1	9/6/2023	19:22	Kestrel	1	20	B	75		Ad	Present
21	1	5/7/2023	11:45	Kestrel	1	-	-	-	F		Perched
22	1	5/7/2023	12:35	Kestrel	1	50	B	37	M		Flying
23	1	5/7/2023	13:33	Kestrel	1	100	B	24			Flying
24	1	5/7/2023	13:54	Kestrel	1	-	-	-			Perched
25	1	6/7/2023	10:37	Kestrel	2	80	B	360			Flying
26	1	6/7/2023	11:52	Kestrel	1	90	B	75			Flying
27	1	1/8/2023	8:35	Kestrel	1	5	A	0		Juv	Perched

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
28	1	2/8/2023	10:11	Kestrel	1	35	B	240	F	Ad	Hunting
29	2	5/3/2023	10:28	Kestrel	1	45	B	170	M	Ad	Soaring
30	2	8/3/2023	16:34	Kestrel	1	20	B	75	F	Ad	Flying
31	2	8/3/2023	16:49	Kestrel	1	15	B	65	F	Ad	Flying
32	2	8/3/2023	16:50	Kestrel	1	15	B	30	M	Ad	Displaying
33	2	10/6/2023	13:40	Kestrel	1	20	B	10	F	Ad	Present
34	2	10/6/2023	13:54	Kestrel	1	40	B	90	F	Ad	Present
35	3	1/8/2023	14:20	Kestrel	1	15	B	20	M	Juv	Fly-land
36	3	1/8/2023	14:40	Kestrel	1	15	B	5	M	Juv	Fly-land
37	3	1/8/2023	14:48	Kestrel	1	20	B	10	M	Juv	Fly-land
38	4	3/8/2023	13:58	Kestrel	1	20	B	40		Juv	Hunting
39	4	9/8/2023	19:36	Kestrel	1	10	B	65	F	Ad	Hunting
40	1	7/9/2023	9:20	Kestrel	1	15	B	40	M	Ad	Present
41	1	7/9/2023	10:11	Kestrel	1	8	A	5	M	Ad	Present
42	1	7/9/2023	10:17	Kestrel	1	12	B	25	M	Ad	Present
43	1	7/9/2023	13:46	Kestrel	1	10	B	5	M	Ad	Present
44	3	6/9/2023	8:46	Kestrel	1	35	B	35		Juv	Present
45	1	19/2/2024	10:14	Kestrel	1	60	B	65	M	Ad	Hunting
46	1	5/3/2024	10:53	Kestrel	1	15	B	20	M	Ad	Hunting
47	1	5/3/2024	11:04	Kestrel	2	15	B	60	M+F	Ad	Hunting
48	3	13/12/2023	14:18	Kestrel	1	15	B	15	M	Ad	Fly-land
49	3	13/12/2023	14:21	Kestrel	1	10	B	20	M	Ad	Fly-land
50	4	30/11/2023	13:35	Kestrel	1	20	B	160			Circling
51	1	20/3/2024	10:36	Kestrel	1	15	B	10	M	Ad	Present
52	1	20/3/2024	11:42	Kestrel	2	15	B	30	M+F	Ad	Mobbing
53	1	20/3/2024	11:58	Kestrel	1	20	B	45	F	Ad	Present
54	1	16/4/2024	8:31	Kestrel	1	50	B	39	F	Ad	Flying
55	1	16/4/2024	8:40	Kestrel	1	40	B	78	M	Ad	Hunting

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
56	1	16/4/2024	8:47	Kestrel	1	20	B	34	F	Ad	Flying
57	1	16/4/2024	10:08	Kestrel	1	50	B	177	M	Ad	Courtship
58	1	16/4/2024	10:08	Kestrel	1	30	B	175	F	Ad	Courtship
59	1	16/4/2024	10:46	Kestrel	1	5	A	29	M	Ad	Flying
60	1	16/4/2024	10:48	Kestrel	1	30	B	6	M	Ad	Flying
61	1	16/4/2024	10:53	Kestrel	1	15	B	4	F	Ad	Flying
62	3	18/4/2024	10:39	Kestrel	1	25	B	59	M	Ad	Hunting
63	3	23/4/2024	15:59	Kestrel	1	10	B	21	F	Ad	Flying
64	3	23/4/2024	16:00	Kestrel	1	10	B	8	F	Ad	Flying
65	3	23/4/2024	16:03	Kestrel	1	10	B	7	M	Ad	Flying
66	3	23/4/2024	16:05	Kestrel	1	20	B	33	M	Ad	Flying
67	3	23/4/2024	16:11	Kestrel	1	10	B	18	F	Ad	Hunting
68	3	23/4/2024	16:13	Kestrel	1	25	B	13	M	Ad	Flying
69	3	23/4/2024	16:18	Kestrel	1	30	B	106	F	Ad	Hunting

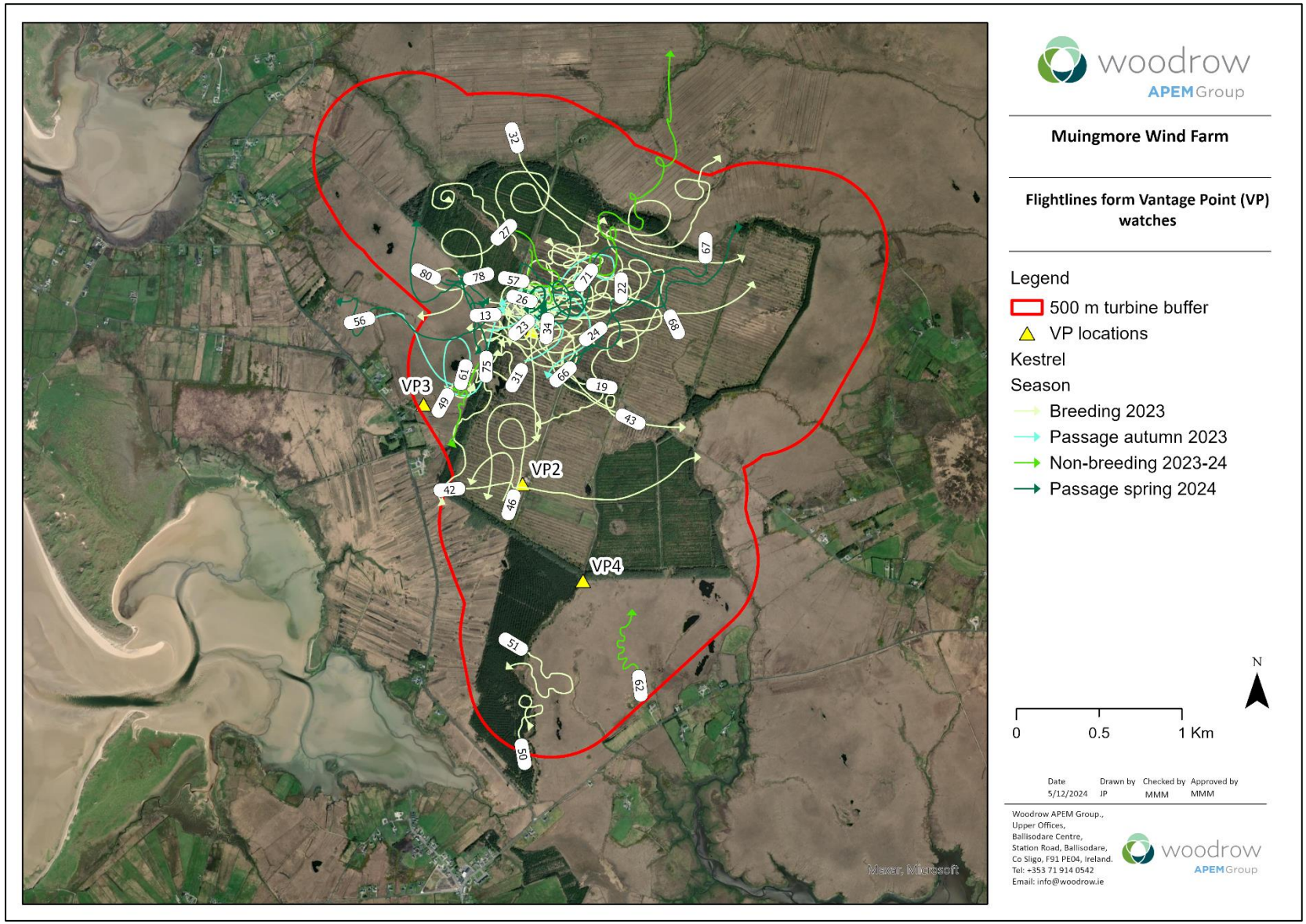


Figure IX.19: Kestrel flightlines from VP watches (Year 3)

Table IX.20: VP watch data for hen harrier

Flight ID	VP No.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	1	09/08/2022	11:25	Hen harrier	1	35	B	210			Flew towards factory, swallows chased it off
2	3	11/08/2022	10:20	Hen harrier	1	70	B	15			Flying west
3	2	22/02/2023	13:27	Hen harrier	1	8	A	150			Hunting over grassland from VP
4	2	22/02/2023	16:12	Hen harrier	1	8	A	300	M	Juv	Present
5	4	20/02/2023	13:22	Hen harrier	1	15	B	40	RG		Hunting
6	4	20/02/2023	13:22	Hen harrier	1	15	B	40	RG		Hunting
7	4	03/03/2023	14:22	Hen harrier	1	3	A	160			Present
8	2	31/10/2023	11:21	Hen harrier	1	2	A	40	F	Ad	Hunting
9	4	20/12/2023	13:30	Hen harrier	1	5	A	20	RG		Present

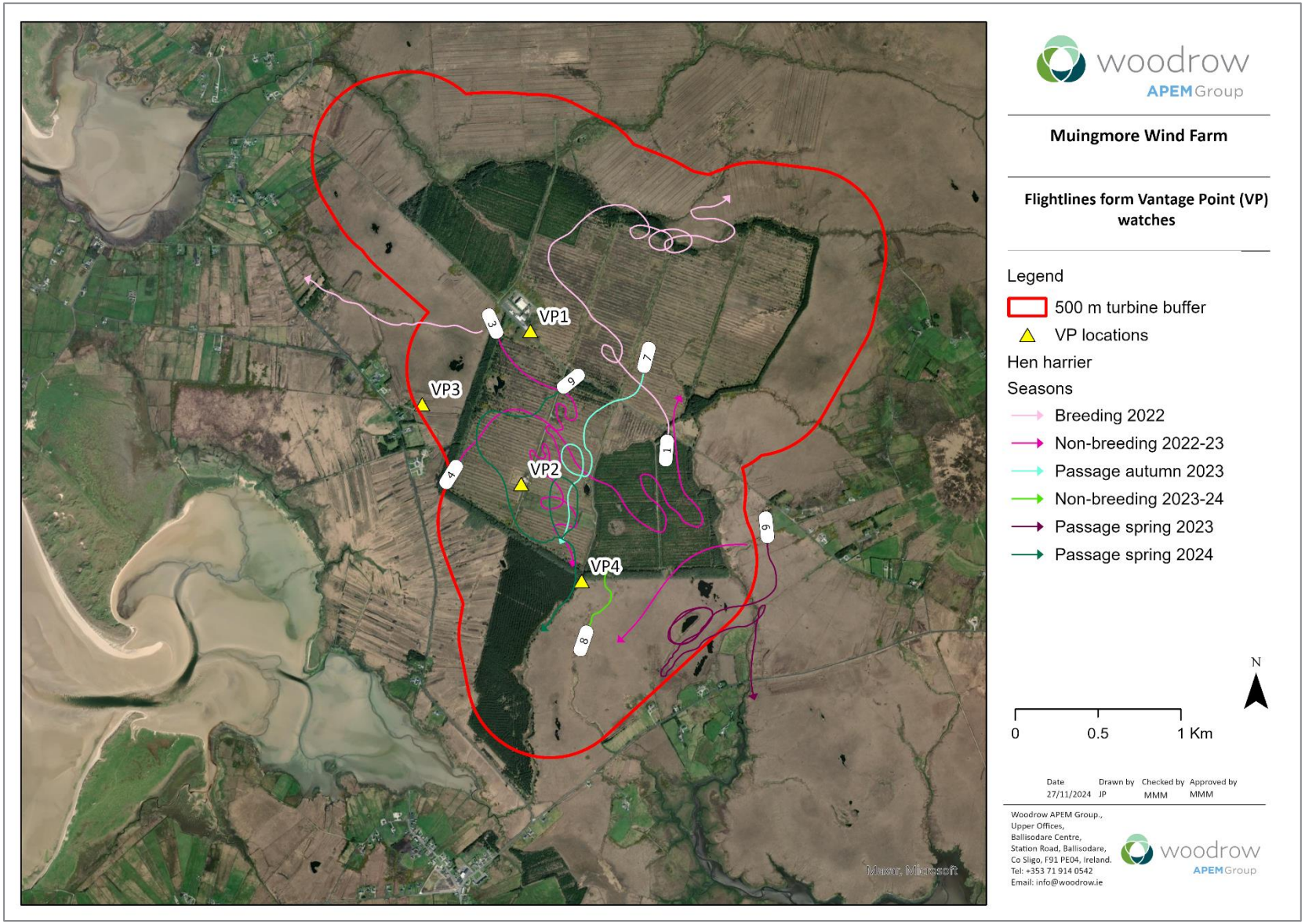


Figure IX.20: Hen harrier flightlines from VP watches

Table IX.21: VP watch data for Merlin

Flight ID	VP no.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total	Sex	Age	Behaviour
1	1	9/2/2022	9:33	Merlin	1	40	B	26	F	Ad	Commuting
2	3	15/11/2022	16:46	Merlin	1	8	A	30	M	Ad	Present
3	4	5/4/2023	12:37	Merlin	1	5	A	8	F		Hunting
4	4	5/4/2023	14:35	Merlin	1	2	A	15	M		Present
5	4	30/11/2023	10:20	Merlin	1	5	A	35	M	Ad	Flying

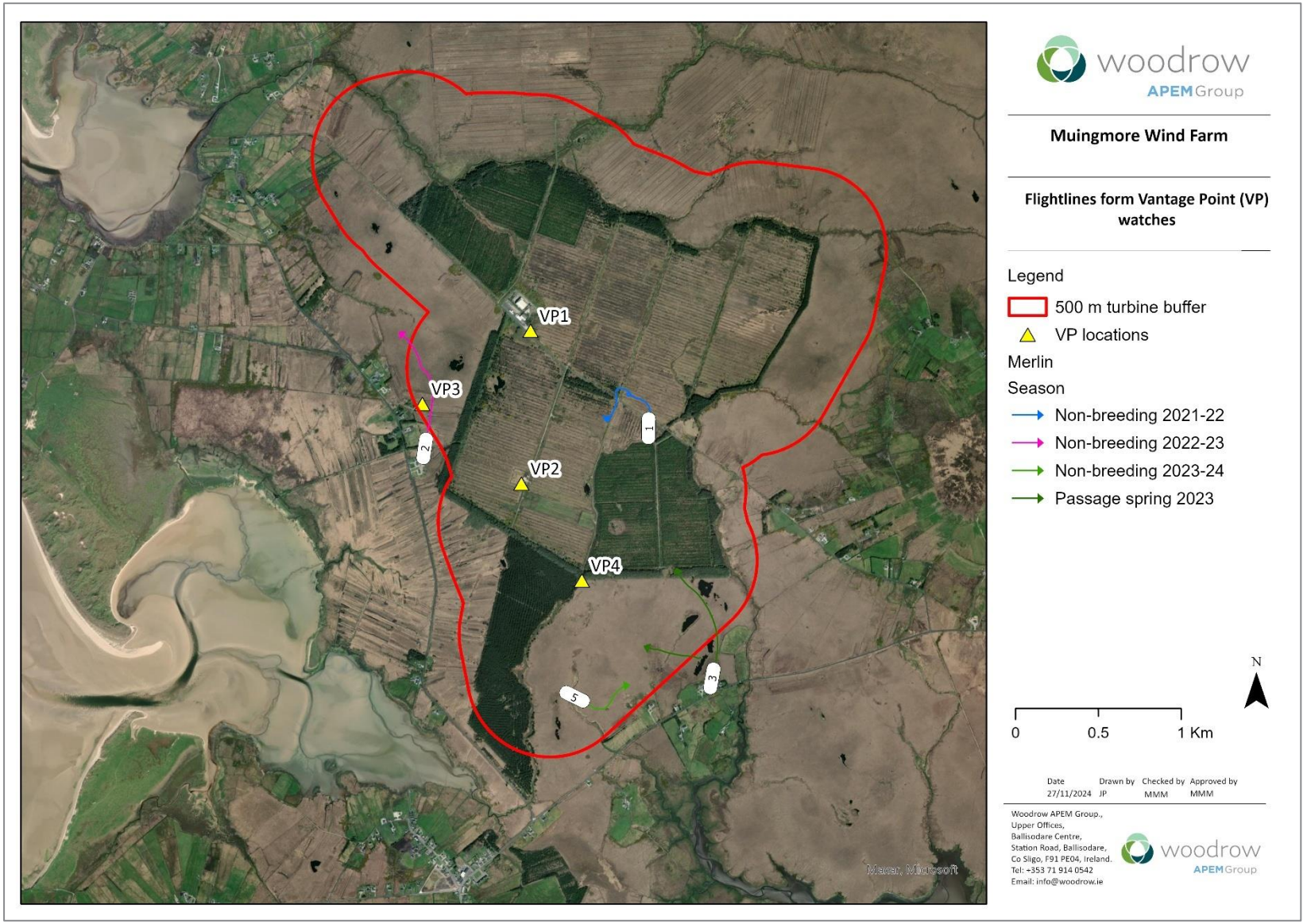


Figure IX.21: Merlin flightlines from VP watches

Table IX.22: VP watch data for hobby

Flight ID	VP No.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
1	3	19/7/2022	10:40	Hobby	1	25	B	240			Mobbing
2	3	19/7/2022	10:57	Hobby	1	5	A	30			Fly-land
3	3	19/7/2022	12:09	Hobby	1	1	A	20			Fly-land

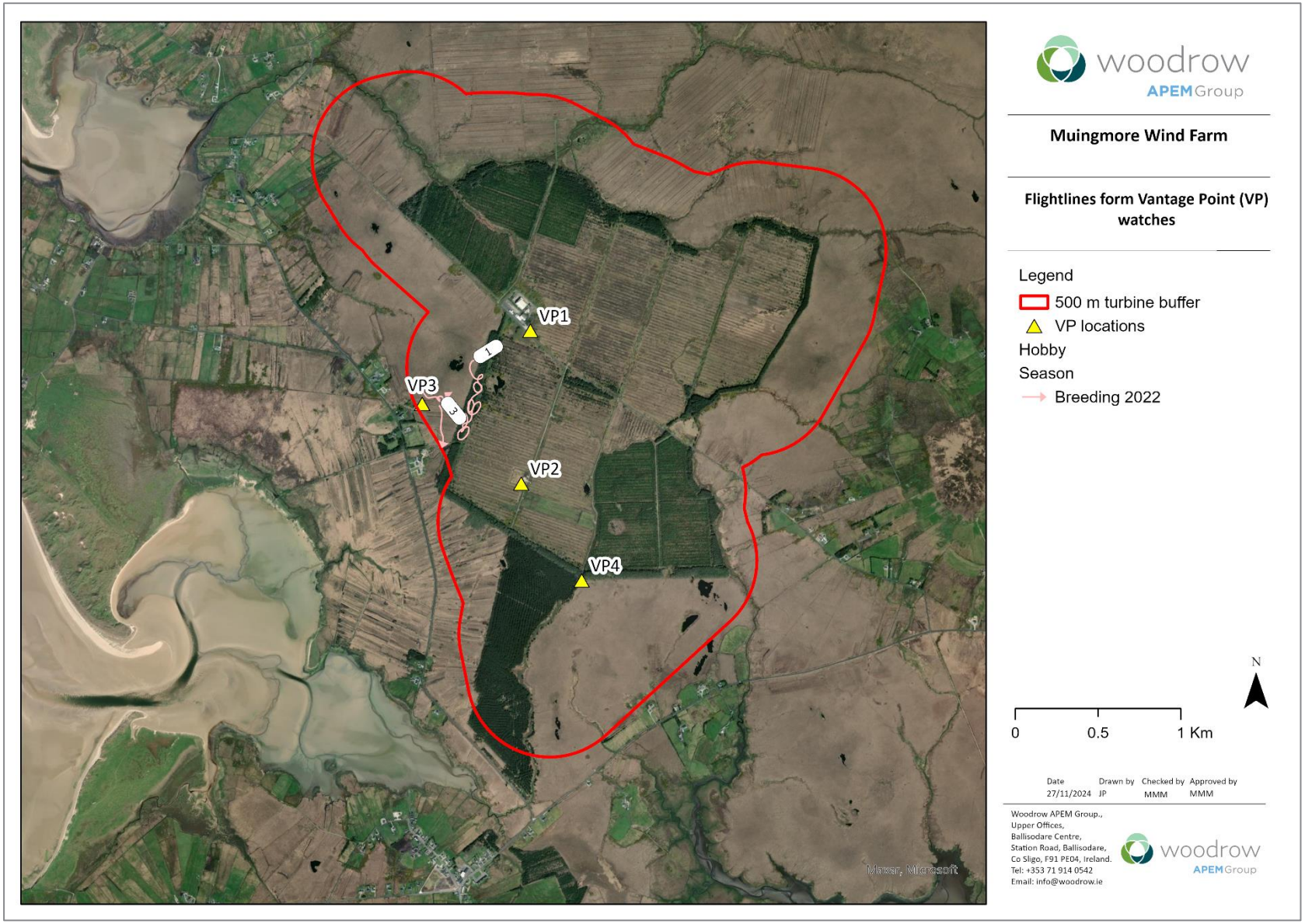


Figure IX.22: Hobby flightlines from VP watches

Table IX.23: VP watch data for peregrine

Flight ID	VP No.	Date	Time	Species	No. birds	Height (m)	Height band	Flight total (secs)	Sex	Age	Behaviour
6	3	21/1/2023	12:13	Peregrine	1	40	B	5			Hunting
7	3	21/1/2023	12:13	Peregrine	1	35	B	10			Hunting
12	4	14/11/2022	15:27	Peregrine	1	65	B	80			Circling
13	4	21/1/2023	14:46	Peregrine	1	40	B	55			Commuting
14	4	21/1/2023	14:46	Peregrine	1	40	B	55			Flying
8	3	14/9/2022	17:29	Peregrine	1	30	B	180			Flying
9	3	13/10/2022	15:17	Peregrine	1	60	B	50			Flying
10	4	13/9/2022	15:30	Peregrine	1	15	B	5			Flying
11	4	13/9/2022	15:45	Peregrine	1	25	B	15			Hunting

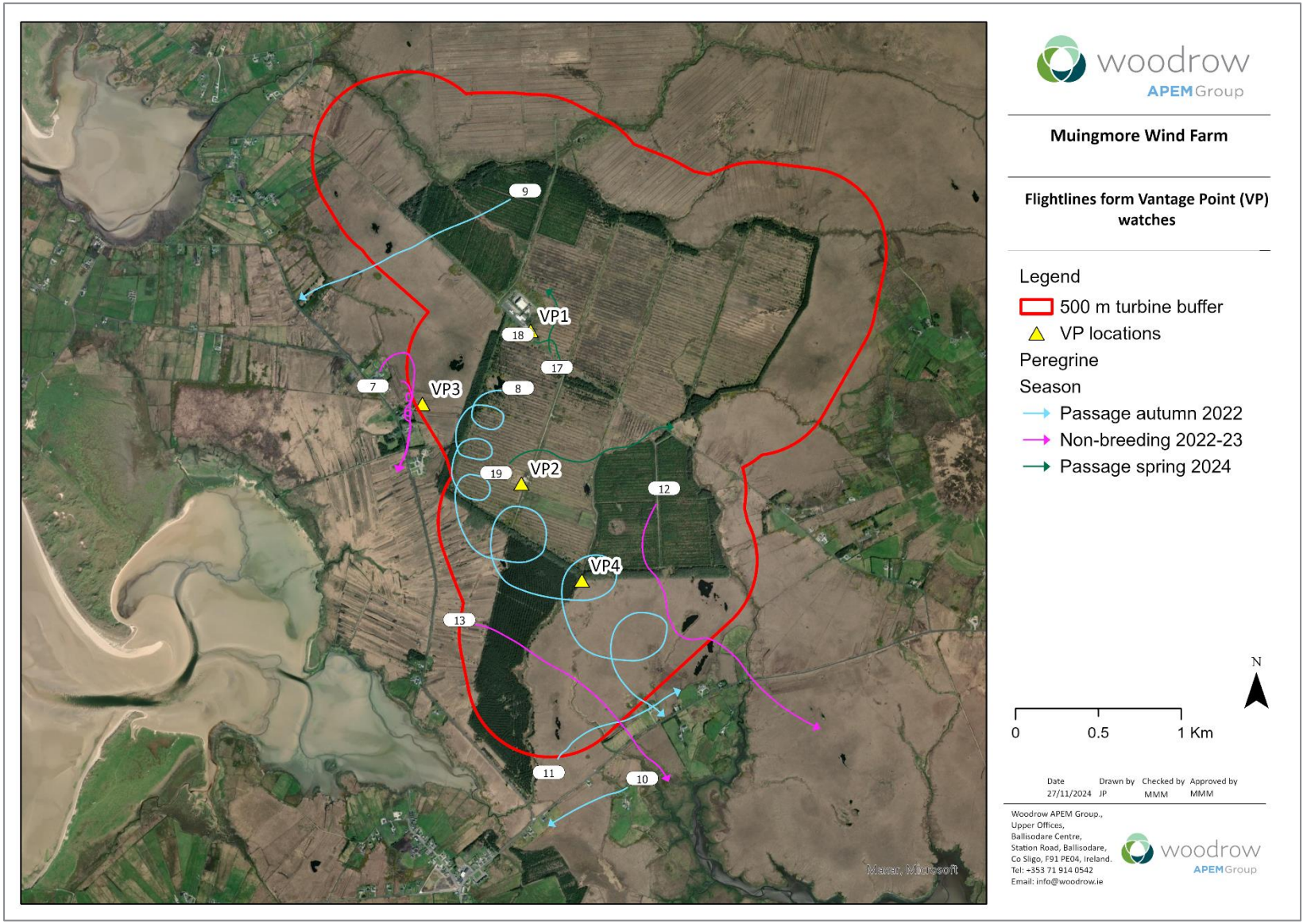


Figure IX.23: Peregrine flightlines from VP watches

Appendix X - Breeding bird survey results

Table X.1: Summary of all breeding bird survey results carried out during the 2021 breeding season

Species	BTO code	Visit 1	Visit 2	Visit 3	BoCCI 2020-2026
Kestrel	K	2	1	-	Red
Meadow pipit	MP	-	-	30	Red
Snipe	SN	2	1	-	Red
Black-headed gull	BH	-		4	Amber
Goldcrest	GC	-	4	2	Amber
Lesser black-backed gull	LB	1	5	-	Amber
Mallard	MA	5	-	-	Amber
Skylark	S		2	2	Amber
Starling	SG	2		-	Amber
Swallow	SL	2	3	-	Amber
Teal	T	1	2	-	Amber
Willow warbler	WW	2	13	14	Amber
Blackbird	B	5	2	-	Green
Blackcap	BC	-	3	-	Green
Blue tit	BT	2	4	-	Green
Chaffinch	CH	3	13	-	Green
Coal tit	CT	-	6		Green
Cuckoo	CK	6	10	7	Green
Dunnock	D	3	2	-	Green
Feral pigeon	FP	6	-	-	Green
Goldfinch	GO	2	-	-	Green
Grey heron	H		1	1	Green
Hooded (grey) crow	HC	1	1	3	Green
Jackdaw	JD	4	-	-	Green
Magpie	MG	-	7	-	Green
Moorhen	MH	-	1	-	Green
Pheasant	PH	2	3	1	Green
Pied wagtail	PW	2	-	-	Green
Raven	RN	8	3	8	Green
Reed bunting	RB	5	-	3	Green
Robin	R	-	9	-	Green
Sedge warbler	SW	7	8	5	Green
Siskin	SK	-	2	-	Green
Sparrowhawk	SH	1	-	-	Green
Stonechat	SC	1	-	2	Green
Whitethroat	WH	-	3	1	Green
Woodpigeon	WP	-	5	-	Green
Wren	WR	2	2	-	Green

Table X.2: Summary of all breeding bird survey results carried out during the 2022 breeding season

Species	BTO code	Visit 1	BoCCI 2020-2026
Kestrel	K.	2	Red
Snipe	SN	1	Red
Meadow pipit	MP	45	Red
Black-headed gull	BH	6	Amber
Herring gull	HG	1	Amber
Lesser black-backed gull	LB	1	Amber
Skylark	S.	4	Amber
Starling	SG	12	Amber
Swallow	SL	12	Amber
Willow warbler	WW	12	Amber
Blackbird	B	7	Green
Blackcap	BC	1	Green
Chaffinch	CH	4	Green
Common redpoll	FR	3	Green
Dunnock	D	6	Green
Goldfinch	GO	8	Green
Grey heron	H	1	Green
Magpie	MG	1	Green
Pied wagtail	PW	1	Green
Raven	RN	2	Green
Robin	R.	2	Green
Sedge warbler	SW	2	Green
Siskin	SK	3	Green
Song thrush	ST	2	Green
Sparrowhawk	SH	1	Green
Woodpigeon	WP	1	Green
Wren	WR	4	Green

Table X.3: Summary of all breeding bird survey results carried out during the 2023 breeding season

Species	BTO code	Visit 1	Visit 2	Visit 3	Visit 4	BoCCI 2020-2026
Kestrel	K.	-	-	5	-	Red
Meadow pipit	MP	56	26	38	18	Red
Snipe	SN	11	1	-	3	Red
Goldcrest	GC	19	28	28	8	Amber
House sparrow	HS	-	2	-	-	Amber
Linnet	LI	-	-	2	-	Amber
Mallard	MA	5	-	1	-	Amber
Sand martin	SM	-	2	-	-	Amber
Skylark	S.	12	26	24	4	Amber
Starling	SG	6	-	-	-	Amber
Swallow	SL	2	18	7	3	Amber

Species	BTO code	Visit 1	Visit 2	Visit 3	Visit 4	BoCCI 2020-2026
Teal	T.	2	-	1	-	Amber
Willow warbler	WW	25	53	48	4	Amber
Blackbird	B.	9	18	13	2	Green
Blackcap	BC	-	7	14	2	Green
Blue tit	BT	7	2	1	-	Green
Chaffinch	CH	17	11	5	2	Green
Chiffchaff	CC	1	1	1	-	Green
Coal tit	CT	19	10	11	2	Green
Common crossbill	CR	-	-	2	-	Green
Cuckoo	CK	-	5	1	-	Green
Dunnock	D.	5	3	4	-	Green
Goldfinch	GO	1	6	1	-	Green
Grasshopper warbler	GH	-	5	7	-	Green
Great black-backed gull	GB	-	-	1	-	Green
Great tit	GT	2	-	1	-	Green
Grey heron	H.	1	-	2	1	Green
Lesser redpoll	LR	10	1	8	-	Green
Long-tailed tit	LT	-	7	5	-	Green
Mistle thrush	M	2	3	3	-	Green
Moorhen	MH	-	-	1	-	Green
Pied wagtail	PW	1	3	-	-	Green
Reed bunting	RB	4	3	2	-	Green
Robin	R.	27	13	11	1	Green
Sedge warbler	SW	-	4	3	-	Green
Siskin	SK	16	23	14	1	Green
Song thrush	ST	8	3	3	1	Green
Stonechat	SC	-	3	16	1	Green
Treecreeper	TC	-	1	2	-	Green
Woodpigeon	WP	1	-	1	-	Green
Wren	WR	30	14	17	3	Green

Appendix XI - Winter walkover survey results

Table XI.1: Summary of all bird survey results carried out during the 2021-22 non-breeding season

Species	BTO code	Visit 1	Visit 2	Visit 3	BoCCI 2020-2026
Kestrel	K.	-	1	-	Red
Meadow pipit	MP	13	3	8	Red
Snipe	SN	5	10	4	Red
Woodcock	WK	-	5	1	Red
Goldcrest	GC	2	3	2	Amber
Linnet	LI	5	5	1	Amber
Whooper swan	WS	-	12	-	Amber
Blackbird	B.	32	27	20	Green
Blue tit	BT	5	4	11	Green
Chaffinch	CH	26	13	12	Green
Coal tit	CT	34	15	7	Green
Dunnock	D.	2	1	1	Green
Golden pheasant	GF	4	-	-	Green
Goldfinch	GO	4	4	-	Green
Great black-backed gull	GB	-	2	-	Green
Grey heron	H.	-	-	1	Green
Pheasant	PH	-	1	4	Green
Pied wagtail	PW	2	-	-	Green
Raven	RN		2	-	Green
Robin	R.	24	26	17	Green
Song thrush	ST	1	2	1	Green
Sparrowhawk	SH	1	-	-	Green
Stonechat	SC	13	-	-	Green
Wren	WR	45	41	15	Green

Table XI.2: Summary of all bird survey results carried out during the 2022-23 non-breeding season

Species	BTO code	Visit 1	Visit 2	Visit 3	BoCCI 2020-2026
Kestrel	K.	1	-	2	Red
Meadow pipit	MP	117	93	28	Red
Redwing	RE	-	3	-	Red
Snipe	SN	12	20	3	Red
Woodcock	WK	-	-	2	Red
Black-headed gull	BH	-	2	-	Amber
Common gull	CM	-	1	-	Amber
Goldcrest	GC	-	-	28	Amber
Hen harrier	HH	-	-	2	Amber
House sparrow	HS	3	-	-	Amber
Linnet	LI	3	2	-	Amber
Blackbird	B.	-	-	3	Green
Blue tit	BT	-	-	1	Green
Bullfinch	BF	1	-	-	Green

Species	BTO code	Visit 1	Visit 2	Visit 3	BoCCI 2020-2026
Coal tit	CT	-	-	12	Green
Common crossbill	CR	2	-	-	Green
Dunnock	D	20	24	3	Green
Fieldfare	FF	-	29	-	Green
Goldfinch	GO	-	-	1	Green
Jack snipe	JS	-	2	1	Green
Lesser redpoll	LR	21	35	3	Green
Mistle thrush	M.	-	1	4	Green
Reed bunting	RB	15	9	2	Green
Robin	R.	-	-	12	Green
Song thrush	ST	11	4	9	Green
Sparrowhawk	SH	1	-	1	Green
Stonechat	SC	-	-	1	Green
Woodpigeon	WP	-	-	2	Green
Wren	WR	-	-	10	Green

Table XI.3: Summary of all bird survey results carried out during the 2023-24 non-breeding season

Species	BTO code	Visit 1	Visit 2	Visit 3	BoCCI 2020-2026
Grey wagtail	GL	1	1	-	Red
Kestrel	K.	1	1	1	Red
Meadow pipit	MP	56	57	16	Red
Redwing	RE	1	-	-	Red
Snipe	SN	15	17	11	Red
Woodcock	WK	-	3	4	Red
Goldcrest	GC	78	-	5	Amber
Mallard	MA	-	-	2	Amber
Teal	T.	-	5	-	Amber
Blackbird	B.	9	-	16	Green
Blue tit	BT	8	-	7	Green
Bullfinch	BF	-	3	-	Green
Chaffinch	CH	30	-	4	Green
Chiffchaff	CC	1	-	-	Green
Coal tit	CT	53	-	1	Green
Common crossbill	CR	24	5	-	Green
Dunnock	D.	20	20	13	Green
Feral pigeon	FP	-	-	30	Green
Goldfinch	GO	4	-	-	Green
Hooded (grey) crow	HC	-	-	2	Green
Jack snipe	JS	1	-	-	Green
Jackdaw	JD	-	-	9	Green
Lesser redpoll	LR	94	21	-	Green
Long-tailed tit	LT	25	-	-	Green
Magpie	MG	-	-	3	Green
Mistle thrush	M.	-	2	-	Green

Species	BTO code	Visit 1	Visit 2	Visit 3	BoCCI 2020-2026
Moorhen	MH	-	-	1	Green
Pied wagtail	PW	1	-	-	Green
Raven	RN	-	-	6	Green
Reed bunting	RB	16	24	9	Green
Robin	R.	55	-	28	Green
Siskin	SK	121	-	-	Green
Song thrush	ST	5	8	1	Green
Sparrowhawk	SH	2	1	-	Green
Stonechat	SC	10	-	-	Green
Treecreeper	TC	2	-	-	Green
Wren	WR	53	-	16	Green

Appendix XII – Bioacoustic recordings

Table XII.1: Target species bioacoustic recordings during Year 2 2023 spring passage season and Year 3 2024 spring passage season

Year	Date	Time (Hour)	Time (Mins:Secs)	BTO code
2023	13/03/2023	21	14:22.4	SN
2023	13/03/2023	21	14:20.9	SN
2023	13/03/2023	21	14:37.9	SN
2023	13/03/2023	21	14:23.1	SN
2023	13/03/2023	21	14:21.4	SN
2023	13/03/2023	19	15:56.5	SN
2023	13/03/2023	21	14:24.1	SN
2023	13/03/2023	21	22:27.4	SN
2023	13/03/2023	21	14:20.1	SN
2023	13/03/2023	21	14:25.0	SN
2023	13/03/2023	21	22:31.3	SN
2023	13/03/2023	21	22:29.7	SN
2023	13/03/2023	21	14:09.8	SN
2023	13/03/2023	19	46:55.4	CU
2023	13/03/2023	19	44:50.1	CU
2023	13/03/2023	19	26:00.8	SN
2023	13/03/2023	19	21:35.6	SN
2023	14/03/2023	19	14:53.3	SN
2023	14/03/2023	6	06:26.0	SN
2023	14/03/2023	19	19:00.3	SN
2023	14/03/2023	19	27:36.1	SN
2023	14/03/2023	20	35:13.7	SN
2023	14/03/2023	6	02:35.7	SN
2023	14/03/2023	22	48:05.0	SN
2023	14/03/2023	6	00:05.3	SN
2023	14/03/2023	6	06:32.6	SN
2023	14/03/2023	6	06:30.3	SN
2023	14/03/2023	6	06:31.5	SN
2023	14/03/2023	22	48:02.4	SN
2023	14/03/2023	22	48:03.3	SN
2023	14/03/2023	20	35:09.9	SN
2023	14/03/2023	6	00:03.2	SN
2023	14/03/2023	6	00:04.0	SN
2023	14/03/2023	20	35:15.5	SN
2023	14/03/2023	22	48:08.0	SN
2023	14/03/2023	19	18:55.8	SN
2023	14/03/2023	6	00:09.9	SN
2023	14/03/2023	19	27:41.4	SN
2023	14/03/2023	6	03:17.3	SN
2023	14/03/2023	6	07:28.2	SN
2023	14/03/2023	6	04:07.0	SN
2023	14/03/2023	6	04:00.6	SN
2023	14/03/2023	6	04:46.1	SN
2023	14/03/2023	6	02:38.7	SN
2023	14/03/2023	21	03:35.1	CU
2023	14/03/2023	20	18:04.6	CU
2023	14/03/2023	19	19:53.0	SN
2023	14/03/2023	6	17:26.7	SN
2023	14/03/2023	6	06:52.6	SN
2023	14/03/2023	6	08:32.0	SN
2023	14/03/2023	6	10:11.0	SN
2023	14/03/2023	6	08:15.8	SN
2023	14/03/2023	19	21:37.8	SN
2023	14/03/2023	6	18:41.7	SN
2023	14/03/2023	6	08:14.7	SN
2023	14/03/2023	6	06:32.6	SN
2023	14/03/2023	19	18:49.4	SN
2023	14/03/2023	19	19:09.1	SN
2023	14/03/2023	6	15:23.2	SN
2023	14/03/2023	6	11:26.5	SN
2023	14/03/2023	19	25:02.3	SN
2023	14/03/2023	19	21:51.8	SN
2023	14/03/2023	19	23:47.9	SN
2023	14/03/2023	6	01:28.2	SN
2023	14/03/2023	6	05:33.3	SN
2023	14/03/2023	19	27:30.0	SN
2023	14/03/2023	19	17:42.6	SN
2023	14/03/2023	19	21:15.5	SN
2023	15/03/2023	5	43:39.2	SN
2023	15/03/2023	19	15:06.4	SN
2023	15/03/2023	4	48:41.3	SN
2023	15/03/2023	5	43:40.1	SN
2023	15/03/2023	5	43:33.3	SN
2023	15/03/2023	4	48:39.1	SN
2023	15/03/2023	6	05:52.5	SN
2023	15/03/2023	5	43:34.8	SN
2023	15/03/2023	5	43:32.5	SN
2023	15/03/2023	19	56:02.6	SN
2023	15/03/2023	5	58:27.5	SN
2023	15/03/2023	5	43:31.8	SN
2023	15/03/2023	19	15:04.1	SN
2023	15/03/2023	5	43:44.8	SN
2023	15/03/2023	5	43:41.7	SN
2023	15/03/2023	6	05:53.8	SN
2023	15/03/2023	19	56:03.3	SN
2023	15/03/2023	19	56:10.2	SN
2023	15/03/2023	19	11:26.3	SN
2023	15/03/2023	2	00:06.1	MH
2023	15/03/2023	19	18:57.8	SN
2023	15/03/2023	6	13:42.7	SN
2023	15/03/2023	6	00:22.7	SN
2023	15/03/2023	6	06:16.3	SN
2023	15/03/2023	6	00:15.0	SN
2023	15/03/2023	6	02:34.2	SN
2023	15/03/2023	6	04:40.7	SN
2023	15/03/2023	6	06:36.3	SN
2023	16/03/2023	23	34:28.3	SN
2023	16/03/2023	23	34:27.4	SN
2023	16/03/2023	23	34:26.6	SN
2023	16/03/2023	19	55:29.4	SN
2023	16/03/2023	20	04:30.5	SN
2023	16/03/2023	23	34:34.2	SN
2023	16/03/2023	20	08:38.9	SN
2023	16/03/2023	20	06:53.8	SN
2023	16/03/2023	20	04:33.7	SN
2023	16/03/2023	19	22:37.1	SN
2023	16/03/2023	19	55:28.0	SN
2023	16/03/2023	19	55:24.7	SN
2023	16/03/2023	20	08:41.5	SN
2023	16/03/2023	20	04:51.7	SN
2023	16/03/2023	20	08:40.5	SN
2023	16/03/2023	19	55:34.7	SN
2023	16/03/2023	20	08:38.2	SN
2023	16/03/2023	19	39:30.3	SN
2023	16/03/2023	19	37:22.6	SN
2023	16/03/2023	20	06:54.7	SN
2023	16/03/2023	20	08:37.4	SN
2023	16/03/2023	19	39:32.9	SN
2023	16/03/2023	20	04:40.6	SN
2023	16/03/2023	20	04:54.4	SN

2023	16/03/2023	19	31:30.5	SN
2023	16/03/2023	20	06:55.6	SN
2023	16/03/2023	19	37:12.7	SN
2023	16/03/2023	19	39:31.9	SN
2023	16/03/2023	23	34:38.8	SN
2023	16/03/2023	19	27:27.6	CU
2023	16/03/2023	23	34:30.3	SN
2023	16/03/2023	19	37:24.5	SN
2023	16/03/2023	20	08:39.8	SN
2023	16/03/2023	19	37:21.2	SN
2023	16/03/2023	20	11:24.7	CU
2023	16/03/2023	19	32:20.6	CU
2023	16/03/2023	19	28:53.8	CU
2023	16/03/2023	19	57:15.4	CU
2023	16/03/2023	20	22:23.7	CU
2023	16/03/2023	18	19:50.7	SN
2023	16/03/2023	19	24:06.7	SN
2023	16/03/2023	19	27:37.6	SN
2023	17/03/2023	6	03:46.1	SN
2023	17/03/2023	19	22:39.2	SN
2023	17/03/2023	19	27:03.5	SN
2023	17/03/2023	4	06:50.0	SN
2023	17/03/2023	4	06:56.4	SN
2023	17/03/2023	19	25:35.1	SN
2023	17/03/2023	19	26:56.7	SN
2023	17/03/2023	2	39:42.7	CU
2023	17/03/2023	19	27:53.6	SN
2023	17/03/2023	19	47:54.2	SN
2023	17/03/2023	19	16:19.8	SN
2023	17/03/2023	19	19:24.4	SN
2023	17/03/2023	19	17:12.9	SN
2023	17/03/2023	19	21:25.7	SN
2023	17/03/2023	19	16:29.2	SN
2023	17/03/2023	19	16:48.6	SN
2023	17/03/2023	19	19:17.3	SN
2023	17/03/2023	19	19:46.4	SN
2023	17/03/2023	19	45:35.1	SN
2023	17/03/2023	19	41:39.9	SN
2023	17/03/2023	19	18:49.5	SN
2023	17/03/2023	19	18:09.1	SN
2023	17/03/2023	19	23:23.2	SN
2023	17/03/2023	19	53:27.9	SN
2023	17/03/2023	16	36:24.6	SN
2023	17/03/2023	19	22:26.1	SN
2023	17/03/2023	19	41:20.7	SN
2023	17/03/2023	19	44:34.7	SN
2023	17/03/2023	19	40:33.3	SN
2023	17/03/2023	19	17:26.2	SN
2023	17/03/2023	19	53:06.2	SN
2023	17/03/2023	19	17:41.1	SN
2023	17/03/2023	19	20:33.5	SN
2023	17/03/2023	19	25:13.9	SN
2023	17/03/2023	19	47:36.8	SN
2023	17/03/2023	20	00:06.8	SN
2023	17/03/2023	19	54:16.9	SN
2023	17/03/2023	19	28:56.9	SN
2023	17/03/2023	19	38:46.8	SN
2023	17/03/2023	4	40:42.1	SN
2023	17/03/2023	4	40:45.0	SN
2023	17/03/2023	19	40:04.2	SN
2023	18/03/2023	4	09:27.3	SN
2023	18/03/2023	4	09:26.3	SN
2023	18/03/2023	4	09:28.5	SN
2023	18/03/2023	20	11:35.9	SN
2023	18/03/2023	3	42:05.5	SN
2023	18/03/2023	4	09:30.8	SN
2023	18/03/2023	3	39:46.8	SN
2023	18/03/2023	3	38:20.9	SN
2023	18/03/2023	20	11:32.5	SN
2023	18/03/2023	20	11:33.2	SN
2023	18/03/2023	20	11:33.8	SN
2023	18/03/2023	3	42:04.7	SN
2023	18/03/2023	4	09:24.7	SN
2023	18/03/2023	20	11:38.9	SN
2023	18/03/2023	4	09:29.5	SN
2023	18/03/2023	20	11:38.1	SN
2023	18/03/2023	20	11:31.7	SN
2023	18/03/2023	20	11:36.5	SN
2023	18/03/2023	4	09:32.8	SN
2023	18/03/2023	20	11:35.2	SN
2023	18/03/2023	3	42:06.3	SN
2023	18/03/2023	3	39:46.0	SN
2023	18/03/2023	3	38:21.9	SN
2023	18/03/2023	4	09:32.0	SN
2023	18/03/2023	3	42:03.9	SN
2023	18/03/2023	3	42:03.0	SN
2023	18/03/2023	20	11:37.2	SN
2023	18/03/2023	20	11:42.3	SN
2023	18/03/2023	3	38:24.1	SN
2023	18/03/2023	3	39:47.5	SN
2023	18/03/2023	3	42:09.8	SN
2023	18/03/2023	20	11:31.0	SN
2023	18/03/2023	3	39:54.3	SN
2023	18/03/2023	19	45:55.9	CU
2023	18/03/2023	19	29:16.3	SN
2023	18/03/2023	22	28:27.2	SN
2023	18/03/2023	19	51:56.9	SN
2023	19/03/2023	5	47:39.8	SN
2023	19/03/2023	5	40:13.6	SN
2023	19/03/2023	5	40:14.9	SN
2023	19/03/2023	5	38:55.4	SN
2023	19/03/2023	5	40:08.6	SN
2023	19/03/2023	5	40:12.5	SN
2023	19/03/2023	5	38:57.3	SN
2023	19/03/2023	5	38:58.3	SN
2023	19/03/2023	5	38:52.1	SN
2023	19/03/2023	5	47:41.5	SN
2023	19/03/2023	5	40:09.5	SN
2023	19/03/2023	5	49:27.6	SN
2023	19/03/2023	5	40:11.4	SN
2023	19/03/2023	5	52:30.9	SN
2023	19/03/2023	5	47:40.7	SN
2023	19/03/2023	5	52:51.8	SN
2023	19/03/2023	5	38:50.9	SN
2023	19/03/2023	5	47:42.6	SN
2023	19/03/2023	5	38:53.2	SN
2023	19/03/2023	5	38:54.3	SN
2023	19/03/2023	5	38:59.5	SN
2023	19/03/2023	5	53:55.5	SN
2023	19/03/2023	5	38:49.0	SN
2023	19/03/2023	5	54:19.5	SN
2023	19/03/2023	5	55:28.2	SN
2023	19/03/2023	5	36:26.4	CU
2023	19/03/2023	20	19:58.3	SN
2023	19/03/2023	19	33:16.3	SN
2023	19/03/2023	19	53:47.3	CU
2023	19/03/2023	6	04:41.8	SN
2023	19/03/2023	6	05:01.1	SN
2023	19/03/2023	6	06:15.6	SN
2023	19/03/2023	6	06:42.5	SN

2023	19/03/2023	6	02:06.0	SN
2023	19/03/2023	6	02:01.4	SN
2023	19/03/2023	6	04:57.0	SN
2023	19/03/2023	6	01:37.5	SN
2023	19/03/2023	6	00:40.1	SN
2023	19/03/2023	6	04:23.0	SN
2023	19/03/2023	19	19:51.0	SN
2023	19/03/2023	19	22:09.4	SN
2023	19/03/2023	19	23:41.7	SN
2023	19/03/2023	5	31:14.5	SN
2023	20/03/2023	5	56:06.3	SN
2023	20/03/2023	23	36:13.7	SN
2023	20/03/2023	1	08:12.1	SN
2023	20/03/2023	23	36:12.5	SN
2023	20/03/2023	5	56:07.9	SN
2023	20/03/2023	1	08:14.2	SN
2023	20/03/2023	1	08:16.4	SN
2023	20/03/2023	1	08:17.6	SN
2023	20/03/2023	1	08:13.1	SN
2023	20/03/2023	3	14:09.6	SN
2023	20/03/2023	21	35:52.5	SN
2023	20/03/2023	19	10:34.8	SN
2023	20/03/2023	19	32:12.2	SN
2023	20/03/2023	19	16:29.9	SN
2023	21/03/2023	5	42:39.3	SN
2023	21/03/2023	5	21:53.2	SN
2023	21/03/2023	5	42:40.8	SN
2023	21/03/2023	5	42:38.1	SN
2023	21/03/2023	4	10:30.7	SN
2023	21/03/2023	5	33:04.9	SN
2023	21/03/2023	5	33:11.5	SN
2023	21/03/2023	5	33:18.9	SN
2023	21/03/2023	5	50:19.0	SN
2023	21/03/2023	5	33:16.2	SN
2023	21/03/2023	5	33:08.2	SN
2023	21/03/2023	5	06:36.1	SN
2023	21/03/2023	0	27:22.5	SN
2023	21/03/2023	5	33:08.7	SN
2023	21/03/2023	5	21:25.9	SN
2023	21/03/2023	5	33:06.2	SN
2023	21/03/2023	5	33:10.6	SN
2023	21/03/2023	5	00:58.3	SN
2023	21/03/2023	0	45:19.5	SN
2023	21/03/2023	5	31:32.3	SN
2023	21/03/2023	5	30:40.5	SN
2023	21/03/2023	5	36:00.6	SN
2023	21/03/2023	5	33:13.3	SN
2023	21/03/2023	5	34:15.4	SN
2023	21/03/2023	5	29:44.0	SN
2023	21/03/2023	5	21:18.1	SN
2023	21/03/2023	5	20:28.8	SN
2023	21/03/2023	5	19:27.3	SN
2023	21/03/2023	5	12:11.9	SN
2023	21/03/2023	4	10:32.9	SN
2023	21/03/2023	5	27:34.0	T
2023	21/03/2023	5	05:27:32	T
2023	21/03/2023	5	33:09.6	SN
2023	21/03/2023	5	15:11.0	SN
2023	21/03/2023	5	32:57.8	SN
2023	21/03/2023	5	29:28.7	SN
2023	21/03/2023	5	13:53.6	SN
2023	21/03/2023	5	10:27.5	SN
2023	21/03/2023	5	30:54.5	SN
2023	21/03/2023	5	31:39.9	SN
2023	21/03/2023	5	20:20.8	SN

2023	21/03/2023	5	32:54.9	SN
2023	21/03/2023	0	45:18.5	SN
2023	21/03/2023	4	10:39.2	SN
2023	22/03/2023	19	28:44.4	SN
2023	22/03/2023	19	30:57.7	SN
2023	22/03/2023	19	35:31.9	SN
2023	22/03/2023	19	30:59.8	SN
2023	22/03/2023	20	31:20.7	SN
2023	22/03/2023	20	14:34.1	SN
2023	22/03/2023	19	25:45.2	SN
2023	22/03/2023	19	25:23.8	SN
2023	22/03/2023	19	25:40.9	SN
2023	22/03/2023	19	25:22.1	SN
2023	22/03/2023	20	32:57.1	SN
2023	23/03/2023	5	16:53.8	SN
2023	23/03/2023	5	32:10.8	SN
2023	23/03/2023	5	32:11.5	SN
2023	23/03/2023	5	41:39.9	SN
2023	23/03/2023	5	16:58.5	SN
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2023	23/03/2023	5	32:13.7	SN
2023	23/03/2023	5	16:59.3	SN
2023	23/03/2023	5	32:17.3	SN
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2023	23/03/2023	5	18:07.4	SN
2023	23/03/2023	5	17:04.8	SN
2023	23/03/2023	5	16:55.3	SN
2023	23/03/2023	5	16:53.2	SN
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2023	23/03/2023	5	38:59.6	SN
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2023	24/03/2023	21	10:55.7	SN
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2023	24/03/2023	0	18:39.0	T
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2023	24/03/2023	19	58:03.0	SN
2023	24/03/2023	20	00:13.4	SN
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2023	24/03/2023	19	39:24.9	SN

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2023	25/03/2023	5	23:57.8	SN
2023	25/03/2023	5	13:32.4	SN
2023	25/03/2023	5	05:12:34	SN
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2023	26/03/2023	5	47:10.4	SN
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2023	26/03/2023	5	21:55.2	SN
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2023	30/03/2023	22	44:14.5	SN
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2023	01/04/2023	23	02:09.5	SN
2023	01/04/2023	4	22:05.8	SN
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2023	01/04/2023	21	22:43.0	SN
2023	01/04/2023	23	04:08.0	SN
2023	01/04/2023	23	05:44.5	SN
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2023	02/04/2023	20	56:29.8	SN
2023	02/04/2023	21	07:19.5	SN
2023	02/04/2023	6	03:46.4	SN
2023	02/04/2023	2	10:29.0	SN

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2023	02/04/2023	0	19:00.7	SN
2023	02/04/2023	3	07:45.0	MH
2023	02/04/2023	23	57:17.4	SN
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2023	02/04/2023	2	12:06.9	SN
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2023	02/04/2023	20	47:23.3	SN
2023	02/04/2023	3	17:34.2	SN
2023	02/04/2023	20	45:21.1	SN
2023	02/04/2023	20	46:19.2	SN
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2023	02/04/2023	2	18:27.1	SN
2023	02/04/2023	2	14:21.2	SN
2023	02/04/2023	21	09:21.2	SN
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2023	02/04/2023	22	59:25.2	SN
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2023	02/04/2023	0	18:32.8	SN
2023	02/04/2023	5	06:13.1	SN
2023	02/04/2023	0	18:35.4	SN
2023	02/04/2023	0	18:48.2	SN
2023	02/04/2023	1	09:13.6	SN
2023	02/04/2023	20	58:59.9	SN
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2023	03/04/2023	1	46:16.3	SN
2023	03/04/2023	1	46:21.2	SN
2023	03/04/2023	5	08:25.4	SN
2023	03/04/2023	1	46:19.6	SN
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2023	03/04/2023	5	13:24.8	SN
2023	03/04/2023	22	20:01.0	SN
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2023	03/04/2023	0	25:15.9	SN
2023	03/04/2023	0	27:34.9	SN
2023	03/04/2023	20	50:13.2	SN
2023	03/04/2023	2	24:03.8	SN

2023	03/04/2023	20	46:36.6	SN
2023	03/04/2023	0	28:20.4	SN
2023	03/04/2023	0	04:01.9	SN
2023	03/04/2023	0	03:39.3	SN
2023	03/04/2023	20	50:10.6	SN
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2023	05/04/2023	23	40:37.5	SN
2023	05/04/2023	23	35:38.4	SN
2023	05/04/2023	23	35:32.7	SN
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2023	05/04/2023	22	15:45.6	SN
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2023	06/04/2023	22	12:18.4	WG
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2023	06/04/2023	22	12:35.2	WG
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2023	06/04/2023	1	42:21.3	SN
2023	06/04/2023	4	38:21.5	SN
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2023	06/04/2023	0	57:35.3	SN
2023	06/04/2023	4	34:35.9	SN
2023	06/04/2023	3	29:50.3	SN
2023	06/04/2023	4	31:39.2	SN
2023	06/04/2023	2	10:48.2	SN
2023	06/04/2023	2	07:40.3	SN
2023	06/04/2023	3	51:45.0	SN

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2023	06/04/2023	3	42:24.8	SN
2023	06/04/2023	4	28:36.4	SN
2023	06/04/2023	4	33:37.6	SN
2023	06/04/2023	1	48:55.4	SN
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2023	06/04/2023	5	41:19.8	SN
2023	06/04/2023	4	20:53.9	SN
2023	06/04/2023	4	35:09.7	SN
2023	06/04/2023	22	47:30.2	SN

2023	06/04/2023	4	35:01.1	SN
2023	06/04/2023	1	00:52.5	SN
2023	06/04/2023	23	51:44.7	SN
2023	06/04/2023	5	07:54.7	SN
2023	06/04/2023	6	05:33.9	SN
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2023	06/04/2023	5	18:03.3	SN
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2023	06/04/2023	0	45:08.4	SN
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2023	06/04/2023	21	23:20.0	SN
2023	06/04/2023	22	10:56.1	WG
2023	06/04/2023	1	31:01.7	SN
2023	06/04/2023	2	58:02.2	SN
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2023	06/04/2023	3	27:38.5	SN
2023	06/04/2023	3	27:42.6	SN
2023	06/04/2023	5	08:14.2	SN
2023	06/04/2023	4	01:20.6	SN

2023	07/04/2023	0	15:35.9	SN
2023	07/04/2023	0	15:35.3	SN
2023	07/04/2023	23	41:16.4	SN
2023	07/04/2023	0	15:33.1	SN
2023	07/04/2023	0	15:32.4	SN
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2023	07/04/2023	23	41:19.0	SN
2023	07/04/2023	4	54:54.1	SN
2023	07/04/2023	21	48:29.1	SN
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2023	07/04/2023	0	15:39.4	SN
2023	07/04/2023	22	10:16.9	SN
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2023	08/04/2023	20	59:44.3	SN
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2024	26/03/2024	20	25:14.8	SN
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2024	27/03/2024	19	37:53.0	SN
2024	27/03/2024	21	54:09.5	CU
2024	27/03/2024	21	54:07.1	CU
2024	27/03/2024	22	53:36.8	CU
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2024	28/03/2024	5	29:51.6	CU
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2024	28/03/2024	21	54:14.8	CU
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2024	28/03/2024	0	51:08.1	CU
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2024	28/03/2024	19	50:40.8	SN
2024	29/03/2024	5	59:03.0	MH
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2024	29/03/2024	23	01:22.1	CU
2024	29/03/2024	21	09:53.0	CU
2024	29/03/2024	23	01:38.7	CU
2024	29/03/2024	20	10:28.0	CU
2024	29/03/2024	23	01:13.4	CU
2024	29/03/2024	21	08:58.6	CU
2024	29/03/2024	21	09:10.0	CU
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2024	30/03/2024	6	05:05.7	CU
2024	30/03/2024	0	21:38.1	CU
2024	30/03/2024	3	32:22.0	CU
2024	30/03/2024	3	51:32.3	CU
2024	30/03/2024	0	19:07.6	CU
2024	30/03/2024	0	10:30.7	CU
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2024	30/03/2024	19	53:05.6	SN
2024	30/03/2024	4	55:42.0	SN
2024	30/03/2024	4	55:50.8	SN
2024	30/03/2024	4	53:43.5	SN

2024	31/03/2024	20	00:48.5	SN
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2024	31/03/2024	21	09:25.7	SN
2024	31/03/2024	19	59:22.6	SN
2024	31/03/2024	20	00:43.9	SN
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2024	02/04/2024	20	10:46.0	SN
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2024	08/04/2024	20	15:41.6	SN
2024	08/04/2024	20	13:37.5	SN
2024	08/04/2024	20	19:35.9	SN
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2024	09/04/2024	5	04:22.7	SN
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Appendix 3 Aquatic Survey Reports

AA Screening and Natura Impact Statement

Muingmore Wind Farm

RWE Renewables Ireland Limited

SLR Project No.: 501.065301.00001

Fisheries assessment of the proposed Muingmore wind farm, Co. Mayo

Prepared by Triturus Environmental Ltd. for SLR Consulting Ltd.

January 2024

Please cite as:

Triturus (2023). Fisheries assessment of the proposed Muingmore wind farm, Co. Mayo. Report prepared by Triturus Environmental Ltd. for SLR Consulting Ltd. January 2024.

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1. Introduction

1.1 Background

Triturus Environmental Ltd. were commissioned were commissioned by SLR Consulting Ltd. to undertake a baseline fisheries assessment of riverine watercourses and lacustrine waterbodies in the vicinity of the proposed Muingmore wind farm project, inclusive of the proposed grid connection route (GCR) and turbine delivery route (TDR), located located near Gweesalia, Co. Mayo (**Figure 2.1**).

The survey was undertaken to establish baseline fisheries data used in the preparation of the EIAR for the proposed project. In order to gain an accurate overview of the existing and potential fisheries value of the riverine watercourses within the vicinity of the project, a catchment-wide electro-fishing survey across 50 no. riverine sites was undertaken (**Table 2.1; Figure 2.1**). A fisheries habitat appraisal of 4 no. small pond sites in vicinity of the site boundary was also undertaken. Electro-fishing helped to identify the importance of the watercourses as nurseries and habitats for fish of high conservation value that included salmonids, European eel (*Anguilla anguilla*) and lamprey (*Lampetra* sp.). The presence of these species, inclusive of important supporting habitat, would inform mitigation to minimise impacts as a result of the proposed wind farm project.

Triturus Environmental Ltd. made an application under Section 14 of the Fisheries (Consolidation) Act, 1959 as substituted by Section 4 of the Fisheries (Amendment) Act, 1962, to undertake a catchment-wide electro-fishing survey in the vicinity of the proposed Muingmore wind farm site boundary and associated infrastructure (i.e. GCR). The surveys were undertaken on the 16th, 17th, 18th and 19th September 2023.

1.2 Fisheries asset of the survey area

Given the remote and minor nature of the watercourses within and adjoining the proposed site boundary (i.e. An Mhoing Mhór River, Doolough Stream, unnamed river and tributaries), fisheries data for was not available prior to this survey.

Tullaghan Bay, to which a small unnamed river draining the proposed site joins, supports a range of common transitional and estuarine species including flounder (*Platichthys flesus*), sand goby (*Pomatoschistus minutes*), 15-spined stickleback (*Spinachia spinachia*) and sprat (*Sprattus sprattus*) (CFB, 2009).

The GCR crossed a high number of minor tributaries of the Owenmore River which is known to support Atlantic salmon (*Salmo salar*) and both brown and sea trout (*Salmo trutta*). The Owenmore is a regionally important salmonid river and is ranked 16th nationally in terms of the accessible fluvial habitat to Atlantic salmon (McGinnity et al., 2003). The Owenmore is a noted recreational salmon and sea trout fishery (O'Reilly, 2009) and, after several years of failure, has met its conservation limit for Atlantic salmon since 2021 (TEGOS, 2023). In addition to salmonids, the Owenmore is also known to support European eel (*Anguilla anguilla*), minnow (*Phoxinus phoxinus*), three-spined stickleback (*Gasterosteus aculeatus*) and lamprey (*Lampetra* sp.) (Triturus 2022 data).

The River Deel (34D01) is crossed by the proposed TDR in Crossmolina, Co. Mayo (where proposed TDR works are required adjacent to the watercourse). The Deel is a designated salmonid watercourse

under the European Communities (Quality of Salmonid Waters) Regulations 1988 (S.I. No. 293/1988) and is a renowned recreational Atlantic salmon fishery. The river is also known to support brown trout, pike (*Esox lucius*), roach (*Rutilus rutilus*), perch (*Perca fluviatilis*), European eel, three-spined stickleback (*Gasterosteus aculeatus*) and minnow (Kelly et al., 2012, 2009; O'Connor, 2004). The Deel supports spawning sea lamprey (*Petromyzon marinus*) as far upstream as Ballycarroon Falls (in relatively high densities), approximately 2.5km upstream of Crossmolina, with *Lampetra* sp. also present both upstream and downstream Crossmolina (O'Connor, 2004).

TDR works are also proposed adjacent to the Ballysodare (Ballisodare) River at Ballysodare, Co. Sligo. The Ballysodare River is known to support Atlantic salmon, brown trout, European eel; *Lampetra* sp., minnow, perch, pike, roach and three-spined stickleback (IFI 2010-2014 data). The river is of very high value as a recreational Atlantic salmon fishery.

Fisheries data for the other survey watercourses was not available prior to this proposed survey.

2. Methodology

2.1 Study area

A catchment-wide fisheries survey of 54 no. sites in the vicinity of the proposed Muingmore wind farm project, inclusive of the proposed GCR and TDR, was conducted on 15th, 16th, 17th, 18th and 19th September 2023 following notification to Inland Fisheries Ireland. The catchment wide approach ensured a robust overview of fisheries related constraints associated with the proposed project.

Table 2.1 Location of *n*=54 electro-fishing survey and fisheries appraisal sites in the vicinity of the proposed Muingmore wind farm, Co. Mayo

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
Site boundary					
A1	Unnamed river	n/a	Doolough	476621	821708
A2	Unnamed river	n/a	L1205 road crossing	476276	820290
B1	Unnamed river	n/a	Muingmore	477254	822741
B2	Unnamed river	n/a	Muingmore	476726	822456
B3	Unnamed river	n/a	Muingmore	477114	822551
B4	Unnamed stream	n/a	Muingmore	477522	822770
B5	Unnamed river	n/a	Tristia	477290	822433
B6	Unnamed river	n/a	L1206 road crossing	477615	821039
C1	An Mhoing Mhór River	33M23	Muingmore	477156	823702
C2	Doolough Stream	33D02	Muingmore	476448	824226
C3	Unnamed stream	n/a	Muingmore	476180	823731
C4	Doolough Stream	33D02	Muingmore	475540	824268
C5	Doolough Stream	33D02	L1205 road crossing	474976	824774
P1*	Pond	n/a	Doolough	476635	822197
P2*	Pond	n/a	Muingmore	476112	822824
P3*	Pond	n/a	Muingmore	475845	822946
P4*	Pond	n/a	Doolough	477354	821591
GCR crossings					
D1	Unnamed stream	n/a	Goolamore	480285	821634
D2	Goolamore River	33G12	Drumanaffrin	481247	822676
D3	Munhin River	33M03	Kilteany	482176	823361
D4	Unnamed river	n/a	Srahmore	484848	823084
D5	Ballybeg Stream	33B40	Srahanarry	486351	823100
D6	Srahanarry Stream	33S23	Srahanarry	487383	823093
D7	Bellanumera Stream	33B38	Briska	487539	822966
D8	Briska River	33B33	Briska	487705	822687
D9	Unnamed stream	n/a	Briska	487788	822587
D10	Unnamed stream	n/a	Briska	487844	822510
D11	Unnamed river	n/a	Briska	490185	822080

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
D12	Unnamed river	n/a	Largan More	490513	822401
D13	Unnamed river	n/a	Largan More	490568	822412
D14	Unnamed stream	n/a	Largan More	490739	822418
D15	Unnamed stream	n/a	Largan More	490894	822413
D16	Unnamed river	n/a	Largan More	491092	822422
D17	Unnamed stream	n/a	Largan More	491297	822394
D18	Unnamed stream	n/a	Largan More	491335	822381
D19	Unnamed stream	n/a	Largan Beg	491399	822356
D20	Unnamed stream	n/a	Largan Beg	491900	822061
D21	Unnamed stream	n/a	Largan Beg	491988	822011
D22	Unnamed stream	n/a	Tawnaghmore	493063	821706
D23	Unnamed stream	n/a	Tawnaghmore	493360	821686
D24	Unnamed river	n/a	Tawnaghmore	493659	821685
D25	Unnamed river	n/a	Ballymonnelly Bridge	493983	821377
D26	Unnamed stream	n/a	Killsallagh	495239	820469
D27	Kilsallagh Stream	33K13	Killsallagh	495346	820428
D28	Unnamed stream	n/a	Killsallagh	495834	820410
D29	Unnamed stream	n/a	Bellacorick	496398	820409
D30	Unnamed stream	n/a	Bellacorick	496504	820323
TDR nodes					
E1	Moneynierin River	33M16	Moneynierin	497643	819577
E2	River Deel	34D01	Crossmolina Bridge	513655	817586
E3	Ballisodare River	35B05	Knoxspark	566745	829045
E4	Carrowgobbadagh Stream	35C95	Carrowgobbadagh	567482	830457
E5	Abbeylands Stream	36A15	Coolcholly	588235	862284
E6	Drumgowan Stream	37D49	Tullygallan	593620	875619
E7	Bogside River	37B26	Dunkineely	576176	875950

* fisheries appraisal only

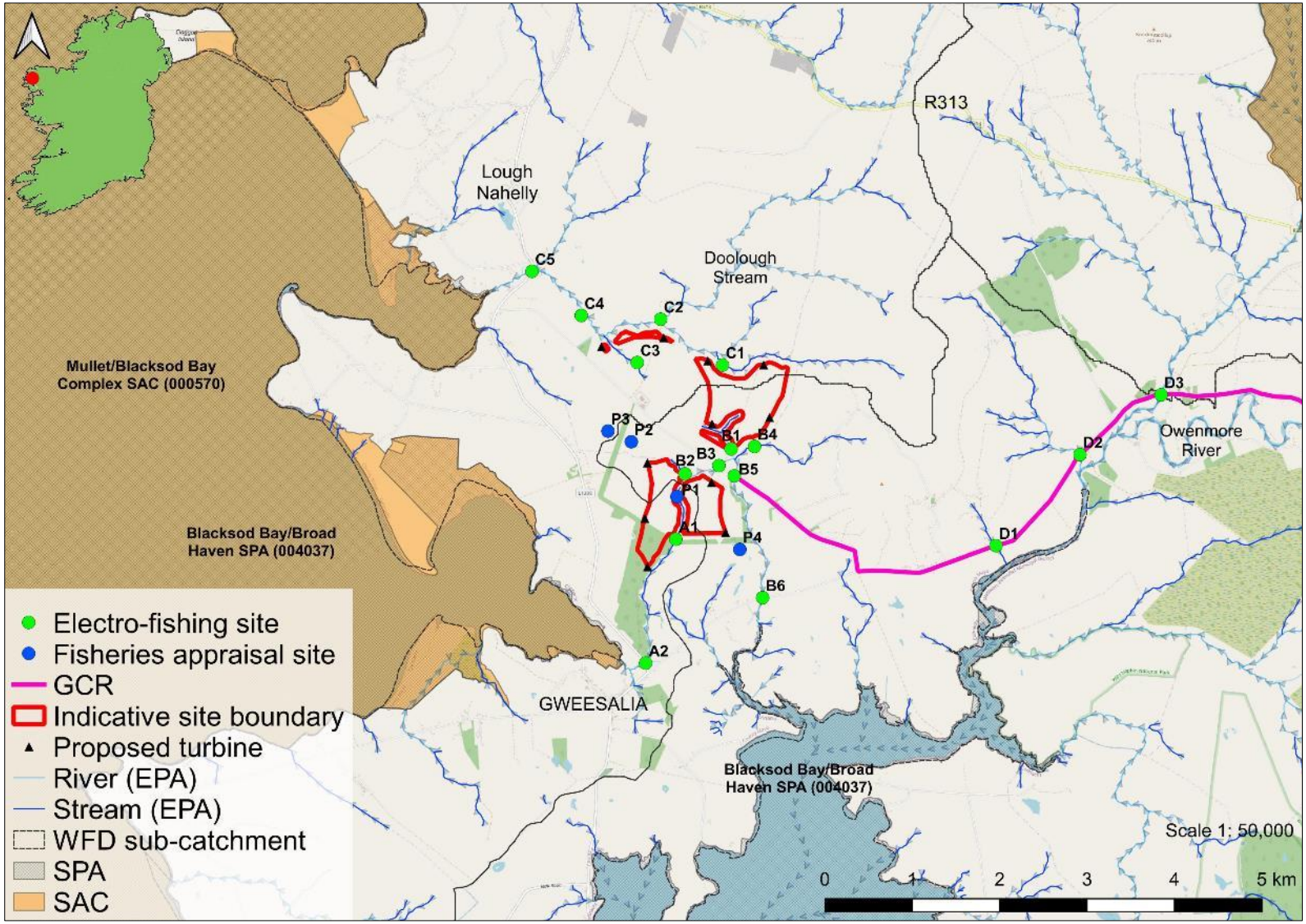

Figure 2.1 Overview of the electro-fishing & fisheries appraisal survey sites in the vicinity of the proposed Muingmore wind farm site boundary, Co. Mayo

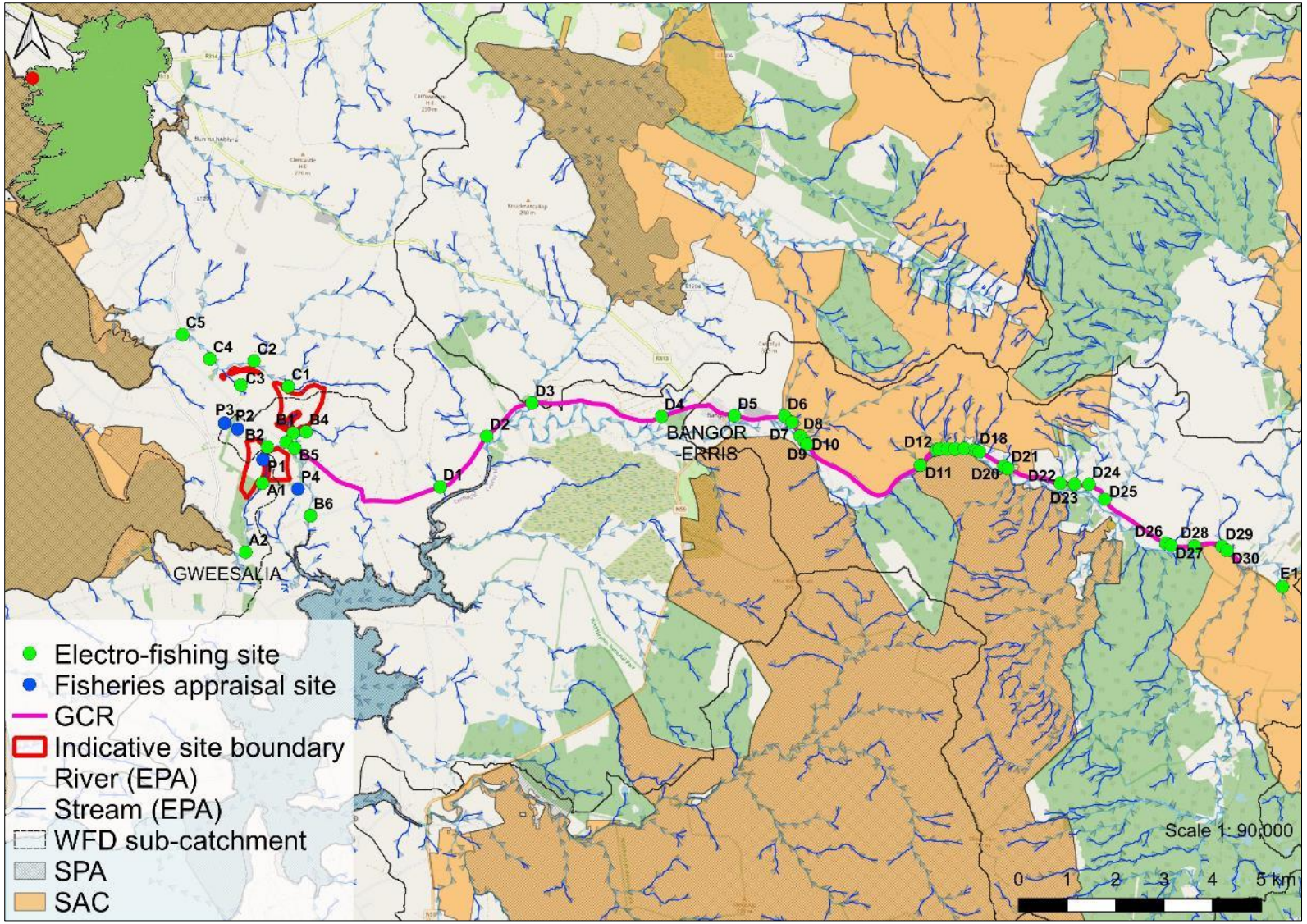

Figure 2.2 Overview of the electro-fishing survey sites in the vicinity of the proposed Muingmore wind farm GCR, Co. Mayo

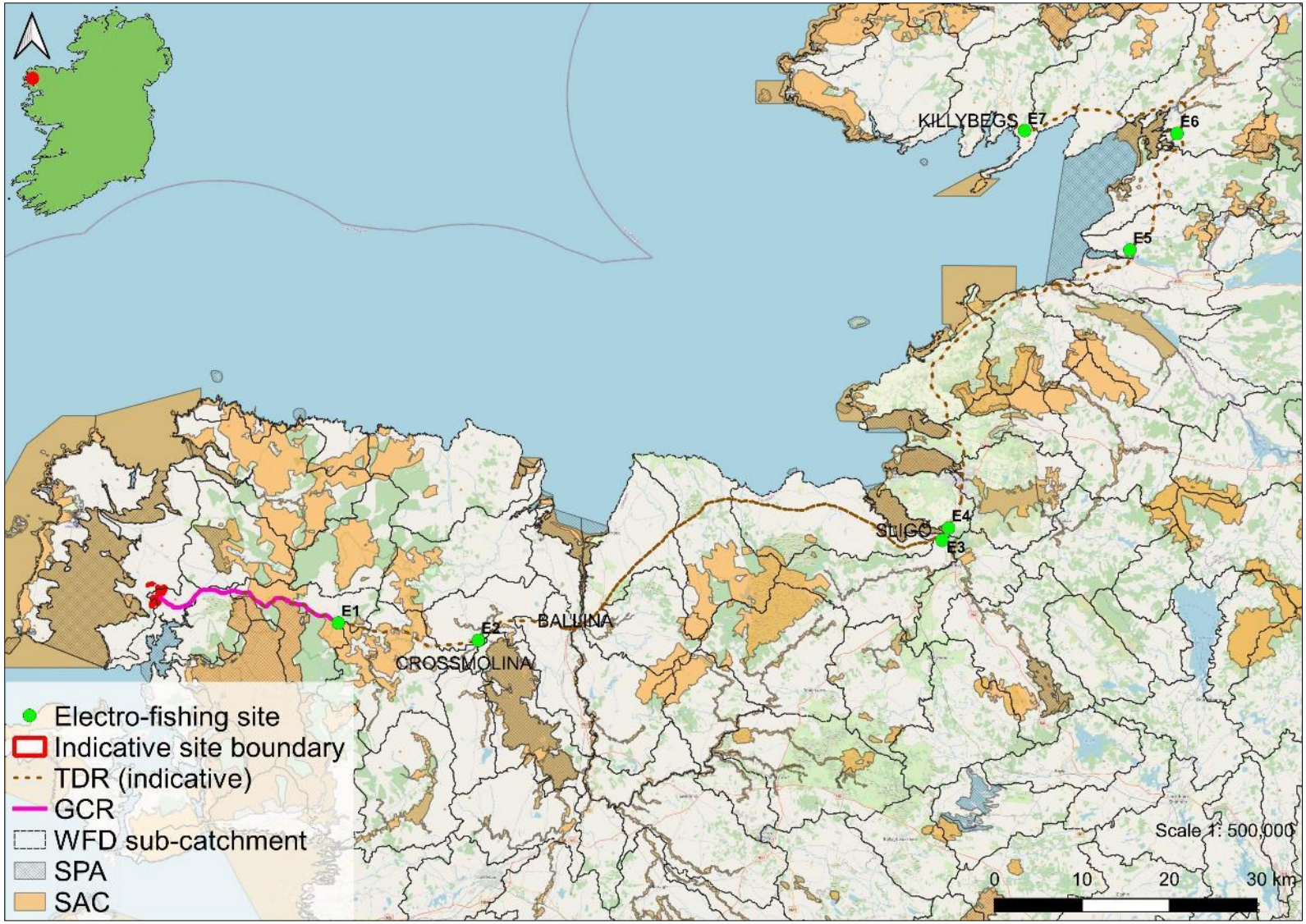

Figure 2.3 Overview of the electro-fishing survey sites in the vicinity of the proposed Muingmore wind farm TDR, Co. Mayo

2.2 Fisheries assessment (electro-fishing)

A single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) was used to electro-fish sites on riverine watercourses in the vicinity of the proposed Muingmore wind farm project in September 2023 following notification to Inland Fisheries Ireland and under the conditions of a Department of the Environment, Climate and Communications (DECC) licence. The catchment-wide electro-fishing (CWEF) survey was undertaken across 13 no. riverine sites, with a fisheries habitat appraisal completed at Lough na gCeann (see **Table 2.1, Figure 2.1**).

Both river and holding tank water temperature was monitored continually throughout the survey to ensure temperatures of 20°C were not exceeded, thus minimising stress to the captured fish due to low dissolved oxygen levels. A portable battery-powered aerator was also used to further reduce stress to any captured fish contained in the holding tank. Salmonids, European eel and other captured fish species were transferred to a holding container with oxygenated fresh river water following capture. To reduce fish stress levels, anaesthesia was not applied to captured fish. All fish were measured to the nearest millimetre and released in-situ following a suitable recovery period.

As three primary species groups were targeted during the survey, i.e., salmonids, lamprey, and eel, the electro-fishing settings were tailored for each species. By undertaking electro-fishing using the rapid electro-fishing technique (see methodology below), the broad characterisation of the fish community at each sampling reach could be determined as a longer representative length of channel was surveyed. Electro-fishing methodology followed accepted European standards (CEN, 2003) and adhered to best practice (e.g., CFB, 2008).

2.2.1 Salmonids and European eel

For salmonid species and European eel, as well as all other incidental species, electro-fishing was carried out in an upstream direction for a 10-minute CPUE, an increasingly common standard approach for wadable streams (Matson et al., 2018). A total of approx. 40-75m channel length was surveyed at each site, where feasible, in order to gain a better representation of fish stock assemblages. At certain sites with limited access (e.g. high average depths), it was more feasible to undertake electro-fishing for a 5-minute CPUE. Discrepancies in fishing effort (CPUE) between sites are provided in the results section (**Table 3.2**).

Relative conductivity of the water at each site was checked in-situ with a conductivity meter and the electro-fishing backpack was energised with the appropriate voltage and frequency to provide enough draw to attract salmonids and European eel to the anode without harm. For the low conductivity waters of the sites (mostly igneous geologies) a voltage of 280-350v, frequency of 35-45Hz and pulse duration of 3.5-4ms was utilised to draw fish to the anode without causing physical damage.

2.2.2 Lamprey

Electro-fishing for lamprey ammocoetes was conducted using targeted quadrat-based electro-fishing (as per Harvey & Cowx, 2003) in objectively suitable areas of sand/silt, where encountered. As lamprey take longer to emerge from silts and require a more persistent approach, they were targeted at a lower frequency (30Hz) burst DC pulse setting which also allowed detection of European eel in

sediment, if present. Settings for lamprey followed those recommended and used by Harvey & Cowx (2003), APEM (2004) and Niven & McAuley (2013). Using this approach, the anode was placed under the water's surface, approx. 10-15cm above the sediment, to prevent immobilising lamprey ammocoetes within the sediment. The anode was energised with 100V of pulsed DC for 15-20 seconds and then turned off for approximately five seconds to allow ammocoetes to emerge from their burrows. The anode was switched on and off in this way for approximately two minutes. Immobilised ammocoetes were collected by a second operator using a fine-mesh hand net as they emerged.

Lamprey species were identified to species level, where possible, with the assistance of a hand lens, through external pigmentation patterns and trunk myomere counts as described by Potter & Osborne (1975) and Gardiner (2003).

2.3 Fisheries habitat appraisal

A fisheries habitat appraisal of all 54 no. sites was undertaken to establish the importance of the supporting habitats as nursery, spawning and or holding habitats. The appraisal surveys focused on evaluating the spawning, nursery and or holding habitat for salmonids and lamprey species but also considered European eel and other fish species. The appraisals of salmonids and lamprey were cognisant of species-specific habitat requirements and preferences as outlined in O'Grady (2006), Hendry et al. (2003), Armstrong et al. (2003), Harvey & Cowx (2003), Maitland (2003) and Hendry & Cragg-Hine (1997). River habitat surveys and fisheries assessments were also carried out utilising elements of the approaches in the River Habitat Survey Methodology (Environment Agency, 2003) and Fishery Assessment Methodology (O'Grady, 2006) to broadly characterise the riverine sites (i.e., channel profiles, substrata etc.).

2.4 Biosecurity

A strict biosecurity protocol following IFI (2010) and the Check-Clean-Dry approach was adhered to during surveys for all equipment and PPE used. Disinfection of all equipment and PPE before and after use with Virkon™ was conducted to prevent the transfer of pathogens or invasive propagules between survey sites. Surveys were undertaken at sites in a downstream order to minimise the risk of upstream propagule mobilisation. Particular cognisance was given towards preventing the spread or introduction of crayfish plague (*Aphanomyces astaci*) (known from the catchment; Triturus 2022 data). Furthermore, staff did not undertake any work in a known crayfish plague catchment for a period of <72hrs in advance of the survey. Where feasible, equipment was also thoroughly dried (through UV exposure) between survey areas. Any aquatic invasive species or pathogens recorded within or adjoining the survey areas were geo-referenced. All Triturus staff are certified in 'Good fieldwork practice: slowing the spread of invasive non-native species' by the University of Leeds.

3. Results

The results of the survey are discussed below in terms of fish population structure, population size and the suitability and value of the surveyed areas as nursery, spawning and or holding habitat for salmonids, European eel, lamprey and other fish species. Scientific names are provided at first mention only. The results area summarised below with regards to sites in the vicinity of the wind farm site boundary and situated on the GCR and TDR.

3.1 Sites in vicinity of the site boundary

3.1.1 Site A1 – unnamed river, Doolough

No fish were recorded via electro-fishing at site A1 on an unnamed river (no EPA code) adjoining the site boundary. The site was not of fisheries value given its heavily modified and heavily silted nature.

Plate 3.1 Representative image of site A1 on an unnamed river, September 2023

3.1.2 Site A2 – unnamed river, Doolough

European eel (*Anguilla anguilla*) (*n*=8) and flounder (*Platichthys flesus*) (*n*=4) were recorded via electro-fishing at site A2 on the lower, tidal reaches of an unnamed river (**Figure 3.1**).

The tidal channel was a good nursery for European eel and transitional fish (namely flounder) but did not support salmonid fish. The narrow channel was of poor suitability as a holding habitat for migratory salmonids (such as sea trout). There was no suitability for lamprey and the species was not recorded.

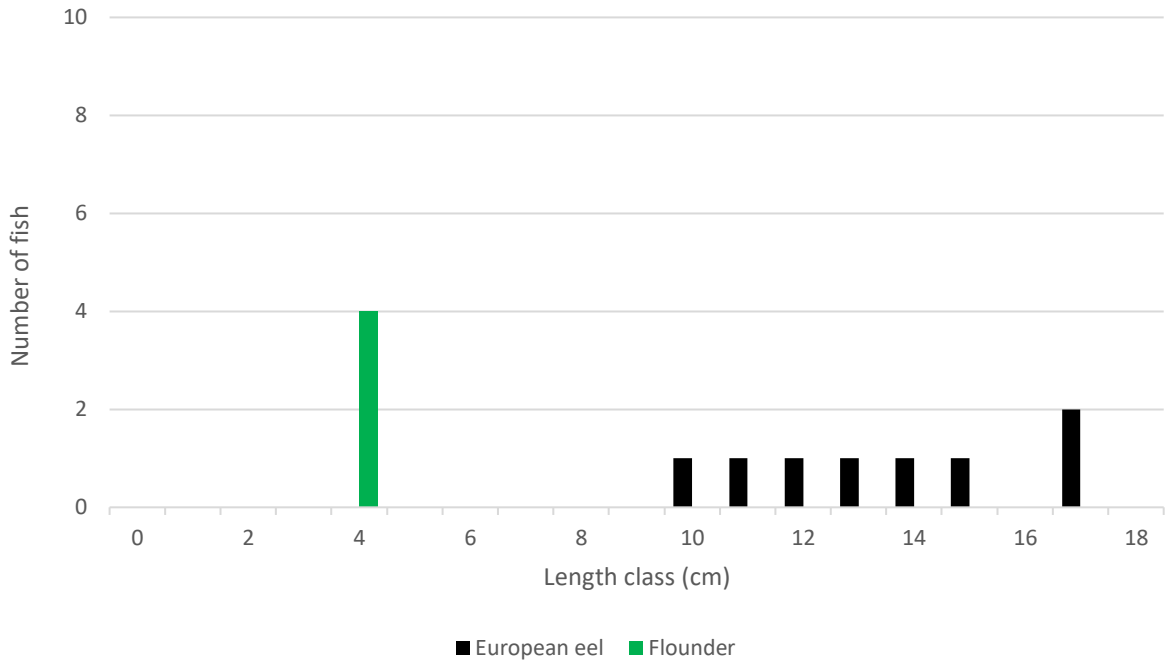

Figure 3.1 Length frequency distribution recorded via electro-fishing at site A1, September 2023

Plate 3.2 Representative image of site A2 on the tidal reaches of a small, unnamed river, September 2023

3.1.3 Site B1 – unnamed river, Muingmore

No fish were recorded via electro-fishing at site B1 on the upper reaches of a small unnamed tributary of Tullaghan Bay. The site was not of fisheries value given historical modifications, heavy siltation and poor flows.

Plate 3.3 Representative image of site B1 on an unnamed Tullaghan Bay tributary, September 2023

3.1.4 Site B2 – unnamed river, Muingmore

No fish were recorded via electro-fishing at site B2 on the upper reaches of a small unnamed tributary of Tullaghan Bay. The site was not of fisheries value given historical modifications, heavy siltation and poor flows.

Plate 3.4 Representative image of site B2 on an unnamed Tullaghan Bay tributary, September 2023

3.1.5 Site B3 – unnamed river, Muingmore

No fish were recorded via electro-fishing at site B3 on a small unnamed tributary of Tullaghan Bay. The site was not of fisheries value given historical modifications, heavy siltation and poor flows.

Plate 3.5 Representative image of site B3 on an unnamed Tullaghan Bay tributary, September 2023

3.1.6 Site B4 – unnamed stream, Muingmore

Brown trout (*Salmo trutta*) (*n*=3) was the only fish species recorded via electro-fishing at site B4 on a small unnamed tributary of Tullaghan Bay (**Figure 3.2**).

Given the stream's very small size and heavily modified nature it was only a poor quality brown trout nursery with a small population of 0+ fish recorded. The quality of salmonid spawning habitat was poor given the presence of heavily bedded boulder, cobble and scattered gravels with high siltation (by peat). The holding value for adult fish was poor given the very limited pool habitat. Despite some low suitability for European eel, none were recorded. The site was unsuitable for lamprey and the species was not recorded.

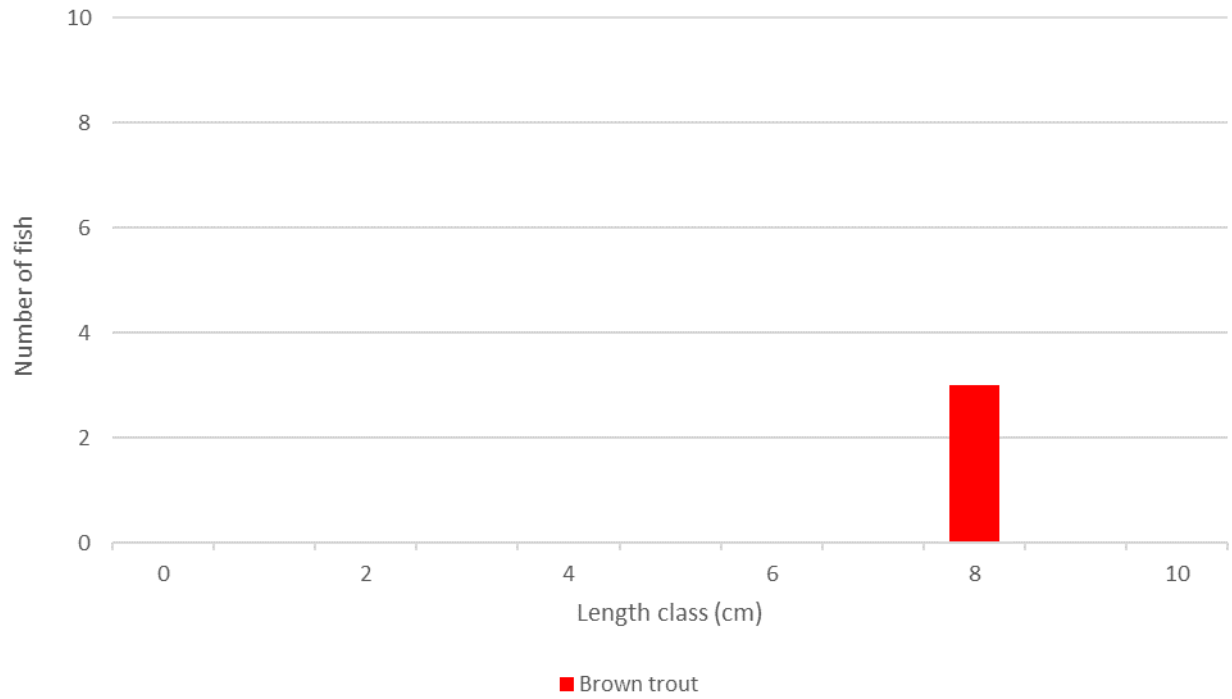

Figure 3.2 Length frequency distribution recorded via electro-fishing at site B4, September 2023

Plate 3.6 Representative image of site B4 on an unnamed Tullaghan Bay tributary, September 2023

3.1.7 Site B5 – unnamed river, Tristia

Brown trout (*n*=20) was the only fish species recorded via electro-fishing at site B5 on a small unnamed tributary of Tullaghan Bay (**Figure 3.3**).

Despite historical drainage the stream was considered a good quality brown trout nursery given it supported a good density of mixed cohort trout. Spawning habitat was of moderate quality given the presence of mixed gravels in pool and deeper glide but was reduced because of siltation pressures. Despite some suitability for European eel, none were recorded (superior habitats present downstream). The site was of too high an energy to support lamprey and no soft sediment settlement areas supporting ammocoetes were present.

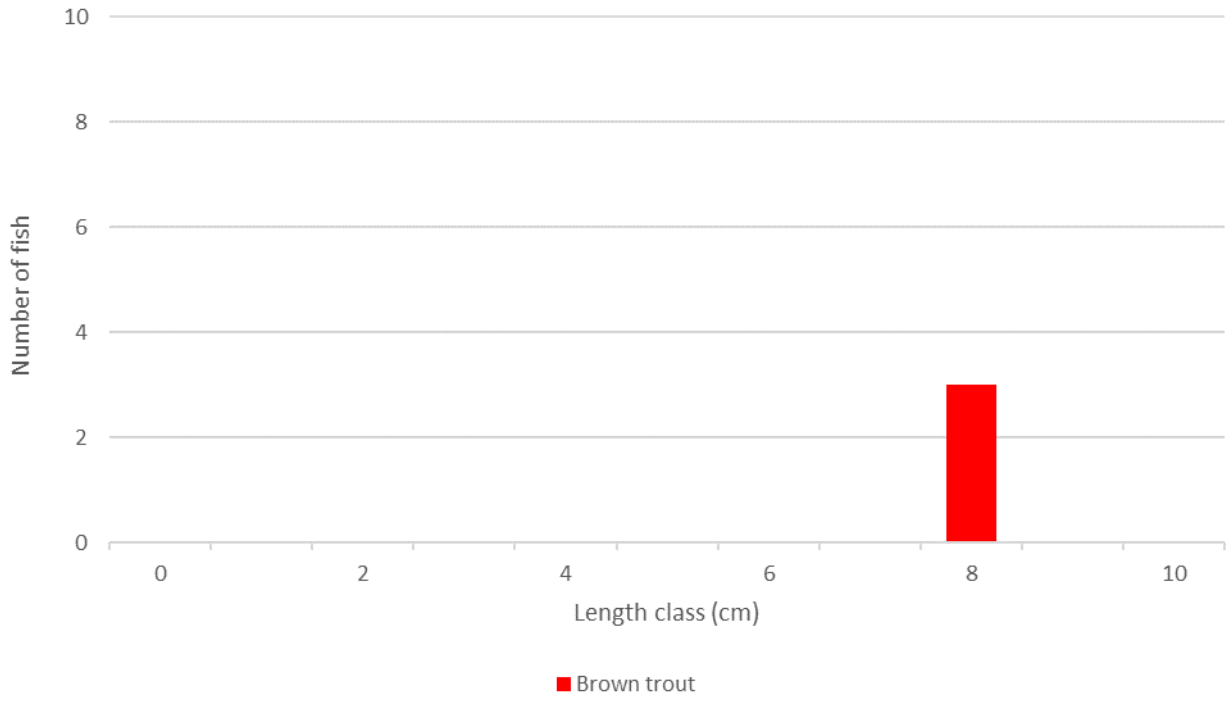

Figure 3.3 Length frequency distribution recorded via electro-fishing at site B5, September 2023

Plate 3.7 Representative image of site B5 on an unnamed Tullaghan Bay tributary, September 2023

3.1.8 Site B6 – unnamed river, Doolough

Atlantic salmon (*Salmo salar*) (*n*=2), brown trout (*n*=40), European eel (*Anguilla anguilla*) (*n*=3) and three-spined stickleback (*Gasterosteus aculeatus*) (*n*=1) were recorded via electro-fishing at site B6 on the lower reaches of an unnamed tributary of Tullaghan Bay (**Figure 3.4**).

The site was a good quality salmonid nursery that supported a good density of trout and a low density of Atlantic salmon. The presence of deeper glide and a rocky bed provided refugia that were however compromised by siltation and eutrophication pressures in addition to historical drainage (i.e. deepening). Salmonid spawning habitat was of moderate quality, being reduced because of siltation and enrichment despite the presence of mixed gravels in deeper glide and pool pockets. Abundant deep glide provided good quality holding habitat for adult salmonids but would have improved with riparian tree cover (that was absent). The watercourse was a moderate quality eel nursery given the presence of deeper water with rocky refugia with a small population recorded present. The upland eroding site was unsuitable for lamprey and the species was not recorded present.

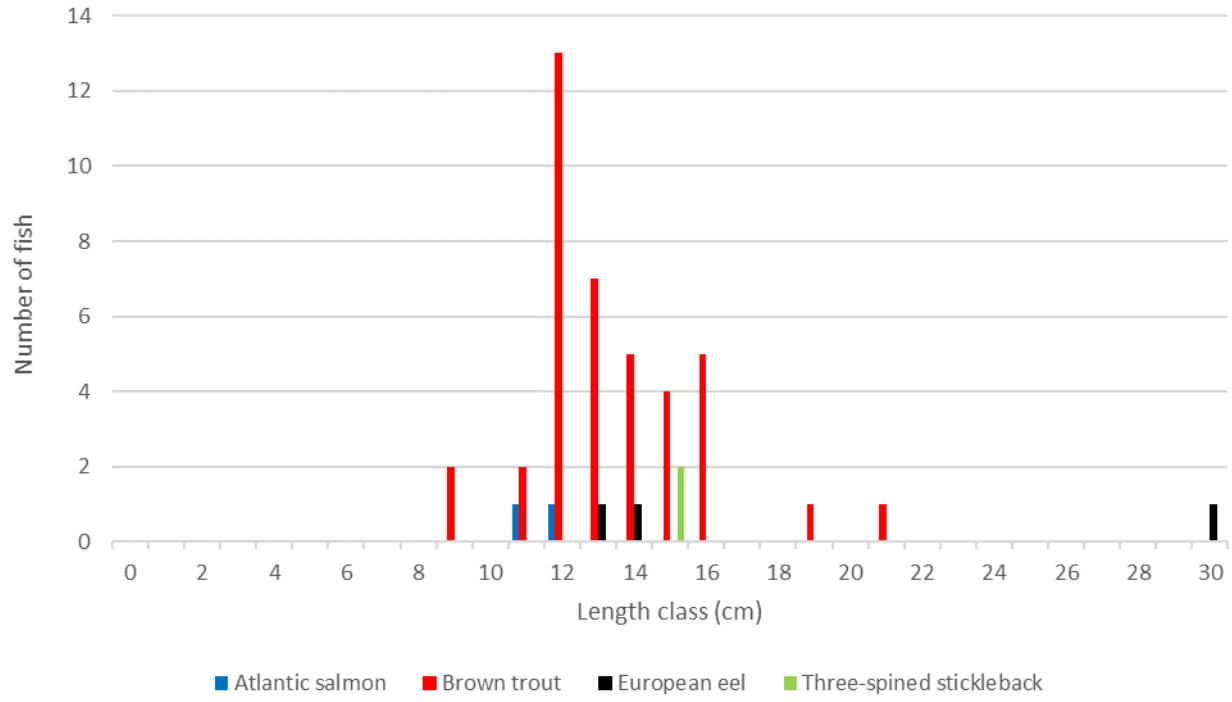

Figure 3.4 Length frequency distribution recorded via electro-fishing at site B6, September 2023

Plate 3.8 European eel recorded at site B6 on an unnamed Tullaghan Bay tributary, September 2023

3.1.9 Site P1 – pond, Doolough

Site P1 was located at a small 0.2ha elliptical pond adjacent to the proposed site boundary. Electro-fishing was not undertaken at the lacustrine site. However, a fisheries appraisal indicated that the pond had good suitability for a small brown trout population (despite an absence of inflowing watercourses) and also had high suitability for European eel given close proximity to nearby upland eroding streams and drainage channels. Both species were detected via eDNA sampling (**Appendix B**).

Plate 3.9 Representative image of site P1, September 2023

3.1.10 Site P2 – pond, Muingmore

Site P2 was located at a small 0.35ha irregular-shaped pond adjacent to the proposed site boundary. Electro-fishing was not undertaken at the lacustrine site. However, a fisheries appraisal indicated that the pond had good suitability for European eel given close proximity to nearby upland eroding streams and drainage channels. Suitability for brown trout was poor given the shallow depths. Whilst brown trout were not recorded via eDNA sampling (thus considered absent), European eel were detected present (**Appendix B**).

Plate 3.10 Representative image of site P2, September 2023

3.1.11 Site P3 – pond, Muingmore

Pond P3 was located at a small 0.4ha pond adjacent to (west of) site P2. Electro-fishing was not undertaken at the lacustrine site. However, a fisheries appraisal indicated that the pond had moderate suitability for brown trout and high suitability for European eel and both species were detected via eDNA sampling (**Appendix B**).

Plate 3.11 Representative image of site P3, September 2023

3.1.12 Site P4 – pond, Doolough

Site P4 was located at a small 0.65ha pond adjacent to the proposed site boundary. Electro-fishing was not undertaken at the lacustrine site. However, a fisheries appraisal indicated that the pond had good suitability for brown trout and European eel and both species were detected via eDNA sampling (**Appendix B**).

Plate 3.12 Representative image of site P4, September 2023

3.1.13 Site C1 – An Mhoing Mhór River, Muingmore

No fish were recorded via electro-fishing at site C1 on the Mhoing Mhór River (EPA code: 33M23), a tributary of the Doolough Stream adjacent to the site boundary. The river was not of fisheries value at this location given its heavily modified nature and siltation pressures.

Plate 3.13 Representative image of site C1 on the Mhoing Mhór River, September 2023

3.1.14 Site C2 – Doolough Stream, Muingmore

Good densities of brown trout (*n*=34) and a low density of European eel (*n*=2) were recorded via electro-fishing at site C2 on the Doolough Stream (33D02) adjacent to the site boundary (**Figure 3.5**).

The site was a good quality salmonid nursery despite historical drainage, siltation and enrichment pressures with a relatively high density of mixed cohort trout. Salmonid spawning habitat was moderate given the presence of mixed gravels in pool and deeper glide as with areas downstream (e.g. site C4) but was reduced because of siltation and enrichment pressures. Suitability for European eel was moderate with a small population of adults present. No soft sediment settlement areas suitable for lamprey ammocoetes were identified and the species was not recorded present.

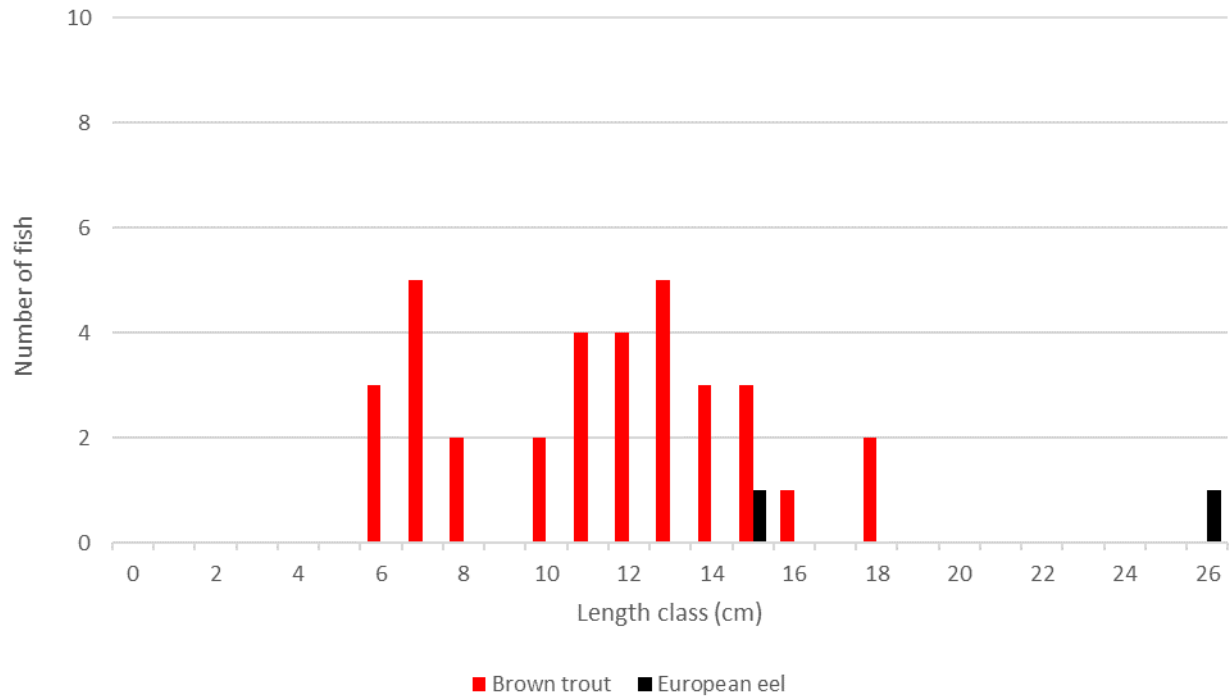

Figure 3.5 Length frequency distribution recorded via electro-fishing at site C2 on the Doolough Stream, September 2023

Plate 3.14 Mixed cohort brown trout recorded at site C2 on the Doolough Stream, September 2023

3.1.15 Site C3 – unnamed stream, Muingmore

No fish were recorded via electro-fishing at site C3 on an unnamed tributary of the Doolough Stream adjacent to the site boundary (**Appendix A**). The site was not of fisheries value at this location given its ephemeral nature and historical modifications.

Plate 3.15 Representative image of site C3 on an unnamed Doolough Stream tributary, September 2023

3.1.16 Site C4 – Doolough Stream, Muingmore

A good density of brown trout (*n*=43) and a low density of European eel (*n*=3) with small numbers of three-spined stickleback (*n*=2) were recorded via electro-fishing at site C4 on the Doolough Stream (33D02). The survey area was approximately 1.2km downstream of site C2 (**Figure 3.6**).

Despite historical drainage and siltation pressures, the site was a good quality salmonid nursery supporting as supported by the good density of juvenile trout. Localised pools and instream boulder provided valuable holding areas for adult salmonids although the quality of the holding habitat was poor overall (shallow water). Mixed gravels provided moderate quality salmonid spawning habitat, with the value reduced due to siltation. The site was of moderate value for European eel with a low density of adults recorded. No soft sediment settlement areas suitable for lamprey ammocoetes were identified and the species was not recorded.

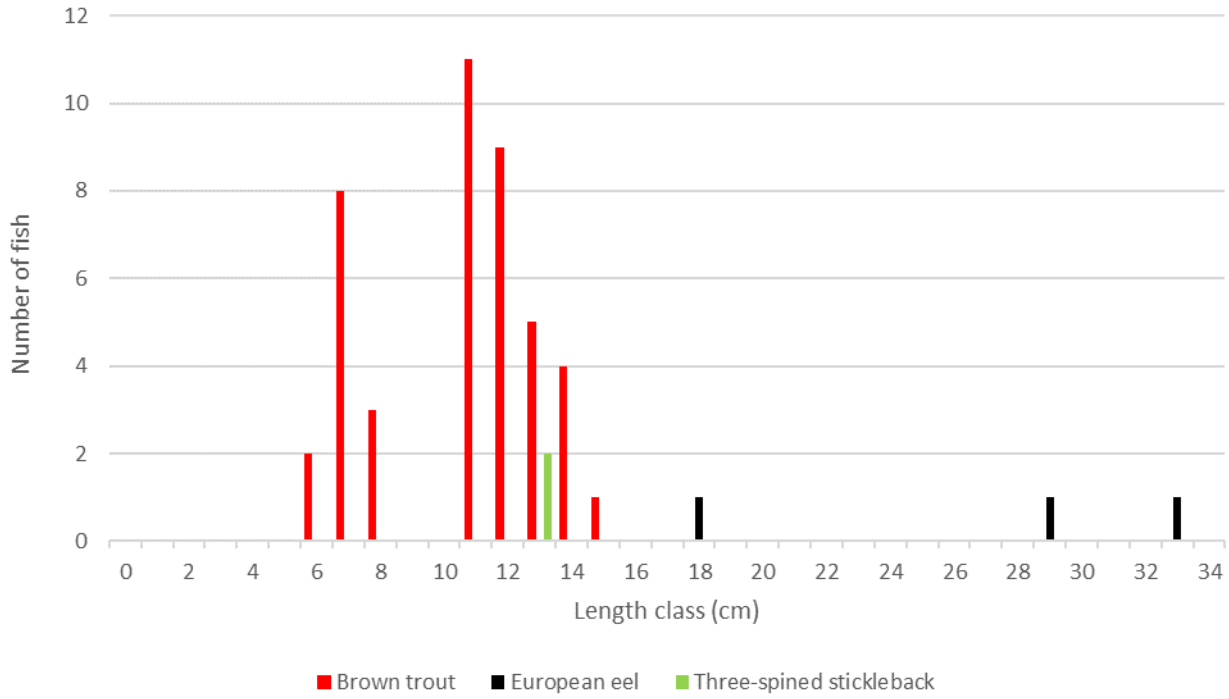

Figure 3.6 Length frequency distribution recorded via electro-fishing at site C4 on the Doolough Stream, September 2023

Plate 3.16 Silver European eel recorded at site C4 on the Doolough Stream, September 2023

3.1.17 Site C5 – Doolough Stream, Muingmore

Brown trout (*n*=48) was the only fish species recorded via electro-fishing at site C5 on the Doolough Stream (33D02) at the L1205 local road crossing approximately 0.9km downstream of site C4 (**Figure 3.7**).

The site was a good quality salmonid nursery supporting a relatively high density of juvenile trout. The presence of deeper glide and a rocky bed provided refugia but these were impacted by siltation and eutrophication pressures in addition to historical drainage (i.e. deepening). Salmonid spawning habitat was of moderate quality. Abundant deep glide provided good quality holding habitat for adult salmonids. The site was a moderate quality European eel nursery given the presence of deeper water with ample refugia but none were recorded. No soft sediment settlement areas suitable for lamprey ammocoetes were identified and the species was not recorded present.

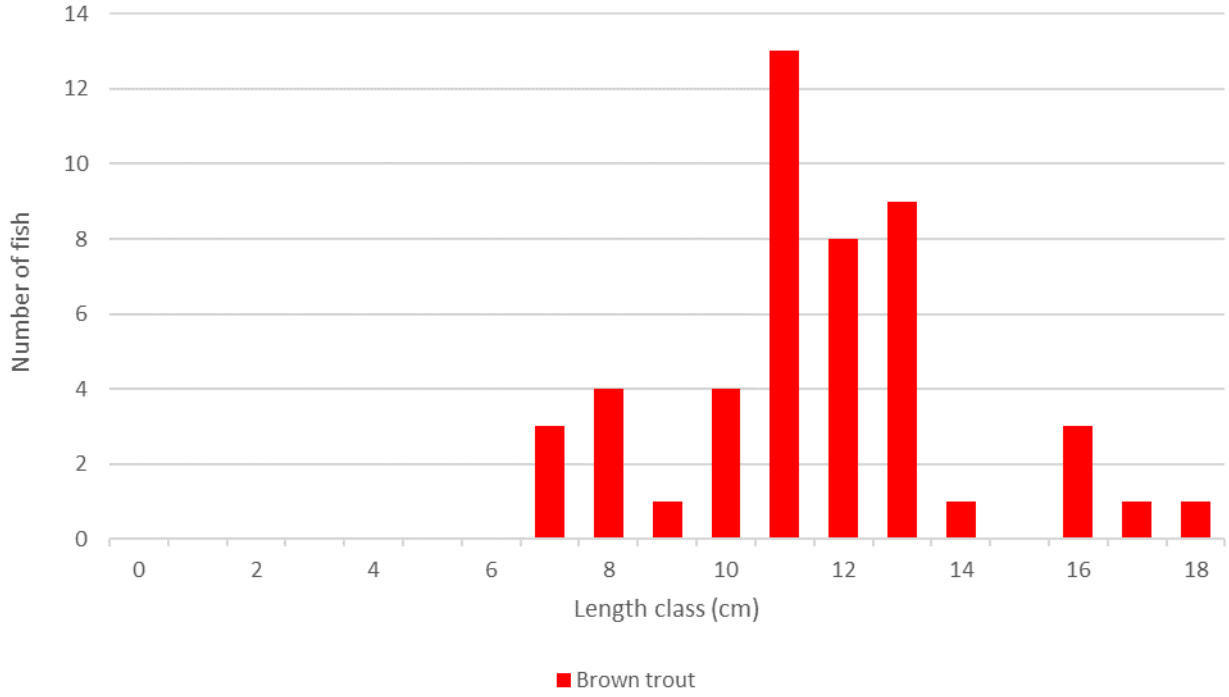

Figure 3.7 Length frequency distribution recorded via electro-fishing at site C5 on the Doolough Stream, September 2023

Plate 3.17 Brown trout recorded at site C5 on the Doolough Stream, September 2023

3.2 GCR sites

3.2.1 Site D1 – unnamed stream, Goolamore

No fish were recorded via electro-fishing at site D1 on an unnamed tributary of the Owenmore River. The site was not of fisheries value at this location given the narrow channel width and depth and historical drainage pressures.

Plate 3.18 Representative image of site D1 on an unnamed Owenmore tributary, September 2023

3.2.2 Site D2 – Goolamore River, Drumanaffrin

Atlantic salmon (*n*=4), brown trout (*n*=21) and minnow (*n*=6) were recorded via electro-fishing at site D2 on the Goolamore River (33G12), a tributary of the Owenmore River (**Figure 3.8**).

The site was a moderate quality salmonid nursery given the stoney bed, shallow glide and pool habitat with mixed cohort populations present. Moderate quality salmonid spawning habitat was present in deeper glide and pool where mixed gravels (compromised by siltation pressures). Deeper glide and pool downstream of the road crossing provided some valuable holding habitat for adult salmonids. Soft sediment accumulations were shallow and flocculent and largely unsuitable for lamprey ammocetes (none recorded). While there some low suitability for European eel, none were recorded.

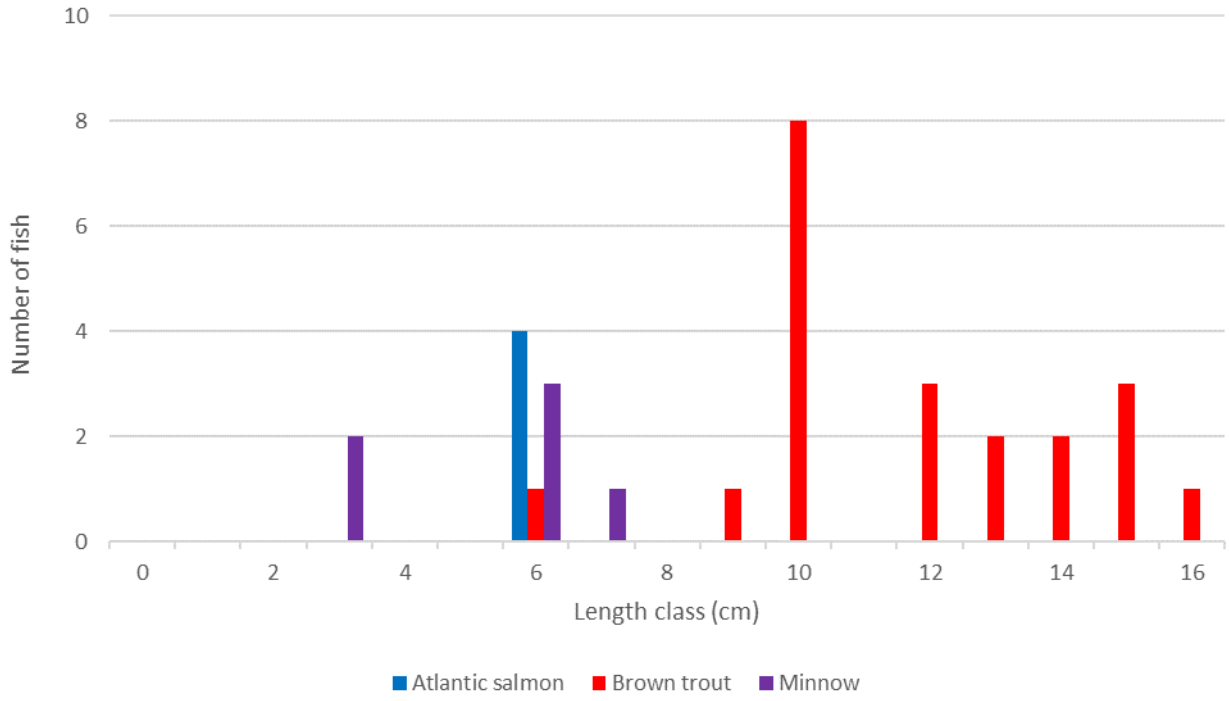

Figure 3.8 Length frequency distribution recorded via electro-fishing at site D2 on the Goolamore River, September 2023

Plate 3.19 Brown trout (top) and Atlantic salmon (bottom) of site D2 on the Goolamore River, September 2023

3.2.3 Site D3 – Munhin River, Kilteany

Atlantic salmon (*n*=12), brown trout (*n*=4), sea trout (*n*=1), lamprey (*Lampetra* sp.) (*n*=3), minnow (*n*=3) and flounder (*n*=3) were recorded via electro-fishing at site D3 on the Munhin River (33M03), a major tributary of the Owenmore (**Figure 3.9**). This was the highest species diversity recorded during the survey.

The site was a good quality salmonid nursery (especially downstream of the bridge) given the stoney bed, shallow glide and riffle areas with macrophyte vegetation. The quality of spawning habitat for salmonid and lamprey was good given the presence of mixed gravels in deeper pool and glide. Holding habitat was also of good quality with deep pool and glide pockets. The site featured moderate quality lamprey nursery habitat in sands below the bridge cutwaters and in the channel margins - these areas supported a low density population of ammocoetes. While some good suitability for European eel existed (i.e. boulder and cobble refugia and deeper water) none were recorded.

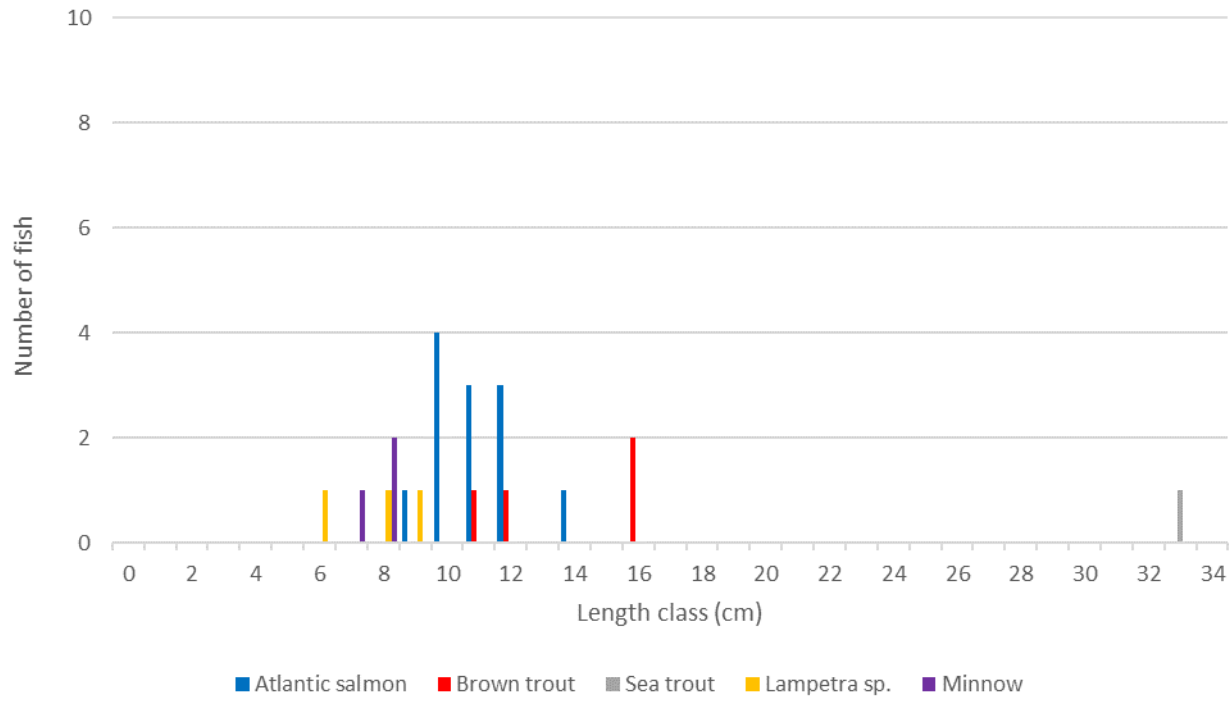

Figure 3.9 Length frequency distribution recorded via electro-fishing at site D3 on the Munhin River, September 2023

Plate 3.20 Sea trout recorded at site D3 on the Munhin River, September 2023

3.2.4 Site D4 – unnamed river, Srahmore

No fish were recorded via electro-fishing at site D4 on an unnamed tributary of the Owenmore River. The site was of poor fisheries value given the narrow channel width and depth, poor flows and historical drainage pressures.

Plate 3.21 Representative image of site D4 on an unnamed Owenmore River tributary, September 2023

3.2.5 Site D5 – Ballybeg Stream, Srahanarry

No fish were recorded via electro-fishing at site D5 on the Ballybeg Stream (33B40), a tributary of the Owenmore River. The site was of poor fisheries value given the narrow channel width and depth and poor flows.

Plate 3.22 Representative image of site D5 on the Ballybeg Stream, September 2023

3.2.6 Site D6 – Srahanarry Stream, Srahanarry

Atlantic salmon (*n*=12) and brown trout (*n*=9) were recorded via electro-fishing at site D6 on the Srahanarry Stream (33S23), a tributary of the Owenmore River (**Figure 3.10**).

The site was a good quality salmonid nursery given the stoney bed with riffle, glide and pool sequences that provided refugia and oxygenated water. Mixed gravels in deeper glide and pool (provided good quality salmonid spawning habitat. The site was a moderate quality holding habitat for adult salmonids (apart from the deep pool immediately below the N59 crossing, which was of higher value). The bridge crossing was considered a significant barrier to salmonids given the vertical 2m fall between the apron and the pool below. Despite some low suitability for European eel, none were recorded. The high energy channel was unsuitable for lamprey and none were recorded.

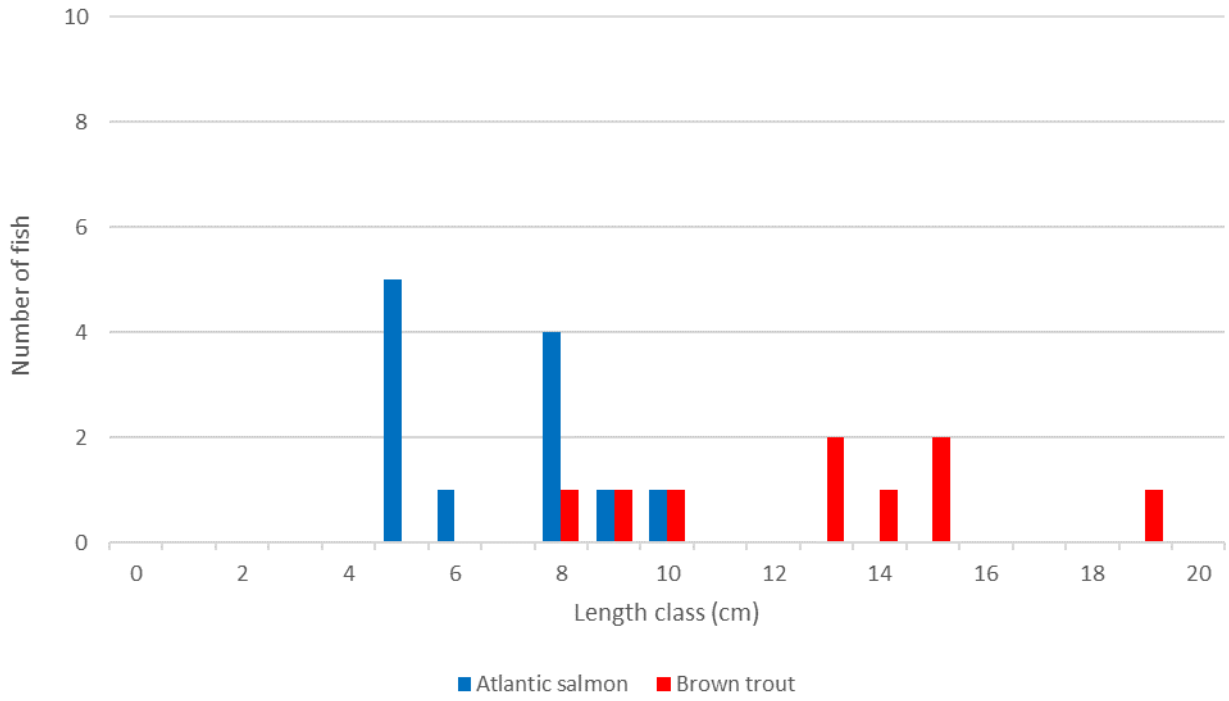

Figure 3.10 Length frequency distribution recorded via electro-fishing at site D6 on the Srahanarry Stream, September 2023

Plate 3.23 Juvenile salmonids recorded at site D6 on the Srahanarry Stream, September 2023

3.2.7 Site D7 – Bellanumera Stream, Briska

No fish were recorded via electro-fishing at site D7 on the Bellanumera Stream (33B38), a tributary of the Owenmore River. The site was of poor fisheries value given the narrow channel width and depth and poor flows.

Plate 3.24 Representative image of site D7 on the Bellanumera Stream, September 2023

3.2.8 Site D8 – Briska River, Briska

Atlantic salmon (*n*=20), brown trout (*n*=16) and European eel (*n*=12) were recorded via electro-fishing at site D8 on the Briska River (33B33), a tributary of the Owenmore River (**Figure 3.11**).

The site was a very good quality salmonid nursery given the stoney bed, riffle, glide and pool sequences that provided refugia and oxygenated water. Good quality spawning habitat was present locally good in the deeper glide and in pool where mixed gravels were present (improving upstream). The holding habitat quality was moderate (again improved upstream of the N59 crossing). The site was also a very important European eel nursery with a high density of eels recorded. The high energy site was unsuitable for lamprey and none were recorded.

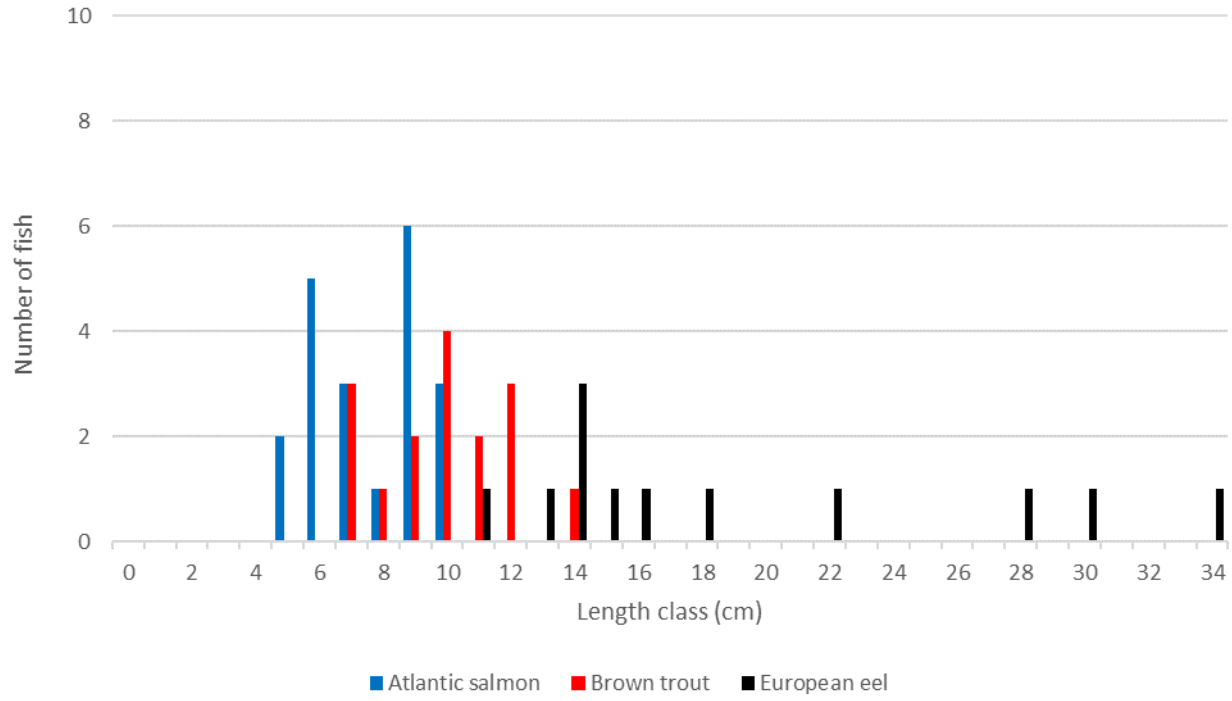

Figure 3.11 Length frequency distribution recorded via electro-fishing at site D8 on the Briska River, September 2023

Plate 3.25 Adult European eel recorded at site D8 on the Briska River, September 2023

3.2.9 Site D9 – unnamed stream, Briska

No fish were recorded via electro-fishing at site D9 on an unnamed tributary of the Owenmore River. The site was of poor fisheries value given the narrow channel width and depth, poor flows and historical modifications.

Plate 3.26 Representative image of site D9, September 2023

3.2.10 Site D10 – unnamed stream, Briska

No fish were recorded via electro-fishing at site D10 on an unnamed tributary of the Owenmore River. The site was of poor fisheries value given the narrow channel width and depth, poor flows and historical modifications.

Plate 3.27 Representative image of site D10, September 2023

3.2.11 Site D11 – unnamed river, Briska

No fish were recorded via electro-fishing at site D11 on an unnamed tributary of the Owenmore River. The site was not of fisheries value given the narrow channel width and depth, poor flows and high natural gradients.

Plate 3.28 Representative image of site D11, September 2023

3.2.12 Site D12 – unnamed river, Largan More

Site D12 on an unnamed tributary of the Owenmore River was dry at the time of survey. The high gradient, ephemeral channel was not of fisheries value.

Plate 3.29 Representative image of site D12, September 2023 (dry channel)

3.2.13 Site D13 – unnamed river, Largan More

Site D13 on an unnamed tributary of the Owenmore River was dry at the time of survey. The high gradient, ephemeral channel was not of fisheries value.

Plate 3.30 Representative image of site D13, September 2023 (dry channel)

3.2.14 Site D14 – unnamed stream, Largan More

Site D14 on an unnamed tributary of the Owenmore River was dry at the time of survey. The high gradient, ephemeral channel was not of fisheries value.

Plate 3.31 Representative image of site D14, September 2023 (dry channel)

3.2.15 Site D15 – unnamed stream, Largan More

Site D15 on an unnamed tributary of the Owenmore River was dry at the time of survey. The high gradient, ephemeral channel was not of fisheries value.

Plate 3.32 Representative image of site D15, September 2023

3.2.16 Site D16 – unnamed river, Largan More

Site D16 on an unnamed tributary of the Owenmore River was dry at the time of survey. The high gradient, ephemeral channel spilling over bedrock was not of fisheries value.

Plate 3.33 Representative image of site D16, September 2023 (dry channel)

3.2.17 Site D17 – unnamed stream, Largan More

Site D17 on an unnamed tributary of the Owenmore River was dry at the time of survey. The high gradient, ephemeral channel was not of fisheries value.

Plate 3.34 Representative image of site D17, September 2023 (dry channel)

3.2.18 Site D18 – unnamed stream, Largan More

Brown trout (*n*=4) and European eel (*n*=2) were the only fish species recorded via electro-fishing at site D18 on an unnamed Owenmore River tributary (**Figure 3.12**).

The narrow, shallow, high gradient site was moderate quality nursery for salmonids and only a small population was recorded. Spawning habitat was localised and impacted by siltation pressures. The site was not of value as a holding area for adult salmonids. The stream was of moderate value for European eel given the presence of boulder, cobble and pool refugia with a low density of fish recorded. The high energy site was unsuitable for lamprey and none were recorded.

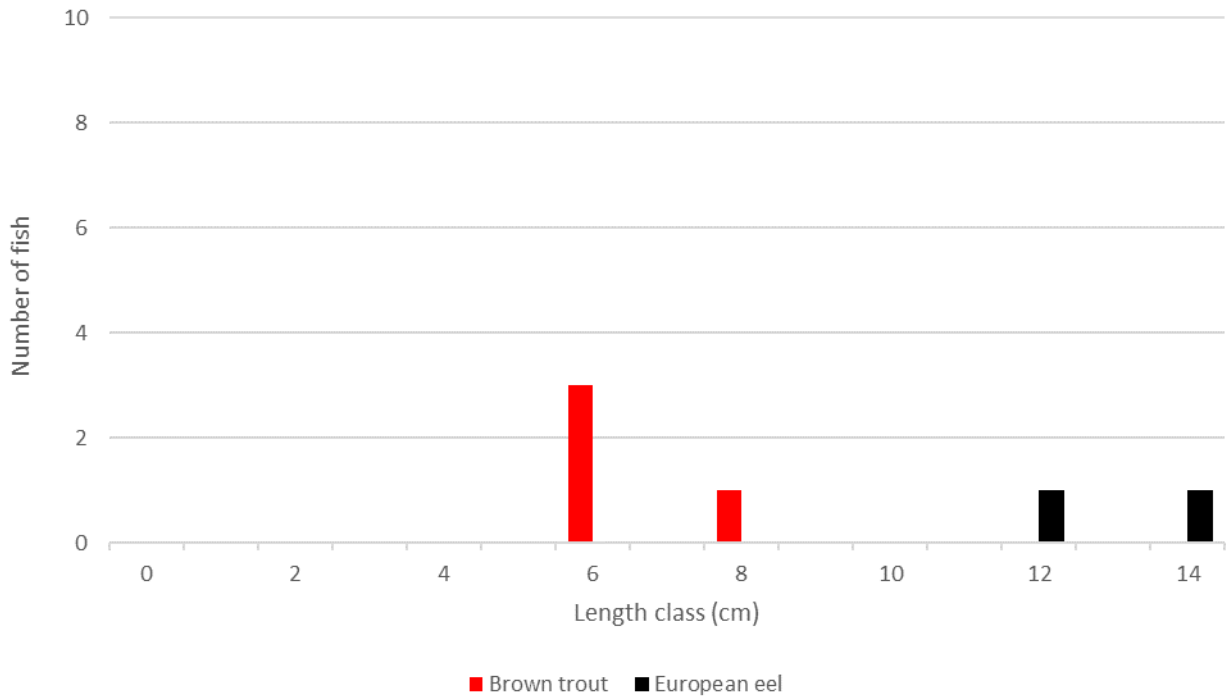

Figure 3.12 Length frequency distribution recorded via electro-fishing at site D18 on an unnamed Owenmore River tributary, September 2023

Plate 3.35 Juvenile European eel recorded at site D18, September 2023

3.2.19 Site D19 – unnamed stream, Largan Beg

Site D19 on an unnamed tributary of the Owenmore River was dry at the time of survey. The heavily modified, ephemeral drainage channel was not of fisheries value.

Plate 3.36 Representative image of site D19, September 2023 (dry channel)

3.2.20 Site D20 – unnamed stream, Largan Beg

No fish were recorded via electro-fishing at site D20 on an unnamed Owenmore River tributary. The small, silted drainage channel featured no flows with stagnant pools of peaty water only at the time of survey and was unsuitable for resident fish.

Plate 3.37 Representative image of site D20, September 2023

3.2.21 Site D21 – unnamed stream, Largan Beg

No fish were recorded via electro-fishing at site D21 on an unnamed Owenmore River tributary. The narrow, historically modified upland stream had no flows and stagnant shallow pools only at the time of survey and was unsuitable for resident fish.

Plate 3.38 Representative image of site D21, September 2023

3.2.22 Site D22 – unnamed stream, Tawnaghmore

Brown trout (*n*=12) were the only fish species recorded via electro-fishing at site D22 on an unnamed Owenmore River tributary (**Figure 3.13**).

The meandering stream at this location was as a moderate quality salmonid nursery, supporting a small mixed cohort population. The presence of shallow glide and riffle with a rocky bed provided sufficient refugia habitat for juveniles. The spawning value was locally moderate being reduced by siltation pressures. The quality of holding habitat was poor given the absence of pool. The site offered some low value as a European eel nursery albeit none were recorded. The high energy, upland stream was unsuitable for lamprey.

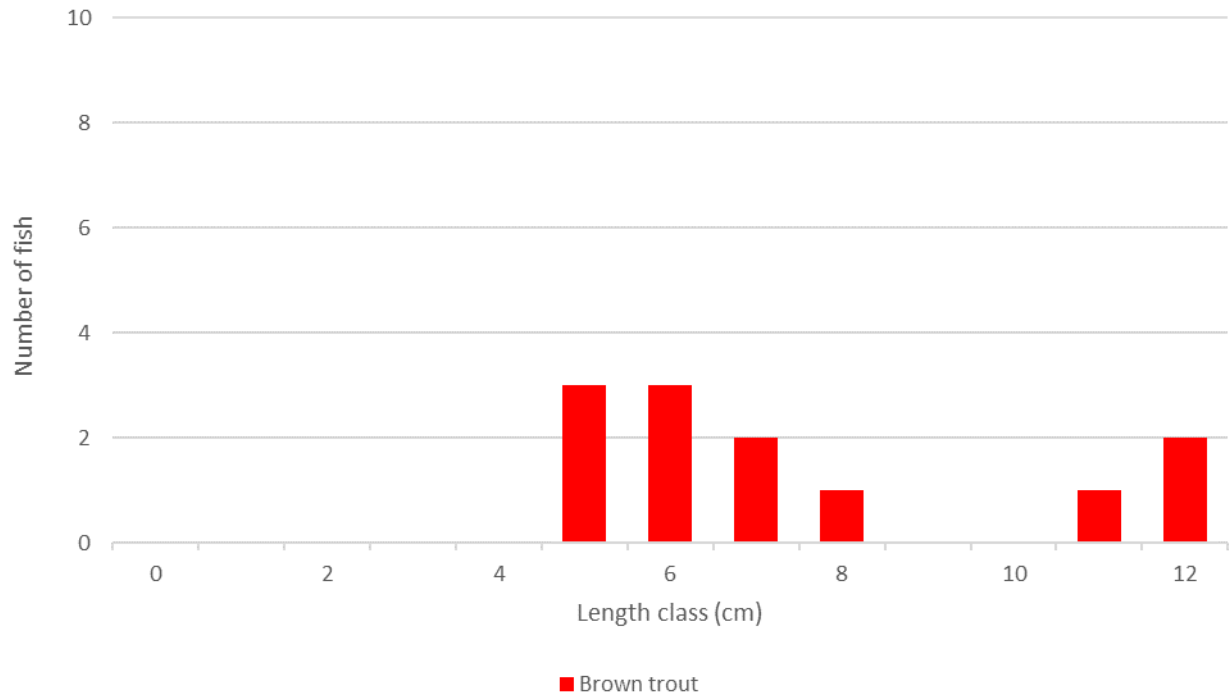

Figure 3.13 Length frequency distribution recorded via electro-fishing at site D22 on an unnamed Owenmore River tributary, September 2023

Plate 3.39 Representative image of site D22, September 2023

3.2.23 Site D23 – unnamed stream, Tawnaghmore

Brown trout (*n*=5) were the only fish species recorded via electro-fishing at site D23 on an unnamed Owenmore River tributary (**Figure 3.14**).

The site was a poor to moderate quality salmonid nursery give low summer flows and siltation

pressures. The spawning value of the site (moderate) was also reduced by siltation pressures. Holding habitat for adult salmonids was moderate given limited deeper pool habitat. The site was of some lower value for European eel (ample refugia) but none were recorded. The upland stream was unsuitable for lamprey.

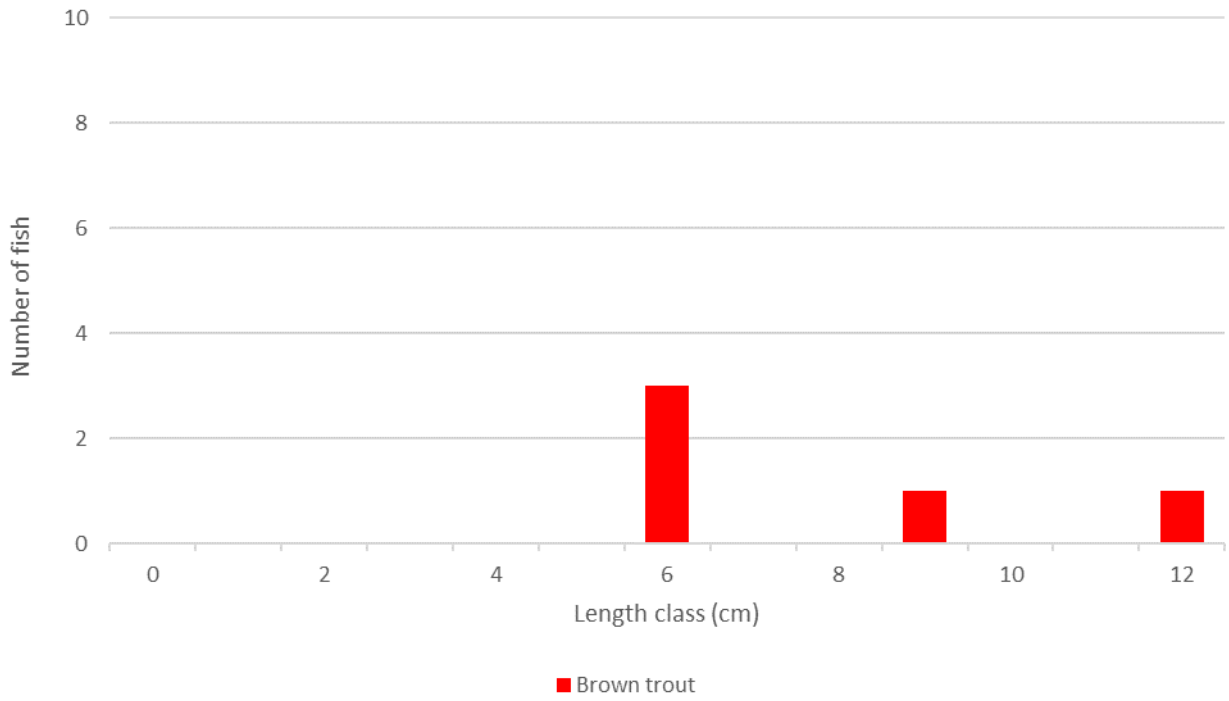

Figure 3.14 Length frequency distribution recorded via electro-fishing at site D23 on an unnamed Owenmore River tributary, September 2023

Plate 3.40 Representative image of site D23, September 2023

3.2.24 Site D24 – unnamed river, Tawnaghmore

Brown trout (*n*=5) were the only fish species recorded via electro-fishing at site D24 on an unnamed Owenmore River tributary (**Figure 3.15**).

The site was a moderate quality salmonid nursery with a moderate density mixed cohort population recorded. The presence of shallow glide and pools with a rocky bed provided sufficient refugia habitat for juveniles. The spawning value of the site (moderate) was reduced by siltation pressures. Holding habitat was good for upland brown trout given the presence of deeper pool habitat provided some good quality holding habitat for adult salmonids (trout only). The site was of some lower value for European eel (ample refugia) but none were recorded. The upland stream was unsuitable for lamprey.

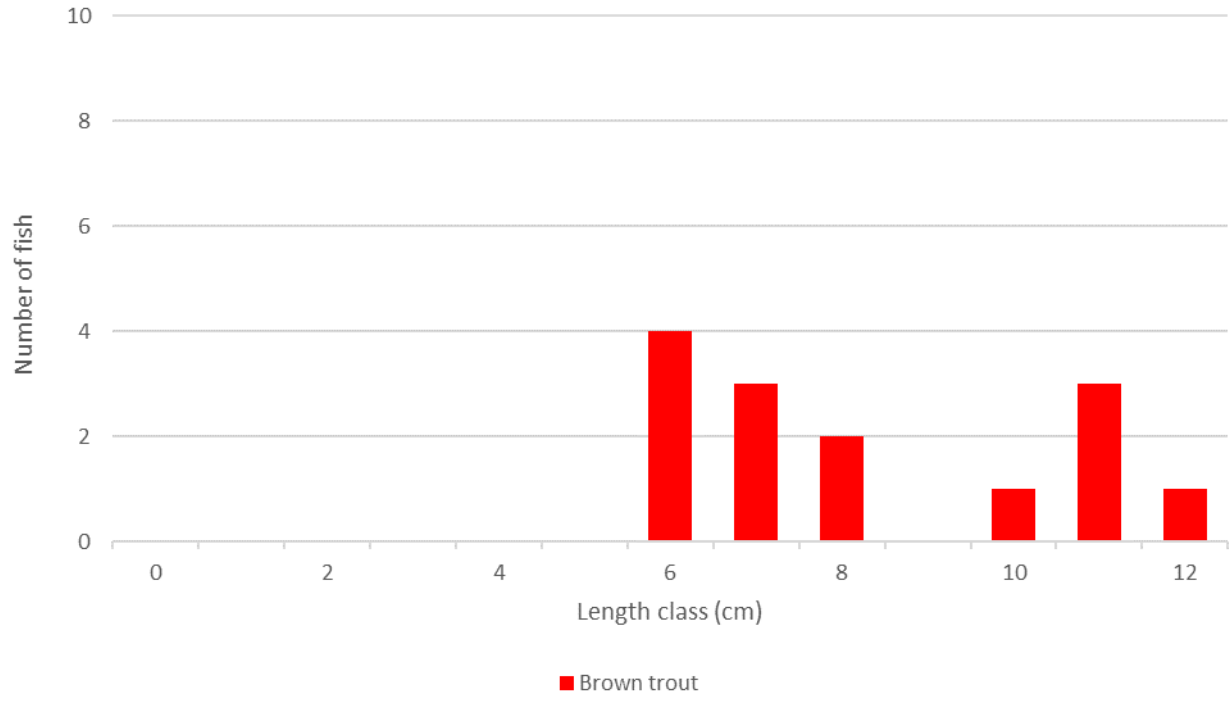

Figure 3.15 Length frequency distribution recorded via electro-fishing at site D24 on an unnamed Owenmore River tributary, September 2023

Plate 3.41 Representative image of site D24, September 2023

3.2.25 Site D25 – unnamed river, Ballymonnelly Bridge

Atlantic salmon (*n*=57), brown trout (*n*=20) and European eel (*n*=2) were recorded via electro-fishing at site D25 on an unnamed Owenmore River tributary (**Figure 3.16**).

The site was an excellent quality salmonid nursery, with high densities of Atlantic salmon and moderate densities brown trout present. Good quality spawning habitat was present locally in deeper pools and glide and the value was reduced only by siltation and enrichment pressures. The site was a moderate quality holding habitat only given a paucity of deeper glide and pool. Moderate quality European eel habitat was present by way of ample refugia, pool habitat and food resources and a small population was recorded. The high energy upland stream was unsuitable for lamprey and none were recorded.

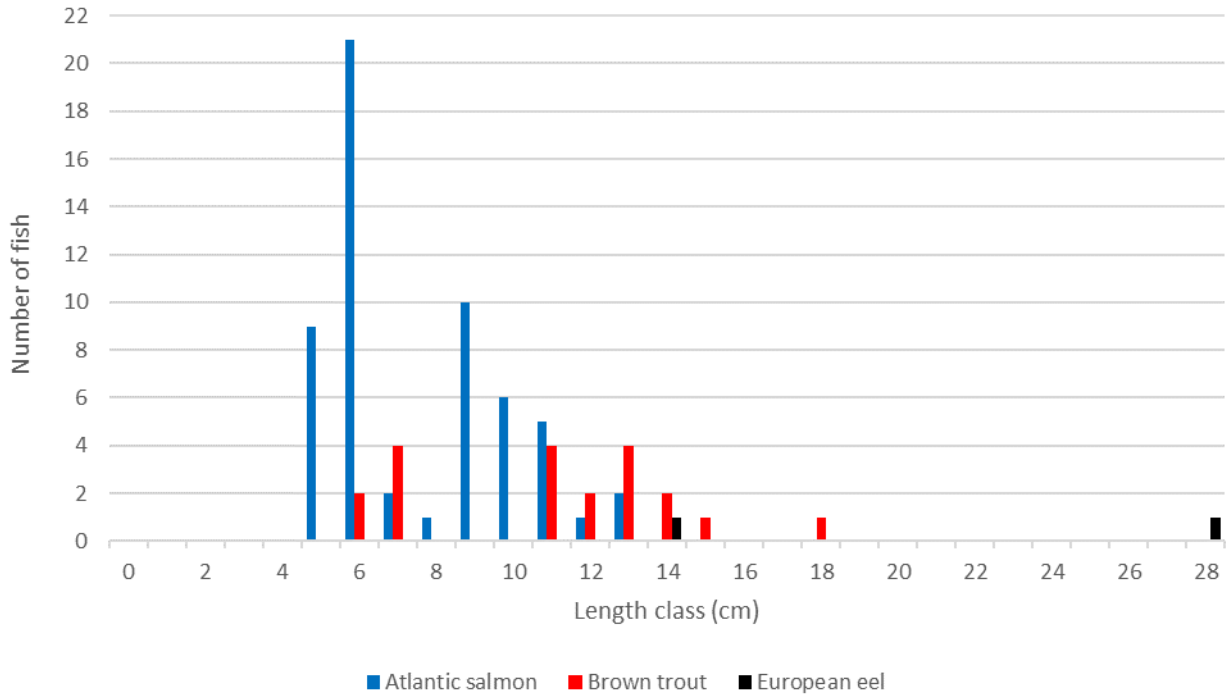

Figure 3.16 Length frequency distribution recorded via electro-fishing at site D25 on an unnamed Owenmore River tributary, September 2023

Plate 3.42 Atlantic salmon parr recorded at site D25, September 2023

3.2.26 Site D26 – unnamed stream, Killsallagh

Atlantic salmon (*n*=2), brown trout (*n*=8) and minnow (*n*=2) were recorded via electro-fishing at site D26 on an unnamed Owenmore River tributary (**Figure 3.17**).

The site was a moderate quality salmonid nursery given mixed coarse substrata and broken flow

patterns that provided refugia but only a small population of 0+ and 1+ fish was present. The site was of poor value as a salmonid spawning habitat due to limited suitable substrata (siltation pressures). The quality of holding habitat was also poor given the paucity of pools. Instream cobble and boulder refugia and prey resources provided some moderate suitability for European eel although the species was not recorded. The high energy upland stream was unsuitable for lamprey.

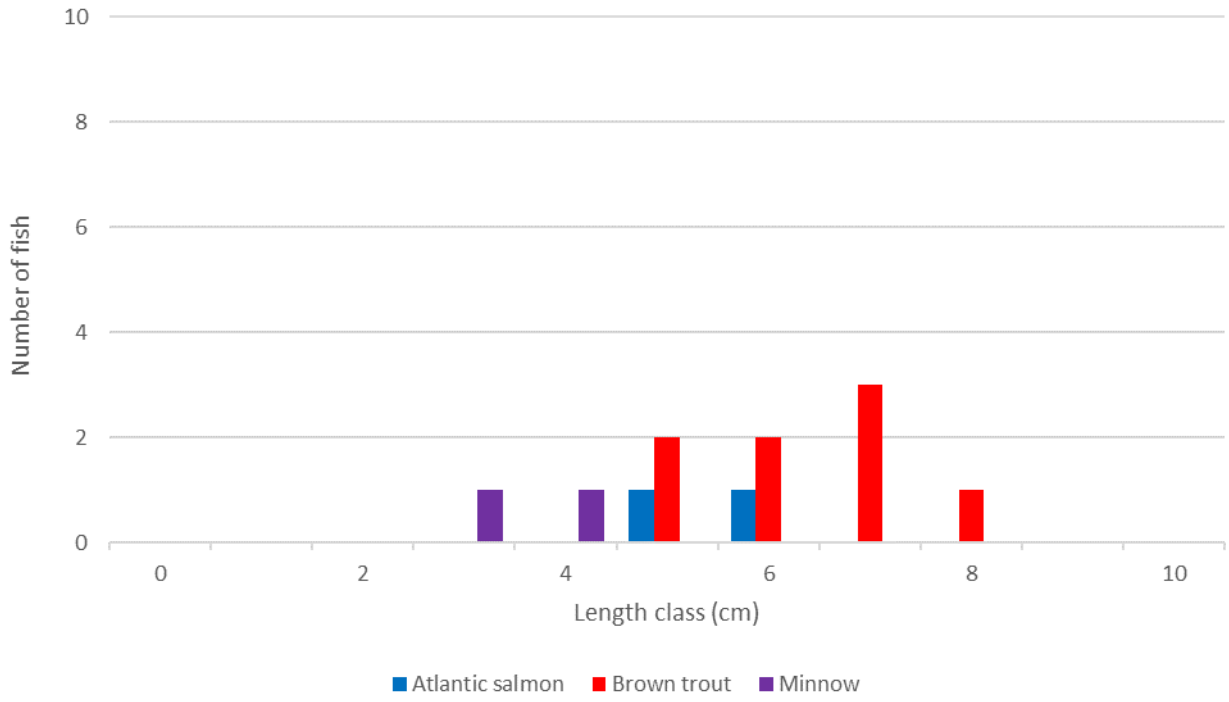

Figure 3.17 Length frequency distribution recorded via electro-fishing at site D26 on an unnamed Owenmore River tributary, September 2023

Plate 3.43 Representative image of site D26, September 2023

3.2.27 Site D27 – Killsallagh Stream, Killsallagh

Site D27 on the Killsallagh Stream (33K13), a tributary of the Owenmore River, was dry at the time of survey. The heavily modified, ephemeral channel was not of fisheries value.

Plate 3.44 Representative image of site D27 on the Killsallagh Stream, September 2023 (dry channel)

3.2.28 Site D28 – unnamed stream, Killsallagh

Site D28 on an unnamed tributary of the Owenmore River was dry at the time of survey. The heavily modified, ephemeral drainage channel was not of fisheries value.

Plate 3.45 Representative image of site D28, September 2023 (dry channel)

3.2.29 Site D29 – unnamed stream, Bellacorick

Brown trout (*n*=6) were the only fish species recorded via electro-fishing at site D29 on an unnamed Owenmore River tributary (**Figure 3.18**).

The site was a poor to moderate quality salmonid nursery given the stream's small size and very low summer flows. However, the presence of mixed coarse substrata and broken flow patterns provided refugia for the small population of 0+ fish. Clean gravels were limited due to siltation and the site was of poor value as a spawning habitat. The value as a holding habitat was also poor given the paucity of pools. Despite some suitability for European eel (instream refugia), none were recorded. The upland stream was unsuitable for lamprey.

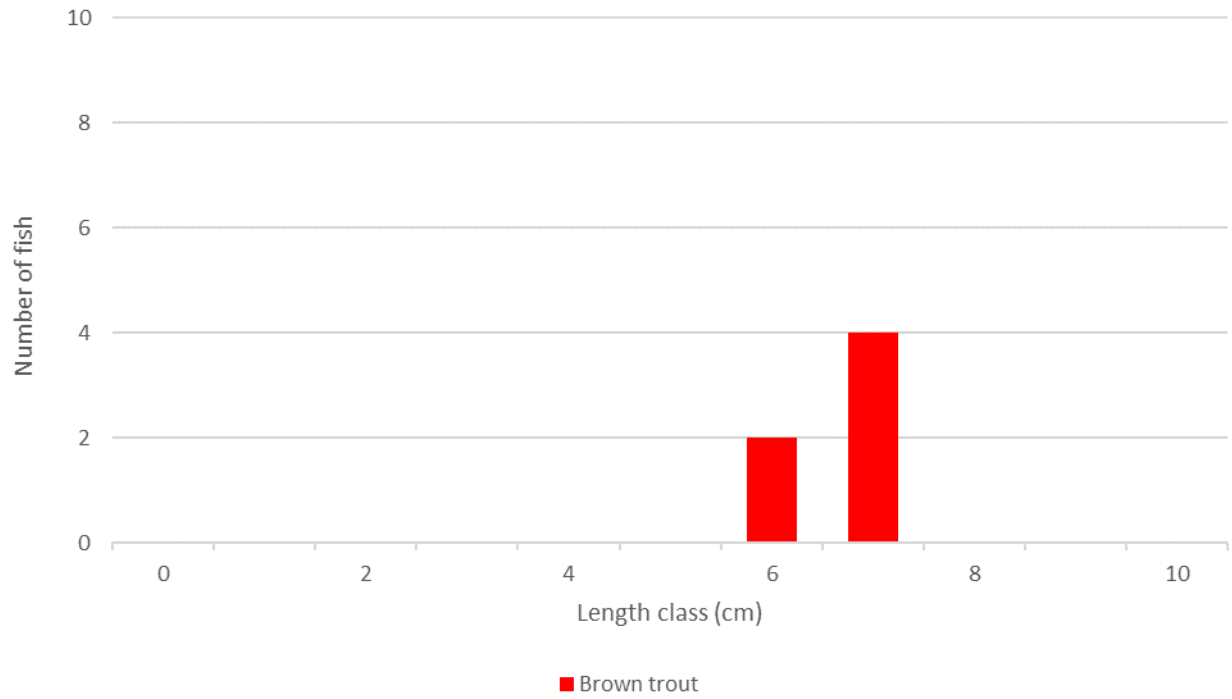

Figure 3.18 Length frequency distribution recorded via electro-fishing at site D29 on an unnamed Owenmore River tributary, September 2023

Plate 3.46 Representative image of site D29, September 2023

3.2.30 Site D30 – unnamed stream, Bellacorick

Brown trout (*n*=4), minnow (*n*=1) and three-spined stickleback (*n*=7) were recorded via electro-fishing at site D30 on an unnamed Owenmore River tributary (**Figure 3.19**).

The site was a poor to moderate quality salmonid nursery given the stream's small size and very low

summer flows. However, the presence of mixed coarse substrata and broken flow patterns provided refugia for the small population of 0+ fish. Clean gravels were limited due to siltation and filamentous algal cover (enrichment) and the site was of poor value as a spawning habitat. The value as a holding habitat was also poor given the paucity of pools. Despite some suitability for European eel (instream refugia), none were recorded. The upland stream was unsuitable for lamprey.

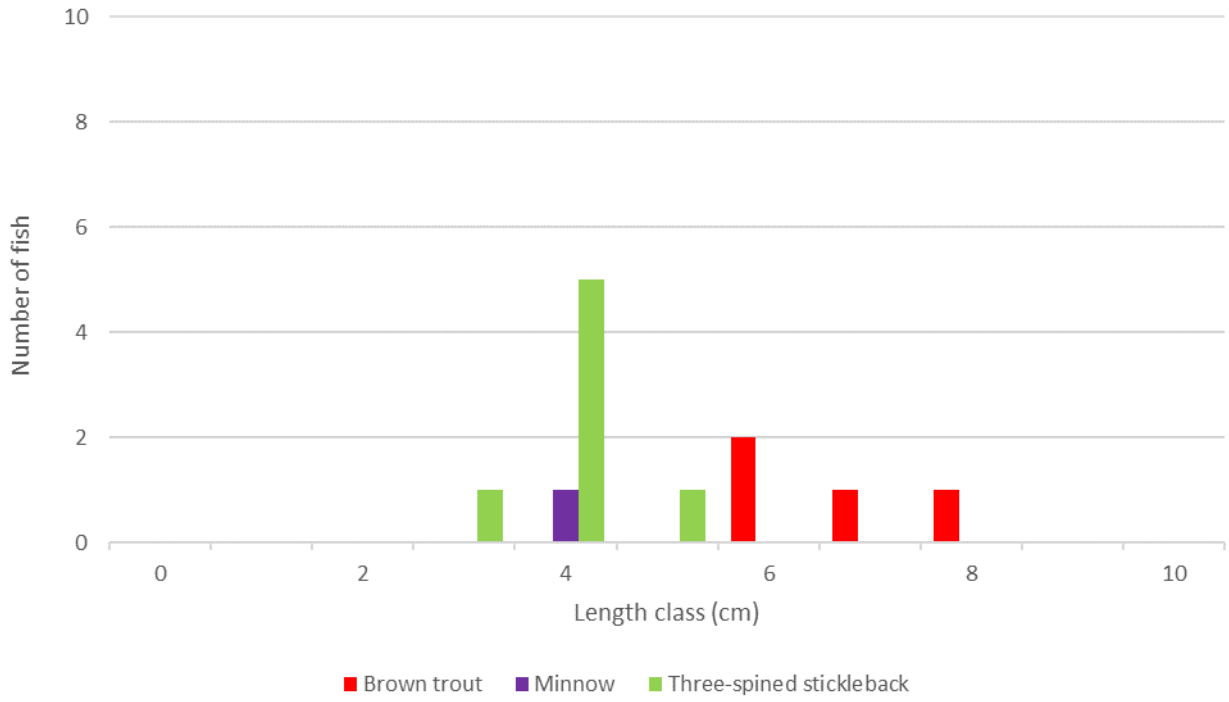

Figure 3.19 Length frequency distribution recorded via electro-fishing at site D30 on an unnamed Owenmore River tributary, September 2023

Plate 3.47 Representative image of site D30, September 2023

3.3 TDR sites

3.3.1 Site E1 - Moneynierin River, Moneynierin

Atlantic salmon (*n*=3), brown trout (*n*=12) and three-spined stickleback (*n*=2) were recorded via electro-fishing at site E1 on the Moneynierin River (33M16), Owenmore River tributary (**Figure 3.20**).

The site was a moderate quality salmonid nursery with a small population of trout recorded. The quality of the nursery habitat was reduced by siltation and enrichment pressures. The spawning value was locally moderate in deeper pools and glide being reduced only by siltation and enrichment pressures. Moderate quality holding habitat was present in localised deeper glide and pool habitat. Despite some low suitability for European eel (instream refugia), none were recorded. The upland stream was unsuitable for lamprey and none were recorded.

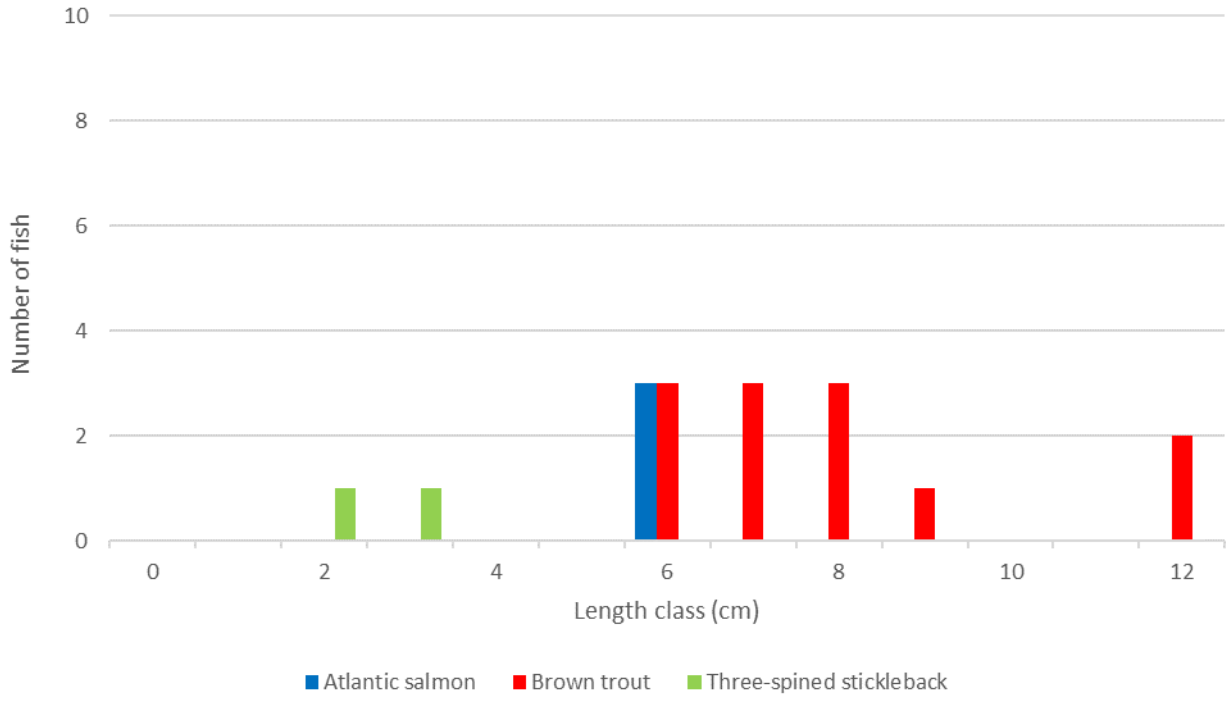

Figure 3.20 Length frequency distribution recorded via electro-fishing at site E1 on the Moneynierin River, September 2023

Plate 3.48 Juvenile brown trout recorded at site E1 on the Moneynierin River, September 2023

3.3.2 Site E2 – River Deel, Crossmolina Bridge

Atlantic salmon (*n*=41), minnow (*n*=3), roach (*Rutilus rutilus*) (*n*=1) and three-spined stickleback (*n*=2) were recorded via electro-fishing at site E2 on the River Deel (34D01) at Crossmolina Bridge (**Figure 3.21**).

The site was considered a good quality salmonid nursery given the stoney bed, riffle, glide and pool sequences that provide refugia and oxygenated water during normal flows. This was supported by the presence of a mixed cohort salmonid population present in stagnant (low summer flow) pools. Good quality spawning habitat was present in deeper glide and pool where mixed gravels are utilised during the autumn and winter (pers. obs.). The quality of holding habitat was moderate in vicinity of the bridge but improves locally in deeper pool (e.g. downstream of the meander). The site was a good quality European eel habitat given abundant refugia and prey resources. The river at this location of too high an energy for lamprey.

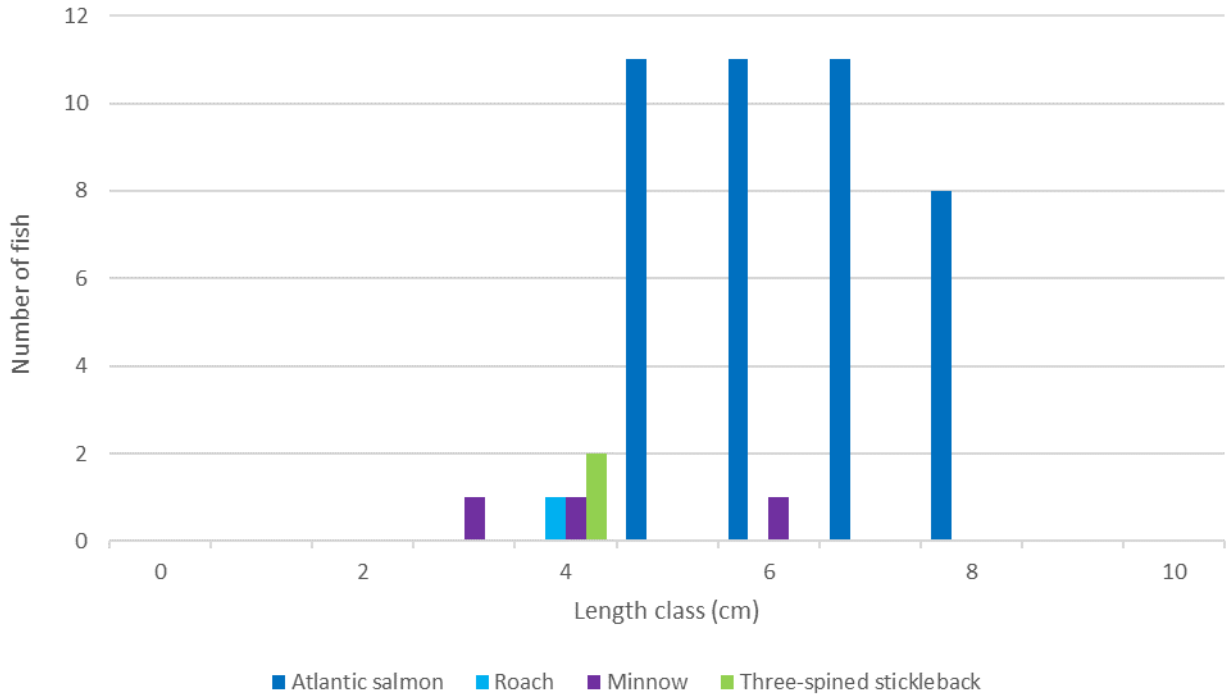

Figure 3.21 Length frequency distribution recorded via electro-fishing at site E2 on the River Deel, September 2023

Plate 3.49 Atlantic salmon parr recorded from stagnant pools at site E2 on the River Deel, September 2023

3.3.3 Site E3 - Ballisodare River, Knoxspark

Atlantic salmon (*n*=34), brown trout (*n*=5) and European eel (*n*=7) were recorded via electro-fishing at site E3 on the Ballisodare River (35B05) (**Figure 3.22**).

The site was a very good quality salmonid nursery given the rocky bed with a natural flow profile of riffle, glide and pool sequences. This provided very good quality refugia and oxygenated water benefitting the mixed cohort salmonid population that was dominated by Atlantic salmon. Good quality spawning habitat was present locally in deeper glide and pool downstream of the bridge where mixed gravels occurred. The site was a high quality holding habitat for adult salmonids and also a very good quality European eel habitat given abundant refugia and prey resources. This was also supported by the presence of numerous adult silver eels (including a particularly large individual of 65cm). The site was of too high an energy for lamprey in the accessible survey areas but some soft sediment areas supporting ammocoetes may be present downstream of the bridge along the river margins in water to deep to electro-fish.

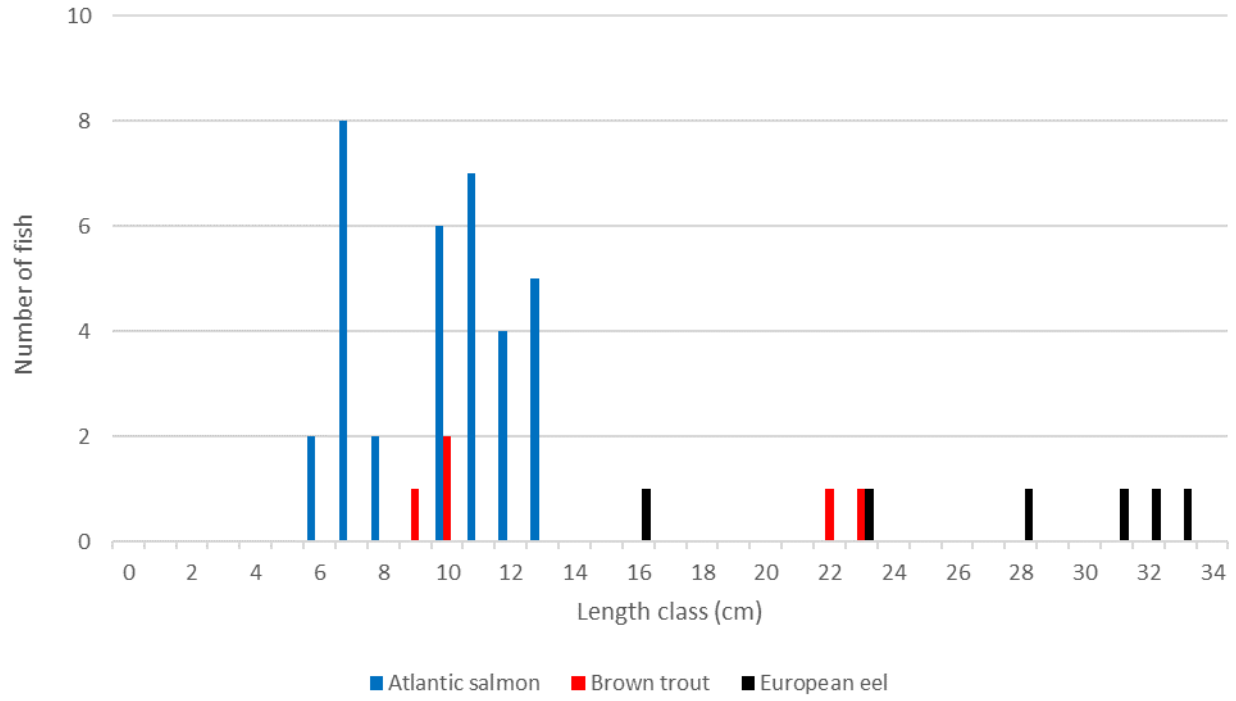

Figure 3.22 Length frequency distribution recorded via electro-fishing at site E3 on the Ballisodare River, September 2023 (*not shown is a 65cm European eel)

Plate 3.50 Adult brown trout recorded at site E3 on the Ballisodare River, September 2023

3.3.4 Site E4 - Carrowgobbadagh Stream, Carrowgobbadagh

European eel (*n*=3) and three-spined stickleback (*n*=7) were the only fish species recorded via electro-fishing at site E4 on the tidal reaches of the Carrowgobbadagh Stream (35C95) (**Figure 3.23**).

The heavily modified site was a poor quality habitat for salmonids given the heavily enriched nature of the channel with profuse growth of pondweeds and soft silty bed and none were recorded present. The site was, however, a very good quality European eel nursery given soft sediment bed for burial by elvers, high macrophyte cover and abundant food resources with a moderate density population recorded. The site had some value for lamprey ammocoetes (e.g. soft sediment burial habitat) albeit spawning habitat was absent and no ammocoetes were recorded.

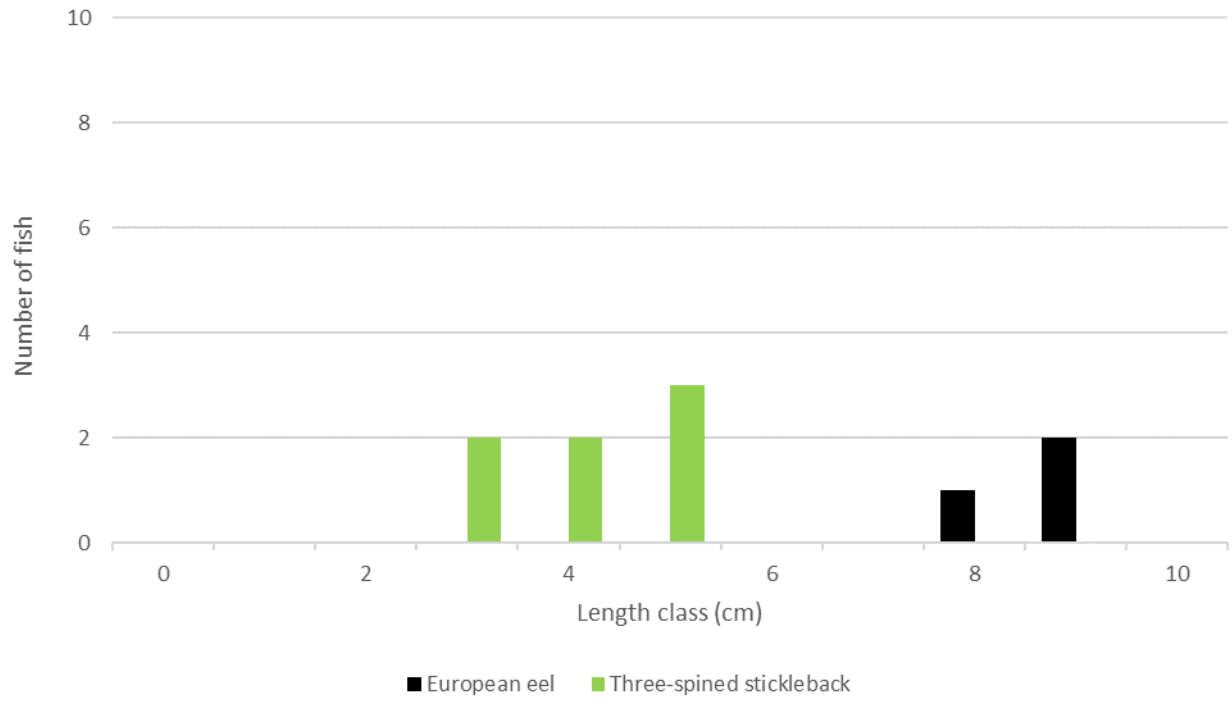

Figure 3.23 Length frequency distribution recorded via electro-fishing at site E4 on the Carrowgobbadagh Stream, September 2023

Plate 3.51 Juvenile European eel recorded at site E4 on the Carrowgobbadagh Stream, September 2023

3.3.5 Site E5 – Abbeylands Stream, Coolcholly

No fish were recorded via electro-fishing at site E5 on the Abbeylands Stream (36A15). The stream was not of fisheries value at this location given its heavily modified nature, siltation, small size and

very limited (low summer) flows.

Plate 3.52 Representative image of site E5 on the Abbeylands Stream, September 2023

3.3.6 Site E6 – Drumgowan Stream, Tullygallan

Site E6 on the Drumgowan Stream (37D49) was dry at the time of survey. The heavily modified, U-shaped ephemeral channel was not of fisheries value.

Plate 3.53 Representative image of site E6 on the Drumgowan Stream, September 2023

3.3.7 Site E7 – Bogside River, Dunkineely

Despite some low suitability for salmonids, no fish were recorded via electro-fishing at site E7 on the Bogside River (37B26).

The high gradient river at this location was a poor quality nursery for salmonids given the small size and very low flows. The heavily bedded boulder, cobble and scattered coarse gravel substrata were exposed to high siltation and were not of value as salmonid spawning habitat. Shallow pools were not of value as holding areas for adult salmonids. The site was a poor quality European eel habitat despite close proximity to the sea, with limited refugia. There were no soft sediment accumulations present capable of supporting lamprey ammocoetes.

Plate 3.54 Representative image of site E7 on the Bogside River, September 2023

Table 3.1 Relative abundance of fish species of higher conservation value recorded per survey site in the vicinity of the proposed Muingmore wind farm, September 2023

Site	Watercourse	Atlantic salmon	Brown trout	*Lampetra* sp.	European eel	Other species
Sites in vicinity of site boundary						
A1	Unnamed river	No fish recorded				
A2	Unnamed river				Medium	Flounder
B1	Unnamed river	No fish recorded				
B2	Unnamed river	No fish recorded				
B3	Unnamed river	No fish recorded				
B4	Unnamed stream		Low			
B5	Unnamed river		Medium			
B6	Unnamed river		High		Low	Three-spined stickleback
C1	An Mhoing Mhór River	No fish recorded				
C2	Doolough Stream		High		Low	
C3	Unnamed stream	No fish recorded				
C4	Doolough Stream		High		Low	Three-spined stickleback
C5	Doolough Stream		Very high			
P1	Pond		eDNA		eDNA	
P2	Pond		eDNA		eDNA	
P3	Pond				eDNA	
P4	Pond		eDNA			
GCR crossings						
D1	Unnamed stream	No fish recorded				
D2	Goolamore River		Medium			Minnow
D3	Munhin River	Medium	Low	Low		Sea trout, flounder, minnow
D4	Unnamed river	No fish recorded				
D5	Ballybeg Stream	No fish recorded				
D6	Srahanarry Stream	Medium	Low			
D7	Bellanumera Stream	No fish recorded				
D8	Briska River	Low	Medium		High	
D9	Unnamed stream	No fish recorded				
D10	Unnamed stream	No fish recorded				
D11	Unnamed river	No fish recorded				

Site	Watercourse	Atlantic salmon	Brown trout	*Lampetra* sp.	European eel	Other species
D12	Unnamed river	No fish recorded				
D13	Unnamed river	No fish recorded				
D14	Unnamed stream	No fish recorded				
D15	Unnamed stream	No fish recorded				
D16	Unnamed river	No fish recorded				
D17	Unnamed stream	No fish recorded				
D18	Unnamed stream		Low		Low	
D19	Unnamed stream	No fish recorded				
D20	Unnamed stream	No fish recorded				
D21	Unnamed stream	No fish recorded				
D22	Unnamed stream		Medium			
D23	Unnamed stream		Low			
D24	Unnamed river		Medium			
D25	Unnamed river	Very high	Medium		Low	
D26	Unnamed stream	Low	Low			Minnow
D27	Kilsallagh Stream	No fish recorded				
D28	Unnamed stream	No fish recorded				
D29	Unnamed stream		Low			
D30	Unnamed stream		Low			Minnow, three-spined stickleback
TDR nodes						
E1	Moneynierin River	Low	Low			Three-spined stickleback
E2	River Deel	High				Minnow, roach, three-spined stickleback
E3	Ballisodare River	High	Low		Medium	
E4	Carrowgobbadagh Stream				Low	Three-spined stickleback
E5	Abbeylands Stream	No fish recorded				
E6	Drumgowan Stream	No fish recorded				
E7	Bogside River	No fish recorded				

Table 3.2 Fish species densities per m² recorded at sites in the vicinity of the proposed Muingmore wind farm via electro-fishing in September 2023 (abundances in parenthesis, **bold** indicates highest density recorded per species)

Site	Watercourse	CPUE (elapsed time)	Approx. area fished (m²)	Fish density per m²								
				Atlantic salmon	Brown trout	Sea trout	Lampetra sp.	European eel	Three-spined stickleback	Flounder	Minnow	Roach
Sites in vicinity of site boundary												
A1	Unnamed river	5	40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A2	Unnamed river	10	100	0.000	0.000	0.000	0.000	0.080 (*n*=8)	0.000	**0.040 (*n*=4)**	0.000	0.000
B1	Unnamed river	5	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B2	Unnamed river	5	30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B3	Unnamed river	5	50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B4	Unnamed stream	10	250	0.000	0.012 (*n*=3)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B5	Unnamed river	10	280	0.000	0.071 (*n*=20)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B6	Unnamed river	10	220	0.009 (*n*=2)	0.182 (*n*=40)	0.000	0.000	0.014 (*n*=3)	0.009 (*n*=2)	0.000	0.000	0.000
C1	An Mhoing Mhor River	5	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C2	Doolough Stream	10	280	0.000	0.121 (*n*=34)	0.000	0.000	0.007 (*n*=2)	0.000	0.000	0.000	0.000
C3	Unnamed stream	5	10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C4	Doolough Stream	10	280	0.000	0.154 (*n*=43)	0.000	0.000	0.011 (*n*=3)	0.007 (*n*=2)	0.000	0.000	0.000
C5	Doolough Stream	10	300	0.000	0.160 (*n*=48)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P1	Pond	n/a	Fisheries appraisal only	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
P2	Pond	n/a	Fisheries appraisal only	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Site	Watercourse	CPUE (elapsed time)	Approx. area fished (m²)	Fish density per m²								
				Atlantic salmon	Brown trout	Sea trout	Lampetra sp.	European eel	Three-spined stickleback	Flounder	Minnow	Roach
P3	Pond	n/a	Fisheries appraisal only	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
P4	Pond	n/a	Fisheries appraisal only	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
P5	Pond	n/a	Fisheries appraisal only	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
GCR crossings												
D1	Unnamed stream	5	20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D2	Goolamore River	10	250	0.016 (*n*=4)	0.084 (*n*=21)	0.000	0.000	0.000	0.000	0.000	**0.024 (*n*=6)**	0.000
D3	Munhin River	10	300	0.040 (*n*=12)	0.013 (*n*=4)	**0.003 (*n*=1)**	**0.5 per m²**	0.000	0.000	0.010 (*n*=3)	0.010 (*n*=3)	0.000
D4	Unnamed river	5	50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D5	Ballybeg Stream	5	60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D6	Srahanarry Stream	10	200	0.060 (*n*=12)	0.045 (*n*=9)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D7	Bellanumera Stream	5	15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D8	Briska River	10	280	0.071 (*n*=20)	0.057 (*n*=16)	0.000	0.000	0.043 (*n*=12)	0.000	0.000	0.000	0.000
D9	Unnamed stream	5	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D10	Unnamed stream	5	45	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D11	Unnamed river	5	20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D12	Unnamed river	n/a	Dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D13	Unnamed river	n/a	Dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D14	Unnamed stream	n/a	Dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Site	Watercourse	CPUE (elapsed time)	Approx. area fished (m²)	Fish density per m²								
				Atlantic salmon	Brown trout	Sea trout	Lampetra sp.	European eel	Three-spined stickleback	Flounder	Minnow	Roach
D15	Unnamed stream	n/a	Dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D16	Unnamed river	n/a	Dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D17	Unnamed stream	n/a	Dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D18	Unnamed stream	5	100	0.000	0.040 (*n*=4)	0.000	0.000	0.020 (*n*=2)	0.000	0.000	0.000	0.000
D19	Unnamed stream	n/a	Dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D20	Unnamed stream	5	15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D21	Unnamed stream	5	10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D22	Unnamed stream	5	100	0.000	**0.120 (*n*=12)**	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D23	Unnamed stream	5	50	0.000	0.100 (*n*=5)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D24	Unnamed river	5	150	0.000	0.093 (*n*=14)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D25	Unnamed river	10	200	**0.285 (*n*=57)**	0.100 (*n*=20)	0.000	0.000	0.010 (*n*=2)	0.000	0.000	0.000	0.000
D26	Unnamed stream	5	100	0.020 (*n*=2)	0.080 (*n*=8)	0.000	0.000	0.000	0.000	0.000	0.020 (*n*=2)	0.000
D27	Kilsallagh Stream	n/a	Dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D28	Unnamed stream	n/a	Dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
D29	Unnamed stream	5	100	0.000	0.060 (*n*=6)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D30	Unnamed stream	5	100	0.000	0.040 (*n*=4)	0.000	0.000	0.000	0.070 (*n*=7)	0.000	0.010 (*n*=1)	0.000
TDR nodes												
E1	Moneynierin River	5	120	0.025 (*n*=3)	0.100 (*n*=12)	0.000	0.000	0.000	0.017 (*n*=2)	0.000	0.008 (*n*=1)	0.000

Site	Watercourse	CPUE (elapsed time)	Approx. area fished (m²)	Fish density per m²								
				Atlantic salmon	Brown trout	Sea trout	Lampetra sp.	European eel	Three-spined stickleback	Flounder	Minnow	Roach
E2	River Deel	10	280	0.146 (*n*=41)	0.000	0.000	0.000	0.000	0.007 (*n*=2)	0.000	0.011 (*n*=3)	0.004 (*n*=1)
E3	Ballisodare River	10	250	0.136 (*n*=34)	0.020 (*n*=5)	0.000	0.000	0.028 (*n*=7)	0.000	0.000	0.000	0.000
E4	Carrowgobbadagh Stream	5	50	0.000	0.000	0.000	0.000	**0.060 (*n*=3)**	**0.140 (*n*=7)**	0.000	0.000	0.000
E5	Abbeylands Stream	5	20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
E6	Drumgowan Stream	n/a	Dry channel	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
E7	Bogside River	10	200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

4. Discussion

The watercourses in the vicinity of the proposed Muingmore wind farm site boundary and turbine array were typically heavily modified lowland channels (straightened, deepened, realigned) draining blanket bog with high rates of siltation (from peat escapement). The proposed GCR crossed a large number of small upland eroding watercourses (most of which were Owenmore River tributaries) that were typically high gradient and suffered from low summer flows. Whilst the TDR crossed a very high number of watercourses, only a low number were surveyed given their proximity to proposed TDR nodes (works areas) - most were small, upland eroding channels. Over of the riverine survey sites (27 of 50) did not support fish at the time of survey given poor quality fisheries habitats or dry, ephemeral channels. A high number of watercourses crossed by the GCR were of high gradient and inherently unsuitable for resident fish, with widespread low summer flows (or indeed no water flows) in these spate channels.

A fish species assemblage typical of Ireland's north-west, namely Atlantic salmon, brown trout, sea trout, European eel, lamprey (*Lampetra* sp.), three-spined-stickleback, minnow and flounder were recorded during the electro-fishing survey (**Table 3.1**). Whilst a number of high conservation value fish species were present in the survey area, Atlantic salmon and European eel were restricted in their distributions, with sea trout and lamprey (*Lampetra* sp.) recorded from single site only.

Although brown trout were relatively widespread in the survey area inclusive of the GCR (recorded at 23 no. sites), Atlantic salmon were more localised and recorded from a total of 10. no sites. These included an unnamed Tullaghan Bay tributary (B6), Goolamore River (D2), Munhin River (D3), Srahanarry Stream (D6), Broska River (D8), unnamed Owenmore tributaries (D25, D26), Moneynierin River (E1), River Deel (E2) and the Ballisodare River (E3) (**Table 3.1**). Sites D8, D25, E2 and E3 were particularly high quality salmonid nurseries, especially for Atlantic salmon, and supported the highest densities recorded during the survey (**Table 3.2**).

Fish populations in vicinity of the site boundary were dominated by brown trout with Atlantic salmon recorded only from the lower reaches of an unnamed Tullaghan Bay tributary (site B6). The Doolough Stream was of high value for brown trout although despite suitability for anadromous sea trout, none were recorded in vicinity of the proposed site. Sea trout were only recorded from site D3 on the Munhin River, a major tributary of the Owenmore River. Many survey sites provided sub-optimal salmonid habitat given siltation (peat escapement), eutrophication and hydromorphological pressures, in addition to steep gradients which reduce the productivity of such watercourses (Wood & Budy, 2009; O'Grady, 2006; Amiro, 1993). As would be expected for higher-gradient, spate channels and watercourses with intermittent or seasonal flows, the quality of salmonid spawning, nursery and holding habitat typically improved in the lower gradient and lower reaches of the surveyed watercourses. Pond sites P1, P3 and P4 in vicinity of the proposed site boundary also supported brown trout (detected via eDNA sampling). While there were no inflowing/outflowing channels or hard substrata for traditional salmonid spawning sites, brown trout can support self-sustaining lacustrine populations in oligotrophic peatland lakes provided wind action sufficiently oxygenates the littorals (Arostegui & Quinn, 2019).

Lamprey (*Lampetra* sp.) were recorded from only a single site on the Munhin River (D3) during the survey, where a low density of ammocoetes (0.5 per m^2) were present in sand accumulations near the road crossing (**Plate 4.1**). This near absence of lamprey reflected the poor habitat suitability in the survey area where watercourses were generally either historically modified peat channels (e.g. near site boundary) and or high energy, higher gradient spate channels. Such conditions reduce the extent of fine gravels required for spawning (Dawson et al., 2015; Rooney et al., 2013; Lasne et al., 2010) and discourage the deposition of fine, organic-rich sediment ≥5cm in depth generally required by larval *Lampetra* spp. (Aronsuu & Virkkala, 2014; Goodwin et al., 2008; Gardiner, 2003). Peat-dominated substrata (i.e., humic deposits), such as those typically found in the vicinity of the proposed site boundary, do not provide suitable burial/burrowing habitat complexity or structure for larvae (ammocoetes) given their invariably fine and flocculent nature (pers. obs.).

European eel are Red-listed in Ireland (King et al., 2011) and are classed as 'critically endangered' on a global scale (Pike et al., 2020). Eel were recorded (in typically low abundances) from a total of 9 no. riverine sites on an unnamed river (A2), an unnamed Tullaghan Bay tributary (B6), Doolough Stream (C2, C4), Briska River (D8), unnamed Owenmore River tributary (D18, D25), Ballisodare River (E3) and the Carrowgobbadagh Stream (E4) (**Table 3.1**). These sites provided deeper water and a greater complexity of refugia (e.g. boulder, macrophyte beds etc.) favoured by the species (Laffaille et al., 2003). Whilst many riverine sites found not to support eel were located in close proximity to the sea and accessible to eel, the species often shows preference for the lowermost, lower gradient reaches of watercourses and estuarine habitats (Degerman et al., 2019; Arai et al., 2006; Moriarty, 2003). Eel were also detected via eDNA sampling at pond sites P1, P2 and P3 where high quality eel habitats were present.

Plate 4.1 *Lampetra* sp. ammocoetes recorded from site D3 on the Munhin River, September 2023, September 2023

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Aquatic baseline report for the proposed Muingmore wind farm, Co. Mayo

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1. Introduction

1.1 Background

Triturus Environmental Ltd. were commissioned by SLR Consulting Ltd. to conduct baseline aquatic and fisheries surveys to inform EIAR preparation for the proposed Muingmore wind farm project, located near Gweesalia, Co. Mayo (**Figure 2.1**). Undertaken on a catchment-wide scale, this report provides a baseline assessment of the aquatic ecology including fisheries, biological water quality, protected species and habitats in the vicinity of the proposed project, inclusive of the grid cable route (GCR). Aquatic surveys were undertaken in September 2023.

1.2 Project description

A full description of the proposed project will be provided in any Environmental Impact Assessment Report (EIAR) used to support consenting applications.

2. Methodology

2.1 Selection of watercourses for assessment

All freshwater watercourses which could be affected directly or indirectly by the proposed wind farm project were considered as part of the current assessment. This included sites in vicinity of the proposed turbine array and site boundary (17 no. sites) in addition to watercourse crossings of the proposed grid cable route (GCR) and watercourses adjacent to turbine delivery route (TDR) nodes (37 no. sites). Thus, a total of 54 no. sites were selected for detailed aquatic assessment (see **Table 2.1, Figure 2.1 & 2.2** below). The flow paths and nomenclature for the watercourses surveyed followed Environmental Protection Agency (EPA) mapping.

In the vicinity of the proposed site boundary, aquatic survey sites were present on the Mhoing Mhór River (EPA code: 33M23), Doolough Stream (33D02) and a number of unnamed watercourses, in addition to 4 no. pond sites (**Table 2.1**). These aquatic survey sites were located within the Owenmore[Mayo]_SC_030 and Glencastle_SC_010 river sub-catchments in hydrometric area 33 (Blacksod-Broadhaven). The proposed GCR primarily followed the existing N59 road between Bangor Erris and Bellacorick, crossing a high number of tributaries of the Owenmore River (**Table 2.1**). A low number of additional survey sites on the Moneynierin River (33M16), River Deel (34D01), Ballisodare River (35B05), Abbeylands Stream (36A15), Drumgowan Stream (37D49) and the Bogside River (37B26) were also surveyed given their proximity to TDR nodes (proposed works areas).

Please note this aquatic report should be read in conjunction with the final Environmental Impact Assessment Report (EIAR) prepared for the proposed project. More specific aquatic methodology is outlined below and in the appendices of this report.

2.2 Aquatic site surveys

Aquatic surveys of the watercourses within the vicinity of the proposed project were conducted on the 15th, 16th, 17th, 18th and 19th September 2023. Survey effort focused on both instream and riparian habitats at each aquatic sampling location (**Table 2.1**). Surveys at each of these sites included a fisheries assessment (electro-fishing and or fisheries habitat appraisal), white-clawed crayfish survey, macrophyte and aquatic bryophyte survey and (where suitable) biological water quality sampling (Q-sampling) and macro-invertebrate sweep sampling. This holistic approach informed the overall aquatic ecological evaluation of each site in context of the proposed project and ensured that any habitats and species of high conservation value would be detected to best inform mitigation.

In addition to the ecological characteristics of the site, a broad aquatic and riparian habitat assessment was conducted utilising elements of the methodology given in the Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003' (EA, 2003) and the Irish Heritage Council's 'A Guide to Habitats in Ireland' (Fossitt, 2000). This broad characterisation helped define the watercourses' conformity or departure from naturalness. All sites were assessed in terms of:

- Physical watercourse/waterbody characteristics (i.e. width, depth, channel form) including associated evidence of historical drainage

- Substrate type and relative condition, listing substrate fractions in order of dominance (i.e. bedrock, boulder, cobble, gravel, sand, silt etc.)
- Flow type by proportion of riffle, glide and pool in the sampling area
- An appraisal of the macrophyte and aquatic bryophyte community at each site
- Riparian vegetation composition and bordering land use practices

Table 2.1 Location of *n*=54 aquatic survey sites in the vicinity of the proposed Muingmore wind farm project, Co. Mayo

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
Site boundary					
A1	Unnamed river	n/a	Doolough	476621	821708
A2*	Unnamed river	n/a	L1205 road crossing	476276	820290
B1	Unnamed river	n/a	Muingmore	477254	822741
B2	Unnamed river	n/a	Muingmore	476726	822456
B3	Unnamed river	n/a	Muingmore	477114	822551
B4	Unnamed stream	n/a	Muingmore	477522	822770
B5	Unnamed river	n/a	Tristia	477290	822433
B6*	Unnamed river	n/a	L1206 road crossing	477615	821039
C1	An Mhoing Mhór River	33M23	Muingmore	477156	823702
C2	Doolough Stream	33D02	Muingmore	476448	824226
C3	Unnamed stream	n/a	Muingmore	476180	823731
C4	Doolough Stream	33D02	Muingmore	475540	824268
C5*	Doolough Stream	33D02	L1205 road crossing	474976	824774
P1†	Pond	n/a	Doolough	476635	822197
P2†	Pond	n/a	Muingmore	476112	822824
P3†	Pond	n/a	Muingmore	475845	822946
P4†	Pond	n/a	Doolough	477354	821591
GCR crossings					
D1	Unnamed stream	n/a	Goolamore	480285	821634
D2	Goolamore River	33G12	Drumanaffrin	481247	822676
D3	Munhin River	33M03	Kilteany	482176	823361
D4	Unnamed river	n/a	Srahmore	484848	823084
D5	Ballybeg Stream	33B40	Srahanarry	486351	823100
D6	Srahanarry Stream	33S23	Srahanarry	487383	823093
D7	Bellanumera Stream	33B38	Briska	487539	822966
D8	Briska River	33B33	Briska	487705	822687
D9	Unnamed stream	n/a	Briska	487788	822587
D10	Unnamed stream	n/a	Briska	487844	822510
D11	Unnamed river	n/a	Briska	490185	822080
D12	Unnamed river	n/a	Largan More	490513	822401
D13	Unnamed river	n/a	Largan More	490568	822412
D14	Unnamed stream	n/a	Largan More	490739	822418
D15	Unnamed stream	n/a	Largan More	490894	822413

Site no.	Watercourse	EPA code	Location	X (ITM)	Y (ITM)
D16	Unnamed river	n/a	Largan More	491092	822422
D17	Unnamed stream	n/a	Largan More	491297	822394
D18	Unnamed stream	n/a	Largan More	491335	822381
D19	Unnamed stream	n/a	Largan Beg	491399	822356
D20	Unnamed stream	n/a	Largan Beg	491900	822061
D21	Unnamed stream	n/a	Largan Beg	491988	822011
D22	Unnamed stream	n/a	Tawnaghmore	493063	821706
D23	Unnamed stream	n/a	Tawnaghmore	493360	821686
D24	Unnamed river	n/a	Tawnaghmore	493659	821685
D25	Unnamed river	n/a	Ballymonnelly Bridge	493983	821377
D26	Unnamed stream	n/a	Killsallagh	495239	820469
D27	Kilsallagh Stream	33K13	Killsallagh	495346	820428
D28	Unnamed stream	n/a	Killsallagh	495834	820410
D29	Unnamed stream	n/a	Bellacorick	496398	820409
D30	Unnamed stream	n/a	Bellacorick	496504	820323
TDR nodes					
E1	Moneynierin River	33M16	Moneynierin	497643	819577
E2	River Deel	34D01	Crossmolina Bridge	513655	817586
E3	Ballisodare River	35B05	Knoxspark	566745	829045
E4	Carrowgobbadagh Stream	35C95	Carrowgobbadagh	567482	830457
E5	Abbeylands Stream	36A15	Coolcholly	588235	862284
E6	Drumgowan Stream	37D49	Tullygallan	593620	875619
E7	Bogside River	37B26	Dunkineely	576176	875950

* eDNA sampling for freshwater pearl mussel, white-clawed crayfish & crayfish plague

†eDNA sampling for brown trout, European eel & smooth newt

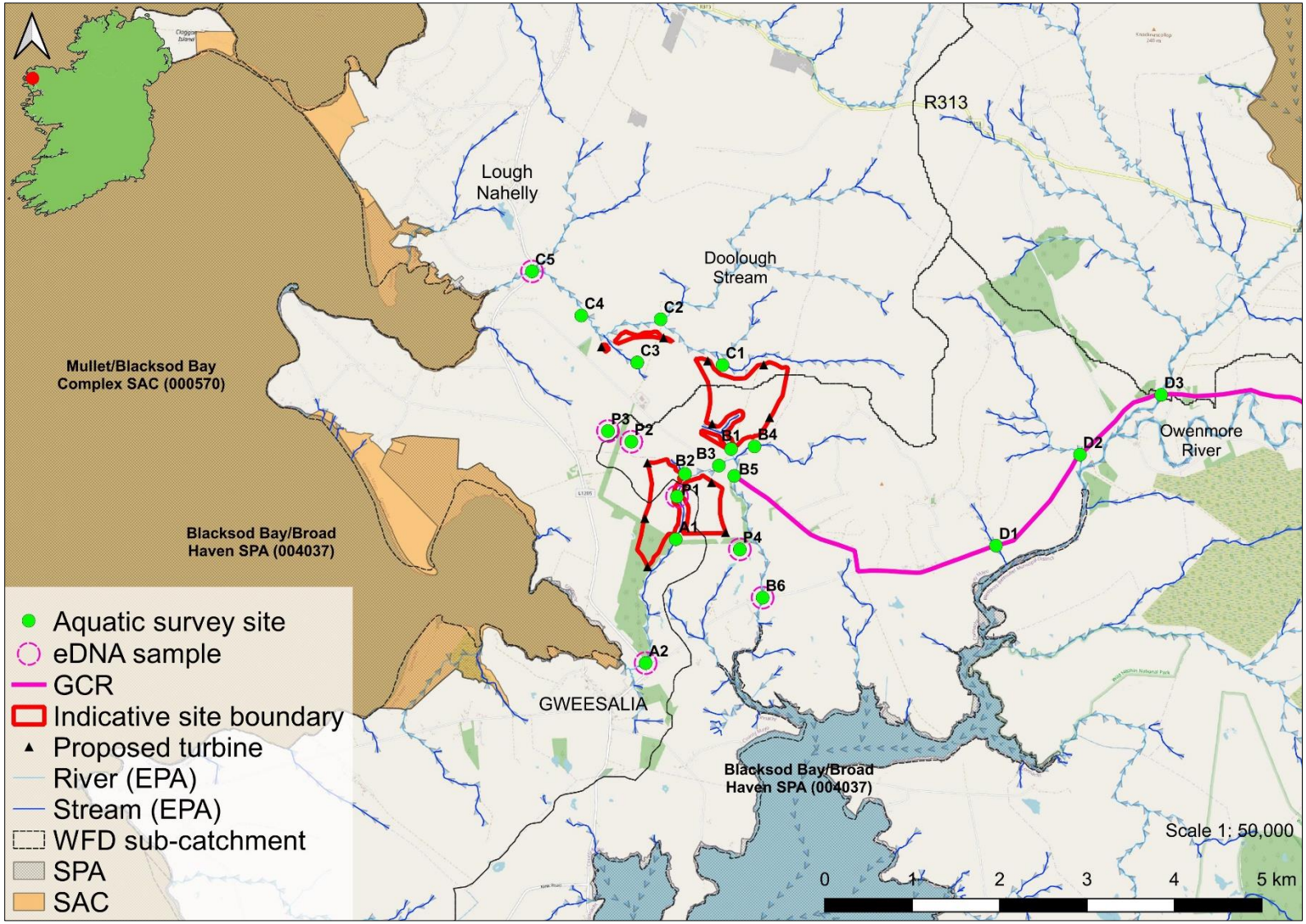

Figure 2.1 Overview of the aquatic survey sites in the vicinity of the proposed Muingmore wind farm site boundary, Co. Mayo

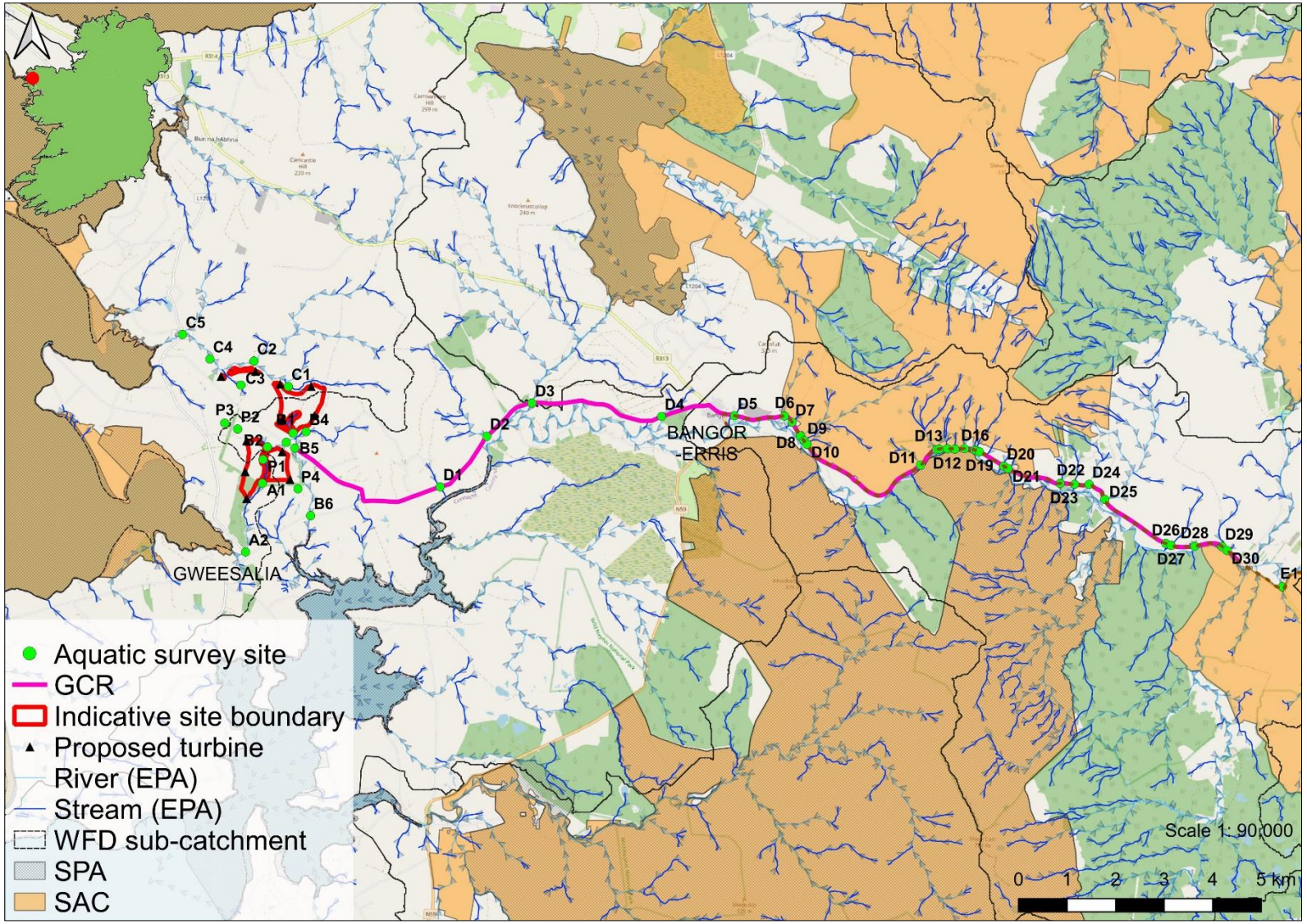

Figure 2.2 Overview of the aquatic survey sites in the vicinity of the proposed Muingmore wind farm GCR, Co. Mayo

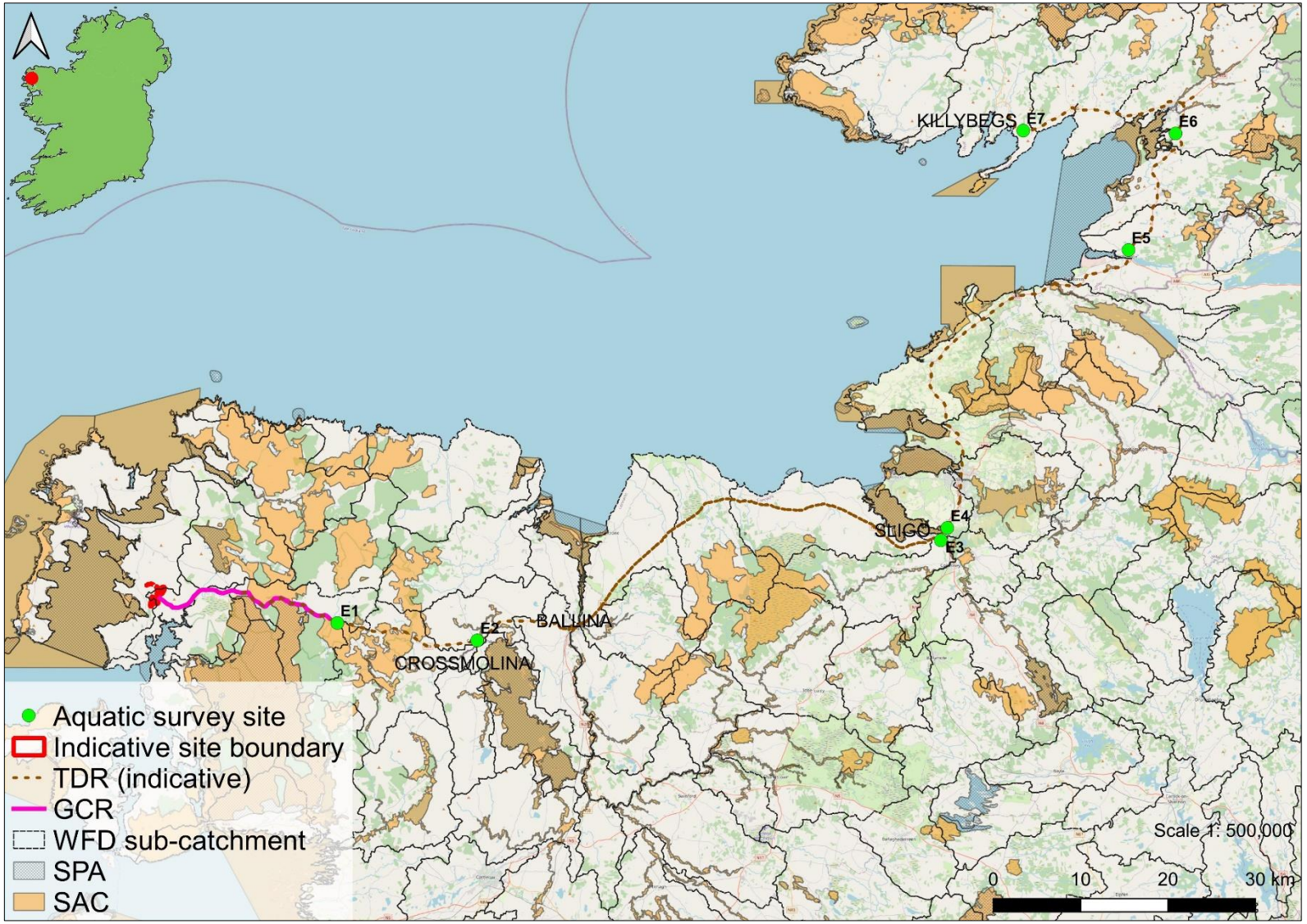

Figure 2.3 Overview of the aquatic survey sites in the vicinity of the proposed Muingmore wind farm TDR, Co. Mayo

2.3 Fisheries assessment (electro-fishing)

A single anode Smith-Root LR24 backpack (12V DC input; 300V, 100W DC output) was used to electro-fish sites on watercourses in the vicinity of the proposed Muingmore wind farm in September 2023 following notification to Inland Fisheries Ireland, under the conditions of a Department of the Environment, Climate and Communications (DECC) licence. The survey was undertaken in accordance with best practice (CEN, 2003; CFB, 2008) and Section 14 licencing requirements.

Furthermore, a fisheries habitat appraisal of the aquatic survey sites was undertaken to establish their importance for salmonid, lamprey, European eel (*Anguilla anguilla*) and other fish species. The baseline assessment also considered the quality of spawning, nursery and holding habitat for salmonids and lamprey within the vicinity of the survey sites. For detailed survey methodology, please refer to accompanying fisheries assessment report in **Appendix A.**

2.4 White-clawed crayfish survey

White-clawed crayfish (*Austropotamobius pallipes*) surveys were undertaken at the aquatic survey sites in September 2023 under a National Parks and Wildlife (NPWS) open national licence (no. C24/2023), as prescribed by Sections 9, 23 and 34 of the Wildlife Act (1976-2023), to capture and release crayfish to their site of capture. As per Inland Fisheries Ireland aquatic biosecurity recommendations, the crayfish sampling started at the uppermost site(s) of the wind farm catchment/sub-catchments in the survey area to minimise the risk of transfer invasive propagules (including crayfish plague) in an upstream direction.

Hand-searching of instream refugia and sweep netting was undertaken according to Reynolds et al. (2010). An appraisal of white-clawed crayfish habitat at each site was conducted based on physical habitat attributes while mustelid spraint was also examined for remains where present. Additionally, a desktop review of crayfish records within the wider survey area was also completed.

2.5 eDNA analysis

Composite water samples were collected from two unnamed rivers (sites A2 & B6) and the Doolough Stream (C5) in September 2023 to detect for the presence of freshwater pearl mussel (*Margaritifera margaritifera*), white-clawed crayfish and crayfish plague (*Aphanomyces astaci*). The eDNA sampling was undertaken to detect cryptically-low populations of these species should they occur in the study area. The sites were strategically chosen to maximise longitudinal (instream) coverage within the catchment (i.e. facilitating a greater likelihood of species detection) (**Figure 2.1**). Pond sites P1, P2, P3 and P4 were also sampled during September 2023 and analysed for brown trout (*Salmo trutta*), European eel and smooth newt (*Lissotriton vulgaris*).

In accordance with laboratory guidance, a composite (500ml) water sample was collected from the sampling point, maximising the geographic spread at the site (20 x 25ml samples at each site), thus increasing the chance of detecting the target species' DNA. The composite sample was filtered and fixed on site using a sterile proprietary eDNA sampling kit. The sample was stored at room temperature and sent to the laboratory for analysis with 48 hours of collection. A total of n=12 qPCR replicates were analysed for the site. Given the high sensitivity of eDNA analysis, a single positive qPCR replicate is considered as proof of the species' presence (termed qPCR No Threshold, or qPCR NT).

Whilst an eDNA approach is not currently quantitative, the detection of the target species' DNA indicates the presence of the species at and or upstream of the sampling point. Please refer to **Appendix B** for full eDNA laboratory analysis methodology.

2.6 Biological water quality (Q-sampling)

A total of 40 no. riverine survey sites[1] were assessed for biological water quality through Q-sampling in September 2023 (**Figure 2.1**). All samples were taken with a standard kick sampling hand net (250mm width, 500µm mesh size) from areas of riffle/glide utilising a 2-minute kick sample, as per Environmental Protection Authority (EPA) methodology (Feeley et al., 2020). Large cobble was also washed at each site for 1-minute (where present) to collect attached macro-invertebrates (as per Feeley et al., 2020). Samples were elutriated and fixed in 70% ethanol for subsequent laboratory identification to species level. Samples were converted to Q-ratings as per Toner et al. (2005) and assigned to WFD status classes (**Table 2.2**). Any rare invertebrate species were identified from the NPWS Red List publications for beetles (Foster et al., 2009), mayflies (Kelly-Quinn & Regan, 2012), stoneflies (Feeley et al., 2020) and other relevant taxa (i.e. Byrne et al., 2009; Nelson et al., 2011).

Table 2.2 Reference categories for EPA Q-ratings (Q1 to Q5) (Toner et al., 2005)

Q value	WFD status	Pollution status	Condition
Q5 or Q4-5	High status	Unpolluted	Satisfactory
Q4	Good status	Unpolluted	Satisfactory
Q3-4	Moderate status	Slightly polluted	Unsatisfactory
Q3 or Q2-3	Poor status	Moderately polluted	Unsatisfactory
Q2, Q1-2 or Q1	Bad status	Seriously polluted	Unsatisfactory

2.7 Pond macro-invertebrate communities

Pond sites P1, P2, P3 and P4 were sampled for macro-invertebrates via sweep netting in September 2023. A standard pond net (250mm width, mesh size 500µm) was used to sweep macrophytes and submerged vegetation to capture macro-invertebrates. The net was also moved along the lake/pond bed to collect epibenthic and epiphytic invertebrates from the substratum (as per Cheal et al., 1993). A 3-minute sampling period was employed. To ensure appropriate habitat coverage, the sampling period was also divided amongst the range of meso-habitats present at the survey sites to get a representative sample for sub-habitats.

2.8 Macrophytes and aquatic bryophytes

Surveys of the macrophyte and aquatic bryophyte community were conducted by instream wading at each of the survey sites, with specimens collected (by hand or via grapnel) for on-site identification. An assessment of the aquatic vegetation community helped to identify any rare macrophyte species listed under the Flora (Protection) Order, 2022, Irish Red lists for vascular plants (Wyse-Jackson et al.,

[1] Of the 50 no. riverine survey sites, 10 no. sites (D12, D13, D14, D15, D16, D17, D19, D27, D28 & E6) were dry at the time of survey

2016) and bryophytes (Lockhart et al., 2012) or habitats corresponding to the Annex I habitats, e.g., 'Water courses of plain to montane levels, with submerged or floating vegetation of the *Ranunculion fluitantis* and *Callitricho-Batrachion* (low water level during summer) or aquatic mosses [3260]' (more commonly referred to as 'floating river vegetation').

2.9 Otter signs

The presence of otter (*Lutra lutra*) was determined through the recording of otter signs within 150m radius of each survey site. Notes on the age and location of signs (ITM coordinates) were made, in addition to the quantity and visible constituents of spraint (i.e. remains of fish, crustaceans, molluscs etc.).

2.10 Aquatic ecological evaluation

The evaluation of aquatic ecological receptors contained within this report uses the geographic scale and criteria defined in the 'Guidelines for Assessment of Ecological Impacts of National Road Schemes' (NRA, 2009).

2.11 Biosecurity

A strict biosecurity protocol following IFI (2010) and the Check-Clean-Dry approach was adhered to during surveys for all equipment and PPE used. Disinfection of all equipment and PPE before and after use with Virkon™ was conducted to prevent the transfer of pathogens or invasive propagules between survey sites. Within each sub-catchment, surveys were undertaken at sites in a downstream order to minimise the risk of upstream propagule mobilisation. Care was given towards preventing the spread or introduction of highly virulent crayfish plague (*Aphanomyces astaci*). Furthermore, staff did not undertake any work in a known crayfish plague catchment for a period of <72hrs in advance of the survey. Where feasible, equipment was also thoroughly dried (through UV exposure) between survey areas. Any aquatic invasive species or pathogens recorded within or adjoining the survey areas were geo-referenced. All Triturus staff are certified in 'Good fieldwork practice: slowing the spread of invasive non-native species' by the University of Leeds.

3. Desktop review

3.1 Survey area description

The proposed Muingmore wind farm site was located in an area of cutover bog near Gweesalia, Co. Mayo within the North-western River Basin District (**Figure 2.1**). The proposed GCR followed the existing road network, primarily along the N59 between Bangor-Erris and Bellacorick, with the TDR extending along the public road network for some 100km from the site boundary to Killybegs, Co. Donegal (**Figure 2.2**). The proposed wind farm site is drained by a number of small, heavily modified lowland watercourses (FW2; Fossitt, 2000) and drainage channels (FW4) present in a landscape dominated by lowland blanket bog and coniferous afforestation. The area is underlain by Neoproterozoic schist and gneiss (Geological Survey of Ireland data). Whilst not located within a European site, the watercourses within and adjoining the site boundary share hydrological connectivity with the Mullet/Blacksod Bay Complex SAC (000470) and Blacksod Bay/Broad Haven SPA (004037).

3.2 Fisheries asset of the survey area

Given the remote and minor nature of the watercourses within and adjoining the proposed site boundary (i.e. An Mhoing Mhór River, Doolough Stream, unnamed river and tributaries), fisheries data for was not available prior to this survey.

Tullaghan Bay, to which a small unnamed river draining the proposed site joins, supports a range of common transitional and estuarine species including flounder (*Platichthys flesus*), sand goby (*Pomatoschistus minutes*), 15-spined stickleback (*Spinachia spinachia*) and sprat (*Sprattus sprattus*) (CFB, 2009).

The GCR crossed a high number of minor tributaries of the Owenmore River which is known to support Atlantic salmon (*Salmo salar*) and both brown and sea trout (*Salmo trutta*). The Owenmore is a regionally important salmonid river and is ranked 16th nationally in terms of the accessible fluvial habitat to Atlantic salmon (McGinnity et al., 2003). The Owenmore is a noted recreational salmon and sea trout fishery (O'Reilly, 2009) and, after several years of failure, is currently meeting its conservation limit for Atlantic salmon since 2021 (TEGOS, 2023). In addition to salmonids, the Owenmore is also known to support European eel (*Anguilla anguilla*), minnow (*Phoxinus phoxinus*), three-spined stickleback (*Gasterosteus aculeatus*) and lamprey (*Lampetra* sp.) (Triturus 2022 data).

The River Deel (34D01) is crossed by the proposed TDR in Crossmolina, Co. Mayo (where proposed TDR works are required adjacent to the watercourse). The Deel is a designated salmonid watercourse under the European Communities (Quality of Salmonid Waters) Regulations 1988 (S.I. No. 293/1988) and is a renowned recreational Atlantic salmon fishery. The river is also known to support brown trout, pike (*Esox lucius*), roach (*Rutilus rutilus*), perch (*Perca fluviatilis*), European eel, three-spined stickleback (*Gasterosteus aculeatus*) and minnow (Kelly et al., 2012, 2009; O'Connor, 2004). The Deel supports spawning sea lamprey (*Petromyzon marinus*) as far upstream as Ballycarroon Falls (in relatively high densities), approximately 2.5km upstream of Crossmolina, with *Lampetra* sp. also present both upstream and downstream Crossmolina (O'Connor, 2004).

TDR works are also proposed adjacent to the Ballysodare (Ballisodare) River at Ballysodare, Co. Sligo. The Ballysodare River is known to support Atlantic salmon, brown trout, European eel; *Lampetra* sp., minnow, perch, pike, roach and three-spined stickleback (IFI 2010-2014 data). The river is of very high value as a recreational Atlantic salmon fishery.

Fisheries data for the other survey watercourses was not available prior to this proposed survey.

3.3 Protected aquatic species

A comprehensive desktop review of available data from the National Parks and Wildlife Service (NPWS), National Biodiversity Data Centre (NBDC), Inland Fisheries Ireland (IFI), Botanical Society of Britain and Ireland (BSBI), National Crayfish Plague Surveillance Programme (NCPSP), Environmental Protection Agency (EPA) and Triturus databases for the 10km grid squares containing and adjoining the project and associated GCR (i.e. F71, F72, F82 & F92) identified records for only a low number of rare and or protected aquatic species.

Records for otter (*Lutra lutra*) were widespread in the respective grid squares, with a concentration of records for the Owenmore River and two records (2005 & 2010) for the Doolough Stream at survey site C5 (**Figure 3.1**) (NPWS & NBDC data, 2005-2023).

The River Deel, crossed by the proposed TDR (not within the aforementioned grid squares), supports a significant freshwater pearl mussel (*Margaritifera margaritifera*) population, with counts estimated at >100,000 adults by Moorkens & Killeen (2009) (data not shown). Over 1000 mussels were recorded in the vicinity of Crossmolina as part of the River Deel (Crossmolina) Drainage Scheme in 2017 (Ryan Hanley, 2018).

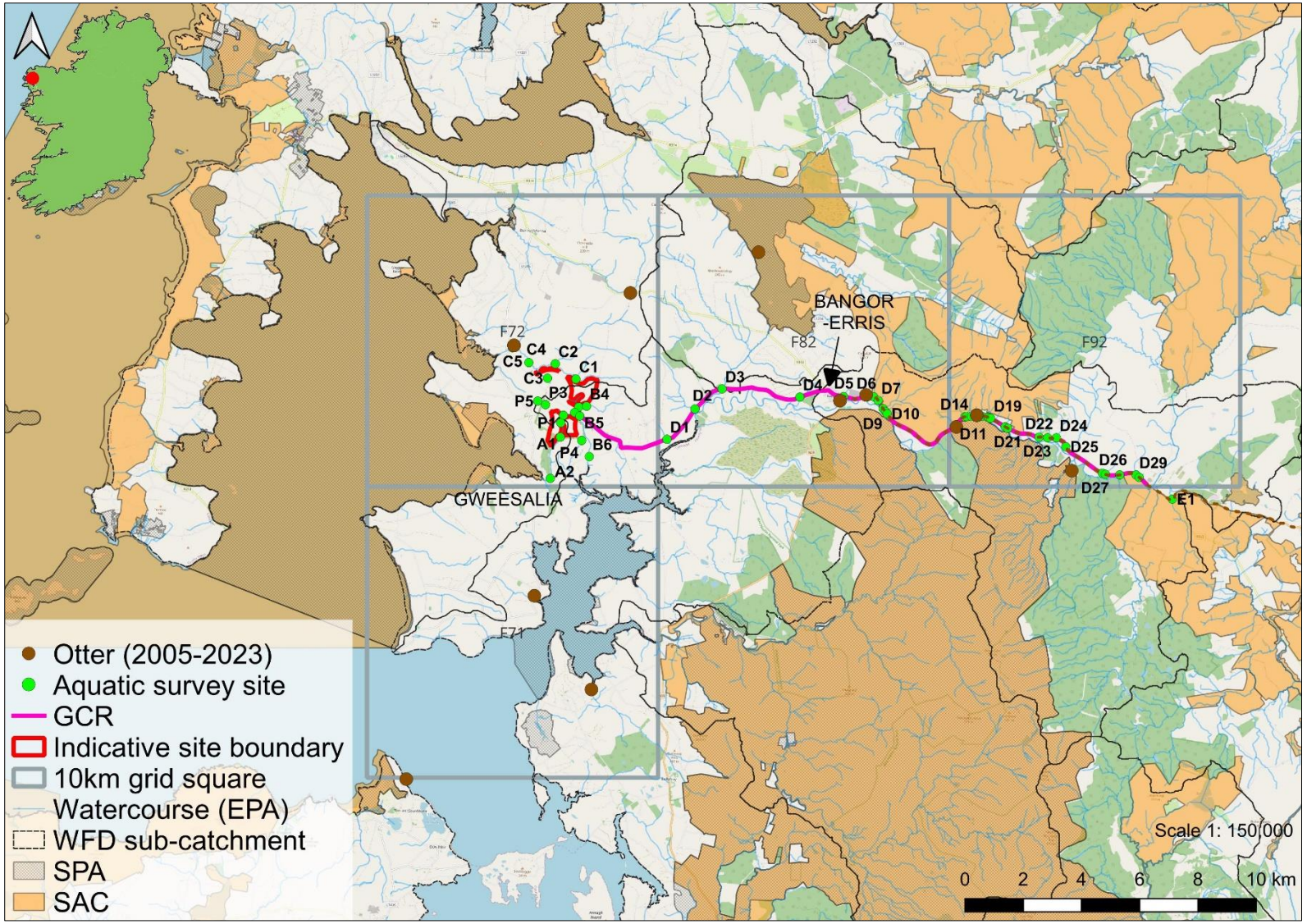

Figure 3.1 Otter records in the vicinity of the proposed project (source: NPWS, NBDC & Triturus data, 2005-2023)

4. Results of aquatic surveys

The following section summarises the 17 no. freshwater survey sites in vicinity of the proposed site boundary while the 37 no. sites crossed by the proposed GCR and TDR nodes are summarised in **Appendix D.**

Biological water quality (Q-sample) and lacustrine sweep sampling results for each survey site are provided in **Appendix C**. Habitat codes are according to Fossitt (2000). Scientific names are provided at first mention only. Please refer to **Appendix A** (fisheries assessment report) for more detailed fisheries results. A summary of the fish species recorded at each survey site is provided in **Table 4.2**. A summary of the aquatic species and habitats of high conservation concern recorded during the surveys is provided in **Table 4.3**. An evaluation of the aquatic ecological importance of each survey site based on these aquatic surveys is provided and summarised in **Table 4.4**.

4.1 Sites in vicinity of the site boundary

4.1.1 Site A1 – unnamed river, Doolough

Site A1 was located on an unnamed river (no EPA code) adjoining the site boundary, approximately 400m downstream of its source near pond site P1. The small lowland peat river (FW2) had been historically deepened and realigned to facilitate land drainage for adjoining conifer plantations. The channel was 0.5m wide and 0.2-0.3m deep with 1m high banks. The profile was of slow-flowing glide and the bed was composed entirely of soft, flocculent peat/silt. Due to high shading and high peat staining, macrophytes were absent although some lesser spearwort (*Ranunculus flammula*) was present along the steep channel margins. Aquatic bryophytes were absent. The site was bordered by mature lodgepole pine (*Pinus contorta*) plantations (WD4) and wet semi-improved grassland (GA1) along the access track.

No fish were recorded via electro-fishing at site A1 (**Appendix A**). The site was not of fisheries value given its heavily modified and heavily silted nature. There was no suitability for white-clawed crayfish and the species was not recorded during the survey. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). However, it should be noted that this was a tentative rating given an absence of suitable riffle areas for sampling (Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, the aquatic ecological evaluation of site A1 was of **local importance (lower value) (Table 4.4).**

Plate 4.1 Representative image of site A1 on an unnamed river, September 2023

4.1.2 Site A2 – unnamed river, Doolough

Site A2 was located on the lower, tidal reaches of an unnamed river at a local road crossing, approximately 1.6km downstream of site A1. The small, semi-natural tidal channel (CW3) was 1-1.5m wide and between 0.1-0.4m deep with bank heights of 1-1.3m. The profile was dominated by slow-flowing deeper glide (tidal in nature). The substrata comprised small boulder and cobble with mixed gravels downstream of the bridge that were heavily silted. With the exception of localised common reed (*Phragmites australis*), the site did not support macrophytes or aquatic bryophytes due to the tidal nature of the channel and high turbidity. The open grassy riparian areas supported red fescue grass (*Festuca rubra*) with scattered sea plantain (*Plantago maritima*) and wild angelica (*Angelica sylvestris*). Scurvy grass (*Cochlearia officinalis*) was present on the muddy exposed banks at low tide. The tidal channel was bordered by upper saltmarsh (CM2) and cutover bog (PB4).

European eel (*Anguilla anguilla*) and flounder (*Platichthys flesus*) were recorded via electro-fishing at site A2 (**Appendix A**). The tidal channel was a good nursery for European eel and transitional fish such as flounder (*Platichthys flesus*) but did not support salmonid fish. The narrow channel was of poor suitability as a holding habitat for migratory salmonids (such as sea trout). There was no suitability for lamprey (*Lampetra* spp.) or white-clawed crayfish. No freshwater pearl mussel or white-clawed crayfish were detected via eDNA sampling (**Table 4.1**). No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). However, it should be noted that this was a tentative rating given an absence of suitable riffle areas for sampling (Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of Red-listed European eel, the aquatic ecological evaluation of site A2 was of **local importance (higher value) (Table 4.4).**

Plate 4.2 Representative image of site A2 on the tidal reaches of a small, unnamed river, September 2023

4.1.3 Site B1 – unnamed river, Muingmore

Site B1 was located on the upper reaches of a small unnamed tributary of Tullaghan Bay adjacent to the proposed site boundary. The small lowland peat channel (FW2) had been straightened and deepened historically with a resulting deep trapezoidal channel. The river was 0.5m wide and between 0.3-0.8m deep with peat stained water. The river had 2-2.5m high banks at grade with the adjoining semi-improved grassland. The river at this location was stagnant at the time of survey (no flows). The substrata were composed exclusively of soft peat with floc[2]. Macrophytes were limited to localised common water starwort (*Callitriche stagnalis*). Aquatic bryophytes were not present. The riparian areas supported scattered grey willow (*Salix cinerea*) and mature sitka spruce (*Picea sitchensis*) growing in the semi-improved wet pasture (GA1) bordering the site.

No fish were recorded via electro-fishing at site B1 (**Appendix A**). The site was not of fisheries value given historical modifications, heavy siltation and poor flows. There was no suitability for white-clawed crayfish. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). However, it should be noted that this was a tentative rating given an absence of suitable riffle areas for sampling (Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

[2] floc is defined as an aggregation of (mostly dead) organic material, mainly from algae and diatoms, but also with potential origins from decaying macrophytes and associated decomposers (bacteria and fungi) (Moorkens & Killeen, 2020)

Given the absence of aquatic species or habitats of higher conservation value, the aquatic ecological evaluation of site B1 was of **local importance (lower value) (Table 4.4).**

Plate 4.3 Representative image of site B1 on an unnamed Tullaghan Bay tributary, September 2023

4.1.4 Site B2 – unnamed river, Muingmore

Site B2 was located on the upper reaches of a small unnamed tributary of Tullaghan Bay adjacent to the proposed site boundary (separate watercourse from that at site B1). The small lowland peat channel (FW2) had been deepened and realigned historically to facilitate bog drainage. The river was 0.5m wide and between 0.2-0.3m deep with stagnant pools of peat stained water. The river had 2m high banks at grade with the adjoining species-poor lowland blanket bog (PB3). The substrata were composed exclusively of soft peat. Due to high peat staining, macrophytes and aquatic bryophytes were not present. Terrestrial encroachment was high with abundant rushes (*Juncus* spp.) and creeping bent (*Agrostis stolonifera*) instream. The site was bordered by bramble (*Rubus fruticosus* agg.) and dense bracken (*Pteridium aquilinum*) scrub that graded into adjoining species-poor blanket bog habitat with young conifer plantations downstream.

No fish were recorded via electro-fishing at site B2 (**Appendix A**). The site was not of fisheries value given historical modifications, heavy siltation and poor flows. There was no suitability for white-clawed crayfish. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). However, it should be noted that this was a tentative rating given an absence of suitable riffle areas for sampling (Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, the aquatic ecological evaluation of site B2 was of **local importance (lower value) (Table 4.4).**

Plate 4.4 Representative image of site B2 on an unnamed Tullaghan Bay tributary, September 2023

4.1.5 Site B3 – unnamed river, Muingmore

Site B3 was located on a small unnamed tributary of Tullaghan Bay at a local road crossing approximately 500m downstream of site B2. The small lowland peat channel (FW2) had been deepened and realigned historically to facilitate bog drainage. The river was 1m wide and between 0.1-0.2m deep with a profile of very slow-flowing glide. The substrata were composed exclusively of soft peat. The site supported occasional common water starwort and blue-water speedwell (*Veronica anagallis-aquatica*). The peaty banks supported the liverwort *Pellia epiphylla*. The site was bordered by bramble and dense bracken scrub that graded into adjoining wet semi-improved pasture (GA1).

No fish were recorded via electro-fishing at site B3 (**Appendix A**). The site was not of fisheries value given historical modifications, heavy siltation and poor flows. There was no suitability for white-clawed crayfish. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Appendix C**). However, it should be noted that this was a tentative rating given an absence of suitable riffle areas for sampling (Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, the aquatic ecological evaluation of site B3 was of **local importance (lower value) (Table 4.4).**

Plate 4.5 Representative image of site B3 on an unnamed Tullaghan Bay tributary, September 2023

4.1.6 Site B4 – unnamed stream, Muingmore

Site B4 was located on a small unnamed tributary of Tullaghan Bay. The small lowland peat channel (FW2) had been deepened and realigned historically through adjoining blanket bog. The deeply incised U-shaped channel was 1m wide and between 0.1-0.2m deep with bank heights of up to 2m. The profile was of swift flowing glide with very localised pool. The substrata comprised heavily bedded boulder with cobble and localised mixed gravels that had high siltation (peat). The channel was too deeply incised and shaded to support macrophyte plants. However, the channel supported the liverwort *Scapania undulata* on instream boulder with *Pellia* sp. and *Fissidens crassipes* on the peaty banks. The riparian areas supported dense bramble and gorse (*Ulex europaeus*) scrub. The site was bordered by lowland blanket bog (PB2) and mature conifer plantations (WD4).

Brown trout (*Salmo trutta*) was the only fish species recorded via electro-fishing at site B4 (**Appendix A**). Given the stream's very small size and heavily modified nature it was only a poor quality brown trout nursery with a small population of 0+ fish recorded. The quality of salmonid spawning habitat was poor given the presence of heavily bedded boulder, cobble and scattered gravels with high siltation (by peat). The holding value for adult fish was poor given the very limited pool habitat. Despite some low suitability for European eel, none were recorded. The site was unsuitable for lamprey or white-clawed crayfish. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q2-3 (poor status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids, the aquatic ecological evaluation of site B4 was of **local importance (higher value) (Table 4.4).**

Plate 4.6 Representative image of site B4 on an unnamed Tullaghan Bay tributary, September 2023

4.1.7 Site B5 – unnamed river, Tristia

Site B1 was located on a small unnamed tributary of Tullaghan Bay at a local road crossing approximately 300m downstream of site B1. The small lowland peat channel (FW2) had been deepened historically but retained a sinuous profile through the adjoining peatland habitat. The heavily peat-stained spate river was 2-2.5m wide and 0.2-0.6m deep with 1.5m high banks. The profile was of slow-flowing glide with localised riffle and pool. The substrata comprised small boulder and cobble with mixed gravels that were heavily silted (peat) with high cover of floc and blankets of iron-oxidising bacteria. Macrophytes were limited to occasional common water starwort and branched-bur-reed (*Sparganium erectum*). Aquatic bryophytes were not present. The riparian areas supported localised bramble and bracken scrub. The site was bordered by degraded lowland blanket bog (PB2) and mature conifer plantations (WD4).

Brown trout was the only fish species recorded via electro-fishing at site B5 (**Appendix A**). Despite historical drainage the stream was considered a good quality brown trout nursery given it supported a good density of mixed cohort trout. Spawning habitat was of moderate quality given the presence of mixed gravels in pool and deeper glide but was reduced because of siltation pressures. Despite some suitability for European eel, none were recorded (superior habitats present downstream). The site was of too high an energy to support lamprey and no soft sediment settlement areas supporting ammocoetes were present. While some low potential for white-clawed crayfish existed given the stoney bed and deeper water, none were recorded. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids, the aquatic ecological evaluation of site B5 was of **local importance (higher value) (Table 4.4).**

Plate 4.7 Representative image of site B5 on an unnamed Tullaghan Bay tributary, September 2023

4.1.8 Site B6 – unnamed river, Doolough

Site B6 was located on the lower reaches of an unnamed tributary of Tullaghan Bay at a local road crossing, approximately 1.6km downstream of site B5. The river at this location represented an upland eroding peatland channel (FW1) that had been historically deepened through adjoining lowland blanket bog. The river was 2m wide and was between 0.1m to 0.7m deep with bank heights of 1-1.2m. The profile was dominated by slow-flowing deeper glide with very localised riffle and pool (given historical drainage works). The substrata comprised small boulder and cobble with mixed gravels that were heavily silted (peat) with high cover of filamentous algae and floc (c. 70%). The site supported abundant common water starwort with the moss species *Fontinalis antipyretica* being frequent on instream boulders. The open riparian areas with scattered bramble, gorse and iris (*Iris psuedacorus*) that graded into bordering degraded lowland blanket bog (PB2).

Atlantic salmon (*Salmo salar*), brown trout, European eel and three-spined stickleback (*Gasterosteus aculeatus*) were recorded via electro-fishing at site B6 (**Appendix A**). The site was a good quality salmonid nursery that supported a good density of trout and a low density of Atlantic salmon. The presence of deeper glide and a rocky bed provided refugia that were however compromised by siltation and eutrophication pressures in addition to historical drainage (i.e. deepening). Salmonid spawning habitat was of moderate quality, being reduced because of siltation and enrichment despite the presence of mixed gavels in deeper glide and pool pockets. Abundant deep glide provided good quality holding habitat for adult salmonids but would have improved with riparian tree cover which was absent from the river. The watercourse was a moderate quality eel nursery given the presence of deeper water with rocky refugia with a small population recorded present. The high energy river was

unsuitable for lamprey given no depositional areas for ammocoetes. While some low potential for white-clawed crayfish existed given the stoney bed and deeper water, no crayfish were recorded present. This was also supported by an absence of white-clawed crayfish in eDNA sampling (**Table 4.1**). No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids (including Atlantic salmon) and Red-listed European eel, the aquatic ecological evaluation of site B6 was of **local importance (higher value) (Table 4.4).**

Plate 4.8 Representative image of site B6 on an unnamed Tullaghan Bay tributary, September 2023

4.1.9 Site P1 – pond, Doolough

Site P1 was located at a small 0.2ha elliptical pond adjacent to the proposed site boundary. The pond featured shallow, quaking margins and depths of 1-2.2m with peat-stained water. The substrata were composed entirely of soft silt (peat). The pond was heavily vegetated with frequent white water-lily (*Nymphae alba*), bog pondweed (*Potamogeton polygonifolius*) and bulrush (*Typha latifolia*). Water forget-me-not (*Myosotis scorpioides*) and bladderwort (*Utricularia* sp.) were recorded as rare. The quaking margins supported abundant *Sphagnum* mosses, mostly *S. cuspidatum,* with marsh cinquefoil (*Comarum palustre*), bog bean (*Menyanthes trifoliata*), wild angelica (*Angelica sylvestris*) and marsh pennywort (*Hydrocotyle vulgaris*). The pond was considered representative of the Annex I habitat 'Natural dystrophic lakes and ponds [3160]'. The site was bordered by scrubby grey willow and degraded lowland blanket bog (PB2).

Electro-fishing was not undertaken at the lacustrine site. However, a fisheries appraisal indicated that the pond had good suitability for a small brown trout population (despite an absence of inflowing

watercourses) and also had high suitability for European eel given close proximity to nearby upland eroding streams and drainage channels. Indeed, both species were detected via eDNA sampling (**Table 4.1**). Despite good suitability for smooth newt, the species was not detected via eDNA sampling. There was no suitability for white-clawed crayfish and the species was not recorded during surveys. No otter signs were recorded in vicinity of the site.

No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via sweep sampling (**Appendix C**).

Given the presence of salmonids and Red-listed European eel (eDNA), in addition to Annex I acid oligotrophic lake habitat [3160], the aquatic ecological evaluation of site P1 was of **county importance (Table 4.4).**

Plate 4.9 Representative image of site P1, September 2023

4.1.10 Site P2 – pond, Muingmore

Site P2 was located at a small 0.35ha irregular-shaped pond adjacent to the proposed site boundary. The pond comprised two small basins connected via a narrow channel. The pond had shallow, quaking margins and depths of 0.3-1.1m with peat-stained water. The substrata were composed entirely of soft silt (peat). The shallow pond was heavily vegetated with frequent white water-lily and occasional bog pondweed and bulbous rush (*Schoenus bulbosus*). Bulrush, bottle sedge (*Carex rostrata*) and spike rush (*Eleocharis palustris*) were also occasional in the margins. *Sphagnum cuspidatum* and *S. capillifolium* were abundant in the quaking margins. The pond was considered representative of the Annex I habitat 'Natural dystrophic lakes and ponds [3160]'. The site was bordered by degraded lowland blanket bog (PB2) with mature coniferous plantations to the west (WD4).

Electro-fishing was not undertaken at the lacustrine site. However, a fisheries appraisal indicated that the pond had good suitability for European eel given close proximity to nearby upland eroding streams

and drainage channels. Suitability for brown trout was poor given the shallow depths. Whilst brown trout were not recorded via eDNA sampling (thus considered absent), European eel were detected (**Table 4.1**). Despite good suitability for smooth newt, the species was not detected via eDNA sampling. There was no suitability for white-clawed crayfish. No otter signs were recorded in vicinity of the site.

No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via sweep sampling (**Appendix C**).

Given the presence of Red-listed European eel (eDNA), in addition to Annex I acid oligotrophic lake habitat [3160], the aquatic ecological evaluation of site P2 was of **county importance (Table 4.4).**

Plate 4.10 Representative image of site P2, September 2023

4.1.11 Site P3 – pond, Muingmore

Pond P3 was located at a small 0.4ha pond adjacent to (west of) site P2. The pond had a complex margin with numerous small peninsulas and bays. The margins were gently sloping and the pond ranged from 0.6-1.5m in depth with a bed composed entirely of deep soft sediment (peat) with a high cover of floc and diatomaceous masses. The water was peat-stained. The shallow basin supported abundant white water-lily and floating bur-reed (*Sparganium angustifolium*). Occasional bulbus rush, spike rush and Red-listed pipewort (*Eriocaulon aquaticum*) were present in the margins with the littorals dominated by *Sphagnum cuspidatum*. Bladderwort (*Utricularia* sp.) was rare. The pond was considered representative of the Annex I habitat 'Natural dystrophic lakes and ponds [3160]' (but not oligotrophic isoetid lake habitat [3110] due to fragmented distribution of indicator species). The site was bordered by lowland blanket bog (PB2) with mature coniferous afforestation (WD4) to the east.

Electro-fishing was not undertaken at the lacustrine site. However, a fisheries appraisal indicated that the pond had moderate suitability for brown trout and high suitability for European eel and both species were detected via eDNA sampling (**Table 4.1**). The heavily vegetated pond was suitable for

smooth newt although none were recorded by sweep sampling or eDNA sampling. There was no suitability for white-clawed crayfish and the species was not recorded present. No otter signs were recorded in vicinity of the site.

No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via sweep sampling (**Appendix C**).

Given the presence of salmonids and Red-listed European eel (eDNA), in addition to Annex I acid oligotrophic lake habitat [3160], the aquatic ecological evaluation of site P4 was of **county importance (Table 4.4).**

Plate 4.11 Representative image of site P3, September 2023

4.1.12 Site P4 – pond, Doolough

Site P4 was located at a small 0.65ha pond adjacent to the proposed site boundary. The pond had a complex margin with numerous small peninsulas and bays. The margins were steep and the pond ranged from 1.4-2.5m in depth with a bed composed entirely of deep soft sediment (peat). The water was peat-stained. Given this and relatively high depths, macrophyte cover was low in the open water areas with rare white-water lily. However, the littorals supported locally frequent bulbous rush and Red-listed pipewort with abundant floating bur-reed on the shelf zone of the shallower southern shore. Bog pondweed and bog bean stands were scattered, with bladderwort (*Utricularia* sp.) recorded as rare. Free-floating agglomerations of *Sphagnum cuspidatum* were present along the margins. Based on the criteria outlined by O'Connor (2015), the macrophyte community locally dominated by pipewort was considered representative of the Annex I habitat 'Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3110]'. The site was bordered by lowland blanket bog (PB2) with mature coniferous afforestation (WD4) to the north.

Electro-fishing was not undertaken at the lacustrine site. However, a fisheries appraisal indicated that the pond had good suitability for brown trout and European eel and both species were detected via eDNA sampling (**Table 4.1**). The pond was largely unsuitable (low macrophyte cover, too deep) to support smooth newt and none were recorded by sweep sampling or eDNA sampling. There was no suitability for white-clawed crayfish. No otter signs were recorded in vicinity of the site.

No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via sweep sampling (**Appendix C**).

Given the presence of salmonids (eDNA) and Red-listed pipewort, in addition to the Annex I Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3110]', the aquatic ecological evaluation of site P4 was of **county importance (Table 4.4).**

Plate 4.12 Representative image of site P4, September 2023

4.1.13 Site C1 – An Mhoing Mhór River, Muingmore

Site C1 was located on the Mhoing Mhór River (EPA code: 33M23), a tributary of the Doolough Stream, adjacent to the site boundary. The lowland depositing peat channel had been deepened historically to facilitate land drainage for adjoining conifer plantations. The river was 0.5m wide and between 0.2-0.3m deep with bank heights of 1.5-2m. The profile was dominated by slow-flowing glide with the substrata comprised entirely of soft peat. Due to high shading and peat-staining, macrophytes were absent. The peaty banks supported the liverwort *Pellia epiphylla*, a species common a wet river banks. The site bordered by degraded lowland blanket bog (PB2) and mature conifer plantations (WD4).

No fish were recorded via electro-fishing at site C1 (**Appendix A**). The river was not of fisheries value at this location given its heavily modified nature and siltation pressures. There was no suitability for white-clawed crayfish and the species was not recorded. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). However, it should be noted that this was a tentative rating given an absence of suitable riffle areas for sampling (Toner et al., 2005). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, the aquatic ecological evaluation of site C1 was of **local importance (lower value) (Table 4.4).**

Plate 4.13 Representative image of site C1 on the Mhoing Mhór River, September 2023

4.1.14 Site C2 – Doolough Stream, Muingmore

Site C2 was located on the Doolough Stream (33D02) adjacent to the site boundary. The lowland depositing stream (FW2) had been historically straightened and deepened through adjoining blanket bog and improved grassland but retained some semi-natural features. The peat-stained stream was 2-3m wide and between 0.2-0.8m deep with banks of 1.5-2m in height. The profile comprised riffle and glide sequences with occasional pool. The substrata were dominated by heavily silted mixed gravels with localised small boulder and cobble. Cover of filamentous algae and floc was high (c.30-40%), indicting significant enrichment. Macrophyte growth was limited to sparse bog pondweed. No aquatic bryophytes were recorded. The site was bordered by degraded blanket bog (PB2) and semi-improved grassland (GA1).

Brown trout and European eel were the only fish species recorded via electro-fishing at site C2 (**Appendix A**). The site was a good quality salmonid nursery despite historical drainage, siltation and enrichment pressures with a relatively high density of mixed cohort trout. Salmonid spawning habitat was moderate given the presence of mixed gravels in pool and deeper glide as with areas downstream (e.g. site C4) but was reduced because of siltation and enrichment pressures. Suitability for European eel was moderate (cobble refugia and sufficiently deep) with a small population of adults present. No soft sediment settlement areas suitable for lamprey ammocoetes were present and the species was

not recorded. While some low potential for white-clawed crayfish existed given instream refugia and deeper water, none were recorded. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and Red-listed European eel, the aquatic ecological evaluation of site C2 was of **local importance (higher value) (Table 4.4).**

Plate 4.14 Representative image of site C2 on the Doolough Stream, September 2023

4.1.15 Site C3 – unnamed stream, Muingmore

Site C3 was located on an unnamed tributary of the Doolough Stream adjacent to the site boundary. The U-shaped lowland depositing peat channel (FW2) had been historically deepened throughout and did not feature flowing water at the time of survey. The stream was 1m wide with stagnant pools of water to 0.1m in depth. The substrata were comprised entirely of soft peat. The site supported abundant watercress (*Nasturtium* agg.) with high levels of terrestrial encroachment by creeping bent grass (*Agrostis stolonifera*).

No fish were recorded via electro-fishing at site C3 (**Appendix A**). The site was not of fisheries value at this location given its ephemeral nature and historical modifications. There was no suitability for white-clawed crayfish and the species was not recorded present. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (poor status)** (**Appendix C**). However, it should be noted that this was a tentative rating given an absence of suitable riffle areas for sampling (Toner et al., 2005). No macro-invertebrate species of conservation value greater than

'least concern', according to national red lists, were recorded via Q-sampling.

Given the absence of aquatic species or habitats of higher conservation value, the aquatic ecological evaluation of site C3 was of **local importance (lower value) (Table 4.4).**

Plate 4.15 Representative image of site C3 on an unnamed Doolough Stream tributary, September 2023

4.1.16 Site C4 – Doolough Stream, Muingmore

Site C4 was located on the Doolough Stream (33D02) approximately 1.2km downstream of site C2. The lowland depositing stream (FW2) had been historically deepened through adjoining blanket bog and improved grassland but retained some semi-natural features with frequent meanders in a sinuous channel. The peat-stained stream was 2-3m wide and between 0.2-0.6m deep with banks of 1.5-2m in height. The profile comprised slow-flowing glide with localised riffle and pool. The substrata were dominated by heavily silted mixed gravels with localised small boulder and cobble. These had a moderate cover (c.20%) of filamentous algae and floc. Macrophyte growth was limited to occasional bog pondweed. Aquatic bryophyte coverage was low although some *Pellia epiphylla* and *Scapania undulata* were present locally. The site was bordered by degraded blanket bog (PB2).

Brown trout, European eel and three-spined stickleback were recorded via electro-fishing at site C4 (**Appendix A**). Despite historical drainage and siltation pressures, the site was a good quality salmonid nursery supporting a relatively high density of juvenile trout. Localised pools and instream boulder provided valuable holding areas for adult salmonids although the quality of the holding habitat was poor overall (shallow water). Mixed gravels provided moderate quality salmonid spawning habitat, with the value reduced due to siltation. The site was of moderate value for European eel with a low density of adults recorded. No soft sediment settlement areas suitable for lamprey ammocoetes were identified. While some low potential for white-clawed crayfish existed given instream refugia and deeper water, none were recorded. No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3-4 (moderate status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and Red-listed European eel, the aquatic ecological evaluation of site C4 was of **local importance (higher value) (Table 4.4).**

Plate 4.16 Representative image of site C4 on the Doolough Stream, September 2023

4.1.17 Site C5 – Doolough Stream, Muingmore

Site C5 was located on the Doolough Stream (33D02) at the L1205 local road crossing approximately 0.9km downstream of site C4. The lowland depositing peatland stream (FW2) had been historically deepened through adjoining lowland blanket bog and bordering improved grassland habitats. The stream was 2-4m wide and between 0.2-0.8m deep with a semi-natural profile and bank heights of 1-1.2m. The profile comprised riffle and glide sequences with occasional pool. The substrata were dominated by heavily silted mixed gravels with localised small boulder and cobble. As per upstream, cover of filamentous algae and floc was high (c.40%), indicting significant enrichment. Macrophyte growth was limited to sparse bog pondweed. No aquatic bryophytes were recorded. The site was bordered by degraded blanket bog (PB2) and semi-improved grassland (GA1). Blanket growth of iron-oxidising bacteria was also present upstream of the bridge in the channel margins. The site supported occasional common water starwort and alternate water-milfoil (*Myriophyllum alterniflorum*) with the moss species *Fontinalis antipyretica* also being occasional on instream boulders. Water horsetail (*Equisetum fluviatile*) and branched bur-reed (*Sparganium erectum*) were also present locally. The open banks supported bramble and gorse that graded into degraded lowland blanket bog (PB2) and improved pasture (GA1).

Brown trout was the only fish species recorded via electro-fishing at site C5 (**Appendix A**). The site was a good quality salmonid nursery supporting a relatively high density of juvenile trout. The presence of

deeper glide and a rocky bed provided refugia but these were impacted by siltation and eutrophication pressures in addition to historical drainage (i.e. deepening). Salmonid spawning habitat was of moderate quality. Abundant deep glide provided good quality holding habitat for adult salmonids. The site was a moderate quality European eel nursery given the presence of deeper water with ample refugia but none were recorded. No soft sediment settlement areas suitable for lamprey ammocoetes were identified. While some low potential for white-clawed crayfish existed given instream refugia and deeper water, none were recorded. No white-clawed crayfish or freshwater pearl mussel were detected via eDNA sampling (**Table 4.1**). No otter signs were recorded in vicinity of the site.

Biological water quality, based on Q-sampling, was calculated as **Q3 (moderate status)** (**Appendix C**). No macro-invertebrate species of conservation value greater than 'least concern', according to national red lists, were recorded via Q-sampling.

Given the presence of salmonids and Red-listed European eel, the aquatic ecological evaluation of site C5 was of **local importance (higher value) (Table 4.4).**

Plate 4.17 Representative image of site C5 on the Doolough Stream, September 2023

4.2 White-clawed crayfish

No white-clawed crayfish were recorded via hand-searching or sweep netting of instream refugia during the survey of 54 no. survey sites. Furthermore, no crayfish were detected via eDNA sampling of the Doolough Stream or two unnamed watercourses in vicinity of the proposed site boundary (**Table 4.1**). These findings were in keeping with the known absence of the species in the wider Owenmore[Mayo]_SC_030 and Glencastle_SC_010 river sub-catchments (**Figure 3.1**).

4.3 eDNA analysis

In keeping with the known historical distribution of the species in the survey area (**Figure 3.1**), no freshwater pearl mussel or white-clawed eDNA was detected in an unnamed river (site A2), unnamed river (B6) or Doolough Stream (C5) (0 positive qPCR replicates out of 12; **Table 4.1, Appendix C**). However, the invasive pathogen crayfish plague (*Aphanomyces astaci*) was detected at all 3 no. riverine sampling locations (**Table 4.1**).

Brown trout eDNA was detected in pond sites P1, P3 and P4 (1 positive replicates out of 12, respectively). European eel eDNA was detected at sites P1, P2 and P3 (12, 12 & 2 positive replicates out of 12, respectively (**Table 4.1**). Despite some habitat suitability, no smooth eDNA was detected in the 4 no. pond sites during the survey.

4.4 Invasive aquatic species

With the exception of crayfish plague (above), no aquatic invasive species were recorded during the September 2023 surveys.

4.5 Biological water quality (macro-invertebrates)

No rare or protected macro-invertebrate species (according to national red lists) were recorded in the biological water quality samples taken from 40 no. riverine sites[3] in September 2023 (**Appendix C**).

A total of 11 no. sites on the Munhin River (D3), Ballybeg River (D5), Srahanarry Stream (D6), unnamed Owenmore River tributaries (D4, D11, D22, D23, D24, D25), Moneynierin River (E1) and the Ballisodare River (E3) achieved **Q4 (good status)** (**Figures 4.1, 4.2 & 4.3**). This was given the presence of the EPA group A (most pollution sensitive) species such as the flattened mayfly *Rhithrogena semicolorata* and stonefly *Protonemura meyeri* in fair numbers (5-10% of total abundance) (**Appendix C**).

A total of 10 no. sites on an unnamed Tullaghan Bay tributary (B3), Doolough Stream (sites C4 & C5), Bellanumera Stream (D7), Briska River (D8), unnamed Owenmore River tributaries (D18, D26, D29 & D3) and the River Deel (E2) achieved **Q3-4 (moderate status)** given the presence of EPA group A mayflies *Ecdyonurus dispar or Heptagenia sulphurea* and or stoneflies *Protonemura meyeri* or *Nemoura cinerea* in low numbers (<5%), respectively (**Appendix C**).

With the exception of site E4 (see below), the remaining sites (i.e. A1, A2, B1, B2, B4, B5, B6, C1, C2, C3, C5, D1, D2, D9, D10, D20, D21 & E7) achieved **Q2-3 or Q3 (poor status)** based on a dominance of

[3] A total of 10 no. sites (D12, D13, D14, D15, D16, D17, D19, D27, D28 & E6) were dry at the time of the survey. Four no. sites (P1, P2, P3 & P4) were ponds and thus were not suitable for Q sampling.

EPA group C species, including the mayfly *Baetis rhodani*, freshwater shrimp (*Gammarus duebeni*) and New Zealand mud snail (*Potamopyrgus antipodarum*) (**Appendix C**). These sites did not support any group A species and an absence of or only low numbers of group B species such as the stonefly *Leuctra hippopus*.

Site E4 on the Carrowgobbadagh River (adjacent to TDR works) achieved **Q2 (bad status)** based on the dominance of highly pollution tolerant group D and E taxa (**Appendix C**). However, the tidal channel was largely unsuitable for Q-sampling given a lack of riffle areas and this rating was therefore tentative (as per Toner et al., 2005).

Many of the Q-ratings recorded in September 2023, particularly higher gradient channels along the GCR, were tentative only due to low summer flows (i.e. absence of riffle or glide habitat).

4.6 Pond macro-invertebrate communities

No rare or protected macro-invertebrate species (according to national red lists) were recorded in the composite sweep samples collected from sites P1, P2, P3 or P4 in September 2023.

The pond samples sample were dominated by a typical assemblage of oligotrophic lacustrine taxa such as damselfly larvae (Coenagrionidae), lesser water boatman (*Corixa punctata*), backswimmers (*Notonecta viridis*), phantom midge larvae (Chaoboridae) and biting midge larvae (*Chironomus* spp.) (**Appendix C**).

Table 4.1 eDNA results in the vicinity of the proposed Muingmore wind farm, Co. Mayo (positive qPCR replicates out of 12 in parentheses)

Site	Watercourse	Freshwater pearl mussel	White-clawed crayfish	Crayfish plague	Brown trout	European eel	Smooth newt
A2	Unnamed river	Negative (0/12)	Negative (0/12)	**Positive (12/12)**	n/a	n/a	n/a
B6	Unnamed river	Negative (0/12)	Negative (0/12)	**Positive (11/12)**	n/a	n/a	n/a
C5	Doolough Stream	Negative (0/12)	Negative (0/12)	**Positive (12/12)**	n/a	n/a	n/a
P1	Pond	n/a	n/a	n/a	**Positive (1/12)**	**Positive (12/12)**	Negative (0/12)
P2	Pond	n/a	n/a	n/a	Negative (0/12)	**Positive (12/12)**	Negative (0/12)
P3	Pond	n/a	n/a	n/a	**Positive (1/12)**	**Positive (2/12)**	Negative (0/12)
P4	Pond	n/a	n/a	n/a	**Positive (1/12)**	Negative (0/12)	Negative (0/12)

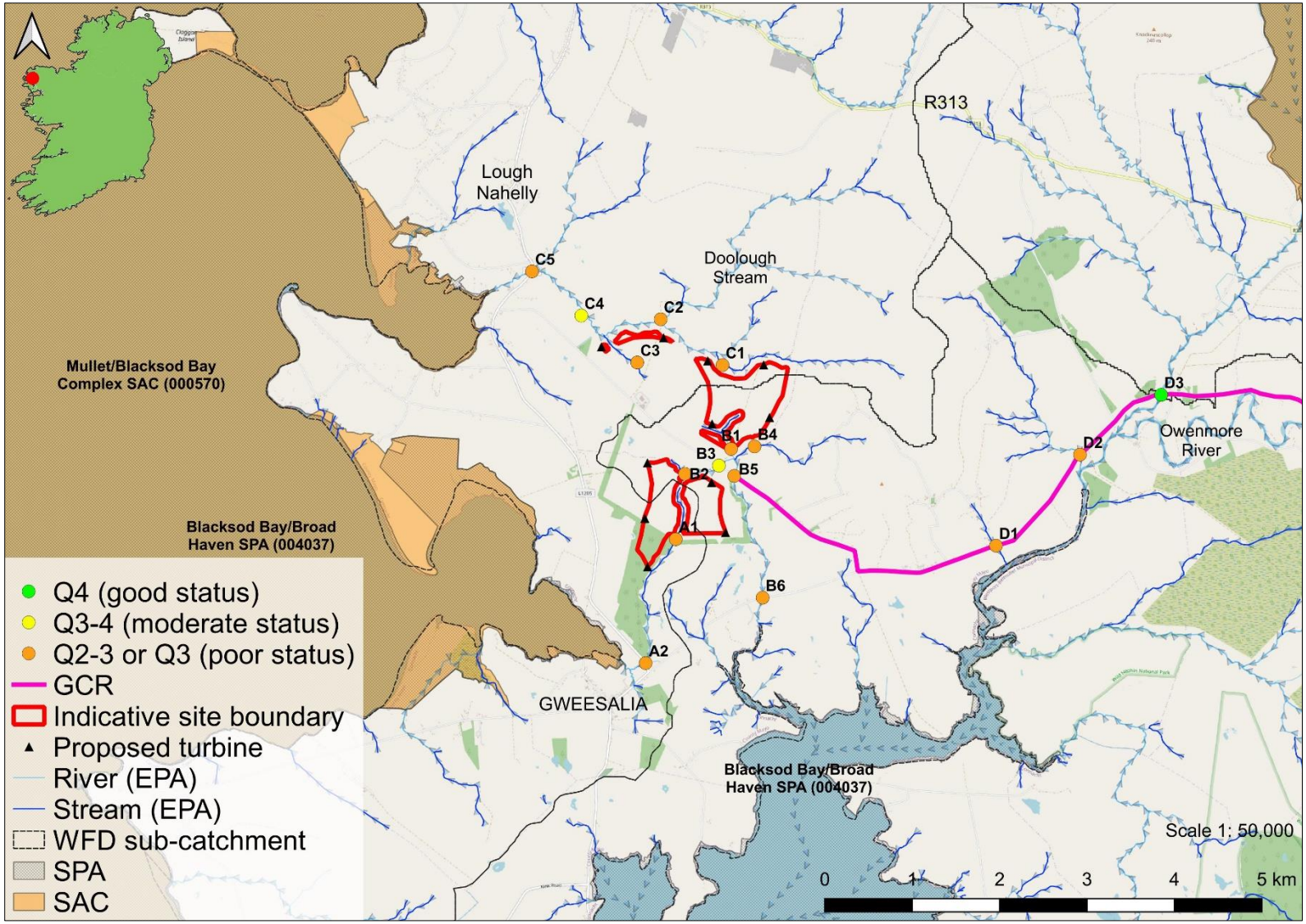

Figure 4.1 Overview of the biological water quality status in the vicinity of the proposed Muingmore wind farm, September 2023

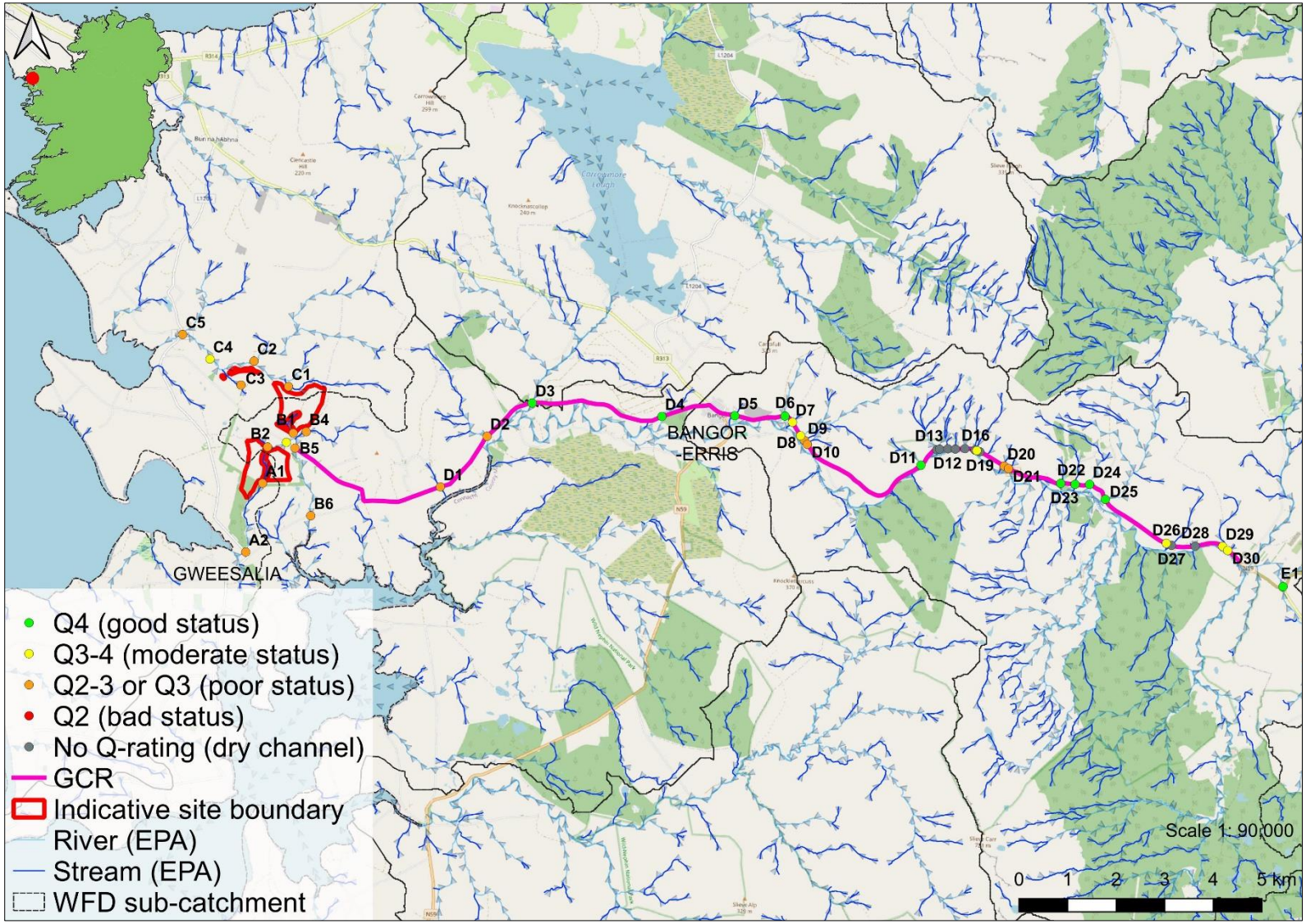

Figure 4.2 Overview of the biological water quality status in the vicinity of the proposed Muingmore wind farm GCR, September 2023

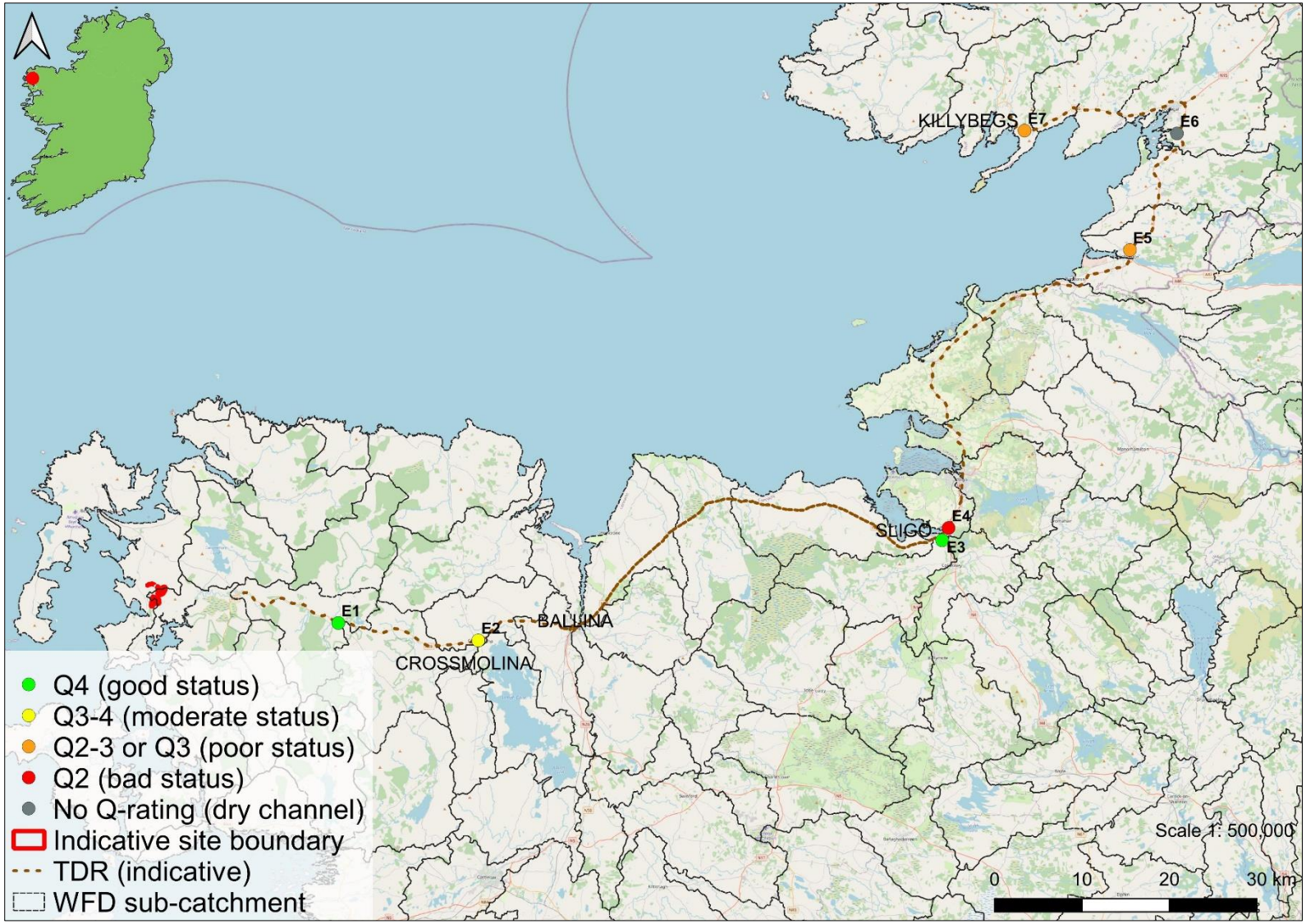

Figure 4.3 Overview of the biological water quality status in the vicinity of the proposed Muingmore wind farm TDR, September 2023

4.7 Aquatic ecological evaluation

An aquatic ecological evaluation of each survey site was based on the results of desktop review (i.e., presence of fish of conservation value), fisheries habitat assessments, the presence of protected or rare invertebrates (e.g. white-clawed crayfish), environmental DNA analysis, the presence of rare macrophytes and aquatic bryophytes and or associated representations of Annex I habitats. Furthermore, biological water quality status also informed the aquatic evaluation (**Table 4.4**).

Sites E2 on the River Deel and E3 on the Ballisodare River were evaluated as **international importance** given their locations within the River Moy SAC (002298) and Unshin River SAC (001898), respectively.

Sites P1, P2, P3 were evaluated as **county importance** given the presence of a macrophyte community representative of the Annex I habitat 'Natural dystrophic lakes and ponds [3160]'. Site P4 was also of **county importance** as it supported abundant pipewort, a near threatened red-listed macrophyte (Wyse-Jackson et al. 2016) and a macrophyte community representative of the Annex I habitat 'Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) [3110]'. Site D3 on the Munhin River was also evaluated as **county importance** due to the presence of several fish species of high conservation value (i.e. salmon and lamprey) and Q4 (good status) water quality and the fact that the river serves as an important ecological corridor between several European sites (e.g. Carrowmore Lake SAC and Blacksod Bay/Broad Haven SPA).

A total of 22 no. sites in vicinity of the site boundary (A2, B4, B5, B6, C2, C4 & C5), GCR (D2, D4, D5, D6, D8, D18, D22, D23, D24, D25, D26, D29 & D30) and TDR (E1 & E4) were evaluated as **local importance (higher value)** in terms of their aquatic ecology. This evaluation was due to the presence of fish species of high conservation value, otter and or Q4 (good status) water quality (**Table 4.4**).

The remaining sites 25 no. sites (i.e. sites A1, B1, B2, B3, C1, C3, D1, D7, D9, D10, D11, D12, D13, D14, D15, D16, D17, D19, D20, D21, D27, D28, E5, E6 & E7) were evaluated as **local importance (lower value)** given an absence of aquatic species or habitats of high conservation value and less than good status water quality.

Table 4.2 Relative abundance of fish species of higher conservation value recorded per survey site in the vicinity of the proposed Muingmore wind farm, September 2023

Site	Watercourse	Atlantic salmon	Brown trout	*Lampetra* sp.	European eel	Other species
Sites in vicinity of site boundary						
A1	Unnamed river	No fish recorded				
A2	Unnamed river				Medium	Flounder
B1	Unnamed river	No fish recorded				
B2	Unnamed river	No fish recorded				
B3	Unnamed river	No fish recorded				
B4	Unnamed stream		Low			
B5	Unnamed river		Medium			
B6	Unnamed river		High		Low	Three-spined stickleback
C1	An Mhoing Mhór River	No fish recorded				
C2	Doolough Stream		High		Low	
C3	Unnamed stream	No fish recorded				
C4	Doolough Stream		High		Low	Three-spined stickleback
C5	Doolough Stream		Very high			
P1	Pond		eDNA		eDNA	
P2	Pond		eDNA		eDNA	
P3	Pond				eDNA	
P4	Pond		eDNA			
GCR crossings						
D1	Unnamed stream	No fish recorded				
D2	Goolamore River		Medium			Minnow
D3	Munhin River	Medium	Low	Low		Sea trout, flounder, minnow
D4	Unnamed river	No fish recorded				
D5	Ballybeg Stream	No fish recorded				
D6	Srahanarry Stream	Medium	Low			
D7	Bellanumera Stream	No fish recorded				
D8	Briska River	Low	Medium		High	
D9	Unnamed stream	No fish recorded				
D10	Unnamed stream	No fish recorded				
D11	Unnamed river	No fish recorded				

Site	Watercourse	Atlantic salmon	Brown trout	*Lampetra* sp.	European eel	Other species
D12	Unnamed river	No fish recorded				
D13	Unnamed river	No fish recorded				
D14	Unnamed stream	No fish recorded				
D15	Unnamed stream	No fish recorded				
D16	Unnamed river	No fish recorded				
D17	Unnamed stream	No fish recorded				
D18	Unnamed stream		Low		Low	
D19	Unnamed stream	No fish recorded				
D20	Unnamed stream	No fish recorded				
D21	Unnamed stream	No fish recorded				
D22	Unnamed stream		Medium			
D23	Unnamed stream		Low			
D24	Unnamed river		Medium			
D25	Unnamed river	Very high	Medium		Low	
D26	Unnamed stream	Low	Low			Minnow
D27	Kilsallagh Stream	No fish recorded				
D28	Unnamed stream	No fish recorded				
D29	Unnamed stream		Low			
D30	Unnamed stream		Low			Minnow, three-spined stickleback
TDR nodes						
E1	Moneynierin River	Low	Low			Three-spined stickleback
E2	River Deel	High				Minnow, roach, three-spined stickleback
E3	Ballisodare River	High	Low		Medium	
E4	Carrowgobbadagh Stream				Low	Three-spined stickleback
E5	Abbeylands Stream	No fish recorded				
E6	Drumgowan Stream	No fish recorded				
E7	Bogside River	No fish recorded				

Table 4.3 Summary of aquatic species and habitats of higher conservation value recorded in the vicinity of the proposed Muingmore wind farm, September 2023

Site	Watercourse	Freshwater pearl mussel	White-clawed crayfish	Otter signs[4]	Annex I aquatic habitats	Rare or protected macrophytes/ aquatic bryophytes	Rare or protected macro-invertebrates	Other species/habitats of high conservation value
Sites in vicinity of site boundary			None recorded	No signs	Not present	None recorded	None recorded	None recorded
A1	Unnamed river		None recorded	No signs	Not present	None recorded	None recorded	None recorded
A2	Unnamed river	Negative eDNA result at site	None recorded; negative eDNA result at site	No signs	Not present	None recorded	None recorded	None recorded
B1	Unnamed river		None recorded	No signs	Not present	None recorded	None recorded	None recorded
B2	Unnamed river		None recorded	No signs	Not present	None recorded	None recorded	None recorded
B3	Unnamed river		None recorded; negative eDNA result at site	No signs	Not present	None recorded	None recorded	None recorded
B4	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
B5	Unnamed river		None recorded	No signs	Not present	None recorded	None recorded	None recorded
B6	Unnamed river	Negative eDNA result at site	None recorded; negative eDNA result at site	No signs	Not present	None recorded	None recorded	None recorded
C1	An Mhoing Mhór River		None recorded; negative eDNA result at site	No signs	Not present	None recorded	None recorded	None recorded
C2	Doolough Stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
C3	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
C4	Doolough Stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
C5	Doolough Stream	Negative eDNA result at site	None recorded; negative eDNA result at site	No signs	Not present	None recorded	None recorded	None recorded
P1	Pond		None recorded	No signs	**Acid oligotrophic lake [3160]**	None recorded	None recorded	**European eel (eDNA)**

Site	Watercourse	Freshwater pearl mussel	White-clawed crayfish	Otter signs[4]	Annex I aquatic habitats	Rare or protected macrophytes/ aquatic bryophytes	Rare or protected macro-invertebrates	Other species/habitats of high conservation value
P2	Pond		None recorded	No signs	**Acid oligotrophic lake [3160]**	None recorded	None recorded	**European eel (eDNA)**
P3	Pond		None recorded	No signs	**Acid oligotrophic lake [3160]**	**Pipewort (*Eriocaulon aquaticum*)**	None recorded	**European eel (eDNA)**
P4	Pond		None recorded	No signs	**Acid oligotrophic lake [3160]; oligotrophic isoetid lake [3110]**	**Pipewort (*Eriocaulon aquaticum*)**	None recorded	None recorded
GCR crossings								
D1	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D2	Goolamore River		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D3	Munhin River		None recorded	No signs	Not present	None recorded	None recorded	**Atlantic salmon, *Lampetra* sp., sea trout**
D4	Unnamed river		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D5	Ballybeg Stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D6	Srahanarry Stream		None recorded	No signs	Not present	None recorded	None recorded	**Atlantic salmon**
D7	Bellanumera Stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D8	Briska River		None recorded	No signs	Not present	None recorded	None recorded	**Atlantic salmon, European eel**
D9	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D10	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D11	Unnamed river		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D12	Unnamed river		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D13	Unnamed river		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D14	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded

Site	Watercourse	Freshwater pearl mussel	White-clawed crayfish	Otter signs[4]	Annex I aquatic habitats	Rare or protected macrophytes/ aquatic bryophytes	Rare or protected macro-invertebrates	Other species/habitats of high conservation value
D15	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D16	Unnamed river		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D17	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D18	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	**European eel**
D19	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D20	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D21	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D22	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D23	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D24	Unnamed river		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D25	Unnamed river		None recorded	No signs	Not present	None recorded	None recorded	**Atlantic salmon, European eel**
D26	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	**Atlantic salmon**
D27	Kilsallagh Stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D28	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D29	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
D30	Unnamed stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
TDR nodes							None recorded	
E1	Moneynierin River		None recorded	No signs	Not present	None recorded	None recorded	**Atlantic salmon**
E2	River Deel		None recorded	No signs	Not present	None recorded	None recorded	**Atlantic salmon**
E3	Ballisodare River		None recorded	**2 no. spraint sites**	**Floating river vegetation [3260]**	None recorded	None recorded	**Atlantic salmon**

Site	Watercourse	Freshwater pearl mussel	White-clawed crayfish	Otter signs[4]	Annex I aquatic habitats	Rare or protected macrophytes/ aquatic bryophytes	Rare or protected macro-invertebrates	Other species/habitats of high conservation value
E4	Carrowgobbadagh Stream		None recorded	No signs	**Floating river vegetation [3260]**	None recorded	None recorded	None recorded
E5	Abbeylands Stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
E6	Drumgowan Stream		None recorded	No signs	Not present	None recorded	None recorded	None recorded
E7	Bogside River		None recorded	No signs	Not present	None recorded	None recorded	None recorded

Conservation value: Eurasian otter (*Lutra lutra*), Atlantic salmon (*Salmo salar*) & lamprey (*Lampetra* spp.) are listed under Annex II of the Directive on the Conservation of Natural Habitats of Wild Fauna and Flora (92/43/EEC) ('EU Habitats Directive') and are protected under the Irish Wildlife Acts 1976-2023. European eel are 'critically endangered' according to most recent ICUN red list (Pike et al., 2020) and listed as 'critically engendered' in Ireland (King et al., 2011). Atlantic salmon and sea trout are also protected under the Wild Salmon and Sea Trout Tagging Scheme (Amendment) Regulations. Apart from the Inland Fisheries Acts 1959 to 2017, non-anadromous brown trout and coarse fish species have no legal protection in Ireland.

[4] Otter signs within 150m of the survey site

Table 4.4 Aquatic ecological evaluation summary of the Muingmore wind farm survey sites according to NRA (2009) criteria

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
Sites in vicinity of site boundary				
A1	Unnamed river	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
A2	Unnamed river	n/a	**Local importance (higher value)**	Red-listed European eel recorded
B1	Unnamed river	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
B2	Unnamed river	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
B3	Unnamed river	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
B4	Unnamed stream	n/a	**Local importance (higher value)**	Brown trout recorded
B5	Unnamed river	n/a	**Local importance (higher value)**	Brown trout recorded
B6	Unnamed river	n/a	**Local importance (higher value)**	Atlantic salmon, brown trout & Red-listed European eel recorded
P1	Pond	n/a	**County importance**	Annex I oligotrophic lake habitat [3160] present
P2	Pond	n/a	**County importance**	Annex I oligotrophic lake habitat [3160] present
P3	Pond	n/a	**County importance**	Annex I oligotrophic lake habitat [3160] present
P4	Pond	n/a	**County importance**	Annex I oligotrophic isoetid lake habitat [3110] & near threatened pipewort present
C1	An Mhoing Mhór River	33M23	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
C2	Doolough Stream	33D02	**Local importance (higher value)**	Brown trout & Red-listed European eel recorded
C3	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
C4	Doolough Stream	33D02	**Local importance (higher value)**	Brown trout & Red-listed European eel recorded

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
C5	Doolough Stream	33D02	**Local importance (higher value)**	Brown trout & Red-listed European eel recorded
GCR sites				
D1	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
D2	Goolamore River	33G12	**Local importance (higher value)**	Atlantic salmon & brown trout recorded
D3	Munhin River	33M03	**County importance**	Atlantic salmon, brown trout, sea trout & lamprey (*Lampetra* sp.) recorded; Q4 (good status) water quality
D4	Unnamed river	n/a	**Local importance (higher value)**	Q4 (good status) water quality
D5	Ballybeg Stream	33B40	**Local importance (higher value)**	Q4 (good status) water quality
D6	Srahanarry Stream	33S23	**Local importance (higher value)**	Atlantic salmon & brown trout recorded; Q4 (good status) water quality
D7	Bellanumera Stream	33B38	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3-4 (moderate status) water quality (tentative rating)
D8	Briska River	33B33	**Local importance (higher value)**	Atlantic salmon, brown trout & Red-listed European eel recorded
D9	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
D10	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
D11	Unnamed river	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
D12	Unnamed river	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value (dry ephemeral channel)
D13	Unnamed river	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value (dry ephemeral channel)
D14	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value (dry ephemeral channel)
D15	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value (dry ephemeral channel)
D16	Unnamed river	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value (dry ephemeral channel)

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
D17	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value (dry ephemeral channel)
D18	Unnamed stream	n/a	**Local importance (higher value)**	Brown trout & Red-listed European eel recorded
D19	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value (dry ephemeral channel)
D20	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
D21	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)
D22	Unnamed stream	n/a	**Local importance (higher value)**	Brown trout recorded; Q4 (good status) water quality
D23	Unnamed stream	n/a	**Local importance (higher value)**	Brown trout recorded; Q4 (good status) water quality (tentative rating)
D24	Unnamed river	n/a	**Local importance (higher value)**	Brown trout recorded; Q4 (good status) water quality
D25	Unnamed river	n/a	**Local importance (higher value)**	Atlantic salmon, brown trout & Red-listed European eel recorded; Q4 (good status) water quality
D26	Unnamed stream	n/a	**Local importance (higher value)**	Atlantic salmon & brown trout recorded
D27	Kilsallagh Stream	33K13	Local importance (lower value)	No aquatic species or habitats of high conservation value (dry ephemeral channel)
D28	Unnamed stream	n/a	Local importance (lower value)	No aquatic species or habitats of high conservation value (dry ephemeral channel)
D29	Unnamed stream	n/a	**Local importance (higher value)**	Brown trout recorded
D30	Unnamed stream	n/a	**Local importance (higher value)**	Brown trout recorded;
TDR sites				
E1	Moneynierin River	33M16	**Local importance (higher value)**	Atlantic salmon & brown trout recorded; Q4 (good status) water quality
E2	River Deel	34D01	**International importance**	**Located within River Moy SAC (002298)**
E3	Ballisodare River	35B05	**International importance**	**Located within the Unshin River SAC (001898)**

Site no.	Watercourse	EPA code	Evaluation of importance	Rationale summary
E4	Carrowgobbadagh Stream	35C95	**Local importance (higher value)**	Red-listed European eel recorded
E5	Abbeylands Stream	36A15	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q2-3 (poor status) water quality (tentative rating)
E6	Drumgowan Stream	37D49	Local importance (lower value)	No aquatic species or habitats of high conservation value (dry ephemeral channel)
E7	Bogside River	37B26	Local importance (lower value)	No aquatic species or habitats of high conservation value; Q3 (poor status) water quality (tentative rating)

Conservation value: Eurasian otter (*Lutra lutra*), Atlantic salmon (*Salmo salar*) & lamprey (*Lampetra* spp.) are listed under Annex II of the Directive on the Conservation of Natural Habitats of Wild Fauna and Flora (92/43/EEC) ('EU Habitats Directive') and are protected under the Irish Wildlife Acts 1976-2023. European eel are 'critically endangered' according to most recent ICUN red list (Pike et al., 2020) and listed as 'critically engendered' in Ireland (King et al., 2011). Atlantic salmon and sea trout are also protected under the Wild Salmon and Sea Trout Tagging Scheme (Amendment) Regulations. Apart from the Inland Fisheries Acts 1959 to 2017, non-anadromous brown trout and coarse fish species have no legal protection in Ireland.

5. Discussion

The watercourses in the vicinity of the proposed Muingmore wind farm project (inclusive of the GCR & TDR) were typically heavily modified lowland channels (straightened, deepened, realigned) draining blanket bog or higher gradient/higher energy upland channels (prone to spate). Significant siltation (primarily from peat escapement), and less so eutrophication, was evident throughout much of the survey area. This, coupled with low summer flows, reduced the aquatic value of many survey watercourses. Nevertheless, over half of the survey sites were evaluated of at least **local importance (higher value)** in terms of their aquatic ecology given the presence of fish of high conservation value and or Q4 (good status) water quality (**Table 4.4**). Sites P1, P2, P3 and P4 were evaluated as **county importance** given the presence of Annex I aquatic habitats. Sites E2 on the River Deel and E3 on the Ballisodare River were evaluated as **international importance** given their locations within the River Moy SAC (002298) and Unshin River SAC (001898), respectively.

5.1 Fisheries

A fish species assemblage typical of Ireland's north-west – namely Atlantic salmon, brown trout, sea trout, European eel, lamprey (*Lampetra* sp.), three-spined-stickleback, minnow and flounder - were recorded during the electro-fishing survey (**Table 4.2**). Although brown trout were relatively widespread in the survey area inclusive of the GCR (recorded at 23 no. sites), Atlantic salmon were more localised and recorded from a total of 10. no sites on an unnamed Tullaghan Bay tributary (B6), Goolamore River (D2), Munhin River (D3), Srahanarry Stream (D6), Broska River (D8), unnamed Owenmore tributaries (D25, D26), Moneynierin River (E1), River Deel (E2) and the Ballisodare River (E3) (**Appendix A**). Fish populations in vicinity of the site boundary were dominated by brown trout with Atlantic salmon recorded only from the lower reaches of an unnamed Tullaghan Bay tributary (site B6). Sea trout were recorded from a single site on the Munhin River (D3). Lamprey (*Lampetra* sp.) were also recorded from a single site only (Munhin River at site D3) and this restricted distribution reflected the poor habitat suitability in the survey area (i.e. higher energy and heavily silted peat channels; **Appendix A**). European eel were recorded in typically low abundances from a total of 9 no. riverine sites on an unnamed river (A2), an unnamed Tullaghan Bay tributary (B6), Doolough Stream (C2, C4), Briska River (D8), unnamed Owenmore River tributary (D18, D25), Ballisodare River (E3) and the Carrowgobbadagh Stream (E4), in addition to pond sites P1, P2 and P3 (eDNA only) (**Table 3.1**). The restricted distribution of European eel in the survey area was also primarily due sub-optimal habitat (**Appendix A**). Of the riverine survey sites, 27 of 50 in total did not support fish at the time of survey given poor quality fisheries habitats or dry, ephemeral channels.

5.2 Annex I aquatic habitats

The Annex I habitat 'Water courses of plain to montane levels, with submerged or floating vegetation of the *Ranunculion fluitantis* and *Callitricho-Batrachion* (low water level during summer) or aquatic mosses [3260]' (commonly referred to as floating river vegetation, FRV) was recorded at sites E3 on the Ballisodare River and E4 on the Carrowgobbadagh Stream (adjacent to proposed TDR works). Whilst not representing a diverse example of the habitat, the tidal reaches of the heavily modified Carrowgobbadagh Stream (E4) supported abundant macrophytes including several FRV indicators such as *Callitriche stagnalis*, *Potamogeton* sp. & *Ranunculus* sp. (EC, 2013). The Ballisodare River (E4)

supported floating river vegetation primarily due to the presence of indicator Ranunculus sp. and *Fontanalis antipyretica*.

Three pond sites (P1, P2, P3 & P4) (in vicinity of the site boundary) corresponded the Annex I habitat 'Natural dystrophic lakes and ponds [3160]'. Annex I acid oligotrophic lakes are typically associated with small lakes and ponds in Atlantic and upland blanket bog, and wet heath (Gray et al., 2022; O'Connor, 2015) and are considered species-poor botanically with a community characterised by bryophytes of the genus *Sphagnum* and sustain the *Utricularietalia* phytosociological order (EC, 2013). In Ireland, this lake habitat has been broadly interpreted as 'species poor lake and pond systems dominated by *Sphagnum* mosses and restricted to blanket bogs and wet heaths' (O'Connor, 2015). Whilst the margins of sites P1, P2 and P3 were dominated by *Sphagnum* species such as *S. cuspidatum*, site P4 was more representative of the Annex I oligotrophic isoetid lake habitat [3110] with species including bog pondweed, bladderwort (*Utricularia* sp.), bulbous rush and locally abundant Red-listed pipewort, a Red-listed, near-threatened species in Ireland with a limited distribution (Wyse-Jackson et al., 2016). However, the co-occurrence of both habitats is common in Ireland (Evans, 2006).

5.3 Crayfish plague detection

No white-clawed crayfish were recorded through hand searching of instream refugia during the surveys, or via eDNA sampling, thus supporting the absence of historical and contemporary records from the Blacksod-Broadhaven hydrometric area (33) and much of the survey area (with the exception of the River Deel & Ballisodare River; NPWS & NCPSP[4] data). This absence is primarily due to low alkalinities and unsuitable geologies for the species (Demers et al., 2005; Lucy & McGarrigle, 1987).

However, the invasive pathogen crayfish plague was detected via eDNA sampling at all 3 no. sampling riverine locations in vicinity of the proposed wind farm site boundary despite the absence of crayfish (**Table 4.1**). Crayfish plague had previously been detected in hydrometric area 33 by Triturus using eDNA sampling in the Owenmore River (near Bellacorick) and Ballinglen River catchments in 2022. Crayfish plague is listed at one of the world's 100 worst invasive species (GISD, 2022; Lowe et al., 2000) and is becoming highly prevalent across Ireland.

5.4 Otter

Although suitable foraging habitat was widespread, otter signs were only recorded (within 150m of the survey sites) at a single site on the Ballisodare River (E3), where 2 no. spraint sites (and anal jelly) were recorded under the N59 road bridge. The paucity of signs throughout the survey area, inclusive of the site boundary and GCR, was considered to mainly reflect the smaller, higher-energy, high gradient nature of most survey watercourses which generally provide more restricted, stochastic prey resources and reduced foraging opportunities for otter compared with lower-gradient, larger watercourses (Scorpio et al., 2016; Remonti et al., 2009). Furthermore, predation by otter (and hence habitat utilisation) in small salmonid tributaries is highly seasonal and closely linked to adult migrations in the autumn and winter periods (Sittenthaler et al., 2019; Carss et al., 1990). No breeding (holt) or couch (resting) areas were identified in the vicinity of the survey sites in September 2023.

[4] National Crayfish Plague Surveillance Programme

5.5 Macro-invertebrates

No rare or protected macro-invertebrate species (according to national red lists) were recorded in the samples taken from 50 no. riverine or 4 no. pond sites (**Appendix C**). Whilst a low number of sites (11 no. but none within vicinity of the proposed site boundary or turbine array; **Figure 4.1**) achieved **Q4 (good status)**, the majority of sampling sites failed to meet the target good status (≥Q4) requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC). Siltation and less so eutrophication of the watercourses (primarily from peat escapement but also agriculture & forestry) was noted during the surveys and is known to be the primary threat to water quality in the survey area (EPA data), in addition to hydromorphological modifications.

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7. Appendix A – fisheries assessment report

Please see accompanying fisheries assessment report

8. Appendix B – eDNA analysis lab report

SureScreen Scientifics

Folio No: E19345
Report No: 1
Client: Triturus Environmental Ltd
Contact: Bill Brazier

TECHNICAL REPORT

ANALYSIS OF ENVIRONMENTAL DNA IN WATER FOR AQUATIC SPECIES DETECTION

SUMMARY

When aquatic organisms inhabit a waterbody such as a pond, lake or river they continuously release small amounts of their DNA into the environment. By collecting and analysing water samples, we can detect these small traces of environmental DNA (eDNA) to confirm the presence or absence of the target species within the waterbody.

RESULTS

Date sample received in laboratory: 20/10/2023
Date results reported: 26/10/2023
Matters affecting result: None

TARGET SPECIES: Brown (Sea) Trout *(Salmo trutta)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK1692	P1 – Pond, Muingmore WF	-	Pass	Pass	Pass	Positive	1/12
FK1691	P3 - Pond, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12
FK1687	P4 - Pond, Muingmore WF	-	Pass	Pass	Pass	Positive	1/12
FK1695	P5 – Pond, Muingmore WF	-	Pass	Pass	Pass	Positive	1/12

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SureScreen Scientifics

Crayfish plague
(Aphanomyces astaci)

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK1608	A2 – Unnamed river, Muingmore WF	-	Pass	Pass	Pass	Positive	12/12
FK1611	B6 – Unnamed river, Muingmore WF	-	Pass	Pass	Pass	Positive	11/12
FK1615	C5 – Doolough Stream, Muingmore WF	-	Pass	Pass	Pass	Positive	11/12

European eel
(Anguilla anguilla)

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK1692	P1 – Pond, Muingmore WF	-	Pass	Pass	Pass	Positive	12/12
FK1691	P3 - Pond, Muingmore WF	-	Pass	Pass	Pass	Positive	12/12
FK1687	P4 - Pond, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12
FK1695	P5 – Pond, Muingmore WF	-	Pass	Pass	Pass	Positive	2/12

Freshwater pearl mussel
(Margaritifera margaritifera)

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK1608	A2 – Unnamed river, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12
FK1611	B6 – Unnamed river, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12
FK1615	C5 – Doolough Stream, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12

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Smooth Newt
(Lissotriton vulgaris)

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK1692	P1 – Pond, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12
FK1691	P3 - Pond, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12
FK1687	P4 - Pond, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12
FK1695	P5 – Pond, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12

White-clawed crayfish
(Austropotamobius pallipes)

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK1608	A2 – Unnamed river, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12
FK1611	B6 – Unnamed river, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12
FK1615	C5 – Doolough Stream, Muingmore WF	-	Pass	Pass	Pass	Negative	0/12

If you have any questions regarding results, please contact us: ForensicEcology@surescreen.com

Reported by: **Jennifer Higginbottom** Approved by: **Lauryn Jewkes**

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METHODOLOGY

The samples detailed above have been analysed for the presence of target species eDNA following scientifically published eDNA assays and protocols which have been thoroughly tested, developed and verified for use by SureScreen Scientifics.

The analysis is conducted in two phases. The sample first goes through an extraction process where the filter is incubated in order to obtain any DNA within the sample. The extracted sample is then tested via real time PCR (also called q-PCR) for each of the selected target species. This process uses species-specific molecular markers (known as primers) to amplify a select part of the DNA, allowing it to be detected and measured in 'real time' as the analytical process develops. qPCR combines amplification and detection of target DNA into a single step. With qPCR, fluorescent dyes specific to the target sequence are used to label targeted PCR products during thermal cycling. The accumulation of fluorescent signals during this reaction is measured for fast and objective data analysis. The primers used in this process are specific to a part of mitochondrial DNA only found in each individual species. Separate primers are used for each of the species, ensuring no DNA from any other species present in the water is amplified.

If target species DNA is present, the DNA is amplified up to a detectable level, resulting in positive species detection. If target species DNA is not present then amplification does not occur, and a negative result is recorded.

Analysis of eDNA requires scrupulous attention to detail to prevent risk of contamination. True positive controls, negative controls and spiked synthetic DNA are included in every analysis and these have to be correct before any result is declared and reported. Stages of the DNA analysis are also conducted in different buildings at our premises for added security.

SureScreen Scientifics Ltd is ISO9001 accredited and participate in Natural England's proficiency testing scheme for GCN eDNA testing. We also carry out regular inter-laboratory checks on accuracy of results as part of our quality control procedures.

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INTERPRETATION OF RESULTS

SIC: **Sample Integrity Check** [Pass/Fail]
When samples are received in the laboratory, they are inspected for any tube leakage, suitability of sample (not too much mud or weed etc.) and absence of any factors that could potentially lead to inconclusive results.

DC: **Degradation Check** [Pass/Fail]
Analysis of the spiked DNA marker to see if there has been degradation of the kit or sample, between the date it was made to the date of analysis. Degradation of the spiked DNA marker may indicate a risk of false negative results.

IC: **Inhibition Check** [Pass/Fail]
The presence of inhibitors within a sample are assessed using a DNA marker. If inhibition is detected, samples are purified and re-analysed. Inhibitors cannot always be removed, if the inhibition check fails, the sample should be re-collected.

Result: **Presence of eDNA** [Positive/Negative/Inconclusive]

Positive: DNA was identified within the sample, indicative of species presence within the sampling location at the time the sample was taken or within the recent past at the sampling location.

Positive Replicates: Number of positive qPCR replicates out of a series of 12. If one or more of these are found to be positive the pond is declared positive for species presence. It may be assumed that small fractions of positive analyses suggest low level presence, but this cannot currently be used for population studies. Even a score as low as 1/12 is declared positive. 0/12 indicates negative species presence.

Negative: eDNA was not detected or is below the threshold detection level and the test result should be considered as evidence of species absence, however, does not exclude the potential for species presence below the limit of detection.

Inconclusive: Controls indicate inhibition or degradation of the sample, resulting in the inability to provide conclusive evidence for species presence or absence.

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9. Appendix C – Macro-invertebrates (biological water quality)

Table 8.1 Macro-invertebrate Q-sampling results for riverine sites in the vicinity of the proposed wind farm site boundary, September 2023 (* = tentative rating)

Group	Family	Species	A1	A2	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	EPA class
Plecoptera	Nemouridae	*Nemoura cinerea*					1							1		**A**
Plecoptera	Leuctridae	*Leuctra fusca*												1	1	**B**
Plecoptera	Leuctridae	*Leuctra hippopus*						1	4	7				3	4	**B**
Trichoptera	Goeridae	*Silo pallipes*													1	**B**
Trichoptera	Limnephilidae	*Potamophylax cingulatus*					1									**B**
Trichoptera	Limnephilidae	sp. indet. (early instar)								2						**B**
Trichoptera	Rhyacophilidae	*Rhyacophila dorsalis*							2							**B**
Odonata	Coenagrionidae	sp. indet.	6			6							2			**B**
Odonata	Libellulidae	Sympetrum sp.	2			1										**B**
Ephemeroptera	Baetidae	*Baetis rhodani*		1				1	29	45		18		17	10	**C**
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*			1	1										**C**
Trichoptera	Polycentropodidae	*Polycentropus kingi*						3								**C**
Crustacea	Gammaridae	*Gammarus duebeni*		17	1			3					1	1	8	**C**
Coleoptera	Dytiscidae	Dytiscidae larva		1	18			1	1				2			**C**
Coleoptera	Dytiscidae	*Dytiscus dimidiatus*					1									**C**
Coleoptera	Dytiscidae	*Hygrotus inaequalis*				1										**C**
Coleoptera	Dytiscidae	*Ilybius fuliginosus*			1											**C**
Coleoptera	Dytiscidae	*Oreodytes sanmarkii*												1	1	**C**
Coleoptera	Dytiscidae	*Oreodytes septentrionalis*												1		**C**
Coleoptera	Dytiscidae	*Stictotarsus duodecimpustulatus*								2		1				**C**
Coleoptera	Elmidae	*Elmis aenea*								1						**C**
Coleoptera	Elmidae	*Limnius volckmari*						1					1		1	**C**
Coleoptera	Elmidae	*Oulimnius tuberculatus*					1					1				**C**
Coleoptera	Gyrinidae	Gyrinidae larva													2	**C**
Coleoptera	Gyrinidae	*Gyrinus substriatus*	2		1	1	1									**C**

Group	Family	Species	A1	A2	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	EPA class
Coleoptera	Hydrophilidae	*Anacaena globulus*	1													**C**
Diptera	Chironomidae	Non-*Chironomus* spp.			2		1				8		15	1	4	**C**
Diptera	Culicidae	sp. indet.			1		1						2			**C**
Diptera	Dixidae	sp. indet.	1		1											**C**
Diptera	Pediciidae	*Dicranota* sp.							1						2	**C**
Diptera	Simuliidae	sp. indet.							2	1		26		4	16	**C**
Diptera	Tipuliidae	sp. indet.	1													**C**
Hemiptera	Corixidae	*Hesperocorixa linnaei*											3			**C**
Hemiptera	Corixidae	*Hesperocorixa sahlbergi*	1			1										**C**
Hemiptera	Hydrometridae	*Hydrometra stagnorum*	1												1	**C**
Hemiptera	Gerridae	*Gerris* sp.									8					**C**
Hemiptera	Notonectidae	Notonectidae nymph			1											**C**
Hemiptera	Veliidae	*Velia caprai*	1													**C**
Hemiptera	Veliidae	Veliidae nymph			1		1						1			**C**
Gastropoda	Tateidae	*Potamopyrgus antipodarum*					2			10		4	4		4	**C**
Arachnida	Hydrachnidiae	sp. indet.													1	**C**
Gastropoda	Lymnaeidae	*Ampullacaena balthica*										4	1	1	18	**D**
Mollusca	Sphaeriidae	sp. indet.	4		4								2			**D**
Crustacea	Asellidae	*Asellus aquaticus*			8		1									**D**
Hirudinidae	Glossiphoniidae	*Glossiphonia complanata*								3		1			1	**D**
Diptera	Chironomidae	*Chironomus* spp.		1	8			8			2				1	**E**
Annelidae	Oligochaeta	sp. indet.							1						2	**n/a**
Malacostraca	Crangonidae	*Crangon crangon*		1												**n/a**
Abundance			**20**	**21**	**48**	**11**	**11**	**18**	**40**	**71**	**18**	**55**	**34**	**31**	**78**	
Q-rating			*Q3	*Q3	*Q3	*Q3	*Q3-4	Q2-3	Q3	Q3	*Q3	Q3	*Q3	Q3-4	Q3	
WFD status			Poor	Poor	Poor	Poor	Mod	Poor	Poor	Poor	Poor	Poor	Poor	Mod	Poor	

Table 8.2a Macro-invertebrate Q-sampling results for riverine sites in the vicinity of the proposed wind farm GCR, September 2023 (* = tentative rating)

Group	Family	Species	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D18	D20	EPA class
Ephemeroptera	Heptageniidae	*Heptagenia sulphurea*			6					1						**A**
Plecoptera	Chloroperlidae	*Siphonoperla torrentium*						1								**A**
Plecoptera	Nemouridae	*Protonemura meyeri*					5	16	2				4	1		**A**
Plecoptera	Nemouridae	*Nemoura cinerea*				7										**A**
Plecoptera	Perlodidae	*Isoperla grammatica*											1			**A**
Ephemeroptera	Baetidae	*Alainites muticus*									1					**B**
Plecoptera	Leuctridae	*Leuctra fusca*							1	1		1				**B**
Plecoptera	Leuctridae	*Leuctra hippopus*	1					5			4	12	3	1		**B**
Trichoptera	Goeridae	*Silo pallipes*		1										1		**B**
Trichoptera	Limnephilidae	*Potamophylax cingulatus*								1						**B**
Trichoptera	Limnephilidae	sp. indet. (early instar)												1		**B**
Trichoptera	Psychomyiidae	*Tinodes waeneri*										1				**B**
Trichoptera	Rhyacophilidae	*Rhyacophila dorsalis*		1									1			**B**
Hemiptera	Aphelocheiridae	*Aphelocheirus aestivalis*			11	1										**B**
Odonata	Coenagrionidae	sp. indet.				11										**B**
Odonata	Libellulidae	Sympetrum sp.				1										**B**
Ephemeroptera	Baetidae	*Baetis rhodani*	1	5	3		40	1	3	10		23	2			**C**
Trichoptera	Hydropsychidae	*Diplectrona felix*	3					1			1		2	1		**C**
Trichoptera	Hydropsychidae	*Hydropsyche instabilis*			10	2	1									**C**
Trichoptera	Philopotamidae	*Philopotamus montanus*									24	2				**C**
Trichoptera	Philopotamidae	*Wormaldia occipitalis*					2	3					4			**C**
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*						2			4		2	1		**C**
Trichoptera	Polycentropodidae	*Polycentropus kingi*													2	**C**
Crustacea	Gammaridae	*Gammarus duebeni*	7	11	4	10			2	2	7	3		6	11	**C**
Coleoptera	Dytiscidae	*Stictotarsus duodecimpustulatus*				1										**C**

Group	Family	Species	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D18	D20	EPA class
Coleoptera	Elmidae	*Elmis aenea*		1					1					1		**C**
Coleoptera	Elmidae	*Limnius volckmari*	2	11	7			1								**C**
Coleoptera	Elmidae	*Oulimnius tuberculatus*						1								**C**
Coleoptera	Scirtidae	Scirtidae larva										1				**C**
Diptera	Chironomidae	Non-*Chironomus* spp.				3	1	2	4		1				2	**C**
Diptera	Culicidae	sp. indet.				1	1									**C**
Diptera	Pediciidae	*Dicranota* sp.	2	1		1	2		1							**C**
Diptera	Simuliidae	sp. indet.		7		1	5	3			3	7	2	1		**C**
Diptera	Tipuliidae	sp. indet.									1				1	**C**
Hemiptera	Gerridae	*Gerris* sp.													8	**C**
Hemiptera	Veliidae	Veliidae nymph		2							1					**C**
Gastropoda	Tateidae	*Potamopyrgus antipodarum*	9	9	6	4	2	1	1	6				11		**C**
Arachnida	Hydrachnidiae	sp. indet.					1									**C**
Hirudinidae	Piscicolidae	*Piscicola* sp.												1		**C**
Gastropoda	Lymnaeidae	*Ampullacaena balthica*			4	1										**D**
Hirudinidae	Glossiphoniidae	*Glossiphonia complanata*			4											**D**
Diptera	Chironomidae	*Chironomus* spp.				1			1							**E**
Annelidae	Oligochaeta	sp. indet.	3	1	1		1	1						2		**n/a**
Abundance			**28**	**50**	**56**	**45**	**61**	**38**	**16**	**21**	**47**	**50**	**21**	**28**	**24**	
Q-rating			Q3	Q3	Q4	Q4	Q4	Q4	*Q3-4	Q3-4	*Q3	*Q3	Q4	Q3-4	*Q3	
WFD status			Poor	Poor	Good	Good	Good	Good	Mod	Mod	Poor	Poor	Good	Mod	Poor	

Table 8.2b Macro-invertebrate Q-sampling results for riverine sites in the vicinity of the proposed wind farm GCR, September 2023 (* = tentative rating)

Group	Family	Species	D21	D22	D23	D24	D25	D26	D29	D30	EPA class
Ephemeroptera	Ephemeridae	*Ephemera danica*		9	15	10	26	14	11	19	**A**
Ephemeroptera	Heptageniidae	*Ecdyonurus dispar*				1					**A**
Ephemeroptera	Heptageniidae	*Rhithrogena semicolorata*					3				**A**
Plecoptera	Chloroperlidae	*Siphonoperla torrentium*					1				**A**
Plecoptera	Perlodidae	*Isoperla grammatica*				1				8	**A**
Ephemeroptera	Baetidae	*Alainites muticus*		1	1	1				3	**B**
Plecoptera	Leuctridae	*Leuctra hippopus*	2	9	9	16	10	2	12	9	**B**
Trichoptera	Sericostomatidae	*Sericostoma personatum*			4	7	5		2	3	**B**
Hemiptera	Aphelocheiridae	*Aphelocheirus aestivalis*			2			1	5	1	**B**
Ephemeroptera	Ephemerellidae	*Serratella ignita*					1				**C**
Trichoptera	Hydropsychidae	*Hydropsyche instabilis*							1	1	**C**
Trichoptera	Hydropsychidae	*Hydropsyche siltalai*	4	1			2			2	**C**
Trichoptera	Philopotamidae	*Wormaldia occipitalis*					1				**C**
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*	1	2					3		**C**
Trichoptera	Polycentropodidae	*Polycentropus kingi*		1			1		2	2	**C**
Coleoptera	Dytiscidae	*Oreodytes septentrionalis*						1			**C**
Coleoptera	Elmidae	*Elmis aenea*		8		8		16	6	5	**C**
Coleoptera	Gyrinidae	*Gyrinus substriatus*								1	**C**
Coleoptera	Scirtidae	Scirtidae larva							1		**C**
Diptera	Chironomidae	Non-*Chironomus* spp.	1				1			1	**C**
Diptera	Culicidae	sp. indet.		1					1		**C**
Diptera	Limoniidae	*Antocha* sp.		9	15	10	26	14	11	19	**C**
Diptera	Pediciidae	*Dicranota* sp.				1					**C**
Diptera	Tipuliidae	sp. indet.					3				**C**
Hemiptera	Corixidae	*Hesperocorixa linnaei*					1				**C**

Group	Family	Species	D21	D22	D23	D24	D25	D26	D29	D30	EPA class
Hemiptera	Gerridae	*Gerris* sp.				1				8	**C**
Hemiptera	Notonectidae	Notonectidae nymph		1	1	1				3	**C**
Hemiptera	Veliidae	Veliidae nymph	2	9	9	16	10	2	12	9	**C**
Hirudinidae	Glossiphoniidae	*Glossiphonia complanata*			4	7	5		2	3	**D**
Diptera	Chironomidae	*Chironomus* spp.			2			1	5	1	**E**
Abundance			**8**	**40**	**37**	**56**	**85**	**36**	**47**	**58**	
Q-rating			*Q3	Q4	Q4	Q4	Q4	Q3-4	Q3-4	Q3-4	
WFD status			Poor	Good	Good	Good	Good	Mod	Mod	Mod	

Table 8.3 Macro-invertebrate Q-sampling results for riverine sites in the vicinity of the proposed wind farm TDR, September 2023 (* = tentative rating)

Group	Family	Species	E1	E2	E3	E4	E5	E7	EPA class
Ephemeroptera	Ephemeridae	*Ephemera danica*			3				**A**
Ephemeroptera	Heptageniidae	*Ecdyonurus dispar*	6		2				**A**
Ephemeroptera	Heptageniidae	*Heptagenia sulphurea*	2	1	3				**A**
Plecoptera	Nemouridae	*Protonemura meyeri*	5						**A**
Ephemeroptera	Baetidae	*Alainites muticus*	1					1	**B**
Plecoptera	Leuctridae	*Leuctra fusca*	5					1	**B**
Trichoptera	Hydroptilidae	*Ithytrichia* sp.			1				**B**
Trichoptera	Odontoceridae	*Odontocerum albicorne*	1						**B**
Trichoptera	Rhyacophilidae	*Rhyacophila dorsalis*		1	3			1	**B**
Trichoptera	Sericostomatidae	*Sericostoma personatum*						1	**B**
Ephemeroptera	Baetidae	*Baetis rhodani*	18		5				**C**
Ephemeroptera	Ephemerellidae	*Serratella ignita*	1		1				**C**
Trichoptera	Hydropsychidae	*Hydropsyche instabilis*	1						**C**
Trichoptera	Hydropsychidae	*Hydropsyche siltalai*	1		1				**C**
Trichoptera	Philopotamidae	*Chimarra marginata*			17				**C**

Group	Family	Species	E1	E2	E3	E4	E5	E7	EPA class
Trichoptera	Philopotamidae	*Wormaldia occipitalis*						3	**C**
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*						1	**C**
Trichoptera	Polycentropodidae	*Polycentropus kingi*					1	1	**C**
Crustacea	Gammaridae	*Gammarus duebeni*	2		3			19	**C**
Coleoptera	Dytiscidae	*Nebrioporus depressus*		1					**C**
Coleoptera	Elmidae	*Elmis aenea*	2		2			2	**C**
Coleoptera	Elmidae	*Limnius volckmari*	1						**C**
Diptera	Chironomidae	Non-*Chironomus* spp.					2		**C**
Diptera	Pediciidae	*Dicranota* sp.	1						**C**
Diptera	Simuliidae	sp. indet.	5		3				**C**
Diptera	Tipuliidae	sp. indet.					5		**C**
Hemiptera	Veliidae	Veliidae nymph						2	**C**
Gastropoda	Bithnyiidae	*Bithynia tentaculata*			3				**C**
Gastropoda	Tateidae	*Potamopyrgus antipodarum*	1	8					**C**
Gastropoda	Planorbidae	*Planorbis planorbis*			1				**C**
Gastropoda	Lymnaeidae	*Ampullacaena balthica*		1		277			**D**
Crustacea	Asellidae	*Asellus aquaticus*		2	1	4	4		**D**
Hirudinidae	Glossiphoniidae	*Glossiphonia complanata*					2		**D**
Diptera	Chironomidae	*Chironomus* spp.				8		1	**E**
Abundance			**53**	**14**	**49**	**289**	**14**	**33**	
Q-rating			Q4	Q3-4	Q4	*Q2	Q2-3	Q3	
WFD status			Good	Mod	Good	Bad	Poor	Poor	

Table 8.4 Macro-invertebrate Q-sampling results for pond sites P1, P2, P3 & P4, September 2023 (listed in order of abundance)

Group	Family	Species	P1	P2	P3	P4
Odonata	Coenagrionidae	sp. indet.	23	22	44	15
Diptera	Chaoboridae	sp. indet.	9	9		1
Hemiptera	Corixidae	*Corixa punctata*	7			
Hemiptera	Notonectidae	*Notonecta viridis*	7	6		
Diptera	Chironomidae	*Chironomus* spp.	4	3	9	2
Mollusca	Lymnaeidae	*Ampullacaena balthica*	4	3		
Diptera	Dixidae	sp. indet.	2			
Trichoptera	Polycentropodidae	*Plectrocnemia conspersa*	2	1		1
Diptera	Chironomidae	Non-*Chironomus* spp.	1		3	
Hemiptera	Corixidae	*Callicorixa praeusta*	1	1		
Hemiptera	Corixidae	*Sigara* sp.	1			
Odonata	Libellulidae	*Sympetrum* sp.	1		7	
Coleoptera	Dytiscidae	*Hygrotus inaequalis*		1		
Coleoptera	Dytiscidae	*Ilybius fuliginosus*		1		
Coleoptera	Gyrinidae	*Gyrinus aeratus*			1	
Coleoptera	Gyrinidae	*Gyrinus substriatus*				1
Diptera	Ceratopogonidae	sp. indet.			3	
Diptera	Culicidae	sp. indet.		1		
Ephemeroptera	Leptophlebiidae	*Paraleptoplebia* sp.			1	1
Hemiptera	Corixidae	*Hesperocorixa moesta*			2	
Mollusca	Sphaeriidae	sp. indet.		7		
Trichoptera	Leptoceridae	*Triaenodes bicolor*			1	
Abundance			**62**	**55**	**71**	**21**

10. Appendix D – aquatic survey site summaries for GCR & TDR sites

Table 10.1 Summary of GCR and TDR aquatic survey sites, September 2023

Site no.	Watercourse (EPA code)	Site characteristics	Fisheries summary	Biological water quality	Ecological evaluation	Representative site image
GCR crossings						
D1	Unnamed stream	Historically deepened & realigned stream (FW2). 0.5m wide, 0.1-0.2m deep. Slow-flowing glide & riffle with no pool. Bedded boulder, cobble & mixed gravels with moderate siltation. No macrophytes due to shading with occasional *Rhynchostegium riparioides*. Bordered by GA1 habitat.	Not of fisheries value due to small size & depths. No fish recorded.	Q3 (poor status)	Local importance (lower value)	
D2	Goolamore River (33G12)	Historically deepened lowland river (FW2) with semi-natural profile of slow-flowing glide & pool. 3m wide& 0.1-0.4m deep. Heavily silted boulder, cobble & mixed gravels. No macrophytes due to shading with abundant *Fontinalis antipyretica* & *Rhynchostegium riparioides*. Bordered by wet GA1 habitat.	Atlantic salmon, brown trout & minnow recorded. Moderate quality salmonid spawning, nursery & holding habitat.	Q3 (poor status)	**Local importance (higher value)**	
D3	Munhin River (33M03)	Large semi-natural lowland tributary of Owenmore River. 8-10m wide and 0.2-1.6m deep with profile of riffle, glide & pool. Abundant mixed gravels & sand with small boulder & cobble. Moderate siltation. Occasional *Potamogeton* sp., *Myriophyllum alterniflorum*, *Callitriche hamulata* & *Sparganium erectum* with frequent *Fontinalis antipyretica.* Bordered by wet GA1 habitat.	Atlantic salmon, brown trout, sea trout, lamprey (*Lampetra* sp.), minnow & flounder recorded. Good quality salmonid habitat with sub-optimal lamprey habitat.	Q4 (good status)	**Local importance (higher value)**	

Site no.	Watercourse (EPA code)	Site characteristics	Fisheries summary	Biological water quality	Ecological evaluation	Representative site image
D4	Unnamed river	Historically straightened & deepened lowland tributary (FW2) of Owenmore River. 1m wide & 0.05-0.1m deep with poor flows. Riffle & stagnant pools. Small boulder with cobble & heavily silted gravels. No macrophytes or aquatic bryophytes. Bordered by GA1 and WD4 habitat.	Not of fisheries value due to small size, shallow depths & poor flows. No fish recorded.	Q4 (poor status)	**Local importance (higher value)**	
D5	Ballybeg Stream (33B40)	Historically realigned lowland tributary (FW2) of Owenmore River. 1.5m wide & 0.05m deep with poor flows & much of bed exposed (dry). Small boulder & cobble with mixed gravels. No macrophytes or aquatic bryophytes. Bordered by BL3 habitat (Bangor Erris).	Not of fisheries value due to small size, shallow depths & poor flows. No fish recorded.	Q4 (poor status)	**Local importance (higher value)**	
D6	Srahanarry Stream (33S23)	Semi-natural upland spate tributary (FW1) of Owenmore River. 1.5-3m wide & 0.1-0.5m deep with boulder cascades. Boulder & cobble with localised mixed gravels. Moderate siltation. No macrophytes but occasional *Fontinalis antipyretica*, *Scapania undulata* & *Brachythecium rivulare*. Bordered by GA1 habitat.	Atlantic salmon & brown trout recorded. Good quality salmonid nursery & spawning habitat. Culvert was a significant barrier to fish passage.	Q4 (poor status)	**Local importance (higher value)**	
D7	Bellanumera Stream (33B38)	Historically realigned upland stream (FW1) with low summer flows. 0.5m wide & 0.05m deep. Exposed small boulder & cobble with coarse gravels, moderate siltation. No macrophytes or aquatic bryophytes. Bordered by wet GA1 habitat.	Not of fisheries value due to small size, depths & poor flows. No fish recorded.	Q3-4 (moderate status) (tentative rating)	Local importance (lower value)	

Site no.	Watercourse (EPA code)	Site characteristics	Fisheries summary	Biological water quality	Ecological evaluation	Representative site image
D8	Briska River	Semi-natural, high-energy upland spate tributary (FW1) of Owenmore River. 2.5-3m wide & 0.1-0.4m deep. Boulder cascades with boulder, cobble & mixed gravels with moderate siltation. No macrophytes but occasional *Fontinalis antipyretica* & *Rhynchostegium riparioides*. Bordered by GA1 habitat.	Atlantic salmon, brown trout & European eel recorded. Very good quality salmonid nursery & good quality spawning habitat. High value eel nursery.	Q3-4 (moderate status)	**Local importance (higher value)**	
D9	Unnamed stream	Historically deepened & realigned upland tributary (FW1) of Owenmore River. 0.5m wide & 0.05m with poor flows. Small boulder & cobble with localised coarse gravels. Moderate siltation. No macrophytes or aquatic bryophytes. Bordered by GA1 habitat.	Not of fisheries value due to small size, depths & poor flows. No fish recorded.	Q3 (poor status) (tentative rating)	Local importance (lower value)	
D10	Unnamed stream	Historically deepened upland tributary (FW1) of Owenmore River. 0.5m wide & 0.05-0.2m deep. Boulder cascades with low flows & shallow glide. Semi-dry bed with cobble & localised coarse gravels, moderate siltation. No macrophytes but occasional *Brachythecium rivulare*. Bordered by GA1 habitat.	Not of fisheries value due to small size, depths & poor flows. No fish recorded.	Q3 (poor status) (tentative rating)	Local importance (lower value)	
D11	Unnamed river	High gradient, seasonal upland tributary (FW1) of Owenmore River. 1-1.5m wide & 0.05m deep. Sinuous profile with cascades & localised pool with angular cobble & boulder. No macrophytes or aquatic bryophytes. Bordered by GA1 habitat.	Not of fisheries value due to small size, depths & poor flows. No fish recorded.	Q3 (poor status) (tentative rating)	Local importance (lower value)	

Site no.	Watercourse (EPA code)	Site characteristics	Fisheries summary	Biological water quality	Ecological evaluation	Representative site image
D12	Unnamed river	Very high gradient, ephemeral upland tributary (FW1) of Owenmore River. 2m wide & dry at the time of survey. Large boulder & cobble bed. No macrophytes or aquatic bryophytes. Bordered by GA1 habitat.	Not of fisheries value due to ephemeral (dry) nature.	n/a (dry channel)	Local importance (lower value)	
D13	Unnamed river	Very high gradient, ephemeral upland tributary (FW1) of Owenmore River. 1m wide & dry at the time of survey. Large boulder & cobble bed. No macrophytes or aquatic bryophytes.	Not of fisheries value due to ephemeral (dry) nature.	n/a (dry channel)	Local importance (lower value)	
D14	Unnamed stream	Very high gradient, ephemeral upland tributary (FW1) of Owenmore River. 1m wide & dry at the time of survey. Large boulder & cobble bed. No macrophytes or aquatic bryophytes.	Not of fisheries value due to ephemeral (dry) nature.	n/a (dry channel)	Local importance (lower value)	
D15	Unnamed stream	Very high gradient, ephemeral upland tributary (FW1) of Owenmore River. 1m wide & dry at the time of survey. Large boulder & cobble bed. No macrophytes or aquatic bryophytes.	Not of fisheries value due to ephemeral (dry) nature.	n/a (dry channel)	Local importance (lower value)	

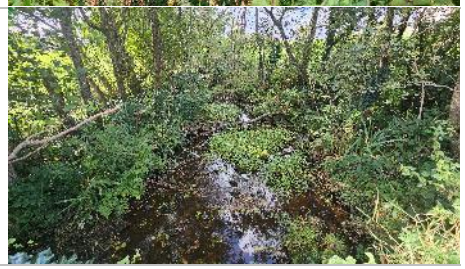
Site no.	Watercourse (EPA code)	Site characteristics	Fisheries summary	Biological water quality	Ecological evaluation	Representative site image
D16	Unnamed river	Very high gradient, ephemeral upland tributary (FW1) of Owenmore River. 2m wide & dry at the time of survey. Large boulder & cobble bed. No macrophytes or aquatic bryophytes.	Not of fisheries value due to ephemeral (dry) nature.	n/a (dry channel)	Local importance (lower value)	
D17	Unnamed stream	Very high gradient, ephemeral upland tributary (FW1) of Owenmore River. 1m wide & dry at the time of survey. Large boulder & cobble bed. No macrophytes or aquatic bryophytes.	Not of fisheries value due to ephemeral (dry) nature.	n/a (dry channel)	Local importance (lower value)	
D18	Unnamed stream	High gradient, upland tributary (FW1) of Owenmore River in incised valley. 1.5-2m wide & 0.1-0.3m deep. Boulder cascades with boulder, cobble & mixed gravels with light siltation. No macrophytes or aquatic bryophytes. Bordered by WN2 habitat.	Brown trout & European eel recorded. Moderate quality salmonid & eel nursery.	Q3-4 (moderate status)	**Local importance (higher value)**	
D19	Unnamed stream	Ephemeral U-shaped, 2m wide drainage channel (FW4) tributary of Owenmore River, dry at the time of survey. No macrophytes or aquatic bryophytes. Bordered by GA1 habitat.	Not of fisheries value due to ephemeral (dry) nature.	n/a (dry channel)	Local importance (lower value)	

Site no.	Watercourse (EPA code)	Site characteristics	Fisheries summary	Biological water quality	Ecological evaluation	Representative site image
D20	Unnamed stream	U-shaped drainage channel (FW4) tributary of Owenmore River, 0.5m wide with no flows & stagnant pools of peaty water. Peat bed (no hard substrata). No macrophytes or aquatic bryophytes. Bordered by GA1 habitat.	Not of fisheries value due to small size, depths & poor flows. No fish recorded.	Q3 (poor status) (tentative rating)	Local importance (lower value)	
D21	Unnamed stream	Historically straightened & deepened upland tributary (FW1) of Owenmore River. 0.5m wide with stagnant shallow water (no flows). Boulder & cobble bed with iron-oxidising bacteria. No macrophytes but *Scapania undulata* locally. Bordered by wet GA1 habitat.	Not of fisheries value due to small size, depths & poor flows. No fish recorded.	Q3 (poor status) (tentative rating)	Local importance (lower value)	
D22	Unnamed stream	Meandering upland tributary (FW1) of Owenmore River. 1-1.5m wide & 0.05-0.15m deep. Riffle & glide with boulder, cobble & bedded, heavily silted mixed gravels. *Veronica beccabunga* along margins with *Rhynchostegium riparioides* & *Hygrohypnum ochraceum*. Bordered by wet GA1 & WD4.	Brown trout recorded. Moderate quality salmonid nursery & spawning habitat, no holding.	Q4 (good status)	**Local importance (higher value)**	
D23	Unnamed stream	High gradient upland tributary (FW1) of Owenmore River. 1-1.5m wide & 0.1-0.3m deep with low flows. Boulder cascades with glide & pool. Boulder, cobble & bedded, heavily silted mixed gravels. No macrophytes but *Rhynchostegium riparioides* on boulders. Bordered by wet GA1.	Brown trout recorded. Moderate quality salmonid nursery, spawning & holding habitat.	Q4 (good status) (tentative rating)	**Local importance (higher value)**	

Site no.	Watercourse (EPA code)	Site characteristics	Fisheries summary	Biological water quality	Ecological evaluation	Representative site image
D24	Unnamed river	High gradient upland tributary (FW1) of Owenmore River. 2m wide & 0.1-0.4m deep with low flows. Boulder cascades with cobble & bedded, heavily silted mixed gravels. No macrophytes but *Chiloscyphus polyanthos* & *Rhynchostegium riparioides* on boulders. Bordered by wet GA1 & WS1.	Brown trout recorded. Moderate quality salmonid nursery & spawning habitat with good quality holding.	Q4 (good status)	**Local importance (higher value)**	
D25	Unnamed river	Moderate gradient upland tributary (FW1) of the Owenmore River. 2-4m wide and 0.2-0.4m deep. Boulder cascades with local riffle-glide-pool sequences. Boulder, cobble & silted mixed gravels. No macrophytes but frequent *Rhynchostegium riparioides*. Bordered by wet GA1 & WS1.	Atlantic salmon, brown trout & European eel recorded. Excellent quality salmonid nursery with good quality spawning & moderate quality holding habitat. Moderate value for eel.	Q4 (good status)	**Local importance (higher value)**	
D26	Unnamed stream	Historically deepened & straightened upland tributary (FW1) of Owenmore River. 1.5m wide & 0.1-0.2m deep. Shallow glide with riffle & localised pool. Boulder, cobble & mixed gravels with high filamentous algal cover & moderate siltation. No macrophytes but abundant *Rhynchostegium riparioides* & *Fontinalis antipyretica*. Bordered by GA1.	Atlantic salmon, brown trout & minnow recorded. Moderate quality salmonid nursery & spawning with poor holding habitat.	Q3-4 (moderate status)	**Local importance (higher value)**	
D27	Kilsallagh Stream (33K13)	Ephemeral U-shaped, 0.5m wide drainage channel (FW4) tributary of Owenmore River, dry at the time of survey. No macrophytes or aquatic bryophytes. Bordered by GA1 habitat.	Not of fisheries value due to ephemeral (dry) nature	n/a (dry channel)	Local importance (lower value)	

Site no.	Watercourse (EPA code)	Site characteristics	Fisheries summary	Biological water quality	Ecological evaluation	Representative site image
D28	Unnamed stream	Ephemeral U-shaped, 2m wide drainage channel (FW4) tributary of Owenmore River, dry at the time of survey. No macrophytes or aquatic bryophytes. Bordered by GA1 habitat.	Not of fisheries value due to ephemeral (dry) nature	n/a (dry channel)	Local importance (lower value)	
D29	Unnamed stream	Historically deepened & straightened upland tributary (FW1) of Owenmore River. 1-1.5m wide & 0.1-0.2m deep. Shallow glide with riffle & localised pool. Boulder, cobble & coarse gravels with moderate siltation. No macrophytes but abundant *Rhynchostegium riparioides*. Bordered by GA1.	Brown trout recorded. Poor to moderate quality salmonid nursery & spawning with poor holding habitat.	Q3-4 (moderate status)	**Local importance (higher value)**	
D30	Unnamed stream	Historically deepened & straightened upland tributary (FW1) of Owenmore River. 1m wide & 0.1-0.2m deep. Shallow glide with riffle & localised pool. Boulder, cobble & heavily bedded coarse gravels with moderate siltation. *Veronica beccabunga*, *Apium nodiflorum* & *Iris psuedacorus* with but abundant *Brachythecium rivulare*. Bordered by GA1.	Brown trout, minnow & three-spined stickleback recorded. Poor quality salmonid habitat overall.	Q3-4 (moderate status)	**Local importance (higher value)**	
TDR nodes						
E1	Moneynierin River (33M16)	Upland eroding river (FW1), 2-3m wide & 0.1-0.4m deep. Riffle, glide & pool with boulder, cobble & mixed gravels. High filamentous algal cover. *Sparganium erectum, Myriophyllum alterniflorum* & *Juncus bulbosus* instream with *Carex rostrata*. Bordered by PB2.	Atlantic salmon, brown trout & three-spined stickleback recorded. Moderate quality salmonid spawning, nursery & holding habitat.	Q4 (good status)	**Local importance (higher value)**	

Site no.	Watercourse (EPA code)	Site characteristics	Fisheries summary	Biological water quality	Ecological evaluation	Representative site image
E2	River Deel (34D01)	Large, semi-natural lowland karstic limestone river (FW1) with low seasonal flows at time of survey. 35m wide & 0.2-0.5m deep with frequent stagnant pools (no flows). Boulder & cobble bed with locally frequent *Fontinalis antipyretica* and *Cinclidotus fontinaloides.* Bordered by BL3 habitat (Crossmolina)	Atlantic salmon, roach, minnow & three-spined stickleback recorded. Good quality salmonid nursery & spawning habitat, moderate quality holding (under normal flows). Unsuitable for lamprey. Freshwater pearl mussel known upstream.	Q3-4 (moderate status)	**International importance (located within River Moy SAC**)	
E3	Ballisodare River (35B05)	Large, semi-natural lowland river (FW2), 30m wide & 0.2-1.5m deep. Riffle, glide & pool with boulder, cobble & mixed gravels. Moderate siltation. Occasional *Ranunculus* sp., *Schoenoplectus lacustris*, *Sparganium erectum* & *Apium nodiflorum* with frequent *Fontinalis antipyretica*, *Rhynchostegium riparioides* and occasional *Chiloscyphus polyanthos* & *Cinclidotus fontinaloides*. Bordered by BL3 habitat.	Atlantic salmon, brown trout & European eel recorded. Very good quality salmonid nursery & holding habitat with good quality spawning. High value for eel. 2 no. otter spraint sites	Q4 (good status)	**International importance (located within Unshin River SAC**)	
E4	Carrowgobbadagh Stream (35C95)	Historically deepened & straightened tidal channel (CW3) downstream of attenuation pond. 3m wide & 1-2m deep. Soft silt bed with abundant macrophytes, *Callitriche stagnalis*, *Potamogeton* sp. & *Ranunculus* sp. (Annex I 3260). Abundant filamentous algae. Bordered by BL3 habitat.	European eel & three-spined stickleback recorded. Poor quality salmonid habitat but of high value as an eel nursery.	Q2 (bad status) (tentative rating)	**Local importance (higher value)**	

Site no.	Watercourse (EPA code)	Site characteristics	Fisheries summary	Biological water quality	Ecological evaluation	Representative site image
E5	Abbeylands Stream (36A15)	U-shaped drainage channel tributary (FW4) of Abbey River. 0.5m wide & 0.1-0.2m deep with very low flows at time of survey. Deep silt bed with marginal *Apium nodiflorum*. Bordered by WS1 & WL2 habitat.	Not of fisheries value due to small size, depths & poor flows. No fish recorded.	Q2-3 (poor status)	Local importance (lower value)	
E6	Drumgowan Stream (37D49)	Ephemeral U-shaped, 0.5m wide drainage channel (FW4) tributary of Owenmore River, dry at the time of survey. No macrophytes or aquatic bryophytes. Bordered by BL3 & GA2 habitat.	Not of fisheries value due to ephemeral (dry) nature	n/a (dry channel)	Local importance (lower value)	
E7	Bogside River (37B26)	Historically deepened & realigned lowland river (FW2). 1-1.5m wide & 0.1-0.2m deep with slow-flowing glide & occasional pool. Heavily bedded boulder, cobble & coarse gravels with high siltation. *Apium nodiflorum* in margins with occasional *Fontinalis antipyretica* & *Chiloscyphus polyanthos*. Bordered by GS4 habitat.	Not of fisheries value due to small size, depths & poor flows. No fish recorded.	Q3 (poor status)	Local importance (lower value)	

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Appendix 4 Habitat Condition Assessment Report

AA Screening and Natura Impact Statement

Muingmore Wind Farm

RWE Renewables Ireland Limited

SLR Project No.: 501.065301.00001

Habitat Condition Assessment

Muingmore Wind Farm

RWE Renewables Ireland

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3	18 March 2026	Andrew Torsney	Richard Arnold	Gareth Hughes
	Click to enter a date.			
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1.0 Overview

Cutover Bog (PB4) and Lowland Blanket Bog (PB3) were recorded within the Proposed Development Site, comprising the Wind Farm footprint (Main Wind Farm Development Site) and the three overrun areas. Full habitat descriptions and mapping are provided in Technical Appendices 5-1 (Technical Habitat Report, Proposed Development Site) and 5-6 (this report) of this EIAR. Several areas exhibit physical structure and plant community composition consistent with the Annex I habitat Blanket Bog [7130]. Where hydrological and vegetative functions are intact, this habitat qualifies as a priority habitat under the Habitats Directive.

Importantly, classification as Cutover Bog (PB4) under the Fossitt system does not preclude alignment with Annex I Blanket Bog [7130]. Annex I classification is determined by geomorphology, peat depth, hydrological regime, and characteristic species assemblages, rather than habitat condition alone. Consequently, areas classified as PB4 may still meet Annex I criteria where these defining attributes are present, irrespective of degradation status.

2.0 Methods

The Proposed Development Site was surveyed in accordance with Best Practice Guidance for Habitat Survey and Mapping published by the Heritage Council of Ireland. Habitats were classified using the standard descriptions and codes set out in 'A Guide to Habitat Types in Ireland' (Heritage Council).

Survey work was undertaken in two phases. The Proposed Main Wind Farm Development Site was surveyed by Dr Alex Fitzgerald (refer to Appendix 5-1), while the three overrun areas were surveyed by Dr Andrew Torsney (refer to Appendix 5-6, this report). Habitat extents were mapped using GIS to calculate the area of each habitat type within the Proposed Development Site.

2.1 Proposed Main Wind Farm Development Site Survey Effort

Within the Proposed Main Wind Farm Development Site, approximately 185 hectares of peatland habitat were identified within the site boundary. In accordance with the Integrated Wetland Management (IWM) guidance, a minimum of 16 habitat condition monitoring plots would be required to characterise habitat condition at this scale. However, a total of 28 plots were undertaken to provide a more robust and spatially representative assessment of species composition and habitat condition. This enhanced survey effort reflects the presence of seven discrete locations where direct habitat loss is proposed. Two monitoring plots were located within each area of potential impact, with a further two plots established in the immediate surrounding habitat to provide contextual baseline condition data. This approach allows for a more defensible comparison between impacted and non-impacted areas and strengthens confidence in the assessment of habitat condition and impact significance. Across all areas mapped as PB4 and/or PB3 habitat a series of 2x2 m plots were assessed across the site.

A total of 28 plots were recorded for the Proposed Main Wind Farm Development Site, 14 of which were within the proposed footprint of the development and 14 were outside of the intended footprint. The data was collected between 11th and the 14th of November 2024 by SLR's Technical Director Andrew Torsney in accordance with the Irish Wildlife Manual No

128[1] and No.79[2]. For the Proposed Main Windfarm Site, the twenty-eight monitoring stops were selected ensuring they were well dispersed across the site (Figure 3-1).

2.2 Overrun Areas Survey Effort

The overrun areas had roughly 14.7 ha of peatland habitats identified – therefore, only 4 quadrats were required. Overrun area 1 had 4 quadrats undertaken and we undertook 8 quadrats at overrun area 3. It was decided to do 8 at the overrun area 3 because the location has been previously mapped as a favourable reference area (FRF) in the Article 17 mapping data. As there were no Annex I peatlands at overrun area 2 no condition assessment was necessary. Across all areas mapped as PB4 and/or PB3 habitat a series of 2x2 m plots were assessed across the site.

The overrun area data was collected between 7th and the 8th of January 2026 by SLR's Technical Director Andrew Torsney in accordance with the Irish Wildlife Manual No 128[3] and No.79[4]. It is important to note that no PB4 or PB3 habitat was recorded in overrun area 2 – therefore no condition assessment was required. The twelve monitoring stops recorded in overrun areas 1 and 3 were dispersed across the sites (Figure 5-2 and Figure 5-3).

2.3 Condition Assessment Methods

At each of these monitoring stops a 2x2 m quadrat was set and all species within were identified using vegetative identification techniques. Plant species nomenclature follows Stace 4 and the percentage cover of each species was identified. Moreover, the criteria were assessed at each quadrat as well as a 20m radius around the monitoring stops according to the relevant IWM assessment methods. For all quadrats the Annex I habitat Blanket bogs (* if active bog) [7130] condition assessment criteria were recorded.

In addition to the above – for the Proposed Main Wind Farm Development Site – a condition assessment was undertaken followed the DEFRA metric. Furthermore, it was noted that at this site the community composition of the vegetation aligned more closely with a mosaic of Northern Atlantic wet heaths with *Erica tetralix* [4010] and European dry heaths [4030] (despite the deep peat substrate). Therefore, as a precaution we recorded the condition assessment for these two habitats also. These are not presented in this report as they are not deemed necessary for the purposes of the assessment – the goal is to provide a 35-year habitat management plan to achieve good status of Blanket Bog habitat which has a higher ecological value and is more appropriate for deep peat.

Further consideration was given to possible occurrences of rare or legally protected plant species (as listed in Flora Protection Order 1999) or Red-listed plant species (Curtis & McGough 1998[5], Wyse Jackson et al. 2016[6]).

[1] Smith, G.F. & Crowley, W. (2020) The habitats of cutover raised bog. Irish Wildlife Manuals, No. 128. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

[2] Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

[3] Smith, G.F. & Crowley, W. (2020) The habitats of cutover raised bog. Irish Wildlife Manuals, No. 128. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

[4] Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

[5] Curtis, T.G.F. & McGough, H.N. (1988) The Irish Red Data Book. 1 Vascular Plants. Stationery Office, Dublin.

[6] Wyse Jackson, M., FitzPatrick, Ú., Cole, E., Jebb, M., McFerran, D., Sheehy Skeffington, M. & Wright, M. (2016) Ireland Red List No. 10: Vascular Plants. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Dublin, Ireland.

Regarding the condition assessment – once the data is recorded the assessment of condition is undertaken based on the pass-fail rates for each of the criteria. Monitoring stops with no failed criteria automatically pass at the stop level. When monitoring stops have failed one or more criteria expert judgement of the ecological condition of those stops may be employed to reassess whether any of those stops might legitimately be permitted to pass, for example if there has been a marginal failure of a single criterion. All other stops are deemed to have failed. In general, it is understood that 4 or more fails is an overall failure of the monitoring stop. At a site level the structure and function of the habitat is assessed regarding Table 2.1.

Table 2.1 Determining site level results for structure and function as per the IWM

Conservation Status	Favourable Good (green)	Unfavourable Inadequate (amber)	Unfavourable Bad (red)
Criteria	No stops fail	1-25% of stops fail	> 25% of stops fail

2.4 Limitations

The survey was conducted in the sub optimal period. However, vegetative identification was used, meaning the flowering heads were not needed to record the species. All species found on site were identified. Cryptic species such as orchids, which would be sub-terranean in this period, were not possible to ID. Overall this is not identified to be a significant limitation, but it does hinder the reliability of the data slightly – this was considered throughout the assessment process.

3.0 Proposed Main Wind Farm Development Site Results

In general, the Proposed Main Wind Farm Development Site is of generally consistent community composition with some patches of obvious pine encroachment from the surrounding woodland, but beyond the scrub encroachment there is no spatial variation to note. A total of 46 species were identified across the site at various levels of percentage cover within each quadrat (as can be seen in Appendix A, Table 3.2 and Table 3.3).

Each quadrat was identified to have a good level of within plot diversity, with the data generally ranging from 0.61-0.88; however, there is one quadrat which has Simpsons index reported at 0.44 (Figure 3-1). However, despite this diversity the overall species composition and condition did not align with good habitat condition.

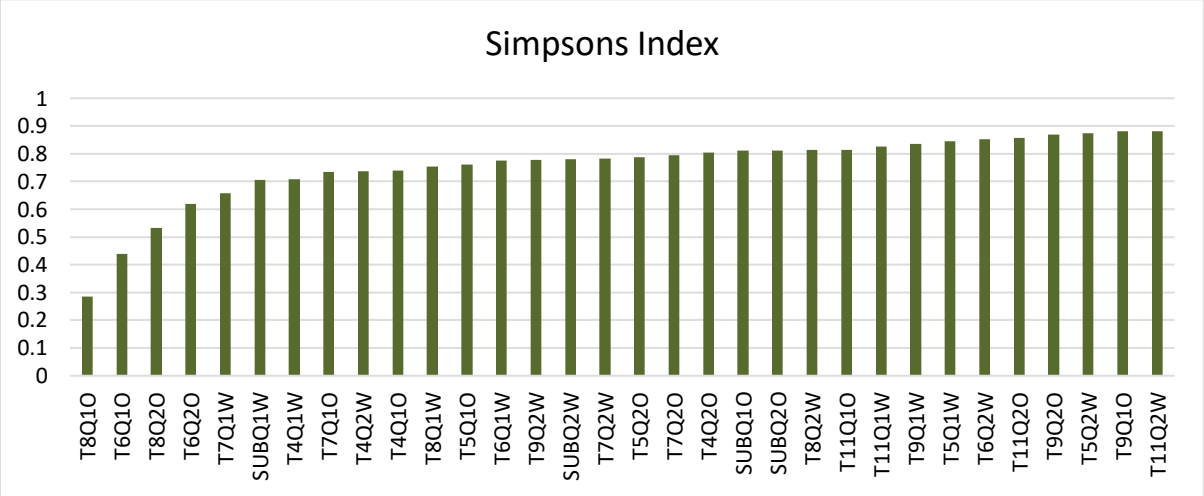

Figure 3-1 Simpsons index for each quadrat showing a range from 0.44 to 0.88

The habitats on site were mapped (Figure 3-3). However, due to accessibility some of the areas had to be identified from a distance, which precluded the ability to conduct a complete condition assessment. The areas used for the condition assessment can be found in Figure 3-4. It is important to note that the full extent of each habitat as mapped in the full habitat map will be used for any BNG assessments following a worst-case scenario approach assuming these areas to be consistent with the condition of the highest rated parcel of land.

In general, the habitats identified on site were of low to moderate condition. This is because the site is extensively drained, with high instances of scrub encroachment prevalent throughout, and invasive species such as Rhododendron and Prickly Heath present throughout the site. The areas where moderate habitat condition was identified were due to a higher abundance of Sphagnum that in other areas, as can be seen in Table 3.2 – and Appendix B.

Table 3.1 Habitat condition assessment results as per the UK habitats process for each of the locations in Figure 3-2 – full details are in Appendix B

Condition Area	Condition Index Value	Passes
Location 1	*Moderate (2)*	*3 Core, 1 Additional*
Location 2	*Low (1)*	*3 Core Only*
Location 3	*Low (1)*	*3 Core Only*
Location 4	*Low (1)*	*3 Core Only*
Location 5	*Moderate (2)*	*3 Core, 1 Additional*
Location 6	*Moderate (2)*	*3 Core, 1 Additional*
Location 7	*Low (1)*	*3 Core Only*
Location 8	*Moderate (2)*	*3 Core, 1 Additional*

As expected, none of the monitoring stops passed the criteria for Blanket Bog [7130]. See Appendix C full details.

4.0 Overrun Areas Site 1 Results

This habitat is assessed as Favourable condition. Vegetation composition and structure are consistent with Annex I blanket bog, with a well-developed hummock–hollow microtopography and a characteristic assemblage of bog indicator species. Sphagnum mosses are frequent (up to c.30% cover, highest in the south), supporting active peat-forming processes. Although overall cover remains below the ≥40% threshold required to qualify as priority active peatland.

Hydrological condition is broadly intact: drainage features are shallow, discontinuous and largely infilled by Sphagnum, indicating limited functional impact, despite the site appearing drier than expected in winter, particularly toward the north. Lichen diversity is notable and there is limited evidence of severe degradation. Areas of standing water with near-complete Sphagnum cover in the southern extent are interpreted as re-vegetated, likely anthropogenic pools and have been mapped separately to reflect their wetter character.

Condition scoring under the DEFRA metric indicates Good (3) condition - 5 Core and 1 additional criterion. All monitoring stops pass the IWM blanket bog criteria. Overall, the habitat is in favourable ecological condition and, while not currently qualifying as priority active blanket bog, it is considered close to that threshold and retains clear potential for restoration through enhanced water retention and further Sphagnum development.

5.0 Overrun Areas Site 3 Results

This area is assessed as Unfavourable - Bad (current condition) based on field evidence. The habitat has been subject to recent and extensive anthropogenic disturbance, including

rotavation and levelling, resulting in widespread exposure of bare peat (c.70%), loss of peatland vegetation structure, absence of Sphagnum, and a disrupted hydrological regime characterised by deep perimeter drains and internal scars. Vegetation present is indicative of early recolonisation and secondary succession, dominated by rushes and competitive grasses, with community composition aligning more closely with wet grassland on deep peat than functioning blanket bog. Both IWM and DEFRA condition assessments fail across all relevant criteria, confirming severe degradation and very low current ecological functionality as blanket bog.

For biodiversity accounting purposes only, the habitat is treated as Favourable / Good based on its designation as an Article 17 Favourable Reference Area for blanket bog. This does not reflect the present ecological state.

Figure 5-1 Layout of quadrat locations on Proposed Development Site

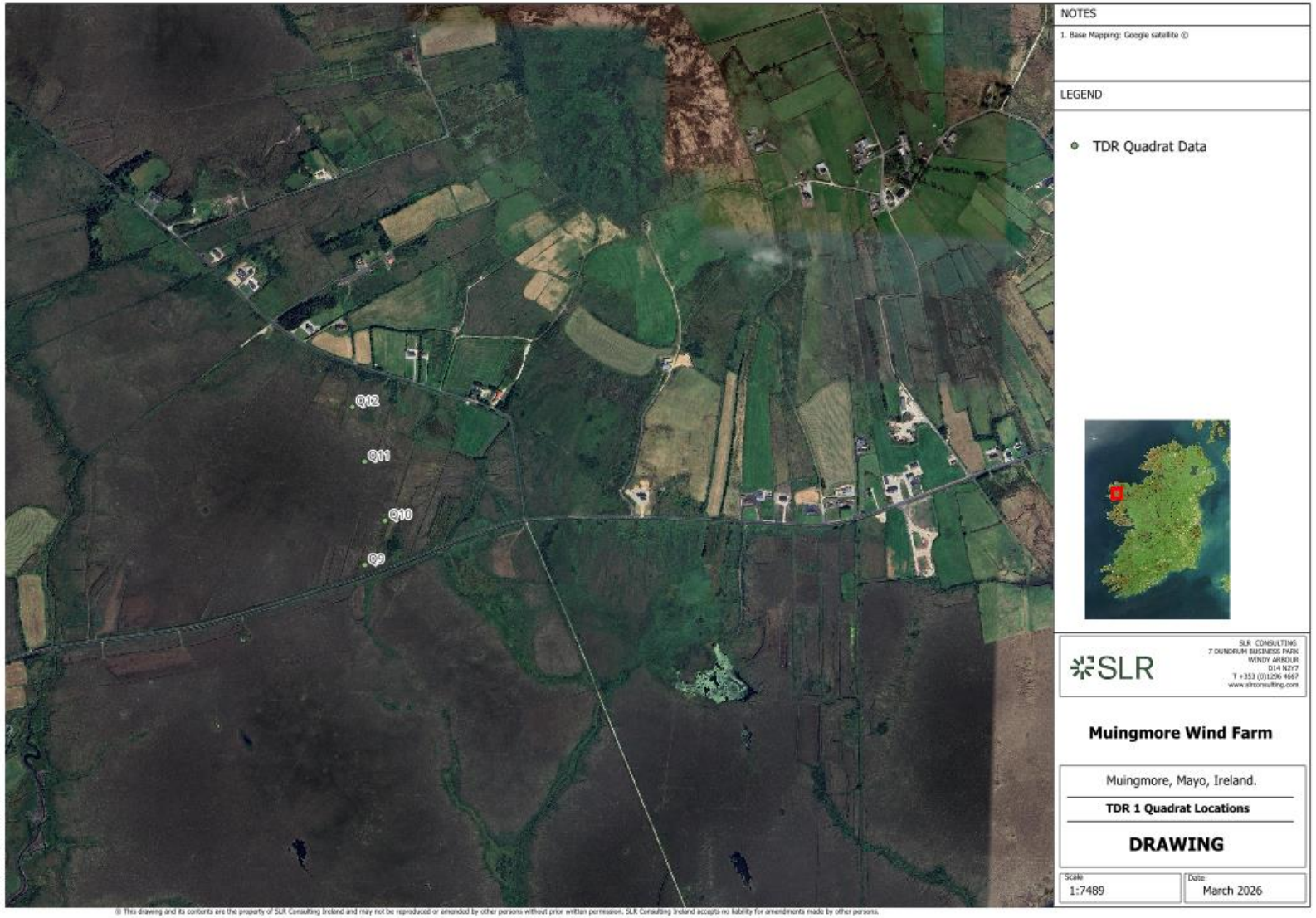

Figure 5-2 Layout of Quadrats at TDR 1

Figure 5-3 Layout of Quadrats at TDR 3

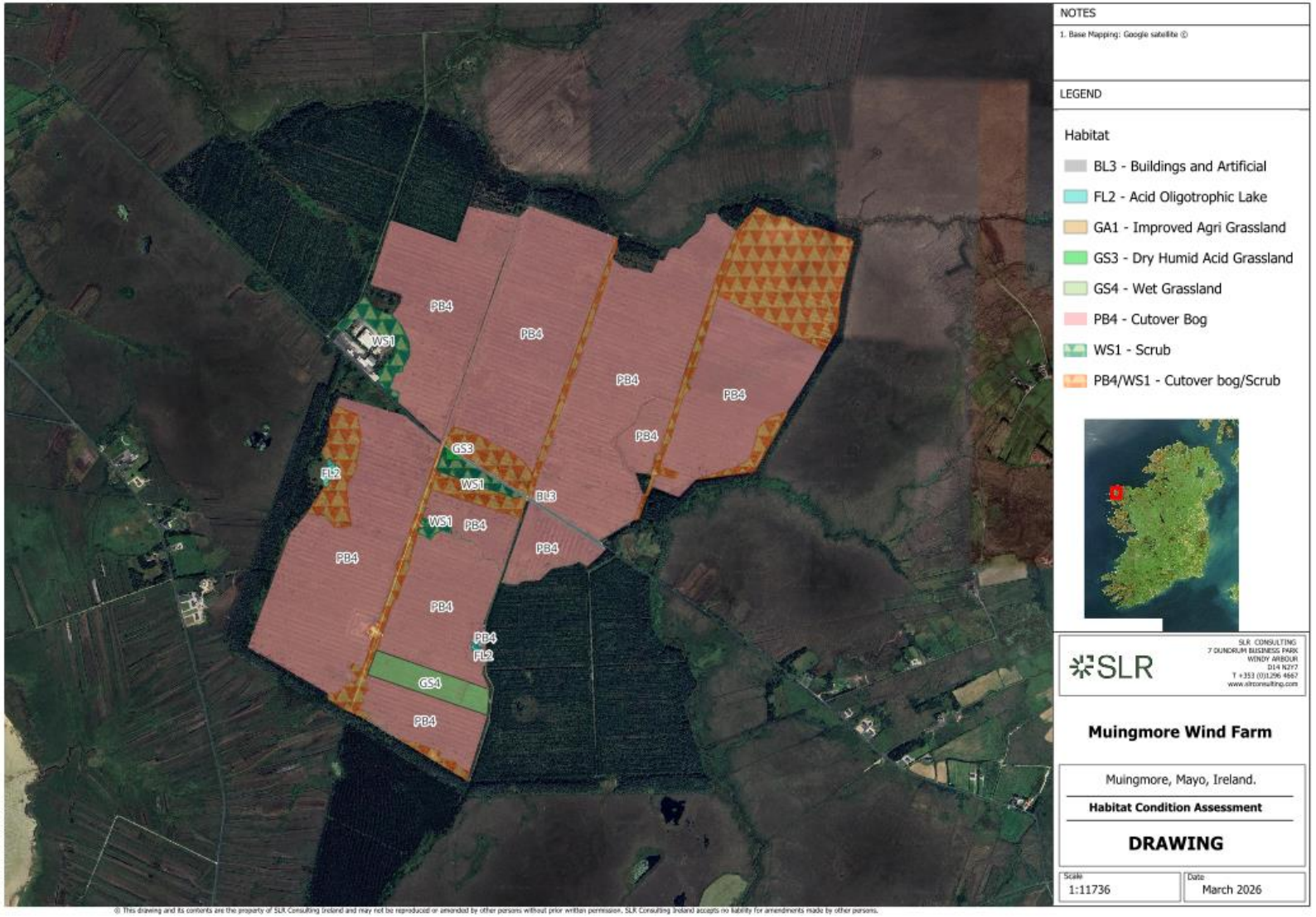

Figure 5-4 Peatland Habitat Map for the Main Windfarm Site

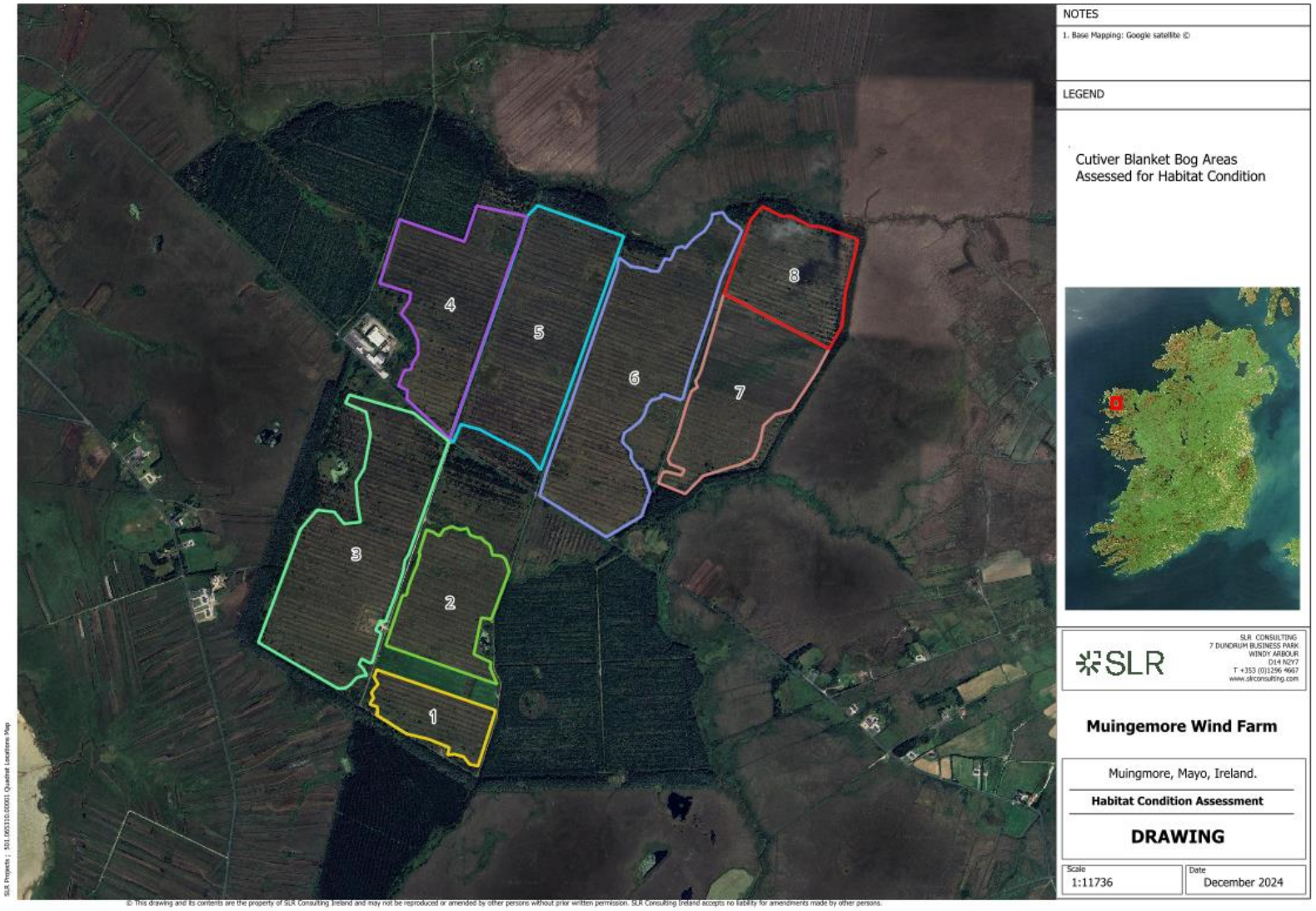

Figure 5-5 Areas of cutover lowland blanket bog assessed for habitat condition

Figure 5-4 Peatland Habitat Map for TDR 1 and TDR 3

6.0 Conclusion

The habitats recorded across the Proposed Development Site comprise blanket bog (PB3) and cutover bog (PB4), corresponding to Annex I Lowland Blanket Bog [7130]. No areas meet the criteria for priority active blanket bog, as Sphagnum cover remains below the ≥40% threshold required to demonstrate sustained active peat formation.

Current habitat condition across much of the site is constrained by historic and ongoing anthropogenic pressures, most notably extensive artificial drainage, scrub and woodland encroachment, and the widespread presence of invasive non-native species, particularly *Rhododendron ponticum*. These pressures have resulted in disrupted hydrological function, altered vegetation structure, and reduced peatland integrity, such that large areas fail to meet condition criteria for favourable blanket bog despite moderate within-plot species diversity.

Notwithstanding this, peat depth remains substantial across the Proposed Development Site and remnants of characteristic blanket bog communities persist, particularly where Sphagnum is locally frequent and drainage features are partially infilled. This indicates that the site retains high restoration potential. Targeted measures focused on hydrological restoration, scrub and invasive species control, and the promotion of Sphagnum recovery are likely to deliver substantial ecological gains. With appropriate management intervention, improvement to Good (3) condition is considered achievable, though this should not be assumed to occur rapidly or uniformly across the site.

Overall, the Proposed Development Site represents a degraded but recoverable peatland system, where current condition reflects management history rather than inherent ecological limitation.

Appendix A Plot data – Species Composition and Habitat Classification

Muingmore Windfarm

RWE Renewables Ireland

Glasshouses 2, 92 George's Street Lower Dún Laoghaire, Co. Dublin, A96 VR66

Prepared by:

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7 Dundrum Business Park, Windy Arbour, Dublin, D14 N2Y7

SLR Project No.: 501.V00727.00008

Species list and relative composition of each quadrat – part 1 of 4

Species (Scientific Name)	T11-Q1W	T11-Q2W	T11-Q1O	T11-Q2O	SUB-Q1W	SUB-Q2W	SUB-Q1O	SUB-Q2O	T4-Q1W	T4-Q2W	T4-Q1O	T4-Q2O
Golden-head Moss (Breutelia chrysocoma)	12	5	3	2	15	8	12	4	5	0	4	0
Heather* (Calluna vulgaris)	65	35	55	18	75	50	60	60	8	6	5	30
Sedges (Carex spp.)	2	30	8	2	8	15	15	18	75	5	3	20
Cross-leaved heath (Erica tetralix)	5	1	5	3	1	0	0	0	0	0	0	3
Common Cottongrass (Eriophorum angustifolium)	20	18	8	30	2	3	2	0	3	0	10	40
Bog-myrtle (Myrica gale)	2	12	0	0	0	0	0	0	0	0	4	0
Bog Asphodel (Narthecium ossifragum)	2	0	0	0	0	0	0	0	0	0	0	0
Non-crustose lichens (Noncrustose lichens)	0	3	3	5	4	2	4	15	21	0	1	0
Lousewort (Pedicularis sylvatica)	0	0	0	0	0	0	0	0	0	5	0	0
Heath Milkwort (Polygala serpyllifolia)	0	0	1	0	0	2	0	2	0	1	2	3
Tormentil (Potentilla erecta)	0	0	0	0	2	2	2	1	3	1	1	2
Black Bog-rush (Schoenus nigricans)	0	0	0	0	0	0	0	0	0	0	0	0
Sphagnum Moss (Sphagnum spp.)	20	4	22	22	8	11	25	5	3	25	70	40
Devil's-bit Scabious (Succisa pratensis)	0	1	0	0	0	0	0	0	0	0	0	0
Deergrass (Trichophorum germanicum)	0	0	0	0	0	0	4	2	0	12	2	0
Bearberry (Arctostaphylos uvaursi)	20	5	6	30	2	1	0	0	0	0	2	0
Bristly Swan-neck Moss (Campylopus atrovirens)	0	1	0	0	0	0	0	0	0	0	0	0
Soft Rush (Juncus effusus)	20	15	50	20	20	5	35	20	2	76	75	0
Pine sp.	5	0	3	0	0	0	0	0	0	0	0	0
Ragwort (Jacobaea vulgaris)	3	1	2	0	0	0	0	0	0	0	0	0
Hard Fern (Blechnum spicant)	1	1	0	0	5	2	2	3	3	0	5	0
Autumn hawkbit (Scorzoneroides autumnalis)	5	2	4	2	2	5	5	4	3	17	10	2
Bog pimpernel (Anagallis tenella)	1	0	0	0	0	0	0	0	0	0	0	0
Creeping buttercup (Ranunculus repens)	2	2	2	4	4	3	3	4	3	2	4	3
Blue sedge (Carex flacca)	0	30	6	0	0	3	3	12	0	0	0	0

Species (Scientific Name)	T11-Q1W	T11-Q2W	T11-Q1O	T11-Q2O	SUB-Q1W	SUB-Q2W	SUB-Q1O	SUB-Q2O	T4-Q1W	T4-Q2W	T4-Q1O	T4-Q2O
Marsh hair moss (Polytrichum commune)	0	2	0	0	0	0	0	0	0	0	0	0
Other moss	0	11	2	0	0	0	0	0	0	0	0	0
Soft Shield Fern (Polystichum setiferum)	0	0	2	2	0	0	0	0	0	6	0	0
Poa sp.	0	1	2	3	0	0	0	0	0	0	0	0
Fescue (Festuca rubra)	2	2	0	5	0	4	4	3	0	0	2	12
Prickly Heath (Gaultheria mucronata)	0	0	0	0	0	1	1	8	0	0	0	0
Great wood-rush (Luzula sylvatica)	0	0	0	0	0	0	0	0	0	0	0	0
Yorkshire fog (Holcus lanatus)	0	0	0	0	0	0	0	0	0	0	3	0
Cocksfoot (Dactylis glomeratus)	0	0	0	0	0	0	0	0	0	0	0	0
Heath Bedstraw (Galium saxatile)	0	0	0	0	0	0	0	0	0	0	1	0
Bare Gound	0	0	0	0	0	0	0	0	0	0	0	0
Purple Moore Grass (Molinia caerulea)	0	0	0	0	0	0	0	0	2	0	0	0
False oatgrass (Arrhenatherum elatius)	0	0	0	0	0	0	0	0	0	0	0	0
Thistle sp.	0	0	0	0	0	0	0	0	0	0	0	0
Field Wood-rush (Luzula campestris)	0	0	0	0	0	0	0	0	0	0	0	0
Common Sedge(Carex Nigra)	0	0	0	0	0	0	0	0	0	0	0	0
Field sorrel (Rumex acetosella)	0	0	0	0	0	0	0	0	0	0	0	0
Crested hair-grass (Koeleria macrantha)	0	0	0	0	0	0	0	0	0	0	0	0
White clover (Trifolium ripens)	0	0	0	0	0	0	0	0	0	0	0	0
Brambles (Rubus fructicosus)	0	0	0	0	0	0	0	0	0	0	0	0
Rhododendron (Rhododendron ponteticum)	0	0	0	0	0	0	0	0	13	7	0	0

Species list and relative composition of each quadrat – part 2 of 4

Species (Scientific Name)	T5-Q1W	T5-Q2W	T5-Q1O	T5-Q2O	T6-Q1W	T6-Q2W	T6-Q1O	T6-Q2O	T7-Q1W	T7-Q2W	T7-Q1O	T7-Q2O
Golden-head Moss (Breutelia chrysocoma)	2	20	5	35	0	0	1	11	90	40	3	16
Heather* (Calluna vulgaris)	45	25	30	12	8	28	5	4	0	18	50	50
Sedges (Carex spp.)	11	11	12	2	4	9	11	3	0	3	2	2
Cross-leaved heath (Erica tetralix)	4	12	7	0	1	3	2	1	0	0	2	1
Common Cottongrass (Eriophorum angustifolium)	11	6	0	0	4	0	0	0	0	0	0	0
Bog-myrtle (Myrica gale)	0	0	0	0	0	0	5	5	0	0	0	0
Bog Asphodel (Narthecium ossifragum)	0	0	0	0	2	1	0	0	0	0	0	0
Non-crustose lichens (Noncrustose lichens)	2	2	4	3	60	8	0	0	3	3	5	2
Lousewort (Pedicularis sylvatica)	0	0	0	0	2	1	0	0	0	0	1	1
Heath Milkwort (Polygala serpyllifolia)	1	1	0	2	1	1	3	2	0	2	2	2
Tormentil (Potentilla erecta)	0	2	1	2	1	1	3	2	0	1	1	2
Black Bog-rush (Schoenus nigricans)	0	0	0	0	11	12	0	0	0	0	0	0
Sphagnum Moss (Sphagnum spp.)	28	25	65	85	8	16	0	0	10	45	55	45
Devil's-bit Scabious (Succisa pratensis)	0	0	0	0	0	0	1	1	0	0	0	0
Deergrass (Trichophorum germanicum)	0	0	0	0	10	30	0	15	0	0	0	0
Bearberry (Arctostaphylos uvaursi)	16	2	4	7	0	2	0	0	1	2	0	0
Bristly Swan-neck Moss (Campylopus atrovirens)	0	0	0	0	0	0	0	0	0	0	0	0
Soft Rush (Juncus effusus)	3	1	0	60	0	0	0	0	100	75	3	12
Pine sp.	1	0	2	1	0	0	0	0	0	8	0	0
Ragwort (Jacobaea vulgaris)	0	0	0	0	1	1	0	0	0	1	0	0
Hard Fern (Blechnum spicant)	5	5	1	16	0	0	0	0	0	1	0	2
Autumn hawkbit (Scorzoneroides autumnalis)	2	3	3	4	0	0	0	0	3	3	2	2
Bog pimpernel (Anagallis tenella)	0	1	0	0	0	0	0	0	0	0	0	0
Creeping buttercup (Ranunculus repens)	2	2	2	2	2	2	2	2	1	2	2	2
Blue sedge (Carex flacca)	0	0	0	0	0	0	0	0	0	0	0	0
Marsh hair moss (Polytrichum commune)	0	0	0	0	0	0	0	0	0	0	0	0

Species (Scientific Name)	T5-Q1W	T5-Q2W	T5-Q1O	T5-Q2O	T6-Q1W	T6-Q2W	T6-Q1O	T6-Q2O	T7-Q1W	T7-Q2W	T7-Q1O	T7-Q2O
Other moss	0	0	0	0	0	0	0	0	0	0	0	0
Soft Shield Fern (Polystichum setiferum)	1	0	0	4	0	0	2	0	10	2	0	0
Poa sp.	0	0	0	0	0	0	0	0	0	0	0	0
Fescue (Festuca rubra)	0	0	0	0	0	0	0	0	0	0	0	0
Prickly Heath (Gaultheria mucronata)	0	0	0	0	0	0	0	0	0	0	0	0
Great wood-rush (Luzula sylvatica)	0	0	0	0	0	0	0	0	0	0	0	0
Yorkshire fog (Holcus lanatus)	0	0	0	0	0	0	0	0	2	0	0	0
Cocksfoot (Dactylis glomeratus)	0	0	0	0	0	0	0	0	0	0	0	0
Heath Bedstraw (Galium saxatile)	0	0	0	1	0	0	0	0	2	0	0	0
Bare Gound	0	0	0	0	15	6	0	12	0	0	0	0
Purple Moore Grass (Molinia caerulea)	30	16	20	4	8	4	100	85	3	6	25	45
False oatgrass (Arrhenatherum elatius)	0	0	0	0	0	0	0	0	0	0	0	0
Thistle sp.	0	0	0	0	0	0	0	0	0	0	0	0
Field Wood-rush (Luzula campestris)	0	0	0	0	0	0	0	0	0	0	0	0
Common Sedge(Carex Nigra)	0	0	0	0	0	0	0	0	0	0	0	0
Field sorrel (Rumex acetosella)	0	0	0	0	0	0	0	0	2	0	0	0
Crested hair-grass (Koeleria macrantha)	0	0	0	0	0	0	0	0	0	0	0	0
White clover (Trifolium ripens)	0	0	0	0	0	0	0	0	0	0	0	0
Brambles (Rubus fructicosus)	0	0	0	3	0	0	0	0	5	0	0	0
Rhododendron (Rhododendron ponteticum)	2	0	0	0	0	0	0	0	0	0	0	0

Species list and relative composition of each quadrat – part 3 of 4

Species (Scientific Name)	T8-Q1W	T8-Q2W	T8-Q1O	T8-Q2O	T9-Q1W	T9-Q2W	T9-Q1O	T9-Q2O
Golden-head Moss (Breutelia chrysocoma)	10	2	0	0	18	12	25	11
Heather* (Calluna vulgaris)	0	0	0	0	28	6	35	21
Sedges (Carex spp.)	3	2	0	0	8	70	22	5
Cross-leaved heath (Erica tetralix)	0	0	0	0	0	0	0	0
Common Cottongrass (Eriophorum angustifolium)	0	0	0	0	0	0	22	25
Bog-myrtle (Myrica gale)	0	0	0	0	0	0	0	0
Bog Asphodel (Narthecium ossifragum)	0	0	0	0	0	0	0	0
Non-crustose lichens (Noncrustose lichens)	1	2	0	0	5	3	3	4
Lousewort (Pedicularis sylvatica)	0	0	0	0	0	0	0	0
Heath Milkwort (Polygala serpyllifolia)	2	0	0	0	0	0	0	0
Tormentil (Potentilla erecta)	0	0	0	0	0	0	2	2
Black Bog-rush (Schoenus nigricans)	0	0	0	0	0	0	0	0
Sphagnum Moss (Sphagnum spp.)	0	8	0	0	75	3	3	12
Devil's-bit Scabious (Succisa pratensis)	0	0	0	0	0	0	0	0
Deergrass (Trichophorum germanicum)	0	0	0	0	0	17	2	6
Bearberry (Arctostaphylos uvaursi)	0	0	0	0	1	0	0	0
Bristly Swan-neck Moss (Campylopus atrovirens)	0	0	0	0	0	0	0	0
Soft Rush (Juncus effusus)	20	50	100	100	55	1	25	2
Pine sp.	0	0	0	0	0	0	0	0
Ragwort (Jacobaea vulgaris)	0	0	0	0	0	0	0	0
Hard Fern (Blechnum spicant)	0	0	4	0	0	0	1	2
Autumn hawkbit (Scorzoneroides autumnalis)	2	5	0	0	7	4	4	5
Bog pimpernel (Anagallis tenella)	0	0	0	0	0	5	0	0
Creeping buttercup (Ranunculus repens)	2	2	0	7	3	2	1	2
Blue sedge (Carex flacca)	0	0	0	0	8	70	21	3
Marsh hair moss (Polytrichum commune)	0	0	0	0	0	0	2	0

Species (Scientific Name)	T8-Q1W	T8-Q2W	T8-Q1O	T8-Q2O	T9-Q1W	T9-Q2W	T9-Q1O	T9-Q2O
Other moss	0	0	0	0	0	0	0	0
Soft Shield Fern (Polystichum setiferum)	0	0	0	0	0	0	0	0
Poa sp.	70	30	2	0	0	0	0	0
Fescue (Festuca rubra)	12	15	0	0	40	20	18	2
Prickly Heath (Gaultheria mucronata)	0	0	0	0	0	0	0	0
Great wood-rush (Luzula sylvatica)	2	2	0	0	11	0	0	0
Yorkshire fog (Holcus lanatus)	2	2	0	7	3	2	1	2
Cocksfoot (Dactylis glomeratus)	1	0	0	0	0	0	0	0
Heath Bedstraw (Galium saxatile)	0	0	0	0	0	0	0	0
Bare Gound	0	0	0	0	0	0	0	0
Purple Moore Grass (Molinia caerulea)	0	0	0	0	0	0	0	0
False oatgrass (Arrhenatherum elatius)	0	0	0	0	6	0	0	2
Thistle sp.	1	0	0	0	0	2	0	0
Field Wood-rush (Luzula campestris)	0	0	0	0	0	3	0	0
Common Sedge(Carex Nigra)	0	0	0	0	0	0	2	0
Field sorrel (Rumex acetosella)	2	3	6	2	0	0	0	0
Crested hair-grass (Koeleria macrantha)	6	2	0	0	0	0	0	0
White clover (Trifolium ripens)	20	3	0	0	0	0	0	0
Brambles (Rubus fructicosus)	0	30	7	45	0	0	0	0
Rhododendron (Rhododendron ponteticum)	0	0	0	0	0	0	0	0

Species list and relative composition of each quadrat – part 4 of 4 (overrun area 1 and 3)

Species (Scientific Name)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Bog rosemary (Andromeda polifolia)	0	0	0	0	0	0	0	0	0	0	0	0
Golden-headed moss (Breutelia chrysocoma)	0	0	0	0	0	0	0	7	10	10	3	4
Heather / Ling (Calluna vulgaris)	0	2	0	0	0	0	0	20	40	20	20	30
Bigelow's sedge (Carex bigelowii)	0	0	0	0	0	0	0	0	0	0	2	0
White earwort (Diplophyllum albicans)	0	0	0	0	0	0	0	0	0	0	0	0
Sundews (count separately) (Drosera spp.)	0	0	0	0	0	0	0	0	0	0	0	0
Crowberry (Empetrum nigrum)	0	0	0	0	0	0	0	0	0	0	0	0
Cross-leaved heath (Erica tetralix)	0	0	0	0	0	0	0	0	0	0	0	0
Common cottongrass (Eriophorum angustifolium)	0	0	0	0	0	0	0	0	0	0	0	0
Hare's-tail cottongrass (Eriophorum vaginatum)	0	0	0	0	0	0	0	0	0	0	0	0
Bogbean (Menyanthes trifoliata)	0	0	0	0	0	0	0	0	0	0	0	0
Bog myrtle / Sweet gale (Myrica gale)	0	0	0	0	0	0	0	0	0	20	2	0
Bog asphodel (Narthecium ossifragum)	0	0	0	0	0	0	1	1	0	1	1	0
Various leafy/shrubby lichens (Non-crustose lichens)	0	0	0	0	0	0	0	20	20	25	40	60
Bog notchwort (Odontoschisma sphagni)	0	0	0	0	0	0	0	0	0	0	0	0
Lousewort (Pedicularis sylvatica)	0	0	0	0	0	0	0	0	0	0	0	0
Pale butterwort (Pinguicula lusitanica)	0	0	0	0	0	0	0	0	0	0	0	0
Purple pouchwort (Pleurozia purpurea)	0	0	0	0	0	0	0	0	0	0	0	0
Heath milkwort (Polygala serpyllifolia)	0	0	0	0	5	5	5	7	1	2	0	0
Woolly fringe-moss (Racomitrium lanuginosum)	0	0	0	0	0	0	0	0	0	0	0	0
Beak-sedges (count separately) (Rhynchospora spp.)	0	0	0	0	0	0	0	0	0	0	0	0
Slender earwort (Scapania gracilis)	0	0	0	6	0	0	6	0	0	0	0	0
Black bog-rush (Schoenus nigricans)	0	0	0	0	0	0	2	3	4	4	4	2
Bog mosses (count separately) (Sphagnum spp. (excl. S. fallax))	0	0	0	0	0	0	0	0	20	30	5	0

Species (Scientific Name)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Deergrass (Trichophorum germanicum)	0	2	30	35	10	15	20	20	3	40	30	25
Bilberry (Vaccinium myrtillus)	0	0	0	0	0	0	0	0	0	0	0	0
Hard rush (Juncus inflexus)	0	0	0	0	80	70	30	0	0	0	0	0
Soft rush (Juncus effusus)	1	2	1	4	6	3	20	15	20	2	2	3
Yorkshire fog (Holcus lanatus)	2	0	0	0	20	20	18	0	0	0	0	0
Bare ground - Non indicator (Bare ground - Non indicator)	90	90	70	65	0	3	50	60	0	0	7	7
Sparse dead veg (Sparse dead veg)	8	8	4	6	0	2	4	5	0	0	0	0
Glaucous sedge (Carex flacca)	0	1	2	0	0	0	4	2	4	0	0	0
Creeping buttercup (Ranunculus repens)	0	0	0	0	3	3	4	2	0	0	0	0
Poa sp (Poa sp)	0	0	0	0	2	10	2	0	0	0	0	0
Bittercress sp (Cardamine sp)	0	0	0	0	0	2	5	0	0	0	0	0
Lesser burdock (Arctium minus)	0	0	0	0	0	0	4	0	0	0	0	0
Purple mooregrass (Molinia caerulea)	0	0	0	0	0	0	0	0	40	2	12	10
Bog moss (Sphagnum fallax)	0	0	0	0	0	0	0	0	10	5	5	0

Habitat Classification matrix of each quadrate relative to Fossit the Irish Vegetation Classification and the IWM Cutover Raised Bog Classification systems

Quadrat	IVC Code	IVC Category	Sphagnum Level	IWM Cutover Habitat Type Code	IWM Cutover Habitat Type Category	Fossit Code
T11-Q1W	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB4 - Cutover Bog
T11-Q2W	BG2E	Calluna vulgaris–Eriophorum spp. bog	Low Sphagnum	LS1	Calluna vulgaris	PB4 - Cutover Bog
T11-Q1O	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB4 - Cutover Bog
T11-Q2O	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB4 - Cutover Bog
SUB-Q1W	BG2E	Calluna vulgaris–Eriophorum spp. bog	Low Sphagnum	LS1	Calluna vulgaris	PB4 - Cutover Bog
SUB-Q2W	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB4 - Cutover Bog
SUB-Q1O	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB4 - Cutover Bog
SUB-Q2O	BG2E	Calluna vulgaris–Eriophorum spp. bog	Low Sphagnum	LS1	Calluna vulgaris	PB4 - Cutover Bog
T4-Q1W	BG2E	Calluna vulgaris–Eriophorum spp. bog	Low Sphagnum	LS1	Calluna vulgaris	PB4 - Cutover Bog
T4-Q2W	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB4 - Cutover Bog
T4-Q1O	BG2E	Calluna vulgaris–Eriophorum spp. bog	High Sphagnum	HS1	Sphagnum subnitens - Erica tetralix	PB4 - Cutover Bog
T4-Q2O	BG2E	Calluna vulgaris–Eriophorum spp. bog	High Sphagnum	HS1	Sphagnum subnitens - Erica tetralix	PB4 - Cutover Bog
T5-Q1W	BG2C	Erica tetralix–Molinia caerulea–Cladonia portentosa bog/heath	Moderate Sphagnum	MS3	Molinia caerulea – Polygala serpyllifolia	PB4 - Cutover Bog
T5-Q2W	BG2C	Erica tetralix–Molinia caerulea–Cladonia portentosa bog/heath	Moderate Sphagnum	MS3	Molinia caerulea – Polygala serpyllifolia	PB4 - Cutover Bog
T5-Q1O	BG2C	Erica tetralix–Molinia caerulea–Cladonia portentosa bog/heath	High Sphagnum	HS3	Sphagnum palustre – Molinia caerulea	PB4 - Cutover Bog
T5-Q2O	BG2E	Calluna vulgaris–Eriophorum spp. bog	High Sphagnum	HS1	Sphagnum subnitens - Erica tetralix	PB4 - Cutover Bog
T6-Q1W	BG2D	Erica tetralix–Schoenus nigricans bog	Low Sphagnum	LS5	Schoenus nigricans	PB4 - Cutover Bog
T6-Q2W	BG2D	Erica tetralix–Schoenus nigricans bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB4 - Cutover Bog

Quadrat	IVC Code	IVC Category	Sphagnum Level	IWM Cutover Habitat Type Code	IWM Cutover Habitat Type Category	Fossit Code
T6-Q1O	BG2C	Erica tetralix–Molinia caerulea–Cladonia portentosa bog/heath	Low Sphagnum	LS3	Molinia caerulea	PB4 - Cutover Bog
T6-Q2O	BG2C	Erica tetralix–Molinia caerulea–Cladonia portentosa bog/heath	Low Sphagnum	LS3	Molinia caerulea	PB4 - Cutover Bog
T7-Q1W	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB4 - Cutover Bog
T7-Q2W	BG2E	Calluna vulgaris–Eriophorum spp. bog	High Sphagnum	HS1	Sphagnum subnitens - Erica tetralix	PB4 - Cutover Bog
T7-Q1O	BG2C	Erica tetralix–Molinia caerulea–Cladonia portentosa bog/heath	High Sphagnum	HS3	Sphagnum palustre – Molinia caerulea	PB4 - Cutover Bog
T7-Q2O	BG2C	Erica tetralix–Molinia caerulea–Cladonia portentosa bog/heath	High Sphagnum	HS3	Sphagnum palustre – Molinia caerulea	PB4 - Cutover Bog
T8-Q1W	BG2E	Calluna vulgaris–Eriophorum spp. bog	Low Sphagnum	LS1	Calluna vulgaris	PB4 - Cutover Bog
T8-Q2W	BG2E	Calluna vulgaris–Eriophorum spp. bog	Low Sphagnum	LS1	Calluna vulgaris	PB4 - Cutover Bog
T8-Q1O	BG2E	Calluna vulgaris–Eriophorum spp. bog	Low Sphagnum	LS1	Calluna vulgaris	PB4 - Cutover Bog
T8-Q2O	BG2E	Calluna vulgaris–Eriophorum spp. bog	Low Sphagnum	LS1	Calluna vulgaris	PB4 - Cutover Bog
T9-Q1W	BG2E	Calluna vulgaris–Eriophorum spp. bog	High Sphagnum	HS1	Sphagnum subnitens - Erica tetralix	PB4 - Cutover Bog
T9-Q2W	BG2E	Calluna vulgaris–Eriophorum spp. bog	Low Sphagnum	LS1	Calluna vulgaris	PB4 - Cutover Bog
T9-Q1O	BG2E	Calluna vulgaris–Eriophorum spp. bog	Low Sphagnum	LS1	Calluna vulgaris	PB4 - Cutover Bog
T9-Q2O	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB4 - Cutover Bog
Q1	BG1C	Schoenus nigricans – Eriophorum angustifolium bog	None	N/A	Calluna vulgaris	PB4 - Cutover Bog
Q2	BG1C	Schoenus nigricans – Eriophorum angustifolium bog	None	N/A	Calluna vulgaris	PB4 - Cutover Bog
Q3	BG2F	*Trichophorum cespitosum/germanicum – Eriophorum angustifolium* peatland	None	N/A	Calluna vulgaris	PB4 - Cutover Bog
Q4	BG2F	*Trichophorum cespitosum/germanicum – Eriophorum angustifolium* peatland	None	N/A	Calluna vulgaris	PB4 - Cutover Bog
Q5	BG1C	Schoenus nigricans – Eriophorum angustifolium bog	None	N/A	Calluna vulgaris	PB4 - Cutover Bog
Q6	BG1C	Schoenus nigricans – Eriophorum angustifolium bog	None	N/A	Calluna vulgaris	PB4 - Cutover Bog

Quadrat	IVC Code	IVC Category	Sphagnum Level	IWM Cutover Habitat Type Code	IWM Cutover Habitat Type Category	Fossit Code
Q7	BG2F	*Trichophorum cespitosum/germanicum* – *Eriophorum angustifolium* peatland	None	N/A	Calluna vulgaris	PB4 - Cutover Bog
Q8	BG2F	*Trichophorum cespitosum/germanicum* – *Eriophorum angustifolium* peatland	None	N/A	Calluna vulgaris	PB4 - Cutover Bog
Q9	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB3 – Blanket Bog
Q10	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB3 – Blanket Bog
Q11	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB3 – Blanket Bog
Q12	BG2E	Calluna vulgaris–Eriophorum spp. bog	Moderate Sphagnum	MS1	Calluna vulgaris - Sphagnum subnitens	PB3 – Blanket Bog

Appendix B Plot data – DEFRA Condition Assessment

Muingmore Windfarm

RWE Renewables Ireland

Glasshouses 2, 92 George's Street Lower Dún Laoghaire, Co. Dublin, A96 VR66

Prepared by:

SLR Environmental Consulting (Ireland) Ltd

7 Dundrum Business Park, Windy Arbour, Dublin, D14 N2Y7

SLR Project No.: 501.V00727.00008

Condition Sheet: WETLAND Habitat Type	LOCATION 1

Habitat Types

Grassland - Floodplain wetland mosaic and CFGM - See the Statutory Biodiversity Metric User Guide.
Wetland - Blanket bog
Wetland - Depression on peat substrates (H7150)
Wetland - Fens (upland and lowland)
Wetland - Lowland raised bog
Wetland - Oceanic valley mire [1] (D2.1)
Wetland - Purple moor grass and rush pastures
Wetland - Reedbeds
Wetland - Transition mires and quaking bogs (H7140)

Habitat Description

Cutover bog which has recolonised. There are regular drains cut every 5m which run the full length of the habitat. These drains are deep and show the peat depth is greater than 50cm indicating the habitat does not align with Heathland habitat. The vegetation shows signs of some hummock formation and there is encroachment from trees such as Pine sp. throughout in low enough density.

Species identified on site within the PB4 - Cutover bog habitat with their relative abundance as per the DOMIN scale; as of 04 November 2024

Common Name	Scientific Name	Category
Heather	*Calluna vulgaris*	Dominant
Soft-rush	*Juncus effusus*	Dominant
Cross-leaved Heath	*Erica tetralix*	Frequent
Hard-fern	*Blechnum spicant*	Occasional
Great Wood-rush	*Luzula sylvatica*	Occasional
Devil's-bit Scabious	*Succisa pratensis*	Rare
Bog Pimpernel	*Anagallis tenella*	Rare
Bog Asphodel	*Narthecium ossifragum*	Rare

For Oceanic valley mires - see EUNIS
See the Statutory Biodiversity Metric User Guide for Floodplain wetland mosaic (FWM) and coastal and floodplain grazing marsh (CFGM). For CFGM also see the below:
Coastal and floodplain grazing marsh UK BAP Priority Habitat description
Priority Habitat Inventory (England) - data.gov.uk
All other wetland habitats - see UK Habitat Classification (UKHab):

On-site or off-site, site name and location	Muingmore Windfarm	Survey date and Surveyor name	4th November 2024 Dr Andrew Torsney

	Assessment was undertaken during the winter period – sub optimal. However vegetative ID was used.	**Survey reference (if relating to a wider survey)**	N/A
Grid reference	476575 821833	**Habitat parcel reference**	LOCATION 1

Condition Assessment Criteria		**Criterion passed (Yes or No)**	**Notes (such as justification)**
Core Criteria - must be assessed for **all wetland habitat types**:			
A	The water table is at, or near the surface throughout the year - this could be open water or saturation of soil at the surface. There is no artificial drainage, unless specifically to maintain water levels as specified above. **Note - this criterion is essential for achieving Good condition.**	No	There are regular drains cut every 5m which run the full length of the habitat. The area is intensively drained.
B	The parcel represents a good example of its specific habitat type - the appearance and composition of the vegetation closely matches its UKHab description, with vascular and non-vascular characteristic indicator species consistently present.[1]	Yes	This is a well representative community composition however, most of the indicator species of higher value such as bog cotton, bog pimpernel etc are at low abundances. The site is notably dominated by soft rush and heather. There is scrub encroachment prevalent throughout.
C	The water supplies (groundwater, surface water and or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.	Yes	There are no water courses throughout the site – the drainage ditches are free from contaminants, but they are stagnant/no flow. This criteria is passed due to lack of water supply through the site.
D	Cover of scrub and scattered trees are less than 10%.	No	Prevalent and pervasive scrub encroachment form the surrounding conifer plantation. As much as 20-25%.

E	Cover of bare ground is less than 5%.	Yes	Limited bare ground, full sward coverage.
F	There is an absence of invasive non-native plant species[2] (as listed on Schedule 9 of WCA[3]) and species indicative of suboptimal condition[4] make up less than 5% of ground cover.	No	Invasive species are recorded in the quadrat data and surrounding area.
Additional Criterion - must be assessed for **Fen and Purple moor grass and rush pasture** habitats only:			
G	No more than 25% of the habitat area has a continuous cover of litter (such as dead vegetation) preventing regeneration.	N/A	N/A
Additional Criterion - must be assessed for **Bog** habitats only:			
H	Sphagnum moss *Sphagnum* spp. and cottongrasses *Eriophorum* spp. are at least Frequent[5]. Cover of ericaceous dwarf shrubs[6] is less than 75%.	Yes	Sphagnum is less than 20-22% and dwarf shrubs are less than 75%.
Additional Criterion - must be assessed for **Reedbed** habitats only:			
I	The reedbed has a diverse structure with between 60% and 80% reeds *Phragmites australis*. Other areas may include open water (at least 10%), species-rich fen and or wet woodland.	N/A	N/A
Additional Criterion - must be assessed for **Floodplain wetland mosaic and CFGM** only:			
J	All ditches recorded within the habitat achieve Good condition as assessed using the Ditch condition sheet.	N/A	N/A

Essential criterion achieved (required for Good condition) Yes or No:			**No**
Number of criteria passed			**4**
Condition Assessment Result	**Condition Assessment Score**	**Score Achieved ×/✓**	
Results for habitats requiring assessment of 6 criteria (Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1)):			
• Passes 5 or 6 core criteria, including criterion A.	Good (3)	N/A	
• Passes 3 or 4 core criteria; OR • Passes 5 core criteria but fails criterion A.	Moderate (2)	N/A	
• Passes 2 or fewer core criteria.	Poor (1)	N/A	
Results for habitats requiring assessment of 7 criteria - core criteria and additional criterion specified for habitat type - all habitat types except Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1):			
• Passes 5 or 6 core criteria including criterion A; AND • Passes additional criterion G, H, I or J (choose the one specified for the habitat type).	Good (3)	-	
• Passes 4 or 5 of 7 criteria; OR • Passes 6 of 7 criteria but fails criterion A or additional criterion G, H, I or J (choose the one specified for the habitat type).	Moderate (2)	**3 Core** **1 Additional**	

• Passes 3 or fewer criteria.	Poor (1)	-	

Suggested enhancement interventions to improve condition score

Block drains.
Remove and manage invasive species.
Remove and manage scrub encroachment.

Footnotes

Footnote 1 – Professional judgement should be used alongside the UKHab description.
Footnote 2 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.
Footnote 3 – Wildlife and Countryside Act 1981 (as amended).
Footnote 4 – Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, common nettle *Urtica dioica*, docks *Rumex* spp., and common ragwort *Jacobaea vulgaris*. There may be additional relevant species local to the region and or site.
Footnote 5 – According to the relative abundance DAFOR scale – Dominant, Abundant, Frequent, Occasional or Rare.
Footnote 6 – Ericaceous dwarf shrubs include: crowberry *Empetrum nigrum*, cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, cranberry *Vaccinium oxycoccos*, heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, and bell heather *Erica cinerea*. There may be additional relevant species local to the region and or site.
Footnote 7 – For fens, specify what fen type is present using base-status and trophic status - alkaline, neutral, or acidic; eutrophic, mesotrophic or oligotrophic.

Condition Sheet: WETLAND Habitat Type	LOCATION 2

Habitat Types

Grassland - Floodplain wetland mosaic and CFGM - See the Statutory Biodiversity Metric User Guide.
Wetland - Blanket bog
Wetland - Depression on peat substrates (H7150)
Wetland - Fens (upland and lowland)
Wetland - Lowland raised bog
Wetland - Oceanic valley mire [1] (D2.1)
Wetland - Purple moor grass and rush pastures
Wetland - Reedbeds
Wetland - Transition mires and quaking bogs (H7140)

Habitat Description

Cutover peatland that has regularised drainage ditches every 5m which run the full length of the site. The ditches are between 1.5 and 2 m deep showing the depth of remaining peat is far greater than 50cm (indicative of heathland habitat). This area is notable drying than the area to the south and the encroachment from trees is less pronounced but there are tracks of brambles in some of the ditches.

For Oceanic valley mires - see EUNIS
See the Statutory Biodiversity Metric User Guide for Floodplain wetland mosaic (FWM) and coastal and floodplain grazing marsh (CFGM). For CFGM also see the below:
Coastal and floodplain grazing marsh UK BAP Priority Habitat description
Priority Habitat Inventory (England) - data.gov.uk
All other wetland habitats - see UK Habitat Classification (UKHab):

On-site or off-site, site name and location	Muingmore Windfarm	**Survey date and Surveyor name**	4th November 2024 Dr Andrew Torsney
	Assessment was undertaken during the winter period – sub optimal. However vegetative ID was used.	**Survey reference (if relating to a wider survey)**	N/A
Grid reference	476476 822187	**Habitat parcel reference**	LOCATION 2

Condition Assessment Criteria	Criterion passed (Yes or No)	Notes (such as justification)

Core Criteria - must be assessed for **all wetland habitat types**:			
A	The water table is at, or near the surface throughout the year - this could be open water or saturation of soil at the surface. There is no artificial drainage, unless specifically to maintain water levels as specified above. **Note - this criterion is essential for achieving Good condition.**	No	There are regular drains cut every 5m which run the full length of the habitat. The area is intensively drained.
B	The parcel represents a good example of its specific habitat type - the appearance and composition of the vegetation closely matches its UKHab description, with vascular and non-vascular characteristic indicator species consistently present.[1]	Yes	This is a well representative community composition however, most of the indicator species of higher value such as bog cotton, bog pimpernel etc are at low abundances. The site is notably dominated by soft rush and heather. There is scrub encroachment prevalent throughout.
C	The water supplies (groundwater, surface water and or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.	Yes	There are no water courses throughout the site – the drainage ditches are free from contaminants, but they are stagnant/no flow. This criterion is passed due to lack of water supply through the site.
D	Cover of scrub and scattered trees are less than 10%.	No	Prevalent and pervasive scrub encroachment form the surrounding conifer plantation. As much as 20-25%.
E	Cover of bare ground is less than 5%.	Yes	Limited bare ground, full sward coverage.
F	There is an absence of invasive non-native plant species[2] (as listed on Schedule 9 of WCA[3]) and species indicative of suboptimal condition[4] make up less than 5% of ground cover.	No	Invasive species are recorded in the quadrat data and surrounding area.

Additional Criterion - must be assessed for **Fen and Purple moor grass and rush pasture** habitats only:			
G	No more than 25% of the habitat area has a continuous cover of litter (such as dead vegetation) preventing regeneration.	N/A	N/A
Additional Criterion - must be assessed for **Bog** habitats only:			
H	Sphagnum moss *Sphagnum* spp. and cottongrasses *Eriophorum* spp. are at least Frequent[5]. Cover of ericaceous dwarf shrubs[6] is less than 75%.	No	Sphagnum is less than 10% and dwarf shrubs are less than 75%.
Additional Criterion - must be assessed for **Reedbed** habitats only:			
I	The reedbed has a diverse structure with between 60% and 80% reeds *Phragmites australis*. Other areas may include open water (at least 10%), species-rich fen and or wet woodland.	N/A	N/A
Additional Criterion - must be assessed for **Floodplain wetland mosaic and CFGM** only:			
J	All ditches recorded within the habitat achieve Good condition as assessed using the Ditch condition sheet.	N/A	N/A
Essential criterion achieved (required for Good condition) Yes or No:			**No**
Number of criteria passed			**3**

Condition Assessment Result	**Condition Assessment Score**	**Score Achieved ×/✓**		
Results for habitats requiring assessment of 6 criteria (Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1)):				
• Passes 5 or 6 core criteria, including criterion A.		Good (3)	N/A	

• Passes 3 or 4 core criteria; OR • Passes 5 core criteria but fails criterion A.	Moderate (2)	N/A	
• Passes 2 or fewer core criteria.	Poor (1)	N/A	
Results for habitats requiring assessment of 7 criteria - core criteria and additional criterion specified for habitat type - all habitat types except Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1):			
• Passes 5 or 6 core criteria including criterion A; AND • Passes additional criterion G, H, I or J (choose the one specified for the habitat type).	Good (3)	-	
• Passes 4 or 5 of 7 criteria; OR • Passes 6 of 7 criteria but fails criterion A or additional criterion G, H, I or J (choose the one specified for the habitat type).	Moderate (2)	-	
• Passes 3 or fewer criteria.	Poor (1)	**3 Core only**	
Suggested enhancement interventions to improve condition score			
Block drains. **Remove and manage invasive species.** **Remove and manage scrub encroachment.**			
Footnotes			
Footnote 1 – Professional judgement should be used alongside the UKHab description. **Footnote 2** – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement. **Footnote 3** – Wildlife and Countryside Act 1981 (as amended). **Footnote 4** – Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, common nettle *Urtica dioica*, docks *Rumex* spp., and common ragwort *Jacobaea vulgaris*. There may be additional relevant species local to the region and or site. **Footnote 5** – According to the relative abundance DAFOR scale – Dominant, Abundant, Frequent, Occasional or Rare. **Footnote 6 –** Ericaceous dwarf shrubs include: crowberry *Empetrum nigrum*, cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, cranberry *Vaccinium oxycoccos*, heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, and bell heather *Erica cinerea*. There may be additional relevant species local to the region and or site. **Footnote 7** – For fens, specify what fen type is present using base-status and trophic status - alkaline, neutral, or acidic; eutrophic, mesotrophic or oligotrophic.			

Condition Sheet: WETLAND Habitat Type	LOCATION 3

Habitat Types

Grassland - Floodplain wetland mosaic and CFGM - See the Statutory Biodiversity Metric User Guide.
Wetland - Blanket bog
Wetland - Depression on peat substrates (H7150)
Wetland - Fens (upland and lowland)
Wetland - Lowland raised bog
Wetland - Oceanic valley mire [1] (D2.1)
Wetland - Purple moor grass and rush pastures
Wetland - Reedbeds
Wetland - Transition mires and quaking bogs (H7140)

Habitat Description

Cutover peatland with recolonised species which are consistent with the rest of the site. Drainage ditches are regularised with higher instances of heather in the ditches than between indicating extensive drying. Scrub encroachment is evident throughout.

For Oceanic valley mires - see EUNIS
See the Statutory Biodiversity Metric User Guide for Floodplain wetland mosaic (FWM) and coastal and floodplain grazing marsh (CFGM). For CFGM also see the below:
Coastal and floodplain grazing marsh UK BAP Priority Habitat description
Priority Habitat Inventory (England) - data.gov.uk
All other wetland habitats - see UK Habitat Classification (UKHab):

On-site or off-site, site name and location	Muingmore Windfarm	**Survey date and Surveyor name**	4th November 2024 Dr Andrew Torsney
	Assessment was undertaken during the winter period – sub optimal. However vegetative ID was used.	**Survey reference (if relating to a wider survey)**	N/A
Grid reference	476178 822633	**Habitat parcel reference**	LOCATION 3

Condition Assessment Criteria	Criterion passed (Yes or No)	Notes (such as justification)

Core Criteria - must be assessed for **all wetland habitat types**:			
A	The water table is at, or near the surface throughout the year - this could be open water or saturation of soil at the surface. There is no artificial drainage, unless specifically to maintain water levels as specified above. **Note - this criterion is essential for achieving Good condition.**	No	There are regular drains cut every 5m which run the full length of the habitat. The area is intensively drained.
B	The parcel represents a good example of its specific habitat type - the appearance and composition of the vegetation closely matches its UKHab description, with vascular and non-vascular characteristic indicator species consistently present.[1]	Yes	This is a well representative community composition however, most of the indicator species of higher value such as bog cotton, bog pimpernel etc are at low abundances. The site is notably dominated by soft rush and heather. There is scrub encroachment prevalent throughout.
C	The water supplies (groundwater, surface water and or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.	Yes	There are no water courses throughout the site – the drainage ditches are free from contaminants, but they are stagnant/no flow. This criterion is passed due to lack of water supply through the site.
D	Cover of scrub and scattered trees are less than 10%.	No	Prevalent and pervasive scrub encroachment form the surrounding conifer plantation. As much as 20-25%.
E	Cover of bare ground is less than 5%.	Yes	Limited bare ground, full sward coverage.
F	There is an absence of invasive non-native plant species[2] (as listed on Schedule 9 of WCA[3]) and species indicative of suboptimal condition[4] make up less than 5% of ground cover.	No	Invasive species are recorded in the quadrat data and surrounding area.

Additional Criterion - must be assessed for **Fen and Purple moor grass and rush pasture** habitats only:				
G	No more than 25% of the habitat area has a continuous cover of litter (such as dead vegetation) preventing regeneration.	N/A	N/A	
Additional Criterion - must be assessed for **Bog** habitats only:				
H	Sphagnum moss *Sphagnum* spp. and cottongrasses *Eriophorum* spp. are at least Frequent[5]. Cover of ericaceous dwarf shrubs[6] is less than 75%.	No	Sphagnum is less than 10% and dwarf shrubs are less than 75%.	
Additional Criterion - must be assessed for **Reedbed** habitats only:				
I	The reedbed has a diverse structure with between 60% and 80% reeds *Phragmites australis*. Other areas may include open water (at least 10%), species-rich fen and or wet woodland.	N/A	N/A	
Additional Criterion - must be assessed for **Floodplain wetland mosaic and CFGM** only:				
J	All ditches recorded within the habitat achieve Good condition as assessed using the Ditch condition sheet.	N/A	N/A	
		Essential criterion achieved (required for Good condition) Yes or No:		**No**
		Number of criteria passed		**3**
Condition Assessment Result	**Condition Assessment Score**	**Score Achieved ×/✓**		
Results for habitats requiring assessment of 6 criteria (Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1)):				
• Passes 5 or 6 core criteria, including criterion A.		Good (3)	N/A	
• Passes 3 or 4 core criteria; OR • Passes 5 core criteria but fails criterion A.		Moderate (2)	N/A	
• Passes 2 or fewer core criteria.		Poor (1)	N/A	

Results for habitats requiring assessment of 7 criteria - core criteria and additional criterion specified for habitat type - all habitat types except Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1):			
• Passes 5 or 6 core criteria including criterion A; AND • Passes additional criterion G, H, I or J (choose the one specified for the habitat type).	Good (3)	-	
• Passes 4 or 5 of 7 criteria; OR • Passes 6 of 7 criteria but fails criterion A or additional criterion G, H, I or J (choose the one specified for the habitat type).	Moderate (2)	-	
• Passes 3 or fewer criteria.	Poor (1)	**3 Core only**	

Suggested enhancement interventions to improve condition score

Block drains.
Remove and manage invasive species.
Remove and manage scrub encroachment.

Footnotes

Footnote 1 – Professional judgement should be used alongside the UKHab description.
Footnote 2 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.
Footnote 3 – Wildlife and Countryside Act 1981 (as amended).
Footnote 4 – Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, common nettle *Urtica dioica*, docks *Rumex* spp., and common ragwort *Jacobaea vulgaris*. There may be additional relevant species local to the region and or site.
Footnote 5 – According to the relative abundance DAFOR scale – Dominant, Abundant, Frequent, Occasional or Rare.
Footnote 6 – Ericaceous dwarf shrubs include: crowberry *Empetrum nigrum*, cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, cranberry *Vaccinium oxycoccos*, heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, and bell heather *Erica cinerea*. There may be additional relevant species local to the region and or site.
Footnote 7 – For fens, specify what fen type is present using base-status and trophic status - alkaline, neutral, or acidic; eutrophic, mesotrophic or oligotrophic.

Condition Sheet: WETLAND Habitat Type	LOCATION 4

Habitat Types

Grassland - Floodplain wetland mosaic and CFGM - See the Statutory Biodiversity Metric User Guide.
Wetland - Blanket bog
Wetland - Depression on peat substrates (H7150)
Wetland - Fens (upland and lowland)
Wetland - Lowland raised bog
Wetland - Oceanic valley mire [1] (D2.1)
Wetland - Purple moor grass and rush pastures
Wetland - Reedbeds
Wetland - Transition mires and quaking bogs (H7140)

Habitat Description

There is a clear dominance of Juncus effucus with heather struggling to take hold. Signs of heather being restricted to drainage ditches which are extensive, spanning the full width of the site and regular every 5m. Heather becomes more dominant as you move north within the land parcel. The heather in this section of lands is notably more mature than in the other sextions of land and there is a large sheep heard grazing within.

For Oceanic valley mires - see EUNIS
See the Statutory Biodiversity Metric User Guide for Floodplain wetland mosaic (FWM) and coastal and floodplain grazing marsh (CFGM). For CFGM also see the below:
Coastal and floodplain grazing marsh UK BAP Priority Habitat description
Priority Habitat Inventory (England) - data.gov.uk
All other wetland habitats - see UK Habitat Classification (UKHab):

On-site or off-site, site name and location	Muingmore Windfarm	**Survey date and Surveyor name**	4th November 2024 Dr Andrew Torsney
	Assessment was undertaken during the winter period – sub optimal. However vegetative ID was used.	**Survey reference (if relating to a wider survey)**	N/A
Grid reference	476311 823520	**Habitat parcel reference**	LOCATION 4

Condition Assessment Criteria	Criterion passed (Yes or No)	Notes (such as justification)

Core Criteria - must be assessed for **all wetland habitat types**:			
A	The water table is at, or near the surface throughout the year - this could be open water or saturation of soil at the surface. There is no artificial drainage, unless specifically to maintain water levels as specified above. **Note - this criterion is essential for achieving Good condition.**	No	There are regular drains cut every 5m which run the full length of the habitat. The area is intensively drained.
B	The parcel represents a good example of its specific habitat type - the appearance and composition of the vegetation closely matches its UKHab description, with vascular and non-vascular characteristic indicator species consistently present.[1]	Yes	This is a well representative community composition however, most of the indicator species of higher value such as bog cotton, bog pimpernel etc are at low abundances. The site is notably dominated by soft rush and heather. There is scrub encroachment prevalent throughout.
C	The water supplies (groundwater, surface water and or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.	Yes	There are no water courses throughout the site – the drainage ditches are free from contaminants, but they are stagnant/no flow. This criterion is passed due to lack of water supply through the site.
D	Cover of scrub and scattered trees are less than 10%.	No	Prevalent and pervasive scrub encroachment form the surrounding conifer plantation. As much as 20-25%.
E	Cover of bare ground is less than 5%.	Yes	Limited bare ground, full sward coverage.
F	There is an absence of invasive non-native plant species[2] (as listed on Schedule 9 of WCA[3]) and species indicative of suboptimal condition[4] make up less than 5% of ground cover.	No	Invasive species are recorded in the quadrat data and surrounding area.
Additional Criterion - must be assessed for **Fen and Purple moor grass and rush pasture** habitats only:			
G	No more than 25% of the habitat area has a continuous cover of litter (such as dead vegetation) preventing regeneration.	N/A	N/A

Additional Criterion - must be assessed for **Bog** habitats only:			
H	Sphagnum moss *Sphagnum* spp. and cottongrasses *Eriophorum* spp. are at least Frequent[5]. Cover of ericaceous dwarf shrubs[6] is less than 75%.	No	Sphagnum is less than 15% and dwarf shrubs are less than 75%. There are some areas with as high as 20% but over the whole polygon this is not frequent.
Additional Criterion - must be assessed for **Reedbed** habitats only:			
I	The reedbed has a diverse structure with between 60% and 80% reeds *Phragmites australis*. Other areas may include open water (at least 10%), species-rich fen and or wet woodland.	N/A	N/A
Additional Criterion - must be assessed for **Floodplain wetland mosaic and CFGM** only:			
J	All ditches recorded within the habitat achieve Good condition as assessed using the Ditch condition sheet.	N/A	N/A
Essential criterion achieved (required for Good condition) Yes or No:			**No**
Number of criteria passed			**3**

Condition Assessment Result	**Condition Assessment Score**	**Score Achieved ×/✓**		
Results for habitats requiring assessment of 6 criteria (Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1)):				
• Passes 5 or 6 core criteria, including criterion A.		Good (3)	N/A	
• Passes 3 or 4 core criteria; OR • Passes 5 core criteria but fails criterion A.		Moderate (2)	N/A	
• Passes 2 or fewer core criteria.		Poor (1)	N/A	
Results for habitats requiring assessment of 7 criteria - core criteria and additional criterion specified for habitat type - all habitat types except Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1):				

• Passes 5 or 6 core criteria including criterion A; AND • Passes additional criterion G, H, I or J (choose the one specified for the habitat type).	Good (3)	-	
• Passes 4 or 5 of 7 criteria; OR • Passes 6 of 7 criteria but fails criterion A or additional criterion G, H, I or J (choose the one specified for the habitat type).	Moderate (2)	-	
• Passes 3 or fewer criteria.	Poor (1)	**3 Core only**	

Suggested enhancement interventions to improve condition score

Block drains.
Remove and manage invasive species.
Remove and manage scrub encroachment.

Footnotes

Footnote 1 – Professional judgement should be used alongside the UKHab description.
Footnote 2 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.
Footnote 3 – Wildlife and Countryside Act 1981 (as amended).
Footnote 4 – Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, common nettle *Urtica dioica*, docks *Rumex* spp., and common ragwort *Jacobaea vulgaris*. There may be additional relevant species local to the region and or site.
Footnote 5 – According to the relative abundance DAFOR scale – Dominant, Abundant, Frequent, Occasional or Rare.
Footnote 6 – Ericaceous dwarf shrubs include: crowberry *Empetrum nigrum*, cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, cranberry *Vaccinium oxycoccos*, heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, and bell heather *Erica cinerea*. There may be additional relevant species local to the region and or site.
Footnote 7 – For fens, specify what fen type is present using base-status and trophic status - alkaline, neutral, or acidic; eutrophic, mesotrophic or oligotrophic.

Condition Sheet: WETLAND Habitat Type	LOCATION 5

Habitat Types

Grassland - Floodplain wetland mosaic and CFGM - See the Statutory Biodiversity Metric User Guide.
Wetland - Blanket bog
Wetland - Depression on peat substrates (H7150)
Wetland - Fens (upland and lowland)
Wetland - Lowland raised bog
Wetland - Oceanic valley mire [1] (D2.1)
Wetland - Purple moor grass and rush pastures
Wetland - Reedbeds
Wetland - Transition mires and quaking bogs (H7140)

Habitat Description

Cutover bog that has been recolonised; the drainage ditches are regular roughly 5m apart spanning the width of the habitat. There is a grass track along the western boundary with no hard core and well vegetated. Scrub encroachment present with willow sp. and pine sp. less than 10% grading higher as you go south – distinct separation in southern polygon. Some species such as thistle and hawksbit are more abundant along track.

Species identified on site within the PB4 - Cutover bog habitat with their relative abundance as per the DOMIN scale; as of 04 November 2024

Common Name	Scientific Name	Category
Soft-rush	*Juncus effusus*	Dominant
Heather	*Calluna vulgaris*	Dominant
Purple Moor-grass	*Molinia caerulea*	Dominant
Moss Sp.	*Moss Sp.*	Abundant
Autumn Hawkbit	*Scorzoneroides autumnalis*	Occasional
Glaucous Sedge	*Carex flacca*	Occasional
Thistle Sp.	*Thistle Sp.*	Occasional
Tormentil	*Potentilla erecta*	Occasional
Cross-leaved Heath	*Erica tetralix*	Occasional
Purple Moor-grass	*Molinia caerulea*	Occasional
Hard-fern	*Blechnum spicant*	Occasional
Prickly Heath	*Gaultheria mucronata*	Rare
Heath Bedstraw	*Galium saxatile*	Rare
Creeping Buttercup	*Ranunculus repens*	Rare
Cock's-foot	*Dactylis glomerata*	Rare

Brambles	*Rubus fruticosus*	Rare
Rhododendron	*Rhododendron ponticum*	Rare
Hard-fern	*Blechnum spicant*	Rare
Purple Moor-grass	*Molinia caerulea*	Rare
Autumn Hawkbit	*Scorzoneroides autumnalis*	Rare
Cross-leaved Heath	*Erica tetralix*	Rare

For Oceanic valley mires - see EUNIS
See the Statutory Biodiversity Metric User Guide for Floodplain wetland mosaic (FWM) and coastal and floodplain grazing marsh (CFGM). For CFGM also see the below:
Coastal and floodplain grazing marsh UK BAP Priority Habitat description
Priority Habitat Inventory (England) - data.gov.uk
All other wetland habitats - see UK Habitat Classification (UKHab):

On-site or off-site, site name and location	Muingmore Windfarm	**Survey date and Surveyor name**	4th November 2024 Dr Andrew Torsney
	Assessment was undertaken during the winter period – sub optimal. However vegetative ID was used.	**Survey reference (if relating to a wider survey)**	N/A
Grid reference	476999 823655	**Habitat parcel reference**	LOCATION 5

Condition Assessment Criteria		**Criterion passed (Yes or No)**	**Notes (such as justification)**
Core Criteria - must be assessed for **all wetland habitat types**:			
A	The water table is at, or near the surface throughout the year - this could be open water or saturation of soil at the surface. There is no artificial drainage, unless specifically to maintain water levels as specified above. **Note - this criterion is essential for achieving Good condition.**	No	There are regular drains cut every 5m which run the full length of the habitat. The area is intensively drained.

B	The parcel represents a good example of its specific habitat type - the appearance and composition of the vegetation closely matches its UKHab description, with vascular and non-vascular characteristic indicator species consistently present.[1]	Yes	This is a well representative community composition however, most of the indicator species of higher value such as bog cotton, bog pimpernel etc are at low abundances. The site is notably dominated by soft rush and heather. There is scrub encroachment prevalent throughout.
C	The water supplies (groundwater, surface water and or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.	Yes	There are no water courses throughout the site – the drainage ditches are free from contaminants, but they are stagnant/no flow. This criterion is passed due to lack of water supply through the site.
D	Cover of scrub and scattered trees are less than 10%.	No	Prevalent and pervasive scrub encroachment form the surrounding conifer plantation. As much as 20-25%.
E	Cover of bare ground is less than 5%.	Yes	Limited bare ground, full sward coverage.
F	There is an absence of invasive non-native plant species[2] (as listed on Schedule 9 of WCA[3]) and species indicative of suboptimal condition[4] make up less than 5% of ground cover.	No	Invasive species are recorded in the quadrat data and surrounding area.
Additional Criterion - must be assessed for **Fen and Purple moor grass and rush pasture** habitats only:			
G	No more than 25% of the habitat area has a continuous cover of litter (such as dead vegetation) preventing regeneration.	N/A	N/A
Additional Criterion - must be assessed for **Bog** habitats only:			
H	Sphagnum moss *Sphagnum* spp. and cottongrasses *Eriophorum* spp. are at least Frequent[5]. Cover of ericaceous dwarf shrubs[6] is less than 75%.	Yes	Sphagnum is as high as 65% in some areas and dwarf shrubs are less than 75%. There are some areas with as high as 20% but over the whole polygon this is not frequent.
Additional Criterion - must be assessed for **Reedbed** habitats only:			

I	The reedbed has a diverse structure with between 60% and 80% reeds *Phragmites australis*. Other areas may include open water (at least 10%), species-rich fen and or wet woodland.	N/A	N/A
Additional Criterion - must be assessed for **Floodplain wetland mosaic and CFGM** only:			
J	All ditches recorded within the habitat achieve Good condition as assessed using the Ditch condition sheet.	N/A	N/A
Essential criterion achieved (required for Good condition) Yes or No:			**No**
Number of criteria passed			**4**

Condition Assessment Result	**Condition Assessment Score**	**Score Achieved ×/✓**		
Results for habitats requiring assessment of 6 criteria (Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1)):				
• Passes 5 or 6 core criteria, including criterion A.		Good (3)	N/A	
• Passes 3 or 4 core criteria; OR • Passes 5 core criteria but fails criterion A.		Moderate (2)	N/A	
• Passes 2 or fewer core criteria.		Poor (1)	N/A	
Results for habitats requiring assessment of 7 criteria - core criteria and additional criterion specified for habitat type - all habitat types except Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1):				
• Passes 5 or 6 core criteria including criterion A; AND • Passes additional criterion G, H, I or J (choose the one specified for the habitat type).		Good (3)	-	
• Passes 4 or 5 of 7 criteria; OR • Passes 6 of 7 criteria but fails criterion A or additional criterion G, H, I or J (choose the one specified for the habitat type).		Moderate (2)	**3 Core** **1 Additional**	

• Passes 3 or fewer criteria.	Poor (1)	-	

Suggested enhancement interventions to improve condition score

Block drains.
Remove and manage invasive species.
Remove and manage scrub encroachment.

Footnotes

Footnote 1 – Professional judgement should be used alongside the UKHab description.
Footnote 2 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.
Footnote 3 – Wildlife and Countryside Act 1981 (as amended).
Footnote 4 – Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, common nettle *Urtica dioica*, docks *Rumex* spp., and common ragwort *Jacobaea vulgaris*. There may be additional relevant species local to the region and or site.
Footnote 5 – According to the relative abundance DAFOR scale – Dominant, Abundant, Frequent, Occasional or Rare.
Footnote 6 – Ericaceous dwarf shrubs include: crowberry *Empetrum nigrum*, cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, cranberry *Vaccinium oxycoccos*, heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, and bell heather *Erica cinerea*. There may be additional relevant species local to the region and or site.
Footnote 7 – For fens, specify what fen type is present using base-status and trophic status - alkaline, neutral, or acidic; eutrophic, mesotrophic or oligotrophic.

Condition Sheet: WETLAND Habitat Type	LOCATION 6

Habitat Types

Grassland - Floodplain wetland mosaic and CFGM - See the Statutory Biodiversity Metric User Guide.
Wetland - Blanket bog
Wetland - Depression on peat substrates (H7150)
Wetland - Fens (upland and lowland)
Wetland - Lowland raised bog
Wetland - Oceanic valley mire [1] (D2.1)
Wetland - Purple moor grass and rush pastures
Wetland - Reedbeds
Wetland - Transition mires and quaking bogs (H7140)

Habitat Description

The cutover peatland is notable compacted to the south with instances of rhododendron invasion dotted throughout but most extensive to the east. The area is relatively consistent with the other peatlands around.

For Oceanic valley mires - see EUNIS
See the Statutory Biodiversity Metric User Guide for Floodplain wetland mosaic (FWM) and coastal and floodplain grazing marsh (CFGM). For CFGM also see the below:
Coastal and floodplain grazing marsh UK BAP Priority Habitat description
Priority Habitat Inventory (England) - data.gov.uk
All other wetland habitats - see UK Habitat Classification (UKHab):

On-site or off-site, site name and location	Muingmore Windfarm	**Survey date and Surveyor name**	4th November 2024 Dr Andrew Torsney
	Assessment was undertaken during the winter period – sub optimal. However vegetative ID was used.	**Survey reference (if relating to a wider survey)**	N/A
Grid reference	477015 823113	**Habitat parcel reference**	LOCATION 6

Condition Assessment Criteria	Criterion passed (Yes or No)	Notes (such as justification)

Core Criteria - must be assessed for **all wetland habitat types**:			
A	The water table is at, or near the surface throughout the year - this could be open water or saturation of soil at the surface. There is no artificial drainage, unless specifically to maintain water levels as specified above. **Note - this criterion is essential for achieving Good condition.**	No	There are regular drains cut every 5m which run the full length of the habitat. The area is intensively drained.
B	The parcel represents a good example of its specific habitat type - the appearance and composition of the vegetation closely matches its UKHab description, with vascular and non-vascular characteristic indicator species consistently present.[1]	Yes	This is a well representative community composition however, most of the indicator species of higher value such as bog cotton, bog pimpernel etc are at low abundances. The site is notably dominated by soft rush and heather. There is scrub encroachment prevalent throughout.
C	The water supplies (groundwater, surface water and or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.	Yes	There are no water courses throughout the site – the drainage ditches are free from contaminants, but they are stagnant/no flow. This criterion is passed due to lack of water supply through the site.
D	Cover of scrub and scattered trees are less than 10%.	No	Prevalent and pervasive scrub encroachment form the surrounding conifer plantation. As much as 20-25%.
E	Cover of bare ground is less than 5%.	Yes	Limited bare ground, full sward coverage.
F	There is an absence of invasive non-native plant species[2] (as listed on Schedule 9 of WCA[3]) and species indicative of suboptimal condition[4] make up less than 5% of ground cover.	No	Invasive species are recorded in the quadrat data and surrounding area.
Additional Criterion - must be assessed for **Fen and Purple moor grass and rush pasture** habitats only:			

G	No more than 25% of the habitat area has a continuous cover of litter (such as dead vegetation) preventing regeneration.	N/A	N/A
Additional Criterion - must be assessed for **Bog** habitats only:			
H	Sphagnum moss *Sphagnum* spp. and cottongrasses *Eriophorum* spp. are at least Frequent[5]. Cover of ericaceous dwarf shrubs[6] is less than 75%.	Yes	Sphagnum is as high as 75% in some areas and dwarf shrubs are less than 75%. There are some areas with as high as 20% but over the whole polygon this is not frequent.
Additional Criterion - must be assessed for **Reedbed** habitats only:			
I	The reedbed has a diverse structure with between 60% and 80% reeds *Phragmites australis*. Other areas may include open water (at least 10%), species-rich fen and or wet woodland.	N/A	N/A
Additional Criterion - must be assessed for **Floodplain wetland mosaic and CFGM** only:			
J	All ditches recorded within the habitat achieve Good condition as assessed using the Ditch condition sheet.	N/A	N/A
Essential criterion achieved (required for Good condition) Yes or No:			**No**
Number of criteria passed			**4**

Condition Assessment Result	**Condition Assessment Score**	**Score Achieved ×/✓**		
Results for habitats requiring assessment of 6 criteria (Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1)):				
• Passes 5 or 6 core criteria, including criterion A.		Good (3)	N/A	
• Passes 3 or 4 core criteria; OR • Passes 5 core criteria but fails criterion A.		Moderate (2)	N/A	
• Passes 2 or fewer core criteria.		Poor (1)	N/A	

Results for habitats requiring assessment of 7 criteria - core criteria and additional criterion specified for habitat type - all habitat types except Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1):			
• Passes 5 or 6 core criteria including criterion A; AND • Passes additional criterion G, H, I or J (choose the one specified for the habitat type).	Good (3)	-	
• Passes 4 or 5 of 7 criteria; OR • Passes 6 of 7 criteria but fails criterion A or additional criterion G, H, I or J (choose the one specified for the habitat type).	Moderate (2)	**3 Core** **1 Additional**	
• Passes 3 or fewer criteria.	Poor (1)	**-**	

Suggested enhancement interventions to improve condition score

Block drains.
Remove and manage invasive species.
Remove and manage scrub encroachment.

Footnotes

Footnote 1 – Professional judgement should be used alongside the UKHab description.
Footnote 2 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.
Footnote 3 – Wildlife and Countryside Act 1981 (as amended).
Footnote 4 – Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, common nettle *Urtica dioica*, docks *Rumex* spp., and common ragwort *Jacobaea vulgaris*. There may be additional relevant species local to the region and or site.
Footnote 5 – According to the relative abundance DAFOR scale – Dominant, Abundant, Frequent, Occasional or Rare.
Footnote 6 – Ericaceous dwarf shrubs include: crowberry *Empetrum nigrum*, cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, cranberry *Vaccinium oxycoccos*, heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, and bell heather *Erica cinerea*. There may be additional relevant species local to the region and or site.
Footnote 7 – For fens, specify what fen type is present using base-status and trophic status - alkaline, neutral, or acidic; eutrophic, mesotrophic or oligotrophic.

Condition Sheet: WETLAND Habitat Type	LOCATION 7

Habitat Types

Grassland - Floodplain wetland mosaic and CFGM - See the Statutory Biodiversity Metric User Guide.
Wetland - Blanket bog
Wetland - Depression on peat substrates (H7150)
Wetland - Fens (upland and lowland)
Wetland - Lowland raised bog
Wetland - Oceanic valley mire [1] (D2.1)
Wetland - Purple moor grass and rush pastures
Wetland - Reedbeds
Wetland - Transition mires and quaking bogs (H7140)

Habitat Description

The cutover peatland with instances of rhododendron invasion dotted throughout but most extensive to the east. The area is relatively consistent with the other peatlands around.

For Oceanic valley mires - see EUNIS
See the Statutory Biodiversity Metric User Guide for Floodplain wetland mosaic (FWM) and coastal and floodplain grazing marsh (CFGM). For CFGM also see the below:
Coastal and floodplain grazing marsh UK BAP Priority Habitat description
Priority Habitat Inventory (England) - data.gov.uk
All other wetland habitats - see UK Habitat Classification (UKHab):

On-site or off-site, site name and location	Muingmore Windfarm	**Survey date and Surveyor name**	4th November 2024 Dr Andrew Torsney
	Assessment was undertaken during the winter period – sub optimal. However vegetative ID was used.	**Survey reference (if relating to a wider survey)**	N/A
Grid reference	477508 823267	**Habitat parcel reference**	LOCATION 7

Condition Assessment Criteria	Criterion passed (Yes or No)	Notes (such as justification)
Core Criteria - must be assessed for **all wetland habitat types**:		

A	The water table is at, or near the surface throughout the year - this could be open water or saturation of soil at the surface. There is no artificial drainage, unless specifically to maintain water levels as specified above. **Note - this criterion is essential for achieving Good condition.**	No	There are regular drains cut every 5m which run the full length of the habitat. The area is intensively drained.
B	The parcel represents a good example of its specific habitat type - the appearance and composition of the vegetation closely matches its UKHab description, with vascular and non-vascular characteristic indicator species consistently present.[1]	Yes	This is a well representative community composition however, most of the indicator species of higher value such as bog cotton, bog pimpernel etc are at low abundances. The site is notably dominated by soft rush and heather. There is scrub encroachment prevalent throughout.
C	The water supplies (groundwater, surface water and or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.	Yes	There are no water courses throughout the site – the drainage ditches are free from contaminants, but they are stagnant/no flow. This criterion is passed due to lack of water supply through the site.
D	Cover of scrub and scattered trees are less than 10%.	No	Prevalent and pervasive scrub encroachment form the surrounding conifer plantation. As much as 20-25%.
E	Cover of bare ground is less than 5%.	Yes	Limited bare ground, full sward coverage.
F	There is an absence of invasive non-native plant species[2] (as listed on Schedule 9 of WCA[3]) and species indicative of suboptimal condition[4] make up less than 5% of ground cover.	No	Invasive species are recorded in the quadrat data and surrounding area.
Additional Criterion - must be assessed for **Fen and Purple moor grass and rush pasture** habitats only:			
G	No more than 25% of the habitat area has a continuous cover of litter (such as dead vegetation) preventing regeneration.	N/A	N/A
Additional Criterion - must be assessed for **Bog** habitats only:			

H	Sphagnum moss *Sphagnum* spp. and cottongrasses *Eriophorum* spp. are at least Frequent[5]. Cover of ericaceous dwarf shrubs[6] is less than 75%.	No	Sphagnum is less that 10% and dwarf shrubs are less than 75%. There are some areas with as high as 20% but over the whole polygon this is not frequent.
Additional Criterion - must be assessed for **Reedbed** habitats only:			
I	The reedbed has a diverse structure with between 60% and 80% reeds *Phragmites australis*. Other areas may include open water (at least 10%), species-rich fen and or wet woodland.	N/A	N/A
Additional Criterion - must be assessed for **Floodplain wetland mosaic and CFGM** only:			
J	All ditches recorded within the habitat achieve Good condition as assessed using the Ditch condition sheet.	N/A	N/A
Essential criterion achieved (required for Good condition) Yes or No:			**No**
Number of criteria passed			**3**

Condition Assessment Result	**Condition Assessment Score**	**Score Achieved ×/✓**		
Results for habitats requiring assessment of 6 criteria (Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1)):				
	• Passes 5 or 6 core criteria, including criterion A.	Good (3)	N/A	
	• Passes 3 or 4 core criteria; OR • Passes 5 core criteria but fails criterion A.	Moderate (2)	N/A	
	• Passes 2 or fewer core criteria.	Poor (1)	N/A	
Results for habitats requiring assessment of 7 criteria - core criteria and additional criterion specified for habitat type - all habitat types except Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1):				
	• Passes 5 or 6 core criteria including criterion A; AND • Passes additional criterion G, H, I or J (choose the one specified for the habitat type).	Good (3)	-	

• Passes 4 or 5 of 7 criteria; OR • Passes 6 of 7 criteria but fails criterion A or additional criterion G, H, I or J (choose the one specified for the habitat type).	Moderate (2)	-	
• Passes 3 or fewer criteria.	Poor (1)	**3 Core Only**	

Suggested enhancement interventions to improve condition score

Block drains.
Remove and manage invasive species.
Remove and manage scrub encroachment.

Footnotes

Footnote 1 – Professional judgement should be used alongside the UKHab description.
Footnote 2 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.
Footnote 3 – Wildlife and Countryside Act 1981 (as amended).
Footnote 4 – Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, common nettle *Urtica dioica*, docks *Rumex* spp., and common ragwort *Jacobaea vulgaris*. There may be additional relevant species local to the region and or site.
Footnote 5 – According to the relative abundance DAFOR scale – Dominant, Abundant, Frequent, Occasional or Rare.
Footnote 6 – Ericaceous dwarf shrubs include: crowberry *Empetrum nigrum*, cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, cranberry *Vaccinium oxycoccos*, heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, and bell heather *Erica cinerea*. There may be additional relevant species local to the region and or site.
Footnote 7 – For fens, specify what fen type is present using base-status and trophic status - alkaline, neutral, or acidic; eutrophic, mesotrophic or oligotrophic.

Condition Sheet: WETLAND Habitat Type	LOCATION 8

Habitat Types

Grassland - Floodplain wetland mosaic and CFGM - See the Statutory Biodiversity Metric User Guide.
Wetland - Blanket bog
Wetland - Depression on peat substrates (H7150)
Wetland - Fens (upland and lowland)
Wetland - Lowland raised bog
Wetland - Oceanic valley mire [1] (D2.1)
Wetland - Purple moor grass and rush pastures
Wetland - Reedbeds
Wetland - Transition mires and quaking bogs (H7140)

Habitat Description

Area to the NE of the site is the wettest with high levels of sphagnum. The drains have been revegetated by reeds causing extra water retention so it appears to be naturally regenerating/recovering.

For Oceanic valley mires - see EUNIS
See the Statutory Biodiversity Metric User Guide for Floodplain wetland mosaic (FWM) and coastal and floodplain grazing marsh (CFGM). For CFGM also see the below:
Coastal and floodplain grazing marsh UK BAP Priority Habitat description
Priority Habitat Inventory (England) - data.gov.uk
All other wetland habitats - see UK Habitat Classification (UKHab):

On-site or off-site, site name and location	Muingmore Windfarm	**Survey date and Surveyor name**	4th November 2024 Dr Andrew Torsney
	Assessment was undertaken during the winter period – sub optimal. However vegetative ID was used.	**Survey reference (if relating to a wider survey)**	N/A
Grid reference	477642 823614	**Habitat parcel reference**	LOCATION 8

Condition Assessment Criteria	Criterion passed (Yes or No)	Notes (such as justification)

Core Criteria - must be assessed for **all wetland habitat types**:			
A	The water table is at, or near the surface throughout the year - this could be open water or saturation of soil at the surface. There is no artificial drainage, unless specifically to maintain water levels as specified above. **Note - this criterion is essential for achieving Good condition.**	No	There are regular drains cut every 5m which run the full length of the habitat. The area is intensively drained.
B	The parcel represents a good example of its specific habitat type - the appearance and composition of the vegetation closely matches its UKHab description, with vascular and non-vascular characteristic indicator species consistently present.[1]	Yes	This is a well representative community composition however, most of the indicator species of higher value such as bog cotton, bog pimpernel etc are at low abundances. The site is notably dominated by soft rush and heather. There is scrub encroachment prevalent throughout.
C	The water supplies (groundwater, surface water and or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.	Yes	There are no water courses throughout the site – the drainage ditches are free from contaminants, but they are stagnant/no flow. This criterion is passed due to lack of water supply through the site.
D	Cover of scrub and scattered trees are less than 10%.	No	Prevalent and pervasive scrub encroachment form the surrounding conifer plantation. As much as 20-25%.
E	Cover of bare ground is less than 5%.	Yes	Limited bare ground, full sward coverage.
F	There is an absence of invasive non-native plant species[2] (as listed on Schedule 9 of WCA[3]) and species indicative of suboptimal condition[4] make up less than 5% of ground cover.	No	Invasive species are recorded in the quadrat data and surrounding area.
Additional Criterion - must be assessed for **Fen and Purple moor grass and rush pasture** habitats only:			
G	No more than 25% of the habitat area has a continuous cover of litter (such as dead vegetation) preventing regeneration.	N/A	N/A

Additional Criterion - must be assessed for **Bog** habitats only:				
H	Sphagnum moss *Sphagnum* spp. and cottongrasses *Eriophorum* spp. are at least Frequent[5]. Cover of ericaceous dwarf shrubs[6] is less than 75%.	Yes	Sphagnum is as high as 75% in some areas and dwarf shrubs are less than 75%. There are some areas with as high as 20% but over the whole polygon this is not frequent.	
Additional Criterion - must be assessed for **Reedbed** habitats only:				
I	The reedbed has a diverse structure with between 60% and 80% reeds *Phragmites australis*. Other areas may include open water (at least 10%), species-rich fen and or wet woodland.	N/A	N/A	
Additional Criterion - must be assessed for **Floodplain wetland mosaic and CFGM** only:				
J	All ditches recorded within the habitat achieve Good condition as assessed using the Ditch condition sheet.	N/A	N/A	
		Essential criterion achieved (required for Good condition) Yes or No:		**No**
		Number of criteria passed		**4**
Condition Assessment Result	**Condition Assessment Score**	**Score Achieved ×/✓**		
Results for habitats requiring assessment of 6 criteria (Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1)):				
• Passes 5 or 6 core criteria, including criterion A.		Good (3)	N/A	
• Passes 3 or 4 core criteria; OR • Passes 5 core criteria but fails criterion A.		Moderate (2)	N/A	
• Passes 2 or fewer core criteria.		Poor (1)	N/A	
Results for habitats requiring assessment of 7 criteria - core criteria and additional criterion specified for habitat type - all habitat types except Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1):				

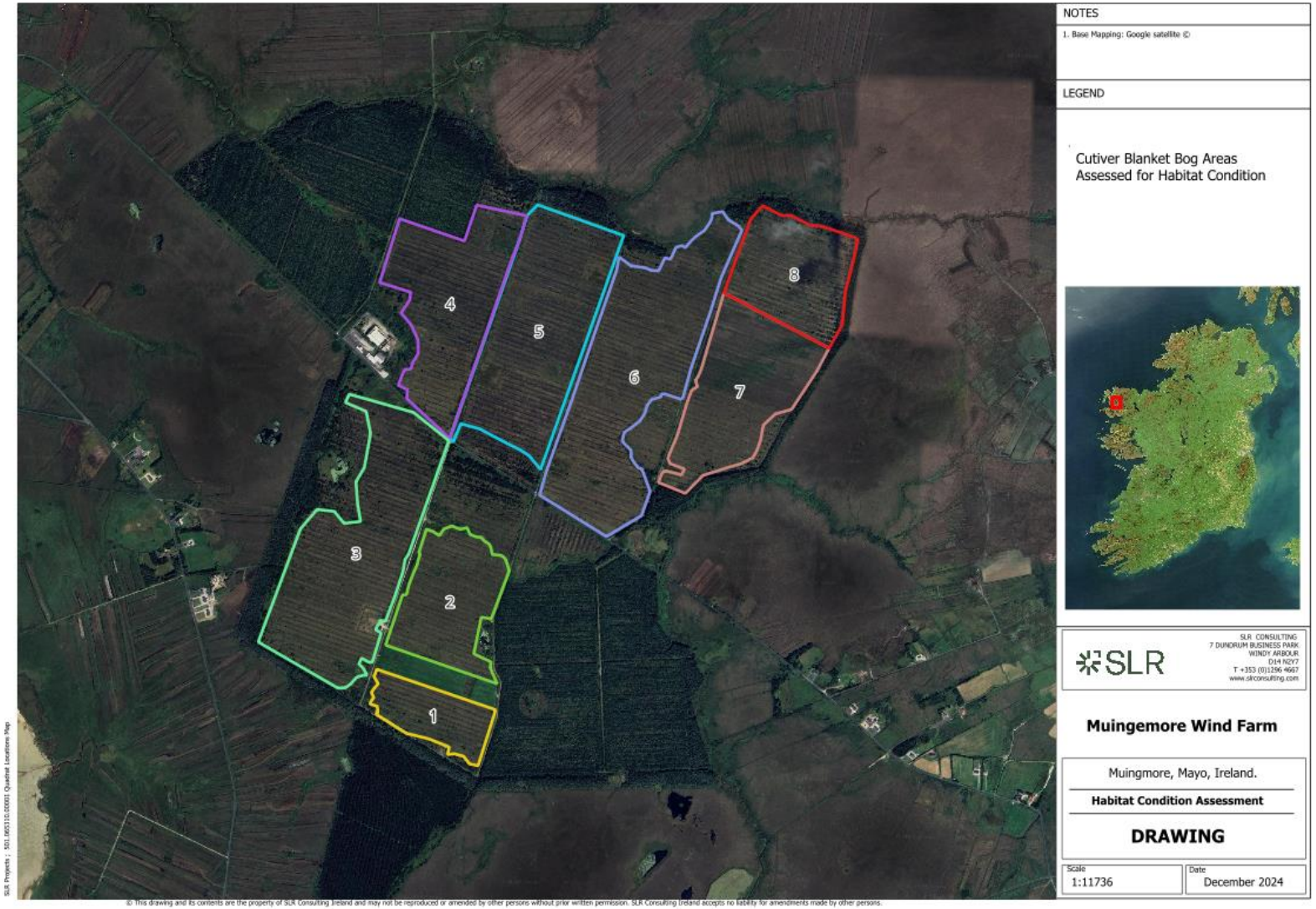
• Passes 5 or 6 core criteria including criterion A; AND • Passes additional criterion G, H, I or J (choose the one specified for the habitat type).	Good (3)	-	
• Passes 4 or 5 of 7 criteria; OR • Passes 6 of 7 criteria but fails criterion A or additional criterion G, H, I or J (choose the one specified for the habitat type).	Moderate (2)	**3 Core** **1 Additional**	
• Passes 3 or fewer criteria.	Poor (1)	**-**	

Suggested enhancement interventions to improve condition score

Block drains.
Remove and manage invasive species.
Remove and manage scrub encroachment.

Footnotes

Footnote 1 – Professional judgement should be used alongside the UKHab description.
Footnote 2 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.
Footnote 3 – Wildlife and Countryside Act 1981 (as amended).
Footnote 4 – Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, common nettle *Urtica dioica*, docks *Rumex* spp., and common ragwort *Jacobaea vulgaris*. There may be additional relevant species local to the region and or site.
Footnote 5 – According to the relative abundance DAFOR scale – Dominant, Abundant, Frequent, Occasional or Rare.
Footnote 6 – Ericaceous dwarf shrubs include: crowberry *Empetrum nigrum*, cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, cranberry *Vaccinium oxycoccos*, heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, and bell heather *Erica cinerea*. There may be additional relevant species local to the region and or site.
Footnote 7 – For fens, specify what fen type is present using base-status and trophic status - alkaline, neutral, or acidic; eutrophic, mesotrophic or oligotrophic.



Location of the areas assessed for condition relative to the DEFEA and UK Habitats Process

Condition Sheet: WETLAND Habitat Type	Overrun Area 1

Habitat Types

Grassland - Floodplain wetland mosaic and CFGM - See the Statutory Biodiversity Metric User Guide.
Wetland - Blanket bog
Wetland - Depression on peat substrates (H7150)
Wetland - Fens (upland and lowland)
Wetland - Lowland raised bog
Wetland - Oceanic valley mire [1] (D2.1)
Wetland - Purple moor grass and rush pastures
Wetland - Reedbeds
Wetland - Transition mires and quaking bogs (H7140)

Habitat Description

Really variable topography with lots of hammocks and hollows. No pools except surrounding the scrubland patch to the south which looks like deep mechanical cuts which have vegetated over. The site is less wet than would be expected in winter - and gets notably drier as you move north. The Sphagnum coverage is consistent with the highest percentage cover being in the south at about 30%. This is not identified to be priority active peatland as the Sphagnum cover is less than 40%. However, the site is in good condition and has potential to be restored to priority active status. There are some drainage ditches, but these are shallow and have Sphagnum blockages, so it is not clear from the site visit why the water retention profile seems weak. There is a notable coverage of non-customs lichens. The floral diversity aligns well with the indicator species of the blanket bog hammer I habitat - however it was identified to be species poor. This is partially due to the timing of the surveys. This is identified to be an annex I blanket bog in favourable condition which is not priority due to the Sphagnum cover. Nonetheless it is noted that it is close to priority status. The area towards the south of the site which is marked separately is the same species composition as the blanket bog to the north - however, there are large standing pools with 100% Sphagnum cover as can be seen in the photo. Therefore, it is mapped separately to denote the wetter area. These pools look like there are man-made and well revegetated.

Species identified in the habitat are listed in the table below according to their relative abundance.

Common Name	Scientific Name	Category
Heather	*Calluna vulgaris*	Dominant
Deergrass	*Trichophorum cespitosum*	Dominant
Bog-myrtle	*Myrica gale*	Occasional
Purple Moor-grass	*Molinia caerulea*	Occasional
Soft-rush	*Juncus effusus*	Occasional
Moss Sp.	*Moss Sp.*	Occasional
Black Bog-rush	*Schoenus nigricans*	Rare

Heath Milkwort	*Polygala serpyllifolia*	Rare
Glaucous Sedge	*Carex flacca*	Rare
Gorse	*Ulex europaeus*	Rare
Rhododendron	*Rhododendron ponticum*	Rare
Stiff Sedge	*Carex bigelowii*	Rare

For Oceanic valley mires - see EUNIS
See the Statutory Biodiversity Metric User Guide for Floodplain wetland mosaic (FWM) and coastal and floodplain grazing marsh (CFGM). For CFGM also see the below:
Coastal and floodplain grazing marsh UK BAP Priority Habitat description
Priority Habitat Inventory (England) - data.gov.uk
All other wetland habitats - see UK Habitat Classification (UKHab):

On-site or off-site, site name and location	Muingmore Windfarm	Survey date and Surveyor name	7th January 2026 Dr Andrew Torsney
	Assessment was undertaken during the winter period – sub optimal. However vegetative ID was used.	**Survey reference (if relating to a wider survey)**	N/A
Grid reference		**Habitat parcel reference**	Over-run Area 1

Condition Assessment Criteria		**Criterion passed (Yes or No)**	**Notes (such as justification)**
Core Criteria - must be assessed for **all wetland habitat types**:			
A	The water table is at, or near the surface throughout the year - this could be open water or saturation of soil at the surface. There is no artificial drainage, unless specifically to maintain water levels as specified above. **Note - this criterion is essential for achieving Good condition.**	Yes	There are no drains on site – there is a ditch that is vegetated over on either side of the fence through the site. The south of the field has a ditch all the way along the road along the southern end. But other than these there is good water retention on site.

B	The parcel represents a good example of its specific habitat type - the appearance and composition of the vegetation closely matches its UKHab description, with vascular and non-vascular characteristic indicator species consistently present.[1]	Yes	This is a well representative community composition however, most of the indicator species of higher value such as bog cotton, bog pimpernel etc are at low abundances. The site is notably dominated by soft rush and heather. There is scrub encroachment prevalent throughout.
C	The water supplies (groundwater, surface water and or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.	Yes	There are no water courses throughout the site. This criterion is passed due to lack of water supply through the site.
D	Cover of scrub and scattered trees are less than 10%.	Yes	There is scrub to the north and south of the site over 10%. However, there is no scrub throughout the main body of the site beyond a few saplings.
E	Cover of bare ground is less than 5%.	Yes	Limited bare ground, full sward coverage.
F	There is an absence of invasive non-native plant species[2] (as listed on Schedule 9 of WCA[3]) and species indicative of suboptimal condition[4] make up less than 5% of ground cover.	No	Invasive species are not recorded in the quadrat data and surrounding area. The area to the north has extensive rhododendron stands.
Additional Criterion - must be assessed for **Fen and Purple moor grass and rush pasture** habitats only:			
G	No more than 25% of the habitat area has a continuous cover of litter (such as dead vegetation) preventing regeneration.	N/A	N/A
Additional Criterion - must be assessed for **Bog** habitats only:			
H	Sphagnum moss *Sphagnum* spp. and cottongrasses *Eriophorum* spp. are at least Frequent[5]. Cover of ericaceous dwarf shrubs[6] is less than 75%.	Yes	Sphagnum is less than 20-22% and dwarf shrubs are less than 75%.
Additional Criterion - must be assessed for **Reedbed** habitats only:			

I	The reedbed has a diverse structure with between 60% and 80% reeds *Phragmites australis*. Other areas may include open water (at least 10%), species-rich fen and or wet woodland.	N/A	N/A
Additional Criterion - must be assessed for **Floodplain wetland mosaic and CFGM** only:			
J	All ditches recorded within the habitat achieve Good condition as assessed using the Ditch condition sheet.	N/A	N/A
Essential criterion achieved (required for Good condition) Yes or No:			**Yes**
Number of criteria passed			**5**

Condition Assessment Result	**Condition Assessment Score**	**Score Achieved ×/✓**	
Results for habitats requiring assessment of 6 criteria (Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1)):			
• Passes 5 or 6 core criteria, including criterion A.	Good (3)	N/A	
• Passes 3 or 4 core criteria; OR • Passes 5 core criteria but fails criterion A.	Moderate (2)	N/A	
• Passes 2 or fewer core criteria.	Poor (1)	N/A	
Results for habitats requiring assessment of 7 criteria - core criteria and additional criterion specified for habitat type - all habitat types except Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1):			

• Passes 5 or 6 core criteria including criterion A; AND • Passes additional criterion G, H, I or J (choose the one specified for the habitat type).	Good (3)	**5 Core** **1 Additional**	
• Passes 4 or 5 of 7 criteria; OR • Passes 6 of 7 criteria but fails criterion A or additional criterion G, H, I or J (choose the one specified for the habitat type).	Moderate (2)	**-**	
• Passes 3 or fewer criteria.	Poor (1)	-	

Suggested enhancement interventions to improve condition score

Unknown due to good condition.

Footnotes

Footnote 1 – Professional judgement should be used alongside the UKHab description.
Footnote 2 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.
Footnote 3 – Wildlife and Countryside Act 1981 (as amended).
Footnote 4 – Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, common nettle *Urtica dioica*, docks *Rumex* spp., and common ragwort *Jacobaea vulgaris*. There may be additional relevant species local to the region and or site.
Footnote 5 – According to the relative abundance DAFOR scale – Dominant, Abundant, Frequent, Occasional or Rare.
Footnote 6 – Ericaceous dwarf shrubs include: crowberry *Empetrum nigrum*, cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, cranberry *Vaccinium oxycoccos*, heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, and bell heather *Erica cinerea*. There may be additional relevant species local to the region and or site.
Footnote 7 – For fens, specify what fen type is present using base-status and trophic status - alkaline, neutral, or acidic; eutrophic, mesotrophic or oligotrophic.

Condition Sheet: WETLAND Habitat Type	Overrun Area 3

Habitat Types

Grassland - Floodplain wetland mosaic and CFGM - See the Statutory Biodiversity Metric User Guide.
Wetland - Blanket bog
Wetland - Depression on peat substrates (H7150)
Wetland - Fens (upland and lowland)
Wetland - Lowland raised bog
Wetland - Oceanic valley mire [1] (D2.1)
Wetland - Purple moor grass and rush pastures
Wetland - Reedbeds
Wetland - Transition mires and quaking bogs (H7140)

Habitat Description

This habitat has been recently rotavated and is recognising bare peat. The peat depth is over 3m deep as observed from the deep drainage ditches around the edge of the site. There are several shallow ditches/scars through the main habitat area. The main species which are decolonising first are deer grass, soft rush, and grass species such as false oatgrass and/or purple moor grass. Overall, the habitat is in extremely poor condition with roughly 70% bare ground and no evidence of Sphagnum.

Species identified in the habitat are listed in the table below according to their relative abundance.

Common Name	Scientific Name	Category
Soft-rush	*Juncus effusus*	Frequent
Deergrass	*Trichophorum cespitosum*	Frequent
Timothy	*Phleum pratense*	Rare

For Oceanic valley mires - see EUNIS
See the Statutory Biodiversity Metric User Guide for Floodplain wetland mosaic (FWM) and coastal and floodplain grazing marsh (CFGM). For CFGM also see the below:
Coastal and floodplain grazing marsh UK BAP Priority Habitat description
Priority Habitat Inventory (England) - data.gov.uk
All other wetland habitats - see UK Habitat Classification (UKHab):

On-site or off-site, site name and location	Muingmore Windfarm	**Survey date and Surveyor name**	7th January 2026 Dr Andrew Torsney
	Assessment was undertaken during the winter period – sub optimal. However vegetative ID was used.	**Survey reference (if relating to a wider survey)**	N/A

Grid reference		Habitat parcel reference	Overrun Area 3

Condition Assessment Criteria		Criterion passed (Yes or No)	Notes (such as justification)
Core Criteria - must be assessed for **all wetland habitat types**:			
A	The water table is at, or near the surface throughout the year - this could be open water or saturation of soil at the surface. There is no artificial drainage, unless specifically to maintain water levels as specified above. **Note - this criterion is essential for achieving Good condition.**	No	Completely cutover and rotovated.
B	The parcel represents a good example of its specific habitat type - the appearance and composition of the vegetation closely matches its UKHab description, with vascular and non-vascular characteristic indicator species consistently present.[1]	No	Devoid of species – some areas with 90% reed and grass cover and other areas with 96% bare peat.
C	The water supplies (groundwater, surface water and or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.	No	No water supply to the site. Stream to the north is fast flowing not thought to be flowing into the site.
D	Cover of scrub and scattered trees are less than 10%.	Yes	Only because the site is devoid of species.

E	Cover of bare ground is less than 5%.	No	96% bare.
F	There is an absence of invasive non-native plant species[2] (as listed on Schedule 9 of WCA[3]) and species indicative of suboptimal condition[4] make up less than 5% of ground cover.	Yes	Only because the site is devoid of species.
Additional Criterion - must be assessed for **Fen and Purple moor grass and rush pasture** habitats only:			
G	No more than 25% of the habitat area has a continuous cover of litter (such as dead vegetation) preventing regeneration.	N/A	N/A
Additional Criterion - must be assessed for **Bog** habitats only:			
H	Sphagnum moss *Sphagnum* spp. and cottongrasses *Eriophorum* spp. are at least Frequent[5]. Cover of ericaceous dwarf shrubs[6] is less than 75%.	No	Zero percent sphagnum.
Additional Criterion - must be assessed for **Reedbed** habitats only:			
I	The reedbed has a diverse structure with between 60% and 80% reeds *Phragmites australis*. Other areas may include open water (at least 10%), species-rich fen and or wet woodland.	N/A	N/A
Additional Criterion - must be assessed for **Floodplain wetland mosaic and CFGM** only:			
J	All ditches recorded within the habitat achieve Good condition as assessed using the Ditch condition sheet.	N/A	N/A

Essential criterion achieved (required for Good condition) Yes or No:			**No**
Number of criteria passed			**4**
Condition Assessment Result	**Condition Assessment Score**	**Score Achieved ×/✓**	
Results for habitats requiring assessment of 6 criteria (Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1)):			
• Passes 5 or 6 core criteria, including criterion A.	Good (3)	N/A	
• Passes 3 or 4 core criteria; OR • Passes 5 core criteria but fails criterion A.	Moderate (2)	N/A	
• Passes 2 or fewer core criteria.	Poor (1)	N/A	
Results for habitats requiring assessment of 7 criteria - core criteria and additional criterion specified for habitat type - all habitat types except Depression on peat substrates (H7150) and Oceanic valley mire [1] (D2.1):			
• Passes 5 or 6 core criteria including criterion A; AND • Passes additional criterion G, H, I or J (choose the one specified for the habitat type).	Good (3)	-	
• Passes 4 or 5 of 7 criteria; OR • Passes 6 of 7 criteria but fails criterion A or additional criterion G, H, I or J (choose the one specified for the habitat type).	Moderate (2)	-	

• Passes 3 or fewer criteria.	Poor (1)	For assessment purposed it is views to be fully failing. Only 2 passes which was just the absence of scrub but this is due to the absence of any vegetation.	

Suggested enhancement interventions to improve condition score

Block drains.
Remove inappropriate management.
Allow to recolonise.

Footnotes

Footnote 1 – Professional judgement should be used alongside the UKHab description.
Footnote 2 – Assess this for each distinct habitat parcel. If the distribution of invasive non-native species varies across the habitat, split into parcels accordingly, applying a buffer zone around the invasive non-native species with a size relative to its risk of spread into adjacent habitat, using professional judgement.
Footnote 3 – Wildlife and Countryside Act 1981 (as amended).
Footnote 4 – Species indicative of suboptimal condition for this habitat type include: creeping thistle *Cirsium arvense*, spear thistle *Cirsium vulgare*, common nettle *Urtica dioica*, docks *Rumex* spp., and common ragwort *Jacobaea vulgaris*. There may be additional relevant species local to the region and or site.
Footnote 5 – According to the relative abundance DAFOR scale – Dominant, Abundant, Frequent, Occasional or Rare.
Footnote 6 – Ericaceous dwarf shrubs include: crowberry *Empetrum nigrum*, cowberry *Vaccinium vitis-idaea*, bilberry *Vaccinium myrtillus*, cranberry *Vaccinium oxycoccos*, heather *Calluna vulgaris*, cross-leaved heath *Erica tetralix*, and bell heather *Erica cinerea*. There may be additional relevant species local to the region and or site.
Footnote 7 – For fens, specify what fen type is present using base-status and trophic status - alkaline, neutral, or acidic; eutrophic, mesotrophic or oligotrophic.

Appendix C Plot data – IWM Blanket Bog [7130] Condition Assessment

Muingmore Windfarm

RWE Renewables Ireland

Glasshouses 2, 92 George's Street Lower Dún Laoghaire, Co. Dublin, A96 VR66

Prepared by:

SLR Environmental Consulting (Ireland) Ltd

7 Dundrum Business Park, Windy Arbour, Dublin, D14
N2Y7

SLR Project No.: 501.V00727.00008

Condition Assessment Criteria results for Blanket Bog [7130] from the Irish Wildlife Manuals, No. 79 – Part 1 of 3

Criteria	T11-Q1W	T11-Q2W	T11-Q1O	T11-Q2O	SUB-Q1W	SUB-Q2W	SUB-Q1O	SUB-Q2O	T4-Q1W	T4-Q2W	T4-Q1O	T4-Q2O	T5-Q1W	T5-Q2W	T5-Q1O	T5-Q2O
Number of positive indicator species present ≥ 7 (Appendix VI)	1	1	1	0	0	0	0	0	0	0	1	0	1	1	0	0
Cover of bryophyte or lichen species, excluding Sphagnum fallax ≥ 10%	1	0	1	1	0	0	0	0	0	1	1	1	1	1	1	1
Cover of each of the following species: Calluna vulgaris, Eleocharis multicaulis, Eriophorum vaginatum, Molinia caerulea, Schoenus nigricans, Trichophorum germanicum individually < 75%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cover of the following negative indicator species: Agrostis capillaris, Holcus lanatus, Phragmites australis, Pteridium aquilinum, Ranunculus repens collectively < 1%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cover of non-native species < 1% (local)	0	0	0	0	1	1	0	1	1	0	0	1	0	0	0	0
Cover of non-native species < 1% (20m vicinity)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Cover of scattered native trees and scrub < 10% (20m vicinity)	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
Crushed, broken and/or pulled up Sphagnum species < 10% of Sphagnum cover	1	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1
Last complete growing season's shoots of ericoids, Empetrum nigrum and Myrica gale showing signs of browsing collectively < 33% (Assess a minimum of 10 shoots distributed across the plot)	1	0	1	1	0	0	0	0	1	0	0	1	1	1	1	1
No signs of burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning (20m vicinity)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
No signs of burning inside boundaries of sensitive areas† (20m vicinity)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cover of disturbed bare ground < 10% (local)	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1
Cover of disturbed bare ground < 10% (20m vicinity)	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1
Area showing signs of drainage resulting from heavy trampling or	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tracking or ditches or peat cutting < 10% (20m vicinity)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cover of erosion gullies and eroded areas within the greater bog mosaic‡ < 5%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Fail	**6**	**8**	**6**	**7**	**10**	**10**	**9**	**8**	**6**	**7**	**6**	**5**	**5**	**5**	**6**	**6**

Condition Assessment Criteria results for Blanket Bog [7130] from the Irish Wildlife Manuals, No. 79 – Part 2 of 3

Criteria	T6-Q1W	T6-Q2W	T6-Q1O	T6-Q2O	T7-Q1W	T7-Q2W	T7-Q1O	T7-Q2O	T8-Q1W	T8-Q2W	T8-Q1O	T8-Q2O	T9-Q1W	T9-Q2W	T9-Q1O	T9-Q2O
Number of positive indicator species present ≥ 7 (Appendix VI)	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0
Cover of bryophyte or lichen species, excluding Sphagnum fallax ≥ 10%	0	1	0	0	1	1	1	1	0	0	0	0	1	0	0	1
Cover of each of the following species: Calluna vulgaris, Eleocharis multicaulis, Eriophorum vaginatum, Molinia caerulea, Schoenus nigricans, Trichophorum germanicum individually < 75%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cover of the following negative indicator species: Agrostis capillaris, Holcus lanatus, Phragmites australis, Pteridium aquilinum, Ranunculus repens collectively < 1%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cover of non-native species < 1% (local)	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
Cover of non-native species < 1% (20m vicinity)	0	0	1	1	0	0	0	0	1	1	1	1	1	1	1	1
Cover of scattered native trees and scrub < 10% (20m vicinity)	1	1	1	1	0	0	1	1	0	0	0	0	1	0	1	1
Crushed, broken and/or pulled up Sphagnum species < 10% of Sphagnum cover	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
Last complete growing season's shoots of ericoids, Empetrum nigrum and Myrica gale showing signs of browsing collectively < 33% (Assess a minimum of 10 shoots distributed across the plot)	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0
No signs of burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning (20m vicinity)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
No signs of burning inside boundaries of sensitive areas† (20m vicinity)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cover of disturbed bare ground < 10% (local)	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
Cover of disturbed bare ground < 10% (20m vicinity)	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
Area showing signs of drainage resulting from heavy trampling or	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tracking or ditches or peat cutting < 10% (20m vicinity)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cover of erosion gullies and eroded areas within the greater bog mosaic‡ < 5%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Fail	**8**	**5**	**6**	**7**	**6**	**7**	**4**	**4**	**8**	**8**	**7**	**7**	**4**	**7**	**6**	**5**

Condition Assessment Criteria results for Blanket Bog [7130] from the Irish Wildlife Manuals, No. 79 – Part 3 of 3

Criteria	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Number of positive indicator species present ≥ 7 (Appendix VI)	0	0	0	0	0	0	0	1	1	1	1	1
Cover of bryophyte or lichen species, excluding Sphagnum fallax ≥ 10%	0	0	0	0	0	0	0	0	1	1	0	0
Cover of each of the following species: Calluna vulgaris, Eleocharis multicaulis, Eriophorum vaginatum, Molinia caerulea, Schoenus nigricans, Trichophorum germanicum individually < 75%	1	1	1	1	1	1	1	1	1	1	1	1
Cover of the following negative indicator species: Agrostis capillaris, Holcus lanatus, Phragmites australis, Pteridium aquilinum, Ranunculus repens collectively < 1%	1	1	1	1	1	1	1	1	1	1	1	1
Cover of non-native species < 1% (local)	1	1	1	1	1	1	1	1	1	1	1	1
Cover of non-native species < 1% (20m vicinity)	1	1	1	1	1	1	1	1	1	1	1	1
Cover of scattered native trees and scrub < 10% (20m vicinity)	1	1	1	1	1	1	1	1	1	1	1	1
Crushed, broken and/or pulled up Sphagnum species < 10% of Sphagnum cover	0	0	0	0	0	0	0	0	1	1	1	1
Last complete growing season's shoots of ericoids, Empetrum nigrum and Myrica gale showing signs of browsing collectively < 33% (Assess a minimum of 10 shoots distributed across the plot)	0	0	0	0	0	0	0	0	1	1	1	1
No signs of burning into the moss, liverwort or lichen layer or exposure of peat surface due to burning (20m vicinity)	1	1	1	1	1	1	1	1	1	1	1	1
No signs of burning inside boundaries of sensitive areas† (20m vicinity)	1	1	1	1	1	1	1	1	1	1	1	1
Cover of disturbed bare ground < 10% (local)	0	0	0	0	1	1	0	0	1	1	1	1
Cover of disturbed bare ground < 10% (20m vicinity)	0	0	0	0	1	1	0	0	1	1	1	1
Area showing signs of drainage resulting from heavy trampling or	0	0	0	0	1	1	1	0	1	0	1	1
tracking or ditches or peat cutting < 10% (20m vicinity)	0	0	0	0	0	0	0	0	1	1	1	1
Cover of erosion gullies and eroded areas within the greater bog mosaic‡ < 5%	1	1	1	1	1	1	1	1	1	1	1	1
Total Fail	**8**	**8**	**8**	**8**	**5**	**5**	**7**	**7**	**0**	**1**	**1**	**1**

Appendix D Plot data – Photomontage

Muingmore Windfarm

RWE Renewables Ireland

Glasshouses 2, 92 George's Street Lower Dún Laoghaire, Co. Dublin, A96 VR66

Prepared by:

SLR Environmental Consulting (Ireland) Ltd

7 Dundrum Business Park, Windy Arbour, Dublin, D14
N2Y7

SLR Project No.: 501.V00727.00008

Plate 1 Photo record of T4-Q1O as at location (ITM) X – 477095, Y – 823122; 14th November 2024

Plate 2 Photo record of T4-Q2O as at location (ITM) X – 477103, Y – 823102; 14th November 2024

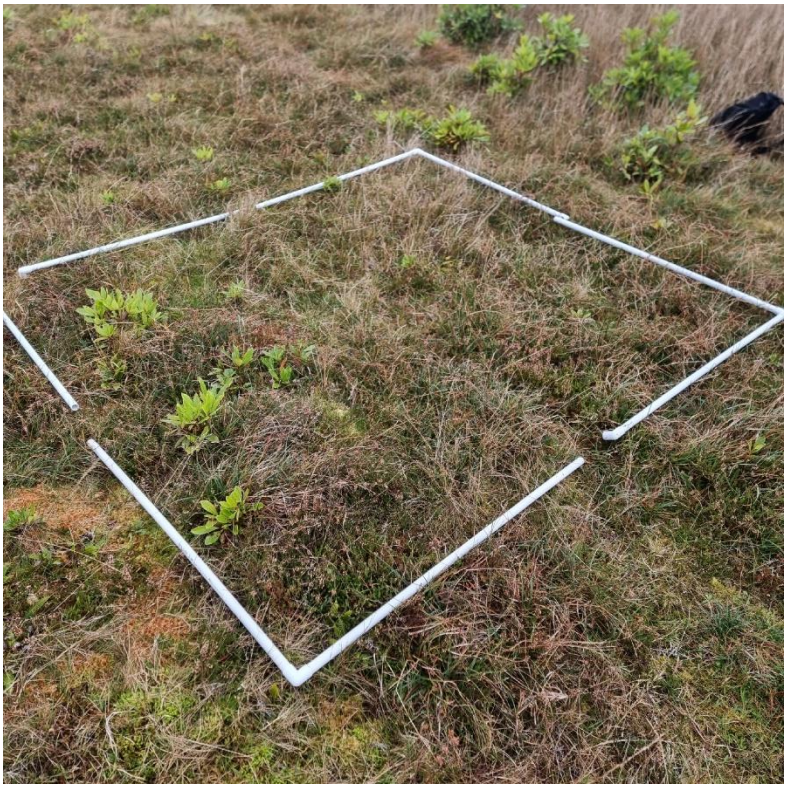


Plate 3 Photo record of T4-Q1W as at location (ITM) X – 477015, Y – 823113; 14th November 2024

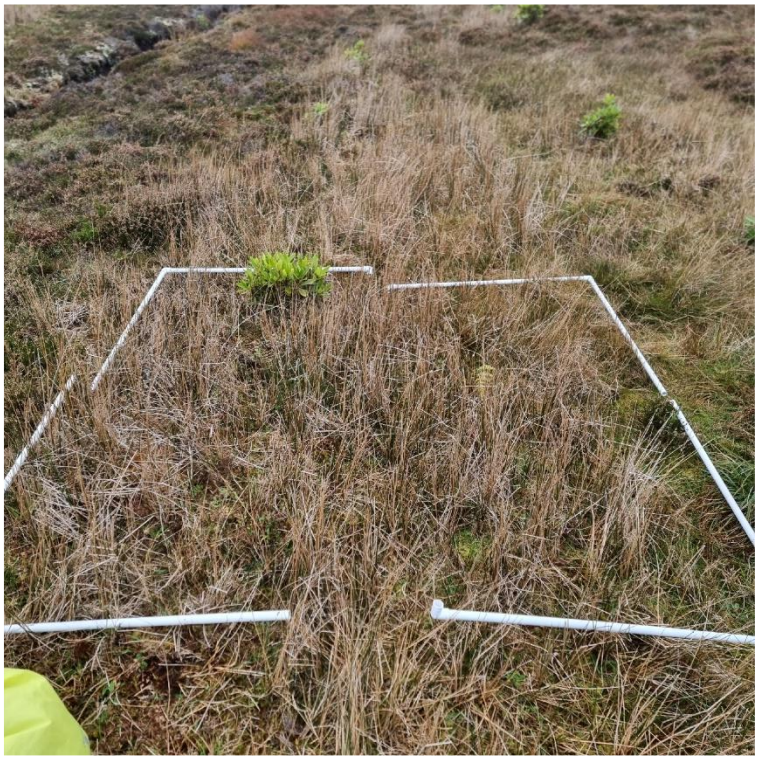


Plate 4 Photo record of T4-Q2W as at location (ITM) X – 476979, Y – 823618; 14th November 2024

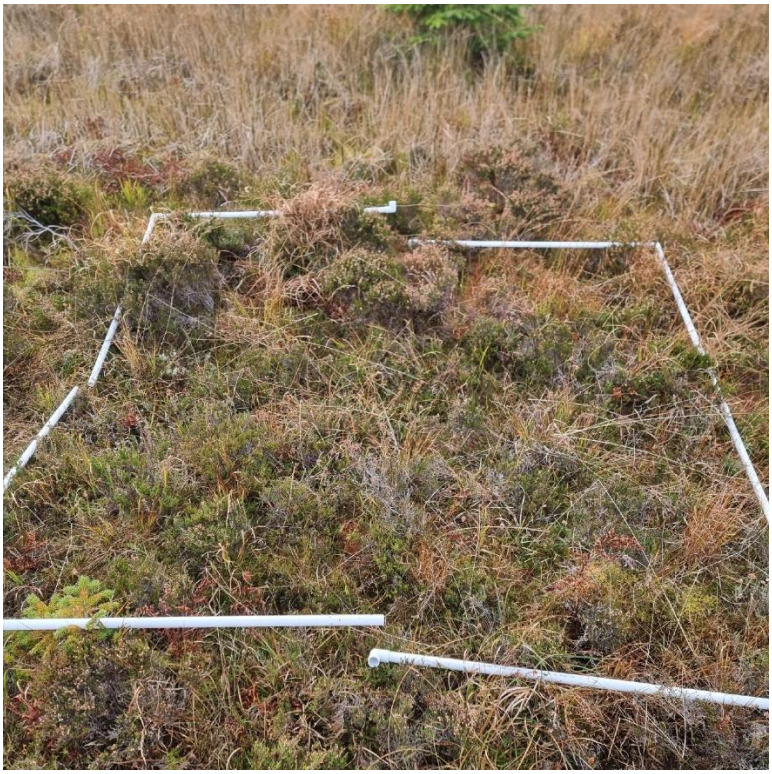


Plate 5 Photo record of T5-Q1O as at location (ITM) X – 476999, Y – 823655; 14th November 2024

Plate 6 Photo record of T5-Q2O as at location (ITM) X – 476976, Y – 823667; 14th November 2024

Plate 7 Photo record of T5-Q1W as at location (ITM) X – 476979, Y – 823594; 14th November 2024

Plate 8 Photo record of T5-Q2W as at location (ITM) X – 477037, Y – 823122; 14th November 2024

Plate 9 Photo record of T6-Q1O as at location (ITM) X – 477495, Y – 823222; 14th November 2024

Plate 10 Photo record of T6-Q2O as at location (ITM) X – 477484, Y – 823218; 14th November 2024

Plate 11 Photo record of T6-Q1W as at location (ITM) X – 477530, Y – 823261; 14th November 2024

Plate 12 Photo record of T6-Q2W as at location (ITM) X – 477508, Y – 823267; 14th November 2024

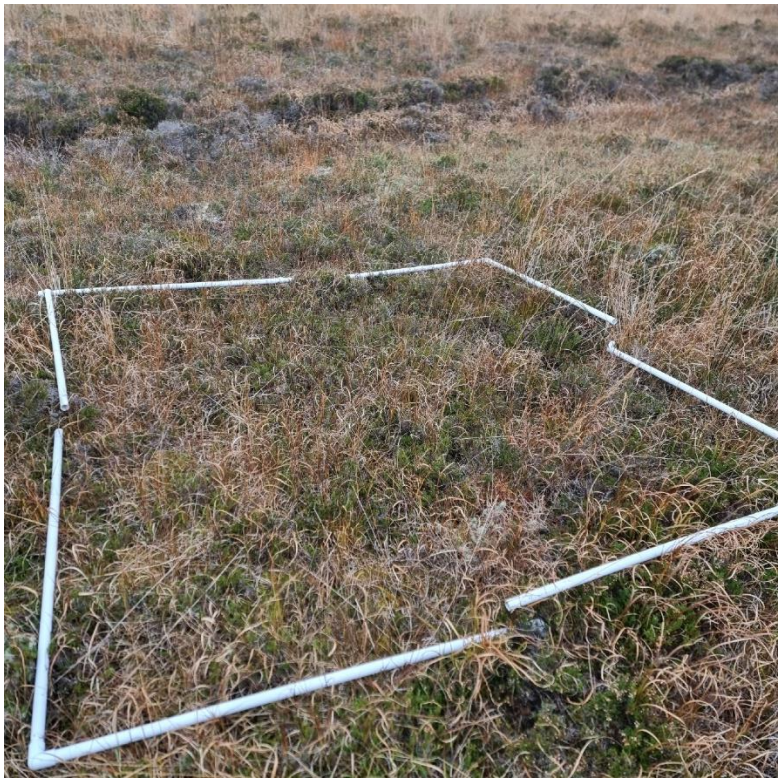


Plate 13 Photo record of T7-Q1O as at location (ITM) X – 477642, Y – 823614; 14th November 2024

Plate 14 Photo record of T7-Q2O as at location (ITM) X – 477625, Y – 823610; 14th November 2024

Plate 15 Photo record of T7-Q1W as at location (ITM) X – 477587, Y – 823676; 14th November 2024

Plate 16 Photo record of T7-Q2W as at location (ITM) X – 477598, Y – 823673; 14th November 2024

Plate 17 Photo record of T8-Q1O as at location (ITM) X – 476467, Y – 822618; 14th November 2024

Plate 18 Photo record of T8-Q2O as at location (ITM) X – 476479, Y – 822618; 14th November 2024

Plate 19 Photo record of T8-Q1W as at location (ITM) X – 476392, Y – 822592; 14th November 2024

Plate 20 Photo record of T8-Q2W as at location (ITM) X – 476402, Y – 822583; 14th November 2024

Plate 21 Photo record of T9-Q1O as at location (ITM) X – 476516, Y – 822228; 14th November 2024

Plate 22 Photo record of T9-Q2O as at location (ITM) X – 476500, Y – 822272; 14th November 2024

Plate 23 Photo record of T9-Q1W as at location (ITM) X – 476467, Y – 822163; 14th November 2024

Plate 24 Photo record of T9-Q2W as at location (ITM) X – 476476, Y – 822187; 14th November 2024

Plate 25 Photo record of T11-Q1O as at location (ITM) X – 476559, Y – 821885; 14th November 2024

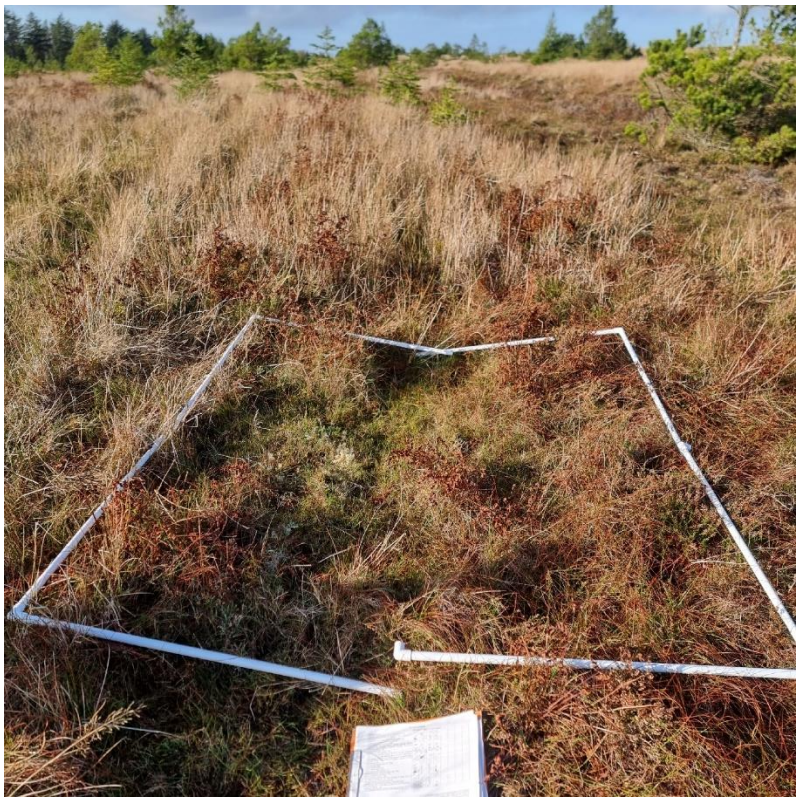


Plate 26 Photo record of T11-Q2O as at location (ITM) X – 476598, Y – 821872; 14th November 2024

Plate 27 Photo record of T11-Q1W as at location (ITM) X – 476575, Y – 821833; 14th November 2024

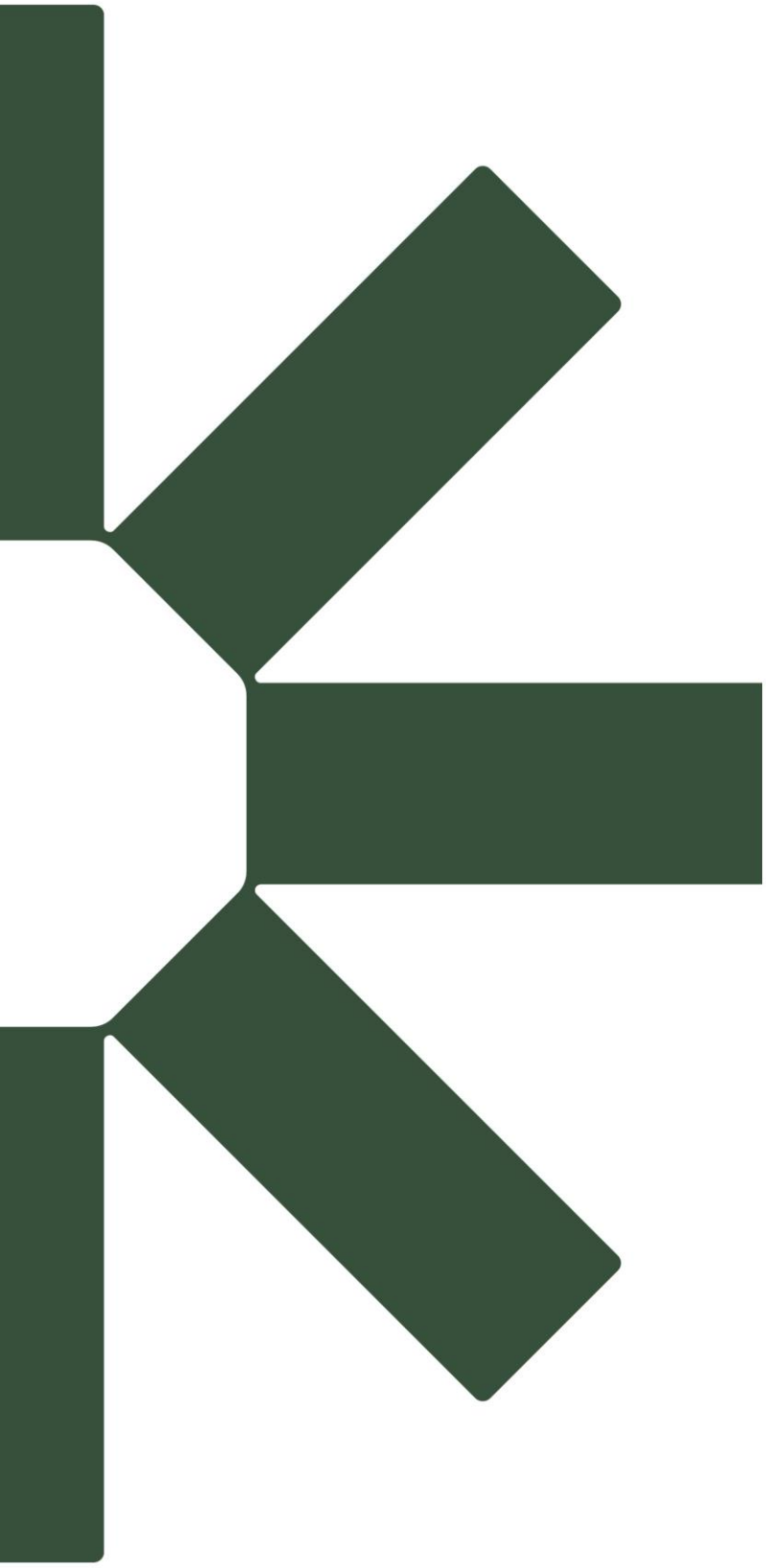
Plate 28 Photo record of T11-Q2W as at location (ITM) X – 476554, Y – 821822; 14th November 2024

Plate 29 Photo record of SUB-Q1O as at location (ITM) X – 476303, Y – 823576; 14th November 2024

Plate 30 Photo record of SUB-Q2O as at location (ITM) X – 476304, Y – 823576; 14th November 2024

Plate 31 Photo record of SUB-Q1W as at location (ITM) X – 476311, Y – 823520; 14th November 2024

Plate 32 Photo record of SUB-Q2W as at location (ITM) X – 476329, Y – 823516; 14th November 2024



Making Sustainability Happen

Appendix 5 Construction and Environmental Management Plan

AA Screening and Natura Impact Statement

Muingmore Wind Farm

RWE Renewables Ireland Limited

SLR Project No.: 501.065301.00001

Muingmore Wind Farm

Construction Environmental Management Plan (CEMP)

RWE Renewables Ireland Limited

Prepared by:

SLR Environmental Consulting (Ireland) Ltd

7 Dundrum Business Park, Windy Arbour, Dublin, D14 N2Y7

SLR Project No.: 501.000571.065301

27 April 2026

Revision: 2

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
00	13 January 2026	TM	NB	GH
1	16 March 2026	TM	LH	GH
2	27 April 2026	LH / RA	AOB	GH
	Click to enter a date.			
	Click to enter a date.			

Basis of Report

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Acronyms and Abbreviations

AIL	Abnormal Indivisible Load
CEMP	Construction Environmental Management Plan
CIRIA	Construction Industry Research and Information Association
CMS	Construction Method statement
CMT	Construction Management Team
CTMP	Construction Traffic Management Plan
ECoW	Ecological Clerk of Works
EIA	Environmental Impact Assessment
EIERP	Environmental Incident and Emergency Response Plan
EPA	Environmental Protection Agency
EPPP	Emergency Pollution Prevention Plan
EPS	European Protected Species
EQS	Environmental Quality Standards
GPP	Guidance for Pollution Prevention
GWDTE	Groundwater Dependent Terrestrial Ecosystems
HGV	Heavy Goods Vehicle
HMP	Habitat Management Plan
MCC	Mayo County Council
MW	Megawatt

PPE	Personal Protective Equipment
PPIP	Pollution Prevention and Incident Plan
PRP	Peatland Restoration Plan
PSCS	Project Supervisor Construction Stage
PSDP	Project Supervisor Design Process
QA	Quality Assurance
RAMS	Risk Assessment Method Statements
SAC	Special Area of Conservation
SHPP	Species & Habitat Protection Plan
SPA	Special Protection Area
SuDS	Sustainable Drainage System
SWMP	Site Waste Management Plan
SHWWR 2013	Safety, Health and Welfare at Work (Construction) Regulations 2013, as amended
TCC	Temporary Construction Compound
TDR	Turbine Delivery Route
WMP	Waste Management Plan
WQMP	Water Quality Monitoring Plan

1.0 Introduction

1.1 Background

This document presents a Construction Environmental Management Plan (CEMP) for RWE Renewables Ireland Limited (the "Applicant"), which sets out the principles and procedures for mitigation measures to achieve environmental management during construction of a proposed renewable energy development within the town lands of Muingmore (An Mhoing Mhór) and Doolough (Dumha Locha), County Mayo. The development comprises a 74.1 to 91 Megawatt (MW) wind farm, with 13 no. turbines and associated infrastructure (including 33kV collector cables), a Turbine Delivery Route (TDR), onsite substation, and battery energy storage system (BESS), which, in consistency with the terminology of the wider planning application documentation, is referred to as the "Proposed Development".

Should consent be granted, this CEMP will be revised and updated to a final version with the appointed Contractor, which will be agreed upon with Mayo County Council (MCC) prior to the commencement of development. The Contractor will use the CEMP to ensure proper environmental management throughout the construction phase of the Proposed Project and will be expanded to cater for any additional management measures required by planning conditions attached to the permission.

The document should be read in conjunction with **Chapter 2: Project Description** and **Chapter 17: Schedule of Mitigation Measures** of the Environmental Impact Assessment Report (EIAR) submitted with the planning application.

The CEMP is a live document that will evolve during the different phases of the Proposed Project. As such it will be subject to ongoing review in order to:

- address relevant conditions required in the approved consent;
- ensure it reflects best practice at the time of construction;
- ensure it incorporates the findings of pre-construction site investigations;
- address changes resulting from the construction methods used by the contractor(s); and
- address unforeseen conditions encountered during construction.

The CEMP will be a key contract document, which will ensure that all mitigation measures, which are considered necessary to protect the environment, are implemented.

1.2 Aims and Objectives

The CEMP will be maintained and updated on site and will be supported by associated design specifications and relevant documentation prepared in accordance with S.I. No. 291/2013 – Safety, Health and Welfare at Work (Construction) Regulations 2013, as amended (SHWWR 2013), including the Project Supervisor Construction Stage's (PSCS) Construction Phase Plan.

Where appropriate, the CEMP, or plans within the CEMP, will form part of the site induction which will be mandatory for all employees, contractors and visitors attending the Main Wind Farm Development Site. All employees and contractors will need to familiarise themselves with the relevant contents of the CEMP and supporting appendices as directed.

Management practices and mitigation measures have been developed for those aspects of the construction works that have been identified as having the potential to adversely affect the environment.

The objectives of the CEMP are to:

- identify the proposed mechanisms for ensuring the delivery of environmental mitigation measures to avoid or reduce potential environmental effects;

- ensure procedures are in place so that there is a prompt response to effects requiring remediation, including reporting and any additional mitigation measures needed to prevent a recurrence;
- provide an outline of the content that will be supplied in the construction method statements and strategies that will be prepared in order to secure mitigation measures in relation to different design aspects of the Proposed Development;
- ensure compliance with legislation and identify where it will be necessary to obtain authorisation from relevant statutory bodies;
- ensure that appropriate monitoring and reporting will be in place;
- provide a framework for reporting, compliance auditing and inspection to ensure environmental aims will be met; and
- set out the Applicant's expectations to guide contractors on their requirements with regards to environmental commitments and environmental management.

1.3 Definition of Terms

For the purposes of assessment, the following terms (Capitalised) are utilised throughout the EIAR:

- **Proposed Project:** Refers to the Proposed Development including the GCR.
- **Proposed Development:** Refers to the elements of the Proposed Project for which planning consent is being sought. This encompasses the wind farm and associated infrastructure (including the 33kV collector cables), Habitat Enhancement Area in the north-west quadrant (NWQ), any development associated with the Turbine Delivery Route (TDR), onsite substation, and battery energy storage system (BESS).
- **Proposed Development Site:** The site where the Proposed Development is located, as defined by the Planning Application Boundary.
- **Main Wind Farm Development Site:** part of the Proposed Development Site which includes the proposed wind turbines and associated infrastructure.

The Northern Cluster of the Main Wind Farm Development Site is comprised of a geographical area to the north of the local road, the L5252. Elements of the Proposed Development which will be located in the Northern Cluster comprise.

- 7 no. turbines (turbine nos. 1-7) and their associated access tracks, hardstandings and foundations.
- 1 no. 110kV substation.
- 1 no. temporary construction compound (TCC1).
- 1 no. BESS.
- 2 no. site access points (AP1 and AP2).
- Internal underground 33kV collector cables which connects both clusters to the onsite substation which is located within the Northern Cluster.
- Habitat Enhancement Area in the north-west quadrant (NWQ).

The Southern Cluster of the Main Wind Farm Development Site is defined by the area to the south of the local road, the L5252. Elements of the Proposed Development which will be located in the Southern Cluster comprise:

- 6 no. turbines (turbine nos. 8-13) and their associated access tracks, hardstandings and foundations.

- 1 no. temporary construction compound (TCC2).
- 1 no. meteorological mast.
- 1 no. site access point (AP3).
- Internal underground 33kV collector cables, connecting to the onsite substation which is located within the Northern Cluster.

Turbine Delivery Route (TDR): Refers to the proposed turbine delivery route from Killybegs Port to the Main Wind Farm Development Site and includes the 3 no. Over-run Areas.

Over-run Areas: Refers to the 3 no. areas (Over-run Areas 1, 2 & 3) along the TDR where temporary accommodation works on private lands are required.

Grid Connection Route (GCR): The designated route for the 110kV Underground Electricity Cable from the Proposed Development onsite substation to the national grid connection point at Bellacorick 110 kV Substation. The GCR will be the subject of a separate planning application.

Habitat Enhancement Area in the NWQ: An area to the north-west of the Main Wind Farm Development Site which will not include any infrastructure related to the Proposed Project other than that to enhance habitat.

1.4 Main Wind Farm Development Site

The Main Wind Farm Development Site and its surrounding area are described in **Chapter 1** and topic specific chapters of the EIAR but a summary is provided here for ease of reference.

The Main Wind Farm Development Site is situated within a coastal region of County Mayo and occupies a relatively condensed area of around 3km in a north-east to south-west orientation, encompassing 2 cluster areas. The surrounding area is predominantly rural in character but there are several small settlements within a 5km radius of the Main Wind Farm Proposed Development Site. The Main Wind Farm Proposed Development Site is also located c. 8km west of Bangor Eris and c.0.5km north of the village of Gweesalia.

Geographically, the Main Wind Farm Development Site lies north of the intersection of roads L1205 and L1206. The L1206 borders the southern edge of the Main Wind Farm Proposed Development Site, while the L1205 runs westward and leads to the R313, located c. 4km north of the Main Wind Farm Proposed Development Site. The R313 provides connections to more extensive road networks, as indicated below.

A local road (L5252) bisects the Main Wind Farm Development Site east to west. This local road branches off from the L1206. This road runs longitudinally through the Main Wind Farm Proposed Development Site, spanning from north-west to south-east, connecting the L1205 and L1206. Notably straight and offering good lines of sight, this road will provide access to the Main Wind Farm Development Site, both north and south of the road.

The Main Wind Farm Development Site predominately consists of cutover lowland blanket bog, conifer plantation and peatland. There is no built development within the Main Wind Farm Proposed Development Site, however a vacant industrial facility is located adjacent to the Northern Cluster but outside the planning application boundary.

The Main Wind Farm Proposed Site is less than 1 km from the Atlantic coastline and is located on low-lying terrain, ranging from approximately 3 m AOD at the southern end to approximately 33 m AOD at the northeastern portion.

A number of small streams are present within the Main Wind Farm Development Site and along the boundaries, such as along the northern boundary, flowing west, the lower portion of the east boundary, flowing south.

There are 109 residential properties indicated in **Figure 4-4 of the EIAR** as being located within 1km of the Main Wind Farm Development Site. The nearest residential property is located c. 740m from the nearest wind turbine (T10). There are 282 residential properties within 500m of the GCR.

1.5 Project Description

Planning permission is sought for a period of 10 years, for a renewable energy development comprising of the construction of a 13 no. turbine wind farm development, with associated 110 kV substation, battery storage, and all associated works on land within the townlands of Muingmore (An Mhoing Mhór), Doolough (Dumha Locha), Tristia (Troiste), Moneynierin (Moing an Iarainn) and Bangor (Baingear) County Mayo.

The planning application area is approximately 454 ha in size. Certain details of the proposed development are unconfirmed in this planning application and an opinion on unconfirmed details from An Coimisiún Pleanála (Case Reference: ABP -321948-25) pursuant to section 37CD of the Planning and Development Act 2000 (as amended) accompanies this planning application. The details unconfirmed in this application are the turbine tip height, rotor diameter and hub height. The range of parameters under which the turbine dimensions will fall are specified on this site notice and in the design flexibility opinion that accompanies this application.

The Proposed Development will consist of:

- Construction of 13 no. wind turbines, each with an overall blade tip height between 179-180m inclusive, rotor diameter between 149-163m inclusive, hub height between 98.5-105m inclusive, in two clusters.
- Battery energy storage system (BESS) compound to include control building with welfare facilities, all associated plant and equipment, security fencing and gates, underground cabling, and all ancillary structures, drainage works, as well as storage and parking.
- Construction of crane hardstands, laydown areas and turbine foundations.
- Construction of permanent internal site access roads including passing bays and all associated drainage infrastructure.
- Construction of a permanent 110 kV onsite electricity substation and onsite IPP (Independent Power Producer) substation to include control buildings with welfare facilities, all associated electrical plant and equipment, security fencing and gates, all associated underground cabling, wastewater holding tanks, and all ancillary structures and works.
- Construction of 33kV underground electricity cabling and communications cabling, including joint bays and ancillary works, to connect the windfarm and battery energy storage system to the proposed onsite substation.
- Construction of two temporary construction compounds with associated temporary site offices, parking areas, welfare facilities and security fencing.
- Development of an internal site drainage network and sediment control systems.
- Temporary works as part of road improvements to facilitate the delivery of abnormal loads and turbine component deliveries from Killybegs Port to site, to include 3 no. over-run areas along the turbine delivery route, (No. 1 in the townland of Tristia onto the L1206, No. 2 in the townland of Moneynierin at the junction of the N59 and the R312, and, No. 3 in the townland of Bangor off the R313).
- Construction of 1 no. new site entrance and the construction/ upgrade of 2 no. additional site entrances (all off local road L5252, west of the L1206),
- Ancillary forestry felling to facilitate construction of the development.

- All associated site development works including landscaping, lighting, soil management and the ongoing maintenance and management of the biodiversity measures in accordance with the Habitat Management Plan and the Peat Restoration Plan.
- The replacement of felled trees with the planting of new trees, and;
- The erection of a permanent meteorological mast 100m in height

A 35-year operational life from the date of full commissioning of the entire wind farm and battery storage is being sought for all works (other than temporary and permanent works specified above), and the subsequent decommissioning. The proposed substation will continue to exist on a permanent basis. Permanent planning permission is being sought for this element.

2.0 Schedule of Mitigation Measures and Implementation

2.1 Schedule of Mitigation Measures

The EIAR has identified the mitigation measures which will avoid or minimise the potential impacts of the Proposed Project

For each mitigation measure identified, the EIAR has detailed the specific mechanism by which it will be adopted, implemented, or enforced, as well as the timeframe within which the mitigation measure is to be carried out.

It will be mandatory for these mitigation measures to be implemented either before or during the construction phase of the Proposed Project, as set out in **Chapter 17** of the EIAR.

2.2 Implementation and Control

Compliance with the CEMP is the key control measure required during construction to ensure mitigation measures necessary to protect the environment are implemented. The CEMP documents the principles and processes to be followed to implement these environmental mitigation measures.

The PSCS will prepare a series of method statements in accordance with the Schedule of Mitigation Measures. These method statements will detail how the contractor intends to implement the mitigation measures set out in the CEMP and will be integrated with their detailed Construction Method Statements.

If any significant changes are required to the Schedule of Mitigation Measures due to changing environmental sensitivities, results of pre-construction confirmatory surveys, unforeseen events or for any other reason, these will be discussed and agreed with statutory bodies in advance of any amended works being carried out. The Schedule of Mitigation Measures will be revised with any approved changes required resulting from the discussions with the relevant statutory bodies. Any such agreed revisions will be submitted to and receive the written approval of the Planning Authority prior to being implemented.

3.0 Roles and Responsibilities

During construction there will be key responsibilities for the Applicant, the PSCS and their teams. Establishing roles and responsibilities in relation to construction will be important in order to ensure the successful construction of the Proposed Project, including the implementation of the CEMP. The personnel who will implement, monitor and respond to the CEMP will be the Applicant's construction team and the PSCS.

3.1 Health and Safety

The construction works will be undertaken in accordance with health and safety legislation, namely:

- Safety, Health and Welfare at Work Act 2005 S.I. No. 10 of 2005) (as amended); and
- Safety, Health and Welfare at Work (Construction) Regulations 2013 S.I. No. 291 of 2013 (as amended) (SHWWR 2013).

The construction works for the Proposed Project will fall under the Safety, Health and Welfare at Work (Construction) Regulations 2013 S.I. No. 291 of 2013 (as amended). As such, the PSCS will provide a Construction Phase (Health and Safety) Plan in accordance with the requirements of the legislation. This Construction Phase (Health and Safety) Plan will provide a blueprint for managing and co-ordinating health and safety during construction. It will contain details of the project description and key information, key personnel and responsibilities, construction management, health and safety arrangements, emergency procedures, control of high-risk activities and record keeping. An induction programme will be implemented to include both the PSCS's site-specific rules and the Applicant's requirements, and it will include instructions for all staff regarding the Emergency Pollution Prevention Plan (EPPP) and relevant procedures.

A mandatory induction will be required for all personnel on site including permanent/temporary contractor/subcontractor, site visitors, client representatives and other 3rd parties. Inductions will be documented.

All site activities will follow a safe system of work, with specific tasks having Risk Assessment Method Statements (RAMS) detailing:

- how the task will be carried out.
- identifying potential hazards and evaluating the risk on the basis of how likely hazards are to occur and what the consequences could be in the event of an incident.
- mitigation measures to be implemented to reduce the risks of the task, which will follow a hierarchy of controls in the following order, with elimination being the most effective and PPE being the least effective:
    - Elimination – physically remove the hazard.
    - Substitution – replace the hazard.
    - Engineering controls – isolate people from the hazard.
    - Administrative controls – change the way people work.
    - PPE – protect the worker with equipment.

RAMS will be recorded, monitored and reviewed in advance of all works and any changes in work procedures. If works change in a manner not anticipated by RAMS, works will be stopped until the risk can be appropriately evaluated. and changes will be implemented accordingly.

Plant operators and construction staff will be trained by the PSCS with regard to spill prevention/mitigation measures and procedures and in the use of relevant mitigation material (e.g. spill kits).

Staff and subcontractors employed by the PSCS will be trained and have to prove certification for all plant, vehicle and use of specialist equipment such as electrical and hot works. Training will be tailored to cover site-specific technology, in particular the BESS and substation, and they will be instructed on the Battery Safety Management Plan.

3.2 Construction Management Team

The Applicant will appoint a Construction Management Team (CMT). The CMT will be led by the designated Project Supervisor for the Design Process (PSDP), which is a legal requirement under the SHWWR 2013 (as amended). The team will include, as a minimum, a Resident Engineer (usually a Health and Safety Manager for the works), a subcontracted Environmental Clerk of Works (ECoW), and a Planning Monitoring Officer.

As the CEMP is a live document, the PSCS will update and implement the document throughout the construction stage. Both the PSDP and PSCS roles are integral to the successful and safe completion of construction projects. While the PSDP lays the foundation for a safe working environment by addressing potential risks in the design phase, the PSCS ensures that the following safety measures are effectively put into practice on-site.

- regular liaison with the PSCS's Site Manager;
- maintaining environmental risk registers;
- communicating with regulators and consultees such as Mayo County Council (MCC) regarding any additions or updates that need to be made to the CEMP including the Schedule of Mitigation Measures; and
- ensuring that any required changes are approved and updated within the CEMP.

The PSCS and Resident Engineer will have the power to stop works at any stage should it be deemed necessary or recommended by the ECoW, i.e., if there were environmental, transport, or health and safety risks from construction that could not be mitigated immediately.

3.3 Ecological Clerk of Works (ECoW)

An ECoW will be appointed during the period of construction and post-construction restoration. The appointment of the ECoW will be approved by MCC.

The role of the ECoW will be to provide environmental advice and monitor compliance with mitigation measures. The ECoW will have tasks (as outlined in **Chapter 17: Schedule of Mitigation Measures**) to carry out during construction and prior to the outset of each construction phase. They will be required to keep an active register of all issues that arise during the works and report as required to MCC.

The ECoW will have sufficient powers to:

- oversee construction work and identify where mitigation measures are required;
- recommend temporary stoppage of works if required; and
- to review working methods and advise whether alternative or more appropriate working methods require to be adopted.

The ECoW will undertake the following activities:

- to work with the PSCS and PSDP to induct all site personnel with regards to key environmental sensitivities and mitigation measures to be applied during construction;

- Toolbox talks shall be given by the ECoW throughout the construction period in the event that additional unforeseen issues arise that require alternative working methods;
- undertaking site walkovers, monitor implementation of the water management measures as stipulated in the Schedule of Mitigation Measures (see **Chapter 17**);
- liaising with contractors during the construction phase;
- inspecting working areas and ensuring compliance with the CEMP;
- undertaking water quality monitoring;
- providing advice on sediment and drainage management;
- communicating with all site personnel regarding any environmental issues and mitigation measures;
- overseeing that all necessary licenses regarding protected species are obtained, if required and facilitating with the support of suitably qualified and experienced Ecologists; and
- documenting and reporting any environmental issues and incidents as required to the applicant and MCC.

3.4 Resident Engineer

The Applicant will appoint a Resident Engineer for the construction of the Proposed Development. The Resident Engineer will provide support to the Construction Management Team and have day to day responsibility for monitoring the Proposed Development onsite on behalf of the PSCS, PSDP and Applicant.

The Resident Engineer will have a wide range of duties including but not limited to:

- overseeing construction works to ensure conformance with the specification, monitoring quality and progress and most importantly ensure that health, safety and the environment is given a high priority at all times. The Resident Engineer will effectively be the Applicant's eyes and ears on the Proposed Development Site and will report directly to the Construction Management Team;
- authority to stop the construction works in the case of a health and safety, environmental or quality issue. This applies when delays may lead to increased risk or damage;
- daily visual inspections of working areas to identify possible construction issues from a quality, environmental, programme and safety perspective. Any issues will be raised directly with the contractor;
- If any pollution is observed, all works will be halted until the source of the pollution has been managed;
- working closely with the ECoW to ensure that ecological and environmental requirements dictated by the CEMP, best practice and the planning conditions are adhered to by the works contractor;
- reviewing construction related documents from all contractors – including method statements and risk assessments and providing comments directly onsite to the PSCS; and
- reporting all environmental or health and safety incidents and near misses to the PSCS in a form and timescale required by the Construction Management Team.

3.5 Project Supervisor Construction Stage (PSCS)

The PSCS will be required to comply with and continually review the CEMP throughout the construction period. Trigger-based reviews will be undertaken should an environmental incident occur, a significant change in construction activity, following audit findings and when method statements are updated. This will include being aware of any changes or updates to the CEMP following the identification of any new environmental sensitivity or any changes to the Proposed Development. These changes will be controlled and implemented by the Applicant's Construction Management Team, as required.

The PSCS and their team (including any sub-contractors) will be responsible for:

- undertaking their duties in accordance with SHWWR 2013 (as amended);
- liaising with the Applicant's Construction Management Team;
- completing the construction of the Proposed Development in a manner which complies with all relevant laws, rules, regulations and supporting guidance;
- acquiring licenses and permits as necessary for their works;
- ensuring that all method statements in line with the principles set out in the CEMP have been provided;
- planning, managing, monitoring and coordinating all pertinent activities relating to construction;
- liaising with and providing justification to the competent authority if any significant changes are required from the Schedule of Mitigation Measures;
- developing and implementing a Pollution Prevention and Incident Plan (PPIP) and ensuring that all personnel (including sub-consultants and sub-contractors) understand and are aware of procedures to be undertaken should an environmental incident occur. This will sit as an additional appendix in the updated CEMP;
- ensuring that all personnel receive training and are aware of the potential to damage sensitive environmental receptors and procedures required to be implemented to avoid, minimise and mitigate against such damage;
- verifying the competence and resources of all personnel working on the Proposed Development and any sub-consultants and sub-contractors that were engaged on the Proposed Development; and
- implementing the Schedule of Mitigation Measures.

3.6 Project Supervisor Design Process (PSDP)

The PSDP can be an individual or body, and generally the role is fulfilled by a firm of architects, chartered surveyors, consulting engineers or project managers. In all cases, the person or company undertaking the role must have the necessary competence to carry out the relevant duties. The PSDP must be appointed before construction design work commences to ensure effectiveness in addressing and coordinating safety and health matters from the very early stages of a project.

The PSDP is responsible for:

- Identifying hazards arising from the design or from the technical, organisational, planning or time-related aspects of the project.
- Where possible, eliminating hazards or reducing the risks.

- Communicating necessary control measures, design assumptions or remaining risks to the PSCS so they can be dealt with in the safety and health plan.
- Ensuring that the work of designers is coordinated to ensure safety.
- Organising co-operation between designers.
- Preparing a written health and safety plan for any project where construction will take more than 500 person days or 30 working days, or there is a particular risk and deliver it to the client prior to tender.
- Preparing a safety file for the completed structure and giving it to the Client/Applicant.
- Notifying the Health and Safety Authority and the client of non-compliance with any written directions issued.
- The PSDP may issue directions to designers, contractors or others.

3.7 Site Personnel

All Site personnel, including all members of the Applicant and PSCS's teams, all sub-contractors and sub-consultants are required to:

- attend all inductions and site-specific training including toolbox talks carried out by the ECoW; and
- implement control measures throughout the Proposed Development Site, as required.

3.8 Communication

Prior to the commencement of construction, the Applicant will set up a community liaison strategy. The objective of community liaison will be to keep the community informed of progress of construction of the Proposed Development. The community liaison strategy will be designed to establish processes to keep the community informed, reviewing incidents that have occurred and how these have been resolved and discussing the forthcoming programme of work. The Applicant has already established a Community Liaison programme through the appointment of a Community Liaison Officer, who has undertaken door to door consultation, scheduled meetings and delivered project updates with named contact details since 2023. Prior to any construction starting on the Proposed Development Site, the community liaison strategy will be updated and communication will be maintained on a monthly basis until construction is complete, and the Proposed Development is operational. Through a programme of community meetings, leaflet drops and a project website, the Applicant will provide contact details of:

- the Resident Engineer – who will be on the Proposed Development Site for the majority of the construction phase;
- the Applicant's Community Liaison Officer; and
- the Applicant's Public Relations Officer.

Any resident who has a question regarding the construction of the Proposed Development will be directed to one of these contacts. All questions will be logged and an auto response will be provided with an anticipated timeframe for a reply.

Once construction has started, the Applicant will provide details of any construction activity that will impact on the local community, such as deliveries.

Careful logging and monitoring of any complaints received, including recording details of the location of the affected party, time of the disturbance and nature of the issue will be reviewed in sequential stages of work programming to reduce the likelihood of further incidents.

4.0 Phasing

4.1 Construction

The construction works will take place over a 24-month period. Construction activities are proposed to occur during standard working hours, from 07:00 to 19:00, Monday to Friday, and 07:00 to 13:00 on Saturdays. While work on Sundays and public holidays is not expected, out of hours works may be required for certain critical activities, such as abnormal load deliveries, concrete pours for turbine foundations, and the lifting of turbine components. These exceptions will only occur with prior approval from MCC.

Through the provisions of the Community Liaison Strategy, the PSCS will keep local residents informed about the proposed working schedule, including the times and duration of any abnormally noisy activity that may cause concern.

The following activities will be carried out during the construction work phases:

- Phase 1 – Site set-up:
  - site preparation, including tree felling and vegetation clearance where necessary;
- access road improvements, including widening and drainage adjustments;
  - establishment of site compounds, including installation of welfare facilities and temporary storage areas;
- Phase 2 – Construction:
  - construction of new site access tracks and upgrades to existing tracks;
  - excavation and construction of turbine foundations;
- preparation and installation of crane hardstanding areas; and
- construction of the substation and BESS.
- Phase 3 – Commissioning:
  - turbine delivery and construction;
- wind farm commissioning;
- substation and BESS testing and commissioning; and
  - turbine and wind farm reliability run;
- Phase 4 – Demobilisation:
  - take over;
  - snagging; and
  - decommissioning of temporary compound / structures and restoration of the Site.

A proposed construction programme is shown in **Table 4-1** for information. The construction phase of the Proposed Development, which includes civil, electrical, grid works, and turbine assembly is anticipated to take 24 months once the proposed turbines are acquired via a competitive tender process. Prior to construction, a final construction programme will be provided to MCC by the PSCS.

Table 4-1: Proposed Construction Programme

Construction Activity	Months																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mobilisation & site set up																								
Site clearance and felling																								
Site access and internal access tracks																								
Turbine hardstands																								
Turbine foundations																								
Turbine Delivery & Installation																								
On Site Cabling																								
Onsite substation, BESS and Grid connection cable works																								
Commissioning and Testing																								
Landscaping, reinstatement and demobilisation																								

4.2 Post Construction Reinstatement

Good practice techniques for vegetation and habitat reinstatement such as the Draft Wind Energy Development Guidelines (Rev December 2019) and Best Practice Guidelines for the Irish Wind Energy Industry (2012) will be adopted and implemented on areas subject to disturbance during construction as soon as practicable.

The following reinstatement works will be implemented as appropriate:

- re-use of turves;
- re-use of topsoil/peat where appropriate; and
- reseeding with appropriate species.

For clarity, the following are definitions for the different plant and peat make-up of the natural ground between the surface and rockhead (from top down):

a) Vegetation:

This is typically plant matter that can be removed/stripped above the ground level (i.e. does not include roots/topsoil). This can vary depending on the nature of the vegetation encountered on site.

b) Turf/Turves:

Turf (turves) refers to the surface layer comprising grass and a matrix of interwoven roots and organic soil. The thickness of turves varies depending on ground conditions and vegetation type, and is typically carefully stripped to maintain integrity for potential reuse.

c) Peat:

The near-surface organic ground formed from partially decomposed vegetation. Thickness is highly variable across the site. The upper peat is typically fibrous with a vegetation mat, underlain by more decomposed, saturated peat. Peat can be excavated as intact turves where reinstatement is required, or otherwise segregated and placed in temporary storage in line with the Peat Management Plan.

d) Superficial Soils:

This is a generic term used for all material between topsoil/peat and rockhead. This can vary in depth and content throughout the depth profile at any location.

e) Weathered Rock:

This is a layer that may exist above rockhead that is neither rock nor superficial material but a mixture of both. It can be mostly fractured rockhead as a result of physical and chemical weathering processes. When excavated it may have elements of fractured rock and superficial material as the boundary can be difficult to distinguish.

In some cases, this can provide suitable engineering material for the construction of foundations, embankments, tracks, etc.

f) Rockhead:

This is a naturally occurring solid aggregate of minerals which lies beneath the superficial soils.

The above terms are defined for clarity as they may be referred to in the CEMP in relation to soil management.

5.0 General Construction Good Practice

References to Good Practice guidance on which the Schedule of Mitigation Measures is based are provided at the rear of this CEMP. Site access will be controlled throughout the construction process by means of secure gated entrances and appropriate site boundary controls, in order to prevent unauthorised access, illegal dumping and use by off-road vehicles.

All backfilling and construction-phase activities will be undertaken in accordance with relevant best practice environmental guidance published by the Environmental Protection Agency and CIRIA C741 – Environmental Good Practice on Site (4th Edition). All waste management activities will comply with the provisions of the Waste Management Act 1996 (as amended).

The main requirements in relation to the Proposed Project are set out below.

5.1 Invasive Species Management

Mitigation measures to safeguard against the introduction or spread of invasive species to or from the Proposed Development Site will be implemented as follows:

- Strict plant and machinery clean-down procedures (high-pressure wash, disinfect, dry).
- Check-Clean-Dry protocol to prevent crayfish plague.
- Imported material is certified to be clean inert and is sourced from reliable suppliers and sites.
- The resident engineer holds power to reject contaminated loads and can be supported by the ECoW.
- Clean down procedures such as wheel washes upon entry and exit of site.

5.2 Peat Management

A detailed Peat Management Plan (PMP) has been developed based on ground investigations undertaken across the Main Wind Farn Development Site as well as a Peat Landslide Hazard Risk Assessment.

The PMP will be followed by all involved in peat excavation and management works. The ECoW will oversee the works and provide guidance where necessary on the excavation, transportation and storage of peat.

A Geotechnical Risk Register will be developed and maintained by the appointed geotechnical engineer.

Undercutting of peat slopes will be avoided. Where this cannot be avoided, a more detailed geotechnical stability assessment of the area of concern by the geotechnical engineer will be undertaken to include review of site-specific ground investigation data and site inspection.

Floating tracks will be access tracks across in areas with excess of 1m deep peat (as described in Section 9.4). Floating tracks will be used for access track construction in areas where peat depths exceed 1 m (as described in Section 9.4). The temporary TDR overrun areas will also primarily use floated construction to minimize excavation in peat and to preserve the existing ground and hydrological conditions.

The established drainage pattern regime will be protected and hydrological management will be implemented to ensure that no areas will receive surcharge. This will ensure that the current level of stability of the peat mass, will be retained if not improved. All drainage channels constructed on site along infrastructure will be ‘shallow’ drainage ditches to maintain stability of both the peat and infrastructure.

Construction activities in peat will be undertaken with due regard to prevailing ground and weather conditions. Peat stability, water content and rainfall will be continuously monitored, and construction methodologies will be adapted as necessary to minimise disturbance to peat and reduce the risk of instability and erosion.

Cut and fill will be avoided in areas of peat greater than 1 m in depth where practicable. Where this cannot be avoided, the following measures will be implemented:

- Excavation will be to a sound stratum / peat substrate.
- Where the depth of cut is deemed unstable, a stepped or benched surface will be implemented with the intention of minimising the exposed surface of the up-slope cut face. Where groundwater becomes a construction issue, sheet piles or cofferdams will be installed.
- All exposed peat surfaces will be protected from erosion and desiccation, by ensuring the integrity and moisture content of the peat is maintained.
- A small bund will be formed at the top of cut slopes to retain moisture within the peat, thereby preventing desiccation and maintaining slope stability.

To minimise the risk of potentially inducing peat landslides during construction of the Proposed Development, the following will be implemented:

- Raise health and safety awareness of the peat environment for construction staff by incorporating the issue into the site induction.
- Include peat slide risk assessment information (e.g. peat instability indicators, best practice and emergency procedures) in toolbox talks with relevant operatives e.g. plant operatives.
- Carry out confirmatory pre-construction surveys and ground investigations prior to the commencement of works.
- Minimise off-track plant movements within areas of peat, use trackways once constructed.

5.3 Handling of Excavated Materials

The construction of tracks, turbine foundations, crane hardstanding areas and the substation and BESS compound will require excavation and handling of peat and substrate material. In order to reduce the risk of localised erosion during excavation and infilling, the area of bare or exposed soils and rock will be kept to a minimum, insofar as practicable.

Excavated materials will be reused or placed in temporary storage. Arisings will be mainly peat, with minor quantities of soil and rock. Description of the existing land, soils and geological setting is provided in EIAR **Chapter 6: Land, Soils and Geology**. Soils and peat will be used for reinstatement works or reuse associated with access tracks, cable trenches, turbine foundations, crane hardstandings and the temporary construction compounds. The priority of the peat material is for reposition and reuse as per the PMP. The upper vegetated turves (where available) will be stored and be used to dress infrastructure edges and to be replaced on areas which have been temporarily stripped.

Excavated material will be used as soon as practicable and as close as possible to the area it was excavated from; however some temporary storage will be required.

5.4 Materials Storage

Excavated, granular, non-organic material required to be stored temporarily will be compacted to reduce the potential for erosion and transfer of sediment and stockpiled in designated areas

at least 50 m from any watercourse. Material placement will be managed to avoid compaction of sensitive habitats and prevent encroachment beyond the defined working area.

Temporary stockpiles will be appropriately sited away from marshy grassland, bog or heath, with the locations agreed in advance with the ECoW. Where required, stockpiled soils (pending re-use) or exposed surfaces (pending further backfilling to final ground level) will be temporarily covered. They will be evaluated and monitored during and following rainfall events and kept stable for safety and to minimise erosion.

Where excavated material cannot be transferred immediately to an appropriate restoration area, short-term storage will be required. In this case, the following good practice will apply:

- peat will be stored in line with the PMP measures;
- local gullies, diffuse drainage lines (or very wet ground) and locally steep slopes will be avoided for storage;
- stored upper turves (incorporating vegetation) will be reinstated adjacent to similar habitats as advised by the ECoW;
- monitoring of stockpiles/excavation areas will occur during and following rainfall events; and
- if material is stockpiled on a slope, silt fences will be utilised to reduce sediment transport in accordance with CIRIA Control of Water Pollution from Construction Sites. Guidance for consultants and contractors (C532)'. Additional measures will be implemented where necessary to control flow of water and sediment transport on site in accordance with this guidance.

Material excavated during new and upgraded access track construction will be stored adjacent to the track and granular, non-organic material compacted in order to limit instability and erosion potential. Peat will not be allowed to dry out, through rewetting and monitored irrigation.

To prevent sediment entrainment and habitat degradation the following will be applied:

- Stockpiles will be stored >50 m from watercourses and stabilised by covering or seeding.
- Silt fencing will be installed at the downslope edges of stockpiles.
- Fine sediment handling will avoid periods of heavy rainfall.
- Material placement will be managed to avoid compaction of sensitive habitats and prevent encroachment beyond the defined working area.

5.5 The Management and Movement of Concrete

5.5.1 Accidental Spillage

Appropriately sized spill kit(s) will be provided and maintained onsite, consideration will be given to suitable locations across the active areas of the Proposed Development Site and to having vehicles, including plant, carry a spill kit. This kit will contain materials, such as absorbent granules and pads, absorbent booms and collection bags. These are designed to halt the spread of spillages and will be deployed, as necessary, should a spillage occur within the construction site.

In the event of any spillage or pollution of any watercourse, the emergency spill procedures as described in the Environmental Incident and Emergency Response Plan (EIERP) will be implemented immediately (refer to Section 6.1).

A speed limit of 24 kph will apply for vehicles onsite and will be monitored and enforced by the PSCS. Maximum vehicle load capacities will not be exceeded.

5.5.2 Vehicle Washing

To avoid mud and debris being tracked onto the public road there will be wash-out facilities within the construction compounds or at the exit points to the L5252, consisting of a sump overlain with a geosynthetic membrane. The geosynthetic membrane will filter out the concrete fines leaving water to pass through to the sump. The sump water will be pumped to a licenced carrier and taken offsite for approved disposal. No washing of concrete-associated vehicles will be undertaken outside the wash out facility, and the area will be signposted, with all site contractors informed of the locations.

Wheel wash facilities will be situated a minimum of 50m away from any watercourse on site and will be placed on an impermeable surface.

Wash facilities will be inspected routinely, with sediment removed and disposed of appropriately to maintain effectiveness.

5.5.3 Concrete Pouring for Turbine Foundations

To prevent pollution, all concrete pours will be planned, and specific procedures adopted in accordance with CIRIA C532 Guidance. These procedures will include:

- ensuring that all excavations are sufficiently dewatered before concrete pours begin and that dewatering continues while the concrete cures. Construction good practice will be followed to ensure that fresh concrete is isolated from the dewatering system;
- ensuring that covers are available for freshly placed concrete to avoid the surface of the concrete washing away during heavy precipitation; and
- perimeter drains will include silt traps where necessary.

The excavated area will be back-filled with compacted layers of graded material from the original excavation, where this is suitable, and capped with peat or soil. The finished surface around the base of the turbine, will be capped with crushed aggregate providing a walkway to allow for safe personnel access.

5.6 Surplus and Waste Material

5.6.1 Introduction

A Waste Management Plan (WMP) will be prepared and submitted to Mayo County Council for agreement prior to the commencement of construction works. The WMP will be prepared in accordance with relevant national and regional waste management policy and guidance, and will apply the principles of the European Waste Hierarchy as set out in the Waste Management Act 1996 (as amended).

The WMP will detail how all waste materials will be managed, including the management and definition of excavated materials.

The PSCS will take all reasonable steps to ensure that all waste from the site is dealt with in accordance with the requirements under the above Act and that materials will be handled efficiently, and waste managed appropriately.

Appropriate waste management, disposal and waste carrier documentation and licences will be obtained (e.g. complete waste transfer notes prior to waste leaving site, ensure all waste carriers have a valid waste carrier’s registration certificate, ensure wastes are disposed of at a correctly licensed site, complete notification for hazardous waste to the EPA).

Waste streams will include wastes generated by plant, machinery and construction workers over the period of the works, for example waste oils, sewage, refuse (paper, carton, plastic etc.), wooden pallets, waste batteries, fluorescent tubes etc.

5.6.2 Hazardous and Other Wastes

Table 5-1 lists the types of waste that are anticipated to be generated during the construction works. Although some waste types may be generated in locations other than the construction compounds, such waste materials will be stored within the construction compounds only. Waste materials generated outside the construction compounds will be taken to the compounds on a daily basis to be managed thereafter.

No oils, greases, hydraulic fluids or other hazardous substances (or associated wastes) will be stored outside designated areas within the Main Wind Farm Development Site. All such materials will be stored only within designated COSHH storage areas located in the construction compounds, substation and BESS compounds. These storage areas will comprise impermeable surfaces, be covered where appropriate, and include fuel spill trays and/or bunded containers.

Table 5-1: Common Construction Wastes

EWC Code	Description
13 01 10*	Used mineral hydraulic oil (non-chlorinated)
13 02 08*	Other waste engine, gear or lube oil
13 02 05*	Waste engine, gear or lube oil (non-chlorinated)
13 02 08*	Other waste engine, gear or lube oil
16 01 07*	Oil filters
20 01 23*	Discarded equipment containing CFCs e.g. waste fridges
16 06 01*	Lead batteries
16 07 08*	Oily waste from transport and storage tanks
16 10 01*	Hazardous liquid wastes to be treated off-site
20 01 21*	Fluorescent tubes and other mercury-containing waste
20 01 33*	Hazardous batteries and accumulators that are collected separately
15 02 02*	Absorbents, filter materials, wiping cloths, clothing contaminated by dangerous substances
15 01 01	Cardboard or paper packaging
15 01 02	Plastic packaging e.g. toner and ink cartridges, polythene sheeting
15 01 03	Wooden packaging e.g. timber pallets
15 01 04	Metallic packaging e.g. drink cans, paint tins
16 01 03	Tyres
16 01 15	Antifreeze fluids that do not contain dangerous substances e.g. Coolants
16 01 17	Ferrous metal from vehicles e.g. car parts
16 02 14	Non-hazardous waste electricals e.g. washing machines, power tools
16 05 05	Gases in pressure containers i.e. gas cylinders
17 01 01	Concrete

EWC Code	Description
17 02 01	Wood from construction or demolition e.g. timber trusses, supports, frames, doors
17 04 11	Cables that do not contain dangerous substances e.g. electric cabling
20 01 01	Paper and card similar to that from households e.g. office paper, junk mail
20 01 30	Non-hazardous detergent e.g. flushing agent/universal cleaner
20 01 39	Separately collected plastics e.g. plastic containers, bottles
20 03 01	Mixed waste similar to that from households e.g. mixed office, kitchen and general waste
20 03 04	Septic tank sludge

*Denotes Hazardous Waste, as categorised by the European Waste Catalogue.

Foul water from the onsite facilities at the construction compounds will be removed from the Proposed Development Site by an appropriately licensed contractor.

5.6.3 Regulatory Compliance

Waste will be transferred to a licensed waste management site or site with a waste exemption. The PSCS will check that the site is licensed and that the licence permits the site to take the type and quantity of waste involved. Copies of the waste management licence or waste exemption license will be held on file.

A 'Waste Transfer Note' must be completed by all parties involved and must be retained for a period of two years. Sub-contractors excavating and hauling waste offsite must complete their own Waste Transfer Notes and copy them to the PSCS. It is not necessary to have a Waste Transfer Note for each load of waste and a Waste Transfer Note can be issued weekly or monthly as a season ticket.

It will be the responsibility of the PSCS to ensure that other parties involved in the transport, storage and disposal of waste are legally entitled to carry out their duties.

5.7 Dust Mitigation

Good practice measures as listed in **Table 5-2** will be adopted during construction to control the generation and dispersion of dust to ensure that significant impacts on neighbouring habitats will not occur. The hierarchy for mitigation will be prevention – suppression – containment.

Table 5-2: Dust Mitigation Measures

Task	Mitigation Measures
Phasing and grading of works	- Internal access roads will be constructed prior to the commencement of other major construction activities. These roads will be finished with graded aggregate. - Grading and reinstatement will be completed progressively. - Double handling of materials is to be avoided. - Dust generating activities will be contained, suppressed or stopped during periods high winds.

Task	Mitigation Measures
Stockpiling of loose materials	- Earthworks and exposed areas/soil stockpiles will be revegetated to stabilise surfaces as soon as practicable. - Materials likely to cause dust will be sealed over and covered. - Material stockpiles will be located away from the site boundary, sensitive receptors, watercourse and surface drains.
Management measures	A water bowser will be used to spray work areas (wind turbine area and cable route) and haul roads, especially during periods of excavation works coinciding with dry periods of weather, to suppress dust migration from the site. - All loads which could cause a dust nuisance will be covered to minimise the potential for fugitive emissions during transport. - The access and egress of construction vehicles will be controlled to designated locations, along defined routes, with all vehicles required to comply with onsite speed limits. - Wheel wash stations will be implemented where vehicles exit on to public roads.

5.8 Noise Management

The sources of construction noise are temporary and vary both in location and their duration as the different elements of the Proposed Development are constructed, and arise primarily through the operation of large items of plant and equipment such as bulldozers, diesel generators, vibration plates, concrete mixer trucks, rollers etc. Noise also arises due to the temporary increase in construction traffic near the Main Wind Farm Development Site. The level of noise varies depending on the different elements of the Proposed Development being constructed.

BS 5228-1:2009 ‘Noise control on construction and open sites; Part 1 – Noise’ will be relied on for guidance on appropriate methods for minimising noise from construction activities.

All construction activities will adhere to good practice as set out in BS 5228-1 as current best practice in the absence of any Ireland specific guidance.

Mitigation measures will be implemented to reduce noise levels with due regard to practicality and cost as per the concept of ‘best practicable means’ as defined in Section 5 of the Air Pollution Act 1987 (as amended).

During construction, a temporary 2.5 m high solid close-boarded wooden fence, or equivalent noise barrier, will be installed on the north section of overrun area 1 as this was identified within **Chapter 9** of the EIAR as having a potential temporary noise impact on the neighbouring dwelling.

Noise management mitigation measures will consider the following:

- Adherence to core working hours.
- Use of low noise or silenced plant.
- Use of prefabrication off site to reduce site activities.
- Avoiding, where possible, multiple activities simultaneously.
- Progressive working away from sensitive receptors rather than static prolonged works.
- Properly maintain plant and prevent unnecessary revving, idling.

- Careful positioning of static plant such as generators, compressors within compounds.
- Use of temporary acoustic screens or barriers or earth bunds.
- Speed restrictions and no unnecessary use of reversing alarms.
- Communication with local residents.

5.9 Site Lighting

Temporary site lighting will be required for specific activities to ensure safe working conditions during winter working and periods of limited natural light.

Sources of artificial lighting will include vehicle and plant headlights; construction and compound lighting; office complex lighting; and localised floodlights/mobile lighting units. The requirement for artificial lighting will be minimised, and unnecessary nighttime working will be avoided where practicable, in accordance with the mitigation measures set out in **Chapter 5** of the EIAR**.**

During the summer months, natural lighting during normal working hours will reduce the need for artificial lighting.

Where artificial lighting is required, it will be kept to the minimum necessary to safely undertake the works. The timing, duration and positioning of lighting will be considered as part of the construction method statement to minimise potential effects on ecological receptors.

Lighting will be directional and time-limited to reduce disturbance to bats and birds.

Artificial lighting will only be used within the limits of the permissible working hours and will be shielded/hooded to negate or minimise any effect to local residents or ecological species.

Directional lighting will be employed to minimise light pollution. This includes angled downward lighting, focused lighting on working areas only and avoiding light spill beyond the site boundary.

5.6 Shadow Flicker

a programmable shadow flicker control module, consisting of bespoke software, a clock, a timer, a switch, a wind direction sensor and a light sensor will be installed on all wind turbines. The module allows for programmed shut down on specific dates at specific times when the sun is bright enough, there is sufficient wind to rotate the blades, and the wind direction is such that nuisance shadow flicker could occur at a specified at-risk receptor. During operation of the proposed turbines, any complaints relating to shadow flicker will be fully investigated by the Applicant and the shadow flicker control system updated accordingly.

5.7 Contractor Parking and Access Arrangements

Parking - parking areas located at the site construction compound will have safe and secure barriers to segregate all personnel from site plant and vehicle routes. No parking will be allowed on internal or public roads; all cars that are directed to the site parking area will be required to reverse park for health and safety reasons.

Each construction compound will have sufficient parking spaces to accommodate workers for the construction period. The Proposed Project Manager/s will ensure that sufficient space is provided within the compounds for vehicles to park, whilst maintaining sufficient space for material and plant storage, loading and unloading and turning of HGVs.

5.8 Construction Traffic Routing

The proposed construction traffic routes are set out in **Chapter 14** of this EIAR and shown on **Figure 14-4** of that chapter. All contractor and delivery traffic will be required to follow these routes. Haulage contractors undertaking deliveries associated with the Proposed Project will be informed of the relevant routes by the Proposed Project Manager/s or delegated representative/s as part of their delivery instructions (and signage along the route will reinforce this information). Contractor staff will be given the construction routes and minibus travel to work arrangements as part of their joining instructions. It is the responsibility of the Proposed Project Manager/s to ensure that all visitors to the Main Wind Farm Development Site are aware of the construction traffic routes prior to travelling to the Main Wind Farm Development Site.

Driver training and Delivery Management Plan delivery instructions to drivers (at Section 5 of the CTMP in **Technical Appendix 14-4** of the EIAR) will reinforce the following:

- Avoidance of parking on the public road except at laybys;
- Not to use residential driveways, farm accesses, or other private accesses for turning; and
- Consideration for pedestrians, cyclists and equestrians on local roads.

6 Pollution Prevention Measures

6.1 Environmental Incident and Emergency Response Plan

The PSCS will be responsible for continuing to develop and implement an Environmental Incident and Emergency Response Plan (EIERP). The plan will provide reference to procedures to be followed in the event of a specific incident. In general, if an environmental incident was to occur, the following will take place immediately:

- mitigation will be implemented to stop or reduce impacts from the incident;
- if these are ineffective, work in the area will cease immediately;
- if necessary, monitoring will be undertaken to identify the source of the incident;
- work will only recommence once it is considered that it will not continue to adversely impact sensitive environmental receptors; and
- provision of a full report by the PSCS and separately by the ECoW to the Applicant following an incident occurring.

The EIERP will reflect site-specific conditions/issues. The PSCS will submit the detailed Plan to the Applicant and PSDP for approval prior to any construction works commencing onsite. The plan will provide:

- a summary of the key actions required as part of the Battery Safety Management Plan (BSMP);
- a summary of local environmental sensitivities, e.g. environmentally designated areas, protected species or habitats and high amenity areas;
- a description of the construction works and appropriate references to other environmental plans and construction method statements;
- an inventory of stored materials and emergency response spill kits;
- details on training requirements, evidence of training of site staff / plant operators in emergency response procedures including inclusion of EIERP training in site inductions and tool box talks; and key staff contacts for environmental management and emergency response;
- detailed procedures to be taken in the event of an incident or emergency (including procedures for positioning and movement of plant) and identification of relevant personnel who will be responsible for implementing such procedures; and
- contact telephone numbers for emergency services and the EPA Pollution out-of-hours telephone number (0818 33 55 99).

A plan of the site will also be provided, detailing:

- all areas of potential pollution sources including the locations of car parks, delivery and fuel / chemical storage areas, oil separator equipment, excavations, and any other high risk areas that could give rise to pollution;
- the location of potential sensitive environmental receptors, including sensitive habitats or species, surface watercourses, drains or culverts where pollution may travel to; and
- the location of spill kits and other pollution control or emergency response equipment.

The procedures for responding to a major pollution incident will be a regular topic at onsite tool box talks and management meetings in order to ensure that the incident response plan is fully understood by all personnel, and that all involved know their role in it. Any lessons learnt

from any response to real incidents will be fed back into the plan to ensure that best practice is followed.

6.2 Re-Fuelling of Vehicles, Plant and Machinery

Vehicle re-fuelling will take place either within the compound at a dedicated impermeable refuelling pad or by mobile double skinned bowsers with a 50 m buffer from watercourses as recommended by OPW (2019). Drainage from the compound will be passed through oil interceptors prior to discharge.

Oils, greases, hydraulic fluids or hazardous substances (or any associated wastes) will be stored under cover, over fuel spill trays / bunded containers within designated storage areas within the construction compounds. There will be no fuel storage outside the compounds. Plant will be maintained in good operational order and any fuel/oil leaks recorded for attention. Absorbent pads/granules in the case of an accidental leak/spillage will be available at the temporary construction compounds.

Good site management practices will be implemented to reduce risks of spills, including regular monitoring and inspection of storage vessels and regular maintenance and servicing of construction plant and equipment. The Applicant will ensure that necessary plant and resources are provided and operated in accordance with best waste management practice and that activities comply fully with environmental management systems and planning consents. The EIERP will include contingency plans / procedures to deal with potential leaks and spills. Emergency spill response kits will be held on Site at strategic locations including refuelling areas and within plant. Refuelling procedures and risk assessments and method statements will be provided by the PSCS to the Applicant for approval prior to work commencing.

6.3 Spillage

All other fuels, oils and potential contaminants, as well as waste oils, will be stored in secure, fit for purpose containers within bunded containment as appropriate and in accordance with the EPA guidance[1]. The refuelling pad would have an impermeable base and bund with a capacity of 110% with sumps provided such that they do not drain directly into the surface water drains. Maintenance of mobile plant will take place within the construction compounds only and will comply with relevant the EPA guidance[2].

6.4 Other Storage

Stockpiles for stone material for the construction of tracks, compounds and hardstandings will be limited to within work areas. Stone deliveries will be aligned with the construction programme, with materials either offloaded and temporarily stored close to the working area or placed, spread, and compacted shortly after delivery. Short-duration storage will be used where immediate use upon delivery is not possible, with temporary stockpiles located within pre-developed areas in close proximity to the working area.

Low mounded stockpiles will be formed from excavated material, adjacent to access tracks, turbine areas and compound areas, away from open drains.

[1] Guidance Note on Storage and Transfer of Materials for Scheduled Activities (EPA, 2004)

[2] Guidance Note on Storage and Transfer of Materials for Scheduled Activities (EPA, 2004)

6.5 Prevention of Mud and Debris on Public Roads

Plant and wheel washing facilities and road sweepers will be provided as required to prevent mud and deposits from being transferred from the Proposed Development Site onto the public highway. Wheel washing facilities will be located at site exits with each vehicle passing through the process before accessing the public road.

Such facilities will be located within a designated hardstanding at least 50m from the nearest watercourse or surface water drain. Runoff from the facilities will be captured within the attenuation basin network described in Section 7.0. Settled solids will be regularly removed and buried along with other silty fines collected from silt fences (see Section 7.4).

Open backed lorries or tippers delivering or removing material to/from the Proposed Development Site will be sheeted where there is a risk of loose or deleterious material being deposited on the local public road network.

Weather responsive management will be conducted by the Principal Contractor where controls will be increased in periods of wet conditions and high vehicle movement volumes.

6.6 Cement / Concrete

Ready-mixed concrete will be brought onto the construction site from an offsite source for use as required.

Any bagged cement will be stored within a soil bunded area on pallets above the ground and covered with secured plastic sheeting to minimise the risk of wind-blown cement and uncontrolled washout occurring.

Any spilled cement will be removed by shovelling/excavator and suitably disposed offsite.

No washing of concrete-associated vehicles would be undertaken outside the designated wash out facility, and the area would be signposted, with all site contractors informed of the locations.

6.7 Silt

Silt laden runoff could be expected from any areas of recently exposed soil or rock and from access tracks in regular use. There will be no discharge or disposal of any material directly into any river, stream or drainage ditch. The measures that will be implemented to control potential silt entrainment in surface water runoff are identified in Section 7.4.

6.8 Waste and Litter

Construction waste is discussed in Section 5.6.

With respect to the control of litter on site, there is little potential for waste generation other than construction waste. A fully authorised and licenced waste management contractor will be appointed prior to the commencement of construction works. This contractor will provide the appropriate receptacles for the collection of the various waste streams, including from domestic/canteen style waste, and will ensure regular emptying and/or collection of these receptacles.

6.9 Hydrocarbon Contamination

6.9.1 Vehicle Maintenance

As noted in Section 5.0, plant and machinery will be regularly maintained to ensure that the potential for fuel or oil leaks/spillages is minimised. All maintenance will be conducted on suitable absorbent spill pads to minimise the potential for groundwater and surface water

pollution. All machinery will be equipped with drip pans to contain minor fuel spillage or equipment leakages.

6.9.2 Chemical Storage

All fuels, oils and other chemicals will be stored in the construction compound in secure, fit for purpose containers within bunded containment as appropriate. The bunded containment will have a capacity of 110% of the volume to be stored and will have impervious, secured walls and base.

The bunded areas will be within the temporary construction compounds and will be underlain by an impermeable ground membrane layer to reduce the potential pathways for contaminants to enter watercourses and groundwater.

7 Drainage and Surface Water Management

7.1 Introduction

Control of water is of great importance during construction to prevent exposed peat and soils eroding and silting up surrounding drainage channels and watercourses. It is essential that the works have little or no impact on the existing hydrology in order to minimise potential impact on ecology and environmental quality of the surrounding area.

The EOW will conduct daily inspections of watercourses and the measures identified in Sections 7.0 and 8.0 below will be implemented across the site to adequately protect hydrological, and related, resources. The measures will be finalised in detail prior to commencement of construction, which will provide the same or greater protection for the water environment as those described in this document. The measures are proportionate to the risk and, where greater risk is highlighted at specific locations prior to construction, specific mitigation measures will be agreed for those locations.

7.2 Site Induction and Training

All employees and contractors will undergo a site induction to ensure that they are familiar with the site rules prior to any work commencing on site. In addition, the PSCS will ensure that all operatives and contractors responsible for handling fuel, oil, concrete or cement or other potential pollutants undergo a thorough induction programme with respect to the relevant proposed pollution control measures. The relevant programme will include, as a minimum, the following:

- waste management;
- emergency response procedures;
- materials management;
- habitat and species protection,
- surface water management;
- potential sources of pollution and their effects on the environment;
- requirements of the contract and legislation with respect to pollution;
- the PSCS's pollution avoidance plan;
- traffic management and routing, including areas where access is not permitted; and
- training in the use of pollution control equipment.

7.3 Site Drainage

During the construction phase of the Proposed Development, measures will be adopted in order to prevent silt, chemicals and/or other contaminants from being washed into existing watercourses. Areas exposed due to the removal of vegetation are more susceptible to erosion during heavy rainfall, so areas will be reinstated as soon as possible to minimise this effect.

Some temporary dewatering may be required during excavations. The measures for sediment control identified in Section 6.0 will provide protection of watercourses from any potential infiltration of sediment. Dewatering activities will be temporary and ditches and existing peat drains will remain in place to convey surface water flows during the operational life of the Proposed Development. Prior to main earthwork activities, interceptor drains, or diversion ditches will be created to minimise the pooling water in areas of development. The employed

diversion method will flow into the existing peat drainage channels. The diversion method will follow the topography of the site and installation shall commence up gradient of all construction to commence. The clean surface water will be collected and diverted to the existing ditches via the peat channels.

A drainage system for the Proposed Development Site will be developed to comprise:

- The excavation of in channel rock drainage channels approx. 2 m in width and 275 mm in depth from the edge of the Proposed Development Site's access tracks.
- Silt fence textile will be laid within the channel. The silt fence textile will be Hy-tex Terrastop premium or similar and will be fixed to the upslope side of the supporting slope within the main drainage channel.
- Support posts for silt fence support and for channel supports will be inserted at the edge of the drainage channel at 1,500 mm intervals.
- Silt fence textile will be anchored using clean drainage stone.

The proposed drainage system will be based on the following methods:

- The first method will involve protecting existing water quality by avoiding disturbance to natural drainage features, minimising any works in or around drainage features, and diverting clean surface runoff around excavations and construction areas.
- The second will involve collecting any drainage water from works areas that might carry silts or sediments, and to route them towards attenuation basins prior to controlled diffuse release over vegetated natural surfaces. To achieve this, shallow surface water drains will be excavated around areas of earthworks to prevent surface water runoff into the working area and thereby protect the wider water network from siltation.

The drainage design for the Proposed Development shall utilise the existing peat drains and drainage ditches.

Perimeter drainage channels will be installed around the compounds and surface water drainage pipework will be installed within trenches in the stone platform, with downpipes from the buildings discharging to the surface water network.

Separate surface water and foul drainage networks will be provided. The network will include manholes located at junctions and directional changes in the drainage pipework as appropriate.

Oil separators will be installed where required, particularly in transformer or plant areas, to prevent hydrocarbons entering the surface water system. Discharge from the built compounds and turbine hardstandings will be directed to a network of associated attenuation basins, which will be connected by a series of underground pipes, as shown on Planning Drawing Number 501.065301.00001.D14.

7.4 Management of Sediment and Surface Waters

Good practice construction techniques[3] will be adopted for the management of sediment and surface water run-off generated during the construction phase of the Proposed Development. Sustainable Drainage Systems (SuDS) will be used where applicable.

Drainage from the Site will include elements of SuDS design. SuDS replicate natural drainage patterns and have several benefits:

[3] CIRIA (2015). The SuDS Manual (C753). London: Construction Industry Research and Information Association (CIRIA).

- SuDS will attenuate run-off, thus reducing peak flow and any flooding issues that might arise downstream;
- SuDS will treat run-off, which can reduce sediment and pollutant volumes in run-off before discharging back into the water environment; and

In addition, a wet weather protocol will be implemented by the PSCS to manage activities during periods of heavy and prolonged precipitation.

Heavy or prolonged rainfall during construction and operation may lead to sediment transport or vegetation causing blockage to infrastructure drainage channels or watercourse crossing structures. Regular monitoring and prompt maintenance of these assets will ensure that the drainage system continues to function as designed.

These measures prevent sediment release, hydrocarbon contamination, alkaline leachate from concrete, and altered hydrological pathways that could impact aquatic habitats, fish spawning areas, macroinvertebrate communities, peatland vegetation and downstream designated nature conservation sites.

7.5 Sustainable Drainage Systems (SuDS)

During drainage design runoff pollutants, such as silt, will be treated within the development, such that the surrounding environment is not harmed, and local drainage connections are not overloaded. SuDS are a sustainable method of reducing the quantity and improving the quality of runoff into local water courses and connecting drainage network systems. They are inspired by natural systems and aim to improve the local amenity and biodiversity.

SuDS are desirable and easily constructible at a large scale for wind farms. Additionally, wind farm sites usually have established vegetation which can act as a form of SuDS, naturally intercepting pollutants and allowing for slow infiltration. Thus, the use of SuDS for wind farm sites can assist in reducing the risk of polluting the local environment and/or overwhelming drainage systems to a non-significant level. There are several forms of SuDS, however the methods set out below will be used:

- Permeable surfaces such as gravelled areas, drain water through voids within the gravel, into the layers below. The access tracks to the wind turbines will be constructed using porous materials, encouraging a natural and slow infiltration process.
- Filter strips are a method of source control constructed by providing a gently sloping vegetated area over which runoff can flow. As runoff passes over the vegetation, pollutants such as silt are intercepted, and flow velocities are reduced, allowing infiltration into the underlying soil or peat. Filter strips are typically located between development areas (e.g. access tracks) and nearby watercourses to provide a buffer for surface water runoff. Their effectiveness depends on appropriate gradients and ground conditions,
- Swales are a source control and a method of deterring runoff from accumulating into one large drainage area. Swales are typically broad but shallow and can be created by excavating a small trench alongside the source of runoff, for example access tracks. Swales assist water into a storage or discharge system to reduce flood risk and encourage slow infiltration.
- Silt fences, which are constructed using a closely woven synthetic geotextile material, are a quick and easy form of SuDS which can be used from the construction stage. They can be established along the leading runoff routes, intercepting high runoff flows and pollutants. Both methods have high capabilities of intercepting the mass of pollutants during the construction stage, with further use of being temporary check dams if required, for example within swales.

- Attenuation basins will be constructed down slope of a wind farm site by constructing a depression within the ground where water from the drainage network and runoff collects. Basins reduce flood risk while encouraging slow infiltration into the ground below.

7.6 Location of Silt Traps

Silt traps will be utilised to trap and filter sediment-laden run-off (in very small quantities) from isolated areas of excavation works at the Proposed Development.

Silt fences will be employed where required, at the downslope edges of stockpile, to minimise sediment levels in run-off. Fine sediment handling will avoid periods of heavy rainfall.

All attenuation basins will be actively managed, with regular inspections and removal of silt build up to control water levels and ensure that any run-off is contained, especially during times of rainfall.

Attenuation basin outflow will be regularly inspected, and discharge may be pumped, when required, for maintenance purposes.

Sediment traps will be installed at the three TDR overrun areas to ensure there is no impact on the water environment from these.

7.7 Location of Attenuation Basins

All attenuation basins will be actively managed, with regular inspections and removal of silt build up to control water levels and ensure that any run-off is contained, especially during times of rainfall. If required to achieve the necessary quality of the final run-off, further measures will be carried out, including increasing the depth of basins, and the use of silt busters.

7.8 Outflow Monitoring from Attenuation Basins

Attenuation basin outflow will be regularly inspected, and discharge may be pumped, when required, for maintenance purposes. Any pumping activities will be supervised and authorised by the PSCS and Site ECoW.

Treated water will be discharged with care in accordance with the following principles:

- water to be discharged in planar sheet flow way rather than as a single point discharge in order to slow and spread the flow and minimise potential scour;
- use of many small/mid diameter off lets, rather than collecting larger volumes of drainage flows to discharge to a smaller number of larger capacity outlet points;
- not allowing direct, contaminated ditch discharge into watercourses, loughs and sensitive wetlands or grasslands; and
- not diverting natural flows, unless under prior agreement with EPA and MCC.

7.9 Foul Drainage

Separate surface water and foul drainage networks will be provided. The network will include manholes located at junctions and directional changes in the drainage pipework as appropriate.

A separate system consisting of foul water drainage pipework, manholes and a foul water holding tank will be installed. The foul water holding tank contents will be tankered off-site by a permitted waste collector to a wastewater treatment plant.

Foul water holding tanks will be provided within the substation and IPP compounds. The foul water holding tank will be a sealed storage tank with all foul water tankered offsite as required by an authorised waste collector to a wastewater treatment plant. Only waste collectors holding valid waste collection permits under the Waste Management (Collection Permit) Regulations, 2007, will be employed to transport foul water away from the Proposed Development Site. The proposed foul water storage tank will be fitted with an automated alarm system that will provide sufficient notice that the tank requires emptying. The foul water storage tank alarm will be part of a continuous stream of data from the Proposed Development's turbines, wind measurement devices and electricity substation that will be monitored 24 hours a day seven days per week. This approach for managing foul water onsite has become a standard practice in wind farm sites. Foul water within the construction compounds will consist of integral holding tanks or external sealed tanks which form part of the site cabins (toilets and canteen). These will be self-contained units and emptied regularly by licensed waste contractors.

The system will be designed for approval by EPA and MCC prior to the construction phase of the Proposed Development.

8 Water Quality Monitoring and Contingency

8.1 Water Quality Monitoring

Water quality monitoring during the construction phase will be undertaken for the surface water catchments that serve the Proposed Development Site, to ensure that none of the tributaries of the main channels are carrying pollutants or suspended solids. Monitoring will be carried out at on a weekly or monthly basis as required on these catchments.

With regard to the protection of the water environment the following risks will be addressed:

- siltation of watercourses;
- discolouration of raw water;
- potential pollution from construction traffic due to diesel spillage or similar;
- alteration of raw water quality resulting from imported track construction material;
- excavation and earthworks;
- use of large quantities of concrete; and
- construction compound and associated drainage/foul drainage and diesel spill issues.

The PSCS will compile a monitoring and maintenance plan for the drainage system and surface water runs for use by the ECoW which will as a minimum include:

- visual monitoring/inspections; and
- During site works, including water crossing construction works, the relevant drainage/surface water runs potentially being impacted by these works will be inspected daily by the ECoW while works are ongoing in this area.

A Water Quality Monitoring Plan (WQMP) is already in place by the Applicant, and this will be submitted to MCC prior to construction and development. The WQMP will be continued to monitor surface water quality, fish populations and macroinvertebrate community prior to, during and post-construction. A robust baseline of water quality in surface watercourses/drainage channels downstream of construction works has already been established prior to construction commencing and can be used a benchmark of water quality for the construction phase monitoring.

Groundwater monitoring standpipes have been installed at locations BH01, BH06 and BH07 within the Main Wind Farm Development Site, and screened in the bedrock to facilitate groundwater quality monitoring.

The purpose of the WQMP is to:

- ensure that the commitments put forward in the EIA Report are fulfilled with regards to identified ground and surface water receptors;
- provide a specification for monitoring prior to, during and after construction;
- provide a record of water quality across the Proposed Development Site that can be compared to rainfall and site activities;
- provide reassurance of the effectiveness of pollution prevention measures installed to protect surface watercourses throughout the construction period; and
- provide data to identify any potential pollution incidents, and to inform a structured approach to manage and control such incidences.

The WQMP records data on water chemistry and ecological indicators (fish, macroinvertebrates) to enable monitoring of surface watercourses down gradient of works areas including watercourse crossings, access tracks, turbine foundations and at control sites (up gradient of works areas), and includes:

- monitoring locations;
- frequency of monitoring prior to, during and after construction;
- parameters for field hydrochemistry testing and laboratory analysis including as a minimum pH, electrical conductivity, suspended solids, dissolved metals, nutrients and hydrocarbons;
- sampling and analysis protocols;
- relevant environmental quality standards (EQS);
- responsibilities for monitoring; the ECoW will be responsible for daily inspections of watercourses particularly around active works areas and watercourse crossings. Further monitoring on a less frequent basis (i.e. monthly) may be done by an external party; and
- procedures to be followed in the event of an environmental incident; and recording and communicating of results.

Any deviation from expected trends will trigger inspection, corrective action and reporting under the EIERP.

Monitoring will involve laboratory analysis of water samples taken at agreed locations (agreed by MCC prior to construction) across the Proposed Development Site and will continue throughout the construction phase and immediately following construction.

8.2 ECoW WQMP Duties

In addition to the monitoring and analysis, regular watercourse inspections (frequency depending on nature and proximity of works to the watercourse) will be undertaken by the ECoW in areas selected in the field and where construction is taking place. As daily inspection points, they will be readily accessible points close to infrastructure.

The regular inspections will include, but not be limited to:

- regular visual inspection of the sediment control structures;
- investigation of problem areas (e.g., those causing silty run-off) to try to establish the cause and locate the source;
- management of the PSCS to comply with method statement activities;
- development of a clear line of communication with site staff to address issues promptly;
- prioritisation of issues so that site staff know how to react to incidents; and
- regular hydrological reporting - daily records and monthly reports.

8.3 Incident Response

Drainage networks provide a conduit for rapid transport of silty water and potential contamination from surface spills of fuels/oils, concrete or chemicals. A pollution incident will include any discharge to the drainage network that could potentially cause environmental damage. Examples of pollution incidents include:

- fuel drips or spills during refuelling;
- leaking plant or equipment;
- leaks from fuel or chemical containers;
- contaminated water or sediment/silt entering a watercourse or drainage network;
- windblown dust and waste;
- excess silt deposition in drainage ditches, channels, culverts following heavy rainfall events;
- operational failures of pumps and pipelines; and
- failures of treatment or sediment controls.

The PSCS will prepare a Pollution Prevention and Incident Plan (see Section 3.5) which will provide emergency response contacts, reporting procedures, and procedures for dealing with all potential pollution incidents during the construction of the Proposed Development.

9 Construction Phase

9.1 Introduction

This section describes in more detail the key components of construction and specific mitigation measures to be incorporated to reduce potential impacts.

The overall site design has been developed in accordance with the mitigation measures identified during the technical assessments of the EIA, and to reflect the requirements and specifications for transporting wind turbine components to the proposed turbine locations.

9.2 Temporary Compounds

The construction project involves establishing two Temporary Construction Compounds (TCC) to support the works. One compound is proposed to be located adjacent to the primary access road which runs through the middle of the Main Wind Farm Development Site, with a second compound located to the north of this near the proposed substation The construction compounds will consist of:

- temporary modular building(s) to be used as security and site offices;
- welfare facilities;
- parking for construction staff, visitors and construction vehicles;
- laydown areas for the storage of large items;
- secure storage for tools, small parts and oils;
- waste storage facilities;
- a receiving area for incoming vehicles; and
- a sealed bunded area where fuel and oil storage tanks will be situated, to prevent potential contamination.

Welfare facilities will be provided for the duration of the construction period in accordance with the SHWWR 2013 (as amended). Facilities for waste management, refuelling, power, water supply (imported containers of potable water) and chemical/material storage will be provided.

All compound lighting will be designed and positioned to minimise disturbance to the surrounding environment, in accordance with the mitigation measures set out in **Chapter 5**. All temporary construction compound lights will be time-limited, directional, shielded and faced away from surrounding habitats.

The construction methodology for the compounds is outlined below:

The compound boundaries will be set out and marked prior to any works commencing. Any significant surface undulations or irregularities will be trimmed and the removed peat placed in designated peat storage areas for reuse or reinstatement, subject to ECoW approval. Otherwise, surface vegetation is to remain intact to increase founding strength.

Where the fibrous top layer is weak or saturated, a geotextile or geocomposite material will be placed directly upon the ground surface to improve load distribution, separation, filtration and drainage.

A base geosynthetic layer, to be specified pending the specific site conditions identified at the pre-construction stage, will be installed across the full compound footprint. Overlaps, anchorage, and tensile orientation will conform to manufacturer requirements.

Imported well-graded granular fill will be tipped incrementally across the compound footprint, progressing outward from the floating access track, and spread by a wide tracked dozer. The initial stone layer will be compacted utilising non vibration methods as determined by the Contractor.

Where required, an intermediate geogrid layer will be installed. This will be placed upon the first stone layer and will be overlapped and tensioned in accordance with the manufacturer's specification.

A second layer of granular fill will be placed upon the intermediate geogrid to the designed thickness. Where very low California Bearing Ratio (CBR) values are encountered, a third geogrid layer may be required.

A final compacted wearing layer of appropriately graded stone will be installed to accommodate construction traffic and pedestrian use.

Where necessary, pressure berms (stabilising berms) will be constructed around the perimeter of the compounds to enhance stability and reduce lateral displacement.

Ongoing consolidation and localised settlement of the compound surface should be expected throughout the construction period. The Contractor will be responsible for maintaining the compound to required standards, including remediation of rutting, settlement, or lateral spread using additional granular fill and localised geogrid repairs where appropriate.

Shallow drainage ditches will be excavated at a safe offset from the compound to prevent undercutting of peat. Existing field drains will be connected where appropriate and protected using silt-management measures such as silt fences or settlement features.

The drainage across the compound will be directed in to an attenuation basin.

Once all construction works are complete, the work areas will be reinstated with excavated peat or soil and either seeded out with native species, allowed to vegetate naturally, or reinstated with excavated grass turves and will be restored to their original condition (in consultation with EPA). The ground surface will be restored in line with the PMP should damage occur during the construction or decommission of the construction compounds.

9.3 Transport Routes (including TDR)

Both construction personnel and materials for the Proposed Project will use defined transport routes set out in the Construction Traffic Management Plan (CTMP) See **Technical Appendix 14-4** of the EIAR.

Primary access to the Proposed Project will be via the TDR originating at Killybegs Port. From Killybegs the route follows the R263 to the N56 north of the port, continues south through Dunkineely, the Mountcharles Bypass and Donegal Bypass, then merges onto the N15. The route continues for approximately 65 km through Ballyshannon and Bundoran before joining the N4 at Sligo. From Sligo the route continues to the N59, passing Ballysadare, Dromore West, Ballina and Crossmolina to reach Bangor Erris. At Bangor Erris, traffic diverts to the R313 and then connects to the L1206, with final approach to the Main Wind Farm Development Site via the L5252 which serves the proposed three access points. These links constitute the agreed abnormal indivisible load (AIL) corridor for turbine components.

Conventional HGVs importing stone, concrete and equipment will also primarily use the national road network from Co. Donegal to Co. Mayo. All of the below licenced quarries and concrete are suitably located so that they can deliver material to their existing customers and for the Proposed Project works. All locations are capable of quickly joining the N59 or are located on the N59.

- A - Barretts Quarry, Bangor Erris
  - 12.2km Haul from origin to Main Wind Farm Development Site
- B - Killala Rock Quarry, Killala
  - 66.1km Haul from origin to Main Wind Farm Development Site
- C - Coolturk Quarries Ltd., Crossmolina
  - 42.8km Haul from origin to Main Wind Farm Development Site
- D - Harringtown Concrete & Quarries, Abbeytown
  - 105.0km Haul from origin to Main Wind Farm Development Site
- E - Molloy Concrete Limited, Ballina
  - 64.9km Haul from origin to Main Wind Farm Development Site

Haul route origin A from Barretts Quarry will egress the origin in a right turn onto the N59 proceeding west for approximately 600m before joining the R313 and continuing west for another 400m. Vehicles on the haul route will turn left onto the L1206 and proceed south for 8km, where they will turn right on to the L5252 proceeding west and entering the Main Wind Farm Development Site through a right turn into AP 1, and AP 2 or a left turn into AP 3.

Haul route origin B from Killala Rock Quarry will egress the origin in a left turn onto the L1111 proceeding east for approximately 2.5km. Vehicles on the haul route will turn right onto the R314 and proceed south for 9km where they will join the N59 in Balina. The haul route continues south on the N59 for 500m before undertaking a turn to the right to continue moving west on the N59 for 42.6km before joining the R313 and continuing west for another 400m. Vehicles on the haul route will turn left onto the L1206 and proceed south for 8km, where they will turn right on to the L5252 proceeding west and entering the Main Wind Farm Development Site through a right turn into AP 1, and AP 2 or a left turn into AP 3.

Haul route origin C from Coolturk Quarries Ltd., Crossmolina, will egress the origin in a right turn onto the N59 proceeding west for approximately 31.1kmm before joining the R313 and continuing west for another 400m. Vehicles on the haul route will turn left onto the L1206 and proceed south for 8km, where they will turn right on to the L5252 proceeding west and entering the Main Wind Farm Development Site through a right turn into AP 1, and AP 2 or a left turn into AP 3.

Haul route origin D from Harringtown Concrete & Quarries, Abbeytown, will egress the origin in a right turn onto the N59 proceeding west for approximately 92.6km before joining the R313 and continuing west for another 400m. Vehicles on the haul route will turn left onto the L1206 and proceed south for 8km, where they will turn right on to the L5252 proceeding west and entering the Main Wind Farm Development Site through a right turn into AP 1, and AP 2 or a left turn into AP 3.

Haul route origin E from Molloy Concrete Limited, Ballina, will egress the origin in a left turn onto the L1321 proceeding north for approximately 10km before making a left turn and joining the R294 and continuing west for another 640m and joining the N59. On the N59 the route proceeds west for approximately 42.6km before joining the R313 and continuing west for another 400m. Vehicles on the haul route will turn left onto the L1206 and proceed south for 8km, where they will turn right on to the L5252 proceeding west and entering the Main Wind Farm Development Site through a right turn into AP 1, and AP 2 or a left turn into AP 3.

For day-to-day Main Wind Farm Development Site access, all staff light vehicles and HGV deliveries will approach using the regional network via the N59 and R313 before routing onto the L1206 and L5252 to reach the 3 no. proposed access points. Internal movements will be managed to minimise queuing at the proposed access points and to keep local junctions clear

during peak periods. Where the grid connection works will require trenching within the public road, traffic management will be implemented in line with the CTMP, including clear temporary signage, phased working and localised lane closures or controlled diversions to maintain safe passage for residents and businesses while cable ducts are installed and reinstated.

Construction traffic management will be undertaken in accordance with the CTMP, including advance route condition surveys on key links, road works required on the three TDR overrun areas, coordinated planning, timing and Garda escort of AIL convoys, temporary signage and escorts where required to safeguard other road users. Passing opportunities and temporary traffic controls will be installed at constrained locations, particularly along the L1206 and L5252, to allow safe interaction between construction vehicles and local traffic. Engagement with Mayo County Council and Transport Infrastructure Ireland will be maintained throughout delivery windows to confirm restrictions, notify any short-term traffic management, and agree reinstatement. Post construction, road condition will be reviewed against pre-works records to identify and rectify any project related damage.

Access to the Main Wind Farm Development Site will be via the public road network, connecting to newly constructed internal access tracks explicitly designed for the Proposed Development. The main site access will be from the L5252 using APs 1-3 for the northern and southern clusters as required. This plan will ensure the safe transport of construction materials, equipment, and turbine components to all work sites.

For day-to-day site access, all staff light vehicles and HGV deliveries will approach from the regional network via the N59 and R313 before routing onto the L1206 and L5252 to reach the northern and southern clusters. Internal movements will be managed to minimise queuing at access points and to keep local junctions clear during peak periods. Where the grid connection works require trenching within the public road, traffic management will be implemented in line with the CTMP, including clear temporary signage, phased working and localised lane closures or controlled diversions to maintain safe passage for residents and businesses while cable ducts are installed and reinstated.

Overall, adherence to the CTMP will ensure that HGV movements and turbine deliveries follow approved routes and that appropriate mitigation measures are in place to minimise disruption, protect road infrastructure and maintain safety for all users along the R263, N56, N15, N4, N59, R313, L1206 and L5252 during the construction period.

Full detail of the assessment of effects on the road network is provided in **Chapter 14: Traffic and Transport** of the EIAR.

9.4 Access Tracks

Internal access tracks, spanning approximately 8.75 km, will be constructed to link turbine locations, the substation, BESS, crane hardstandings, and temporary compounds, providing continuous connectivity for construction and future maintenance activities.

The access tracks on this site will primarily use floated construction to minimize excavation in peat and to preserve the existing ground and hydrological conditions. Furthermore, there will be existing tracks which will be enhanced and built upon as well as founded, cut trucks where there is no peat or very shallow peat. The floated tracks will consist of geogrid(s), geotextile and granular stone build constructed on top of the ground surface. The existing track enhancement will utilise the existing makeup and be enhanced through geogrid, geotextile and granular stone widening and thickening to specification. Finally, where there is no peat or shallow peat, cut access tracks will be founded on suitable strata and will receive a geogrid and granular build. This specification provides robust bearing capacity and controls rutting under heavy trafficking, including abnormal indivisible load deliveries. The finished running width will be approximately 6 m, with localised widening at bends, junctions, and passing places to accommodate turbine transport and installation vehicles.

Access tracks will be formed from a sub-base of general fill and finished off with a cap- stone / wearing course of graded crushed rock to provide a nominal Type-B (Series 800) finish. Wearing course stone will be of a suitable material that is not susceptible to breaking down / weathering to a high fines content material.

Maintenance of the running surface on all access tracks will be carried out on a regular basis, as required, to prevent undue deterioration. Loose track material generated during the use of access tracks will be prevented from reaching watercourses by maintaining an adequate cross fall on the tracks. Periodic maintenance of tracks by way of brushing or scraping will be carried out to minimise the generation of wheel ruts, which could lead to some track material being washed away.

On-site signage will be positioned to identify access points, one-way systems, speed limits, and designated parking and laydown areas, ensuring clear route guidance and safe vehicle movements throughout the construction phase. Traffic management measures will regulate entry to and egress from the public road network, reduce queuing at site entrances, and protect local road users. Within the site, route discipline will be enforced to separate construction traffic from sensitive working areas and to maintain clear approaches to crane pads, turbine hardstandings, and laydown zones.

9.5 Floating Tracks

Internal access across the Main Wind Farm Development Site will be provided predominantly by floating tracks constructed over peat and soft soils to avoid excavation and preserve the existing hydrological regime.

Floating tracks will vary dependent on the peat's CBR value which will be obtained during detailed site investigations for each track section. The range of the depth can be between 400mm and 1500mm thickness with a varied depth and quantity of geocomposite layer placement. A standard floating track incorporates two geogrid layers, or similar.

A general construction methodology of floating tracks will be followed and will consists of the following procedures where applicable:

- The designed alignment of the track will be marked out and clearly indicated prior to any construction works.
- The ground surface will receive a base geogrid, placed directly along the track alignment, in line with the geogrid manufacturer's specification. Where the ground surface lacks a fibrous surface layer, a geotextile or geocomposite (typically bonded geogrid and geotextile) will be placed to improve strength, separation, filtration and drainage.
- The makeup of the track will follow the designed requirement which may differ across the Main Wind Farm Development Site subject to the grounds CBR values. General methodology consists of an initial layer of specified, well-graded, granular fill being tipped in sections, typically 10m, on the base geogrid and spread using a suitable dozer, followed by a second geogrid, topped with the same specified fill and completed with a surface layer to accommodate construction traffic requirements.
- The stone buildup can range with interchangeable geogrid depths and quantities subject to the ground condition requirements. Very low CBR values may require up to three geogrid installations throughout its depth.
- In sections of floating tracks where lateral support is deemed necessary, pressure berms or stabilising berms will be constructed either side of the track. This is an

unlikely requirement due to the flat topography on site but may be beneficial for the reuse of excavated material. The berms act as a counterweight which widen the base of an embankment load to increase the factor of safety against slip failure.

- Shallow drainage ditches will be excavated and will tie into the existing field drains where applicable.
- Both drainage ditches and cable trenches will follow the alignment of the access tracks and will be suitably distanced to ensure track stability is maintained.

9.6 Upgrading existing tracks

The existing on-site tracks are incorporated into the Proposed Development design and will form a foundation for the construction of upgraded floating roads, or cut roads where ground conditions permit. In both cases, the existing tracks will have their depth increased as well as their width to ensure track specifications are met. The historic peat compaction and drainage caused by the continued use of the tracks will benefit the founding of the upgraded floating tracks.

The improvement and extension of the existing floating tracks will follow the same methodology of the floating track construction where existing tracks are located on deep peat. The upgraded track will have interlocking geogrids installed over and around the existing track to form a base in which the upgraded track will utilise.

Where existing tracks are located on shallow peat or soils, the methodology of cut access tracks will be used. The width of the existing track and the required distance on either side of the track, will be extended to suit the requirement.

9.7 Cut Access Tracks

Cut access tracks will be formed on suitable underlying material (superficial soil or rock with sufficient bearing capacity) in the following manner:

- Stripping of surface vegetation (turves) and careful stockpiling of this material.
- Excavating the remaining superficial soil materials and stockpiling this material.
- Where different superficial materials are present these will be stored according to type. This material will be retained for reinstatement purposes.
- The exposed suitable track formation will receive a geogrid prior to rock fill material being tipped from dumper trucks directly onto the proposed access track alignment.
- This material will then be either spread by a dozer or placed by a hydraulic excavator and compacted in layers, typically using vibratory rollers.

9.7.1 Drainage, sediment control and peat-sensitive measures

Existing drainage infrastructure will be retained and utilised where possible, and improved where required, with new drainage provided along new access tracks. Drainage measures will be developed at the construction design stage to favour shallow, peat-sensitive and discontinuous features rather than continuous deep V-ditches, and will tie into existing field drains where appropriate. Frequent cross-drains, check structures and SuDS features will be used where needed to manage runoff rate and quality and to avoid undercutting peat at the track margins. Drainage ditches and cable trenches will follow the track alignment and be set at a suitable distance to maintain track stability.

During the initial post-construction period, temporary silt management measures (such as sediment traps and silt control features) will be implemented where appropriate until natural regeneration or reseeding is established. Trackside and slope conditions will be monitored, and any unexpected, localised erosion or sediment mobilisation will be addressed promptly through regrading, reinstatement and additional drainage or silt controls as necessary, consistent with the EIAR and Peat Management Plan commitments.

9.7.2 Materials and maintenance

Stone for new internal access tracks will be sourced from suitable quarries in the vicinity of the site. Finished surfaces will be formed to provide a robust running course (for example, a Type B Series 800 style finish where appropriate), and the Resident Engineer will undertake routine inspection and maintenance to manage settlement, rutting and surface degradation. This will include maintaining adequate crossfall, periodic brushing/scraping to control rut formation, and dust suppression during dry weather if required.

9.7.3 Onsite Vehicle Movements

Access tracks will be designed to be single track with a 6m running track and space for stone shoulders where required.

During the periods of delivery of the large components, the Contractor will use appropriate site communications and access control techniques to enable safe one-way operation of the tracks.

The presence of crane pads within the construction compound will facilitate traffic movement onsite. Internal track junctions will also be used to facilitate multiple options for construction traffic movement. This will allow vehicles to move more directly between construction locations and double as passing places.

9.8 Turbines and Foundations

The wind turbines will have a maximum blade-tip height of approximately 179-180 m (depending on the final turbine model selected within the assessed range). Each turbine will be supported by a reinforced concrete foundation designed to provide stability under construction, operational and extreme environmental loading, including overturning, fatigue and settlement criteria.

The final foundation solution for each turbine will be confirmed at construction stage following completion of the confirmatory ground investigation and the turbine supplier's requirements. Given the prevalence of peat and soft ground across the site, piled foundations are anticipated to be the predominant solution, with gravity foundations used only where competent founding strata and settlement performance allow.

In locations where piling is deemed necessary, reinforced piles will support a reinforced concrete foundation, measuring 22 meters in diameter. In areas suitable for gravity foundations, diameters will be 27 meters, with depths reaching 3.5 meters, all situated below the finished ground level. For gravity foundations, an assumed concrete volume of 1,000 cubic meters has been used for assessment purposes. Any turbine-specific adjustments will be made where piling is required, based on the measured depth to competent strata influencing the pile schedule.

An overview construction methodology for piled foundations is outlined below.

- The turbine location, foundation footprint and associated working area shall be set out and marked prior to commencement of works.

- Access to each turbine location shall be via the pre-constructed floating access track. A temporary working area shall be established at the end of the track using geogrid(s) and granular stone to provide a stable platform for excavators, piling rigs and ancillary construction plant.
- A controlled excavation cell shall then be formed to the designed foundation formation level. Excavation will proceed through peat and soft soils until the specified piling platform formation is reached. Excavated peat shall be stored in accordance with the PMP for reposition or reuse.
- Shallow surface water drains will be excavated around the working area to prevent surface water runoff into the working area.
- Subject to peat depth, water ingress and stability conditions, excavation support shall be provided through one of the following methods:
    - Sheet Pile, Rock or Modular Cofferdam - Used where peat is saturated or unstable. A method will be chosen based on ground conditions with sheet piled and modular cofferdams being temporary and rock cofferdams being left in situ.
    - Benched Excavation - Used where peat has sufficient shear strength to maintain stable slopes, subject to geotechnical approval and slope toe support where required.
- A designed piling pad will be constructed at formation layer consisting of geogrid and stone build up to the specified requirement based on the piling rig used.
- Piling shall be carried out in accordance with the detailed foundation design and the appointed piling contractor's method statement. The final pile type and installation method shall be determined by ground investigation results, accounting for peat characteristics, underlying strata and environmental constraints. Piling methods may include:
    - Bored Piles with Temporary Casing – Suitable in saturated or unstable peat to prevent ingress or instability.
    - Continuous Flight Auger – Typically used where bore stability can be maintained and groundwater inflow is manageable.
- Pile casings shall be advanced through peat to prevent wall collapse and ensure clean concrete placement. Piles shall be installed to a competent bearing layer.
- A steel reinforcement case will be slotted down the casing prior to concrete pouring through a tremie pipe or similar.
- Once the piles have been cured, they will be cut to the designed pile-cut level ensuring uniform height across the foundation footprint. The top of the piles will be cleaned and prepared for the foundation construction.
- A blinding layer shall be placed across the foundation footprint to provide a level, clean surface for the foundation reinforcement installation. Reinforcement steel, including anchor ring and pedestal reinforcement, shall be fixed in accordance with the structural design.
- Duct routes will be set out along the designated cable entry side of the foundation, typically at 90 degrees to the proposed door entry. The ducts are installed through the

formwork openings, tied to the reinforcement, sealed and end capped to prevent concrete ingress.

- Temporary formwork will be installed prior to concrete pouring.
- The foundation slab will be poured in a continuous pour and vibrated using high-frequency vibrators to remove entrapped air. The concrete will be placed using appropriate methods such as pump lines.
- Following curing of the foundation slab, the pedestal will receive its specified concrete pour within erected formwork. Once all concrete has cured and been verified, the formwork can be removed.
- Backfill material, specified upon bulk density, will be placed around the foundation to near existing ground level where a final, graded surface layer will be placed.
- Temporary excavation supports (sheet piles, modular cofferdams or slopes) shall be removed or restored and reinstated.

Gravity foundations will generally follow the same enabling and preparatory construction sequence described for piled foundations, including set-out, access arrangements, establishment of the working platform, surface water management and excavation controls.

The primary difference is that gravity foundations do not require piling operations or associated piling platforms. Instead, following excavation to the designed formation level and installation of any required excavation support measures (e.g. cofferdams or benched slopes), the foundation is constructed directly on competent bearing strata or engineered replacement fill, subject to ground conditions confirmed during excavation.

Once the formation has been prepared and accepted, the construction sequence continues with blinding, reinforcement installation (including anchor and pedestal reinforcement), ducting provision, formwork installation, concrete placement, curing, and subsequent backfilling and reinstatement in line with the same principles adopted for piled foundations.

These procedures comply with the guidelines established in **Chapter 2** of the EIAR and will be carried out in accordance with the Peat Management Plan to properly handle and segregate peat, and sensitively reinstate disturbed ground.

9.9 Crane Pads

Adjacent to each turbine foundation, crane pads (hardstandings) will be constructed to provide stable working areas for turbine delivery, erection, maintenance and component replacement. The pads will comprise geotextile-separated, compacted granular build-ups with geosynthetic reinforcement as required, and the final arrangement will be confirmed in line with the final turbine model and in response to local ground conditions, peat depth and crane loading requirements. In areas of deeper peat and low bearing capacity, the crane pad will incorporate a piled solution. Where the peat is shallower and competent formation can be achieved, excavation will be undertaken to the required formation level for construction.

The construction methodology for the crane pads located in deep peat will be as follows:

- Temporary geosynthetic-reinforced working platforms, or piling pads, for piling rigs shall be constructed on top of the ground surface to a specified requirement based on the piling rig proposed. The platforms will consist of geogrid(s) and granular stone.
- The specified piling method shall be carried out across the crane pad area to a detailed design schedule and in accordance with the specified number, spacing, and

arrangement of piles as indicated in the design documentation. Should construction stage determine that crane loading on auxiliary pads require piles, these areas will also be piled to the same methodology.

- The piling type and installation method will follow the same principles as the piled foundation with piles installed to a competent bearing layer.
- The piles will receive a reinforcement cage and specified concrete.
- Once cured, each pile will be cut down to specified elevation to create a uniform cap level and cleaned prior to pile caps being constructed.
- High-strength specified geogrids will be installed over the set pile caps to the manufacturer's specification and quantity. A well-graded granular material will be placed and compacted in controlled layers over the geogrids to completion.
- Blade laydowns, assembly areas, and temporary storage areas will generally be constructed as floating hardstands. These will consist of a designed stone depth with interchangeable geosynthetic quality and quantity based on ground conditions.
- The Contractor will be responsible for maintaining the hardstands to required standards, including remediation of rutting, settlement, or lateral spread using additional granular fill and localised geogrid repairs where appropriate.
- Peripheral, shallow drainage ditches will be formed around the hardstand to intercept surface runoff and protect peat stability.

The construction methodology for the crane pad and hardstand on competent bearing strata will be as follows:

- Topsoil and unsuitable material within the hardstand footprint will be stripped to the required depth and stockpiled or reused in accordance with the PMP. Subgrade preparation will include proof-rolling, localised excavation of soft spots, and replacement with engineered fill where necessary.
- Where ground conditions require improvement, a base geogrid layer will be installed.
- Stone placement upon the excavated formation level will be carried out in layers with each layer being suitable compacted until specified thickness is achieved.
- The crane pad will be constructed to the design platform level and bearing capacity specified by final crane model.
- Peripheral drainage, such as shallow ditches, will be formed around the hardstand to intercept surface water runoff and to prevent water ingress.
- Surplus topsoil will be placed along the side of the hardstanding and dressed to blend in with surrounding landscaping.

Crane pads will be constructed to facilitate the installation of turbine components. Their location and orientation have been optimised to utilise the existing topography, minimise land take and avoid environmental constraints where applicable.

Crane pads will remain in place for the operational life of the development. Following construction, adjacent laydown and assembly areas will be reinstated where practicable, using stored peat and soils to soften platform edges and integrate the hardstanding with surrounding ground levels. Surface water drainage will be incorporated to manage runoff and prevent erosion while maintaining peat-sensitive hydrological conditions, and pad orientation will be optimised to make use of local topography and minimise land take.

9.10 Substation

The turbines will be connected by underground collector cabling to a newly constructed 110 kV on-site substation within the Main Wind Farm Development Site. The substation will provide the interface between the wind farm, BESS and the national grid and will include the switchgear, protection and metering equipment required for export. The substation compound will measure 84.5m wide on the southwest width and 82m wide on the northeast width by 149m long on the northwest length and 147.5m on the southeast length. The compound will accommodate two control buildings alongside the necessary electrical equipment for grid connection. The Customer Switchgear Room (IPP building) will be operated by the Applicant and is designed at 22.1 m x 12.7 m with an overall height of 6.17 m, while the Transmission System Operator Control Building (EirGrid building) will measure 27 m x 20 m with an overall height of 7.85 m.

The compound will be enclosed by a 2.6 m high steel palisade fence with internal segregation fencing where required, and lighting will be provided by pole-mounted fittings and external wall lights to support safe operation and maintenance. Staff welfare will be provided within the control buildings, with a proposed rainwater harvesting system supplying limited water for toilet flushing and handwashing through a tank installed adjacent to the buildings.

The substation and IPP compound will be constructed in line with the following principles:

- The Substation and BESS compound boundary and layout will be set out and marked prior to any works commencing.
- All peat within the footprint of the Substation and BESS compound shall be excavated in accordance with the design model. Excavated peat shall be stored in accordance with the PMP, and only with ECoW approval, for reuse around the Substation and BESS compounds and in accordance with the wider peat restoration plans for the Proposed Site.
- Following peat removal, the exposed formation will be inspected and proof-rolled.
- Any significant undulations or irregularities within the compound footprints following the removal of peat will be excavated or trimmed.
- Localised soft spots will be excavated and backfilled with engineering fill as directed by the project engineer or stabilised using a geogrid and engineering fill.
- A geotextile separator layer will be installed over the prepared formation surface to prevent contamination of the structural fill.
- Geogrid reinforcement layers will be installed in accordance with the design and subject to the ground conditions to provide load distribution and stability.
- Imported crushed stone will be placed in layers of specified thickness and compacted using suitable plant to achieve required density and bearing capacity.
- The depth of stone and number of geogrid layers will be subject to ground conditions and design requirements.
- Finished levels will be graded where required to promote surface water runoff towards the drainage systems.
- Tracks across the compounds will be constructed in stages to allow for temporary access, intermediate access and the final access standard once all major works are complete.

Drainage measures will be implemented to control surface water runoff and prevent ingress into working areas, including the use of shallow perimeter drains and localised drainage

features. All drainage will be constructed in accordance with the site drainage strategy and integrated with site infrastructure.

Cable infrastructure will be installed in accordance with the project layout, including ducting, trenching and cable routing from the turbines to the wider network. Installation will be coordinated with foundation and civil works to ensure correct positioning, protection and segregation.

A range of concrete foundations will be constructed across the substation and IPP compound. Raft foundations will be constructed for major buildings within the compound including the EirGrid control building and the MV switchgear building. Other concrete foundations will include concrete plinths, base slabs and post foundations.

Electrical infrastructure, including internal turbine connections and associated equipment, will be installed following completion of the civil works.

Fencing, access gates, CCTV and lighting will be installed as required to protect infrastructure and restrict unauthorised access during construction and operation.

Any oil-containing equipment will be installed with appropriate containment, and site activities will follow good housekeeping, designated refuelling arrangements and spill response procedures. The substation will be a permanent installation and, upon completion of construction and commissioning, will be handed over to EirGrid for operation.

9.11 BESS

It is proposed to construct one onsite BESS compound with a capacity to reflect the generation capacity of the proposed wind farm. The BESS will have the future ability to store excess power being generated locally on the grid and will release it back into the grid when there is a demand for it. The BESS will comprise 120 Battery Containers and 15 Inverter Containers in total, within a compound measuring 156m long on the northwest length, 153m long on the southeast length and 99m wide either side, secured by a 2.6m high palisade fence.

Each of the 120 battery container units will measuring 2.9m in overall height, 2.54m in width and 6m in overall length. Each of the 15 inverter units will measure 2.9m in overall height, 2.7m in width and 6m in overall length.

Prior to construction of the BESS, an area incorporating a drainage system surrounding it will be marked out by a qualified engineer prior to excavation and installation of the drainage system. Peat is present at a depth from 1.8m to up to 3m across the proposed BESS and substation compound area and will be excavated in accordance with the proposed design, including details on slope excavation of peat. This will remove the need for piled foundations.

The construction methodology, drainage, cabling and security for the BESS compound will follow the same principles as the substation and IPP compound.

The BESS MW switchgear building will be set upon a raft foundation with BESS PCS units on concrete slabs and battery container units on concrete plinths.

The associated BESS equipment will be connected to the substation via underground cables. Marker tape and cable tiles will be placed above the buried services.

9.12 Internal Collector Cable Layout

The cable layout for the Proposed Development will involve underground cabling that connects each turbine to the on-site substation, facilitating efficient energy transfer to the national grid. Wherever feasible, cables will be installed in trenches alongside the internal access tracks, minimizing ground disturbance and reducing the environmental footprint. The trenches will be

carefully prepared, with cables laid in protective conduits surrounded by a bedding layer of sand or cement-bound material (CBM) to ensure durability and stability.

Appropriate buffers and environmental management measures will be implemented to avoid impacts on sensitive areas and habitats. The design will incorporate measures to manage drainage and protect watercourses, particularly in areas where cables need to cross such features.

When installing cables a standoff distance will be agreed with the ECoW with silt control measures being implemented such as silt fences, sediment traps or the use of the attenuation basins.

Cable trenching backfill material will consist of suitable, non-contaminated, inert material ensuring that no pollutants or deleterious substances are introduced to the ground and surrounding environment.

9.13 Watercourses

9.13.1 General

The Main Wind Farm Development Site is drained by a network of small peat and forestry drains that connect into larger “main” peat drains running along the existing access road and, in places, along the site boundary. The main drains in the northern part of the site ultimately discharge to the Doolough Stream and the An Mhoing Mhór Stream, while drainage from the central and southern parts of the site flows via unnamed drains to the Irish Sea.

Watercourses in the northern area of the site are classified as “At Risk” with a current WFD status of “Poor”, while those in the southern area are “Under Review” with a “Good” status. Protection of these receiving waters is therefore a key environmental constraint during construction. As part of the project design, all wind turbines and associated infrastructure on the Main Wind Farm Development Site have been sited outside the 50m watercourse buffer zone.

In relation to over-run areas 2 and 3 of the TDR, the temporary tracks will encroach on the 50m buffer to the nearby streams. Appropriate construction mitigation measures will be implemented to prevent surface run-off of sediment or potential pollutants into these watercourses. These include:

- No refuelling of vehicles / machinery and no storage of stockpile material within 50 m of nearby drains and streams;
- No discharge from the temporary construction works at the over-run areas to nearby drains or river channels;
- Silt fences will be installed between any construction works and the river channel and any drains within the 50 m buffer to ensure no silt will enter the water course;
- Daily visual inspections will be undertaken at all drains and river channels; and
- If any pollution is observed, all works will be halted until the source of the pollution has been managed.
- Upon completion of works, the Proposed Development Site will be restored to its existing land use without delay.

Tracks have been routed to minimise any crossing of the watercourses. There are two new and two upgraded watercourse crossings proposed within the internal access track network. The new crossings (WCX1 and WCX2) will be provided as culverts according to typical specifications identified in Planning Drawing Number 501.065301.00001.D19.

New crossings are designed to convey 1% Annual Exceedance Probability Mid-range Future Scenario (AEP MRFS) storm event, with a minimum 300mm freeboard level. This is in line with the Office of Public Works (OPW) requirements. A Section 50 application will be required to obtain the consent of the OPW for the construction of the crossings.

The two existing watercourse crossings on the access tracks (WCX3 and WCX4) will be upgraded to accommodate the new loads posed by construction traffic and operation. Upgrades will include the strengthening of existing structures, installation of appropriately sized culverts.

All instream works are to be minimised and carried out in low flow conditions where feasible. Silt control measures are to be implemented and all disturbed areas are to be reinstated promptly to prevent sediment runoff and protect the water quality.

There is only one water crossing associated with the TDR over-run areas. Overrun area 2 crosses the Moneynierin (WFD ID MUING_010) and a temporary crossing will be required here. No instream works, modification of the river channel or obstruction of flow will be required and on completion of works, the site will be restored to its existing land use without delay.

Although Overrun area 1 is located within the vicinity of an unnamed stream (WFD ID OWENMORE (MAYO)_060), there will be a 50 m buffer between this stream and any proposed construction or infrastructure related to this over-run area. There will be no construction works required on the crossing structures to facilitate the turbine delivery.

The GCR will not require any new watercourse crossings

All construction works on the Proposed Development Site, and specifically construction works to be undertaken within and in the vicinity of the watercourse, will be completed in compliance with current legislation and best practice as detailed through sections 5 to 8 and in the reference list contained within this CEMP.

The ECoW will be consulted on all watercourse crossing works. Surveys by the ECoW will be carried out immediately prior to construction of the crossing to identify areas of ecological interest and more specifically, mammal and fish activity in watercourses to ensure that adequate mitigation measures are built into the design.

9.13.2 Design Philosophy

Good practice set out in NRA (2008) and Inland Fisheries Ireland (2016) guidance has been incorporated to watercourse crossing design, including the measures detailed below:

- where appropriate, the watercourse will be routed through culverts appropriately sized and designed not to impede the flow of water and will allow safe passage for wildlife, such as fish, water voles, otters etc. (i.e. the crossings will have a capacity well in excess of the design flow);
- when installing culverts, care will be taken to ensure that the construction does not pose a permanent obstruction to migrating species of fish, or riparian mammals (i.e. the crossing will make provision for fish and wildlife migration);
- culverts will be sized so that they do not interfere with the bed of the stream during construction, (i.e. the crossing will leave the watercourse in as natural condition as possible);
- culverts with a single orifice will be used in preference to a series of smaller culverts that may be more likely to become blocked with flotsam and create erosion (i.e. the crossing will not constrict the channel);
- ease and speed of construction are important to minimise disruption to the watercourse and surrounding habitat;

- culverts will be designed for the life of the project;
- culverts will be low maintenance; and
- culverts will be visually in keeping with the surroundings.

In accordance with guidance and the requirements of an Office of Public Works (OPW) in Section 50 application licence under the Arterial Drainage Act, 1945, the watercourse crossings have been designed to be appropriate for the width of watercourse being crossed, and the prevailing ecological and hydrological situation (i.e. the "sensitivity" of the watercourse). Environmental factors including the ecological sensitivity of the watercourse, water quality protection and hydrological processes as well as engineering factors include the width, depth, gradient of the channel, flow characteristics, ground conditions and anticipated loading will influence the selection of structure type and the design of the crossing.

The watercourse crossings will be designed to convey a minimum 1 in 200 years plus climate change return period flood event, and individually sized and designed to suit the specific requirements and constraints of its location.

The watercourse crossing will include splash boards and run-off diversion measures to prevent direct siltation of watercourses.

9.13.3 Culverts

Culverts are used where a closed crossing is required and where this can be achieved without unacceptable hydraulic or ecological effects. Culvert type and size will be confirmed at construction stage, informed by the local drain geometry, flow conditions and constructability. For this site, crossings will be required over both small and main peat drains (typically circa 0.5 m wide by 0.75 m deep for smaller drains, and up to circa 2 m wide at the top and about 1.5 m deep for main drains).

General culvert requirements will include:

- sizing and alignment to minimise blockage risk and prevent backwatering and local flooding;
- integration with existing peat drainage so that flows are not diverted into new preferential pathways;
- inlet and outlet detailing to protect embankments and reduce erosion potential, using appropriately selected protection measures compatible with peatland settings;
- inspection and maintenance access so that accumulated sediment and vegetation can be removed promptly, particularly following heavy rainfall events.

Temporary crossing arrangements, where required, will be controlled through method statements and will include measures to prevent direct discharge of sediment-laden runoff to the drain or watercourse during the works.

9.13.4 Relevant Mitigation Measures

The following is a summary of the relevant mitigation measures and general good practice associated with the development of watercourse crossings:

- site track crossings will be constructed with granular materials, which will limit the production of surface runoff and the direct discharge of sediment into the watercourse;
- the methods of drainage described for the site tracks in Section 9.4.3 will prevent the significant discharge of surface runoff and suspended solids into the watercourse adjacent to the tracks. This is owing to the runoff being collected within the upslope ditch, the presence of peat dams and culverts at appropriate intervals so as to limit

longitudinal flow and the discharging of water to the downslope ground. There will therefore be no long runs of ditches that directly discharge into watercourses;

- the watercourse crossing will be designed to avoid disruption and/or habitat loss to aquatic systems or to affect free passage of fish; and
- where possible, a minimum buffer strip of 50 m will be kept free from development from the top of the banks of any watercourse/waterbody.

9.14 GCR

Prior to the GCR installation works within public roads (subject to a separate planning application), all access points (domestic, business, farm) will be considered when finalising the temporary road closures and diversions, to maintain local access and avoid impacts on various land uses.

The construction of the GCR installation shall consist of a mixture of trench excavation and inline horizontal directional drilling (HDD) where trench excavation is not suitable within the public corridor, such as at watercourses, culverts, bridges and existing utilities.

Invasive species such as Japanese Knotweed have been identified along the route and will need to be treated in accordance with the European Communities (Bird and Natural Habitats) Regulation 2011, S.I. No. 477 of 2011 and EU Invasive Alien Species Regulations (EU) No. 1143/2014.

Measures in this CEMP will also apply to the GCR.

10 Pre-Construction Confirmatory Surveys, Protected Species and Monitoring

10.1 Pre-Construction Confirmatory Surveys

Detailed site investigations that can only be undertaken at the construction stage will be undertaken prior to ground works to confirm the findings of the pre application surveys. This will enable the designers/engineers to confirm the suitability of engineering methods. Preconstruction habitat and protected/ notable mammal surveys will be required to confirm management plans, in recognition of the constant evolution of ecological habitats. Confirmatory surveys for protected species will be undertaken by the ECoW in line with the locations and programme of works. Survey outcomes will inform the designers/engineers in selecting appropriate working methods.

10.2 Water Quality Monitoring

Prior to the works commencing, baseline water quality monitoring will be undertaken by an appropriately qualified and experienced independent consultant to establish the water quality prior to any interference from the works.

This will be undertaken in accordance with the proposed water quality monitoring developed by the PSCS and as detailed within Section 8.0.

This water quality monitoring is to be agreed and reviewed by the Applicant in advance of the works commencing to ensure that the conditions during the monitoring and the testing undertaken are representative and allow a suitable benchmark to be established.

10.3 Archaeology

The Proposed Development Site has undergone an assessment to identify any potential archaeological or cultural heritage features within the development area. Only one statutory archaeological or cultural heritage designations has been identified within the Main Wind Farm Development Site boundary, with several recorded archaeological features and sites of interest exist in the surrounding area, particularly within a 5 km radius. These include protected structures, architectural conservation areas, and regionally significant heritage assets that are identified in **Chapter 12** of the EIAR. Construction works at Turbine 11 have been designed to avoid an archaeological zone located c.0.23 km away from the zone of protection of national monument (crannog registered as Site and Monument Record MA025-004).

10.4 Ecology and Biodiversity

The Proposed Development Site does not contain any statutory ecological designations; however, it is located near several sensitive ecological features and habitats of high conservation value. Full details of any potential ecological resources in and around the Proposed Development Site are provided in **Chapter 5: Biodiversity** of the EIAR.

The closest statutory designations include the Blacksod Bay/Broadhaven Special Protection Area (SPA) and the Mullet/Blacksod Bay Complex Special Area of Conservation (SAC), both situated less than 1 km from the Proposed Development Site boundary. These areas support important habitats, such as mudflats, salt marshes, and machair systems, as well as protected species, including otters (Lutra lutra), petalwort (Petalophyllum ralfsii), and various bird species such as light-bellied Brent geese and red-breasted mergansers.

Baseline ecological information has been informed by a desk study and targeted field surveys. A high-level ecological constraints survey for the TDR (including overrun areas) was

completed on **26 July 2023**, with additional survey work and reporting completed on **18 July 2025** to cover parcels not confirmed at the time of the 2023 survey.

The desk study for the 2025 work drew on publicly available datasets (including EPA mapping, NPWS resources, the NBDC database, I-WeBS data and relevant planning portals), and the field surveys mapped habitats in accordance with Fossitt classifications and best-practice habitat survey guidance, recording invasive species and notable/protected flora and fauna where observed. Please see **Table 5-5** in **Chapter 5** for dates and timing of completed ecology surveys.

While works are not proposed within European site boundaries as part of the turbine delivery route elements assessed, a number of European sites occur within the surrounding receiving environment, and some locations have hydrological connectivity to designated sites via drains, ditches and watercourses. For example, European sites within the wider area of assessed turbine delivery route work locations include Blacksod Bay/Broad Haven SPA, Broadhaven Bay SAC, Mullet/Blacksod Bay Complex SAC and Owenduff/Nephin Complex SAC/SPA (among others), with distances varying by location.

10.5 General Pre-Construction Confirmation Surveys

To prevent accidental disturbance to resting places of mammals (badgers, red squirrel, pine marten, otter and hedgehog), a confirmatory ecological walkover survey will be undertaken prior to any construction activities within the development footprint.

Similarly, trees and structures within the works corridor will be re-assessed for bat roosting potential, with any inspections or emergence surveys carried out as required under licence.

Confirmatory checks for nesting birds will be carried out for construction undertaken during the bird breeding season. If nests are recorded, ongoing monitoring and appropriate exclusion zones will be implemented to determine when and where works can proceed. If exclusion zones cannot be implemented, NPWS will be contacted and based on their advice, additional mitigation will be implemented, with relevant licences applied for if required – although at this point it is important to note that no licences are required based on the results of the surveys.

10.6 Peatland and Habitat Management

A detailed Habitat Management Plan has been prepared to ensure the overall improvement of the condition of the cutover blanket bog within the Proposed Development Site. Prior to any construction work taking place, activities will be planned against the strategic management plan and vegetation clearance will be planned to avoid the main bird breeding season from March to September, inclusive. The ECoW will provide specific advice regarding timings and micro-siting of construction activities to minimise disturbance to mammals, birds and aquatic fauna.

If unforeseen site clearance and construction activities are required to take place during the main breeding bird season, pre-commencement confirmatory surveys will be undertaken to ensure that nest destruction and disturbance is avoided. This will include the implementation of disturbance-free buffers for common snipe (400 m).

10.7 Construction

10.7.1 Vegetation Clearance, Earthworks and Excavations

The Habitat Management Plan has identified measures to remove and control invasive species such as Rhododendron and Prickly Heath which have been discovered on site.

Temporary works areas will be sited on previously disturbed or low-value habitats where possible and reinstated post-construction. Drainage controls, settlement measures and buffers (as described in Section 7.0) will be implemented to prevent runoff from entering sensitive habitats. Lighting will be directional and time-limited to reduce disturbance to bats and birds.

The following management measures will be taken to minimise general habitat loss, fragmentation and disturbance:

- Vegetation clearance will be limited to the minimum footprint required.
- Woodland, treeline and hedgerow trimming will follow seasonal constraints to protect nesting birds and roosting bats.
- Root protection zones and exclusion fencing will be implemented to prevent unnecessary encroachment into retained habitats.
- Excavations for cables and turbine bases will incorporate silt fences, cut-off drainage and rapid reinstatement to prevent sediment release to watercourses.
- Stockpiles and construction zones will be fenced to avoid accidental overspill into adjacent habitats.
- Amphibian-proof fencing will be implemented around any basins/pools that may attract frogs or smooth newts while construction work is ongoing in close proximity.

General good practice construction techniques to control invasive species that will be implemented are identified in Section 5.0. Measures set out in Section 5.2 on stockpiling and material handling will be implemented to prevent sediment entrainment and habitat degradation.

Measures set out in Section 6.0 will be implemented to protect vegetation, prevent smothering of bryophytes and lichens, and reduce the risk of dust entering aquatic systems.

Measures set out in Section 7.0 will be implemented to prevent sediment release, hydrocarbon contamination, alkaline leachate from concrete, and altered hydrological pathways that could impact aquatic habitats, fish spawning areas, macroinvertebrate communities, peatland vegetation and downstream designated nature conservation sites.

The Peatland Restoration (PRP) and Habitat Management Plan (HMP) (see **Technical Appendix 5-5 of the EIAR**) includes management of key species and will ensure that all required protection measures are undertaken with regard to protected species and the habitat which they rely upon.

The HMP will ensure all required precautions are taken to safeguard protected species from disturbance, injury and death and to protect any structure, place or habitat, which any such protected species uses for growth, breeding, resting, shelter or protection during the construction and, operation of the Proposed Development (with emphasis on the construction phase).

Good practice measures to protect sensitive ecological receptors during the construction phase will be implemented, including the erection of temporary protective fencing demarcating the working footprint, to be monitored and supervised by the ECoW with advice on remedial actions where necessary – as per the PRP and HMP (see **Technical Appendix 5-5 of the EIAR**).

The HMP will be fulfilled by adopting the following objectives throughout the construction of the Proposed Development:

- objective A – Implement a monitoring and protection plan for protected species;

- objective B – Follow an approved procedure if a sensitive ecological receptor is suspected/identified; and
- objective C – Ensure adequate education and awareness of site personnel.

The ECoW will have the specific remit of monitoring compliance with the PRP and HMP (See **Technical Appendix 5-5 of the EIAR**) during the construction phase and report any breaches to the Construction Project Management Team. The ECoW's role will involve direct monitoring of all activities on the Proposed Development Site to the extent the ECoW considers this to be required, and/or training of nominated personnel to carry these out in a manner likely to minimise the potential for impact on the protected species. The ECoW will also agree changes to construction operations to prevent breaches of the HMP.

10.8 Tree Felling

The proposed method of tree felling near infrastructure will be limited to:

- 10 m wide exclusion zone to be established from the edges of any aquatic zones or water hotspots as per Standards for Felling & Reforestation (Department of Agriculture, Food and the Marine (DAFM), 2019).
- 5 m wide exclusion zone to be established from the edges of any relevant watercourses (DAFM, 2019).
- Construction works at Turbine 11 have been designed to avoid an archaeological zone located c.0.23 km away from the zone of protection of national monument (crannog registered as Site and Monument Record MA025-004).
- In the event that an unrecorded archaeological feature is found during tree felling, the discovery must be immediately reported to the National Museum of Ireland or the Garda Síochána. A minimum exclusion zone of 20m must be established around the feature until the site of the find has been investigated (Forest Service, 2000).
- All mitigation measures that are required under the standards, guidelines and conditions in place at the time of issue of the felling licence by the Minister for the Department of Agriculture, Food and the Marine (DAFM).

10.8.1 Species Specific Control Measures

The HMP also includes specific measures for species management for species such as Kestrel for agreement with MCC, in advance of works commencing on Main Wind Farm Development Site. The HMP will set out in sufficient detail the measures and procedures that will be followed to ensure the protection of sensitive species as well as legally protected species during construction.

10.8.1.1 Construction-type Works

The ECoW will oversee activity during the construction and reinstatement periods (at a frequency to be agreed with MCC), to ensure natural heritage interests are safeguarded. The role of the ECoW will include the following specific roles with regard to the ornithology interest of the Main Wind Farm Development Site:

- clearance of woodlands and uncultivated vegetation i.e. trees (including vegetation removal for creation/maintenance of requisite bat mitigation buffers around the wind turbines), will be undertaken outside the main breeding season from March to September inclusive.

- the ECoW will undertake pre-construction confirmatory surveys for nesting birds throughout the construction period that falls within the nesting season and set up and monitor appropriate exclusion areas whilst nests of relevant species are in use.
- once vegetation has been removed from the works corridor, these areas will be retained in a condition that limits suitability for nesting birds for the remainder of the construction phase. Cover for ground nesting species will be made unsuitable by cutting vegetation or tracking over with an excavator.

10.8.1.2 Operation of Wind Turbines

Mitigation measures to limit foraging interest for common kestrel will be implemented to avoid risk of collision with the operational wind turbines. These will focus on reducing prey availability in an area of 91.4 m to 105.5 m surrounding each turbine for conifer and 72.1 m to 90.4 m for scrub (depending on the final choice of turbine model selected):

- creation of uniformly short vegetation heights via infrequent mowing or trimming of vegetation.
- removal of timber/brash from felling and chipping of tree stumps to ground level.
- spread and compaction of chipped wood and spoil to create a flat surface to prevent rapid colonisation of new vegetation.
- piping/filling over of open field/forestry drains.

10.8.1.3 Species Monitoring

Based on current best-practice guidelines (SNH, 2009 and NatureScot, 2021) and in accordance with EC Recommendation (C/2022/3219), a targeted range of flight activity surveys and collision monitoring (carcass searching) will be undertaken for birds and bats will be undertaken in years 1, 2 and 3 post construction, to monitor the rate of avian/bat turbine collisions and identify any significant effects.

Should the bird monitoring programme indicate that there is a significant effect on bird populations during operation of the wind turbines, a curtailment procedure for turbine operation will be implemented where appropriate during ‘at-risk’ time periods and weather conditions, and as discussed and agreed with the National Parks and Wildlife Service (NPWS).

Should the bat monitoring programme indicate that the implemented bat buffer areas around turbines are not sufficiently effective in avoiding a significant effect on bat populations during operation of the wind turbines, additional measures such as feathering of blades and/or curtailment of turbines will be investigated.

11 Reinstatement

During the construction of infrastructure elements (as detailed in Section 9.0), excavation will be necessary for locations such as turbine foundations, substations, BESS platforms, and localized cut sections. The vegetated peat layer will be carefully lifted intact as turves, with the growing side facing up, and stored adjacent to the work area. The underlying catotelm peat will be excavated to the required depth and stored separately to prevent mixing.

To minimize peat movement, direct placement into restoration areas will be prioritized whenever possible. Storage areas will be located at least 50m away from water features and arranged as low, stable mounds not exceeding 1m in height. If short-term storage is necessary, the peat will be irrigated as needed to prevent drying out and placed on separation layers to maintain stability.

Following construction, reinstatement will proceed as soon as practicable, working progressively with the build. Restored profiles will be graded to blend with surrounding ground, with excavated peat used to batter platform edges and soften the interface with adjacent habitats. Intact turves will be relaid to maximise vegetative recovery, and, where needed, supplementary revegetation or brash spreading will be applied in line with the habitat restoration approach in the EIAR. On floated track margins and other areas without excavation, the existing vegetated mat will be retained and protected during construction, limiting the need for reinstatement to local repairs.

Drainage features will be reinstated to peat-sensitive layouts that preserve natural flow paths and avoid concentrated drawdown, with small check structures used where required to control velocities during the early establishment period. Temporary silt controls will be maintained until vegetation has re-established and runoff is demonstrably clean. Where erosion is observed on embankments or cut faces, local re-grading and re-turfing will be undertaken promptly to stabilise surfaces and protect water quality.

Quality assurance and aftercare will include immediate post-reinstatement inspection of each area, followed by routine monitoring by the Resident Engineer and ECoW to confirm vegetation take, peat surface condition and the effectiveness of drainage and silt controls. Any deficiencies will trigger corrective actions such as additional turf placement, irrigation, minor re-grading, or temporary sediment fencing. Peat mass balance records will be maintained and updated through construction to evidence that excavated peat is reused on site for restoration, consistent with the PMP, which anticipates no surplus peat requiring off-site disposal.

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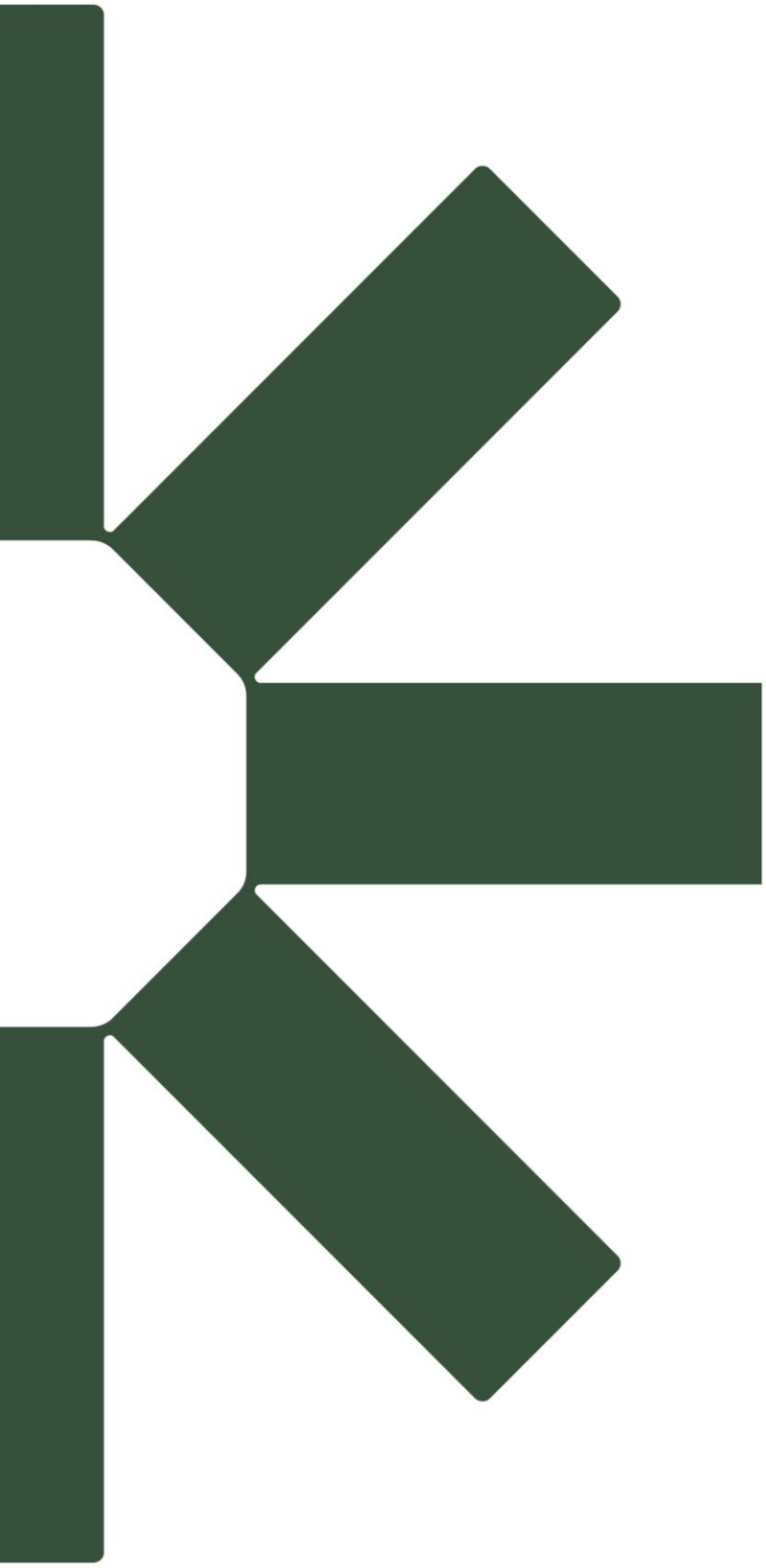


Making Sustainability Happen

Appendix 6 Supporting Information for the European Sites

AA Screening and Natura Impact Statement

Muingmore Wind Farm

RWE Renewables Ireland Limited

SLR Project No.: 501.065301.00001

European sites with functional connectivity (ecological pathways) to the area including their Qualifying Interests, known threats and pressures

Site Code	Site Name	Qualifying Feature	Pressures Codes	Known Threats and Pressures
000466	Bellacorick Iron Flush SAC	Marsh saxifrage (Saxifraga hirculus) [1528]	D01.01, C01.03.02, K01.03	Paths, tracks, cycling tracks, Mechanical removal of peat, Drying out
000470	Mullet/Blacksod Bay Complex SAC	Fixed coastal dunes with herbaceous vegetation - grey dunes [2130], Large shallow inlets and bays [1160], Salicornia and other annuals colonising mud and sand [1310], Machairs * in Ireland [21A0], Atlantic decalcified fixed dunes (Calluno-Ulicetea) [2150], Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation [3150], Otter (Lutra lutra) [1355], Mudflats and sandflats not covered by seawater at low tide [1140], Shifting dunes along the shoreline with Ammophila arenaria - white dunes [2120], Petalwort (Petalophyllum ralfsii) [1395], Alkaline fens [7230], Reefs [1170]	A02.01, J02.12.01, E03.01, G01, C01.01.02, G05.09, A08, X, A05.02, C01.02, F02, A04.01.02, A04.01.01	Agricultural intensification, Sea defense or coast protection works, tidal barrages, Disposal of household or recreational facility waste, Outdoor sports and leisure activities, recreational activities, Removal of beach materials, Fences, fencing, Fertilisation, No threats or pressures, Stock feeding, Loam and clay pits, Fishing and harvesting aquatic ressources, Intensive sheep grazing, Intensive cattle grazing
000472	Broadhaven Bay SAC	Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330], Submerged or partially submerged sea caves [8330], Large shallow inlets and bays [1160], Reefs [1170], Mudflats and sandflats not covered by seawater at low tide [1140]	A02.01, E03, F01, C01.01.02, A04.01, F02.02.05, J02.02.02, J02.12, A05.02, X, E03.01	Agricultural intensification, Discharges, Marine and Freshwater Aquaculture, Removal of beach materials, Intensive grazing, Benthic dredging, Estuarine and coastal dredging, Dykes, embankments, artificial beaches, general, Stock feeding, No threats or pressures, Disposal of household or recreational facility waste

Site Code	Site Name	Qualifying Feature	Pressures Codes	Known Threats and Pressures
000476	Carrowmore Lake Complex SAC	Slender green feather-moss (Hamatocaulis vernicosus) [6216], Marsh saxifrage (Saxifraga hirculus) [1528], Blanket bogs * if active bog [7130], Depressions on peat substrates of the Rhynchosporion [7150]	A04, B01, C01.03.01, D01.01, C01.03.02, E01.03, D01.02, F02.03, I01	Grazing, Forest planting on open ground, Hand cutting of peat, Paths, tracks, cycling tracks, Mechanical removal of peat, Dispersed habitation, Roads, motorways, Leisure fishing, Invasive non-native species
000495	Duvillaun Islands SAC	Common Bottlenose Dolphin (Tursiops truncatus) [1349], Grey Seal (Halichoerus grypus) [1364]	X, D03.01.01, E01, E06.02, A04.03, F02, D02, H06.01	No threats or pressures, Slipways, Urbanised areas, human habitation, Reconstruction, renovation of buildings, Abandonment of pastoral systems lack of grazing, Fishing and harvesting aquatic ressources, Utility and service lines, Noise nuisance, noise pollution
000500	Glenamoy Bog Complex SAC	Juniperus communis formations on heaths or calcareous grasslands [5130], Depressions on peat substrates of the Rhynchosporion [7150], Slender green feather-moss (Hamatocaulis vernicosus) [6216], Petalwort (Petalophyllum ralfsii) [1395], Marsh saxifrage (Saxifraga hirculus) [1528], Northern Atlantic wet heaths with Erica tetralix [4010], Atlantic salmon (Salmo salar) [1106], Blanket bogs * if active bog [7130], Machairs * in Ireland [21A0], Transition mires and quaking bogs [7140], Vegetated sea cliffs of the Atlantic and Baltic coasts [1230], Natural dystrophic lakes and ponds [3160]	G05.01, G01, G05.09, B05, E03.01, A04.01.02, B02.02, E01.03, B01, C01.01.02, A02.01, C01.03.02, J02.12, C01.03.01, D01.02	Trampling, overuse, Outdoor sports and leisure activities, recreational activities, Fences, fencing, Use of fertilizers (forestry), Disposal of household or recreational facility waste, Intensive sheep grazing, Forestry clearance, Dispersed habitation, Forest planting on open ground, Removal of beach materials, Agricultural intensification, Mechanical removal of peat, Dykes, embankments, artificial beaches, general, Hand cutting of peat, Roads, motorways

Site Code	Site Name	Qualifying Feature	Pressures Codes	Known Threats and Pressures
000534	Owenduff/Nephin Complex SAC	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260], Juniperus communis formations on heaths or calcareous grasslands [5130], Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) [3110], Atlantic salmon (Salmo salar) [1106], Blanket bogs * if active bog [7130], Transition mires and quaking bogs [7140], Northern Atlantic wet heaths with Erica tetralix [4010], Alpine and Boreal heaths [4060], Otter (Lutra lutra) [1355], Slender green feather-moss (Hamatocaulis vernicosus) [6216], Marsh saxifrage (Saxifraga hirculus) [1528], Natural dystrophic lakes and ponds [3160]	C01.03, F02.03, F03.01, B, E01.03, X, D01.02, A04, J01, A08	Peat extraction, Leisure fishing, Hunting, Sylviculture, forestry, Dispersed habitation, No threats or pressures, Roads, motorways, Grazing, Fire and fire suppression, Fertilisation
000542	Slieve Fyagh Bog SAC	Blanket bogs * if active bog [7130]	B01, E01.03, C01.03.01, K01.01, D01.02, A04, C01.03.02	Forest planting on open ground, Dispersed habitation, Hand cutting of peat, Erosion, Roads, motorways, Grazing, Mechanical removal of peat
001497	Doogort Machair/Lough Doo SAC	Petalwort (Petalophyllum ralfsii) [1395], Machairs * in Ireland [21A0]	G02.08, G05.01, L07, G01.08, G01.03, A10, G01.02, G02, A04, C01.03, K01.01	Camping and caravans, Trampling, overuse, Storm, cyclone, Other outdoor sports and leisure activities, Motorised vehicles, Restructuring agricultural land holding, Walking, horseriding and non-motorised vehicles, Sport and leisure structures, Grazing, Peat extraction, Erosion

Site Code	Site Name	Qualifying Feature	Pressures Codes	Known Threats and Pressures
001501	Erris Head SAC	Alpine and Boreal heaths [4060], Vegetated sea cliffs of the Atlantic and Baltic Coasts [1230]	C01.03.01, A04.02.02, C01.02, D01.01, F05.05, E03.01, X, G01.02, G05.09, D05	Hand cutting of peat, Non intensive sheep grazing, Loam and clay pits, Paths, tracks, cycling tracks, Shooting, Disposal of household or recreational facility waste, No threats or pressures, Walking, horseriding and non-motorised vehicles, Fences, fencing, Improved access to site
001922	Bellacorick Bog Complex SAC	Geyer`s whorl snail (Vertigo geyeri) [1013], Depressions on peat substrates of the Rhynchosporion [7150], Alkaline fens [7230], Marsh saxifrage (Saxifraga hirculus) [1528], Northern Atlantic wet heaths with Erica tetralix [4010], Natural dystrophic lakes and ponds [3160], Blanket bogs * if active bog [7130]	A04, C01.03.02, E02, I01, D05, F03.01, E01.03, D02.01, D01.02, B01, C01.03.01	Grazing, Mechanical removal of peat, Industrial or commercial areas, Invasive non-native species, Improved access to site, Hunting, Dispersed habitation, Electricity and phone lines, Roads, motorways, Forest planting on open ground, Hand cutting of peat
001955	Croaghaun/Slievemore SAC	European dry heaths [4030], Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani) [8110], Blanket bogs * if active bog [7130], Northern Atlantic wet heaths with Erica tetralix [4010], Alpine and Boreal heaths [4060]	I01, A04, D01.01, A10, C01.03, C01.01.01, G01	Invasive non-native species, Grazing, Paths, tracks, cycling tracks, Restructuring agricultural land holding, Peat extraction, Sand and gravel quarries, Outdoor sports and leisure activities, recreational activities
002144	Newport River SAC	Atlantic salmon (Salmo salar) [1106], Freshwater pearl mussel (Margaritifera margaritifera) [1029]	B, G05.09, A08, A10, G01.01.02, C01.03, I01, F02.03, E01.03, A04	Sylviculture, forestry, Fences, fencing, Fertilisation, Restructuring agricultural land holding, Non-motorized nautical sports, Peat extraction, Invasive non-native species, Leisure fishing, Dispersed habitation, Grazing

Site Code	Site Name	Qualifying Feature	Pressures Codes	Known Threats and Pressures
002177	Lough Dahybaun SAC	Slender naiad (Najas flexilis) [1833]	X, C01.03	No threats or pressures, Peat extraction
002298	River Moy SAC	Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0], Degraded raised bogs still capable of natural regeneration [7120], Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) [6510], Otter (Lutra lutra) [1355], Sea lamprey (Petromyzon marinus) [1095], Brook lamprey (Lampetra planeri) [1096], Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0], Depressions on peat substrates of the Rhynchosporion [7150], Active raised bogs [7110], Atlantic salmon (Salmo salar) [1106], Alkaline fens [7230], White-clawed crayfish (Austropotamobius pallipes) [1092]	B01, H01.05, C01.03, F03.02, J02.04, B05, I01, D04.02, A02.01, F03.02.04, F02.03	Forest planting on open ground, Diffuse pollution to surface waters due to agricultural and forestry activities, Peat extraction, Taking and removal of animals (terrestrial), Flooding modifications, Use of fertilizers (forestry), Invasive non-native species, Aerodrome, heliport, Agricultural intensification, Predator control, Leisure fishing
002998	West Connacht Coast SAC	Bottlenose dolphin (Tursiops truncatus) [1349]	H06.01, D03.02, E03, H03, X, F02, E03.01	Noise nuisance, noise pollution, Shipping lanes, Discharges, Marine water pollution, No threats or pressures, Fishing and harvesting aquatic ressources, Disposal of household or recreational facility waste
004004	Inishkea Islands SPA	Turnstone (Arenaria interpres) [A169], Arctic tern (Sterna paradisaea) [A194], Common Gull (Larus canus) [A182], Little Tern (Sterna albifrons) [A195], Dunlin (Calidris alpina) [A149], Herring Gull (Larus argentatus) [A184], Ringed Plover (Charadrius hiaticula) [A137],	A04, G01.02, X	Grazing, Walking, horseriding and non-motorised vehicles, No threats or pressures

Site Code	Site Name	Qualifying Feature	Pressures Codes	Known Threats and Pressures
		Sanderling (Calidris alba) [A144], Barnacle goose (Branta leucopsis) [A045], Shag (Phalacrocorax aristotelis) [A018], Purple Sandpiper (Calidris maritima) [A148]		
004036	Killala Bay/Moy Estuary SPA	Dunlin (Calidris alpina) [A149], Sanderling (Calidris alba) [A144], Ringed Plover (Charadrius hiaticula) [A137], Redshank (Tringa totanus) [A162], Curlew (Numenius arquata) [A160], Wetland and Waterbirds [A999], Grey Plover (Pluvialis squatarola) [A141], Golden Plover (Pluvialis apricaria) [A140], Bar-tailed Godwit (Limosa lapponica) [A157]	G01.02, F02.03, A08, E01	Walking, horseriding and non-motorised vehicles, Leisure fishing, Fertilisation, Urbanised areas, human habitation
004037	Blacksod Bay/Broad Haven SPA	Ringed Plover (Charadrius hiaticula) [A137], Dunlin (Calidris alpina) [A149], Light-bellied Brent Goose (Branta bernicla hrota) [A046], Sandwich Tern (Sterna sandvicensis) [A191], Red-throated Diver (Gavia stellata) [A001], Common Scoter (Melanitta nigra) [A065], Wetland and Waterbirds [A999], Red-breasted Merganser (Mergus serrator) [A069], Great Northern Diver (Gavia immer) [A003], Sanderling (Calidris alba) [A144], Curlew (Numenius arquata) [A160], Bar-tailed Godwit (Limosa lapponica) [A157], Slavonian Grebe (Podiceps auritus) [A007]	F02.03.01, G01.02, E01, F01, A08, F02.03	Bait digging or collection, Walking, horseriding and non-motorised vehicles, Urbanised areas, human habitation, Marine and Freshwater Aquaculture, Fertilisation, Leisure fishing
004052	Carrowmore Lake SPA	Sandwich Tern (Sterna sandvicensis) [A191]	F02.03, K03.04, B	Leisure fishing, Predation, Sylviculture, forestry

Site Code	Site Name	Qualifying Feature	Pressures Codes	Known Threats and Pressures
004072	Stags of Broad Haven SPA	Leach's Storm-petrel (Oceanodroma leucorhoa) [A015], Storm Petrel (Hydrobates pelagicus) [A014]	X, F02	No threats or pressures, Fishing and harvesting aquatic ressources
004074	Illanmaster SPA	European storm petrel (Hydrobates pelagicus) [A014]	X	No threats or pressures
004084	Inishglora and Inishkeeragh SPA	Herring Gull (Larus argentatus) [A184], Lesser Black-backed Gull (Larus fuscus) [A183], Barnacle goose (Branta leucopsis) [A045], Cormorant (Phalacrocorax carbo) [A017], Storm Petrel (Hydrobates pelagicus) [A014], Arctic tern (Sterna paradisaea) [A194], Shag (Phalacrocorax aristotelis) [A018]	A04, G01.02	Grazing, Walking, horseriding and non-motorised vehicles
004093	Termoncarragh Lake and Annagh Machair SPA	Dunlin (Calidris alpina) [A149], Barnacle goose (Branta leucopsis) [A045], Chough (Pyrrhocorax pyrrhocorax) [A346], Greenland White-fronted Goose (Anser albifrons flavirostris) [A395], Corncrake (Crex crex) [A122], Whooper Swan (Cygnus cygnus) [A038], Wetland and Waterbirds [A999], Lapwing (Vanellus vanellus) [A142]	E01.03, D01.02, A04, A10, A08	Dispersed habitation, Roads, motorways, Grazing, Restructuring agricultural land holding, Fertilisation
004098	Owenduff/Nephin Complex SPA	Merlin (Falco columbarius) [A098], Golden Plover (Pluvialis apricaria) [A140]	B, F03.01, A04, C01.03, F02.03, A08, J01, D01.02, E01.03	Sylviculture, forestry, Hunting, Grazing, Peat extraction, Leisure fishing, Fertilisation, Fire and fire suppression, Roads, motorways, Dispersed habitation
004111	Duvillaun Islands SPA	Fulmar (Fulmarus glacialis) [A009], Barnacle goose (Branta leucopsis) [A045], Storm Petrel (Hydrobates pelagicus) [A014]	A04	Grazing

Site Code	Site Name	Qualifying Feature	Pressures Codes	Known Threats and Pressures
004227	Mullet Peninsula SPA	Corncrake (Crex crex) [A122]	A01, A04, A03, E01.02	Cultivation, Grazing, Mowing or cutting of grassland, Discontinuous urbanisation
004228	Lough Conn and Lough Cullin SPA	Common Gull (Larus canus) [A182], Greenland White-fronted Goose (Anser albifrons flavirostris) [A395], Common Scoter (Melanitta nigra) [A065], Tufted Duck (Aythya fuligula) [A061], Wetland and Waterbirds [A999]	B, A08, F02.03, I01	Sylviculture, forestry, Fertilisation, Leisure fishing, Invasive non-native species
004235	Doogort Machair SPA	Dunlin (Calidris alpina) [A149]	A04, M02, X	Grazing, Changes in biotic conditions, No threats or pressures

Further information on the Qualifying Interests of SACs that have undergone assessment

Qualifying Interests of SACs that have undergone assessment including summaries of current threats and sensitivities

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
[1013]	Geyer's Whorl Snail (Vertigo geyeri)	The main pressures facing this species are associated with abandonment of land, and both undergrazing and overgrazing by livestock.	A06, A09, A10, K04	Abandonment of grassland management (e.g. cessation of grazing or of mowing), Intensive grazing or overgrazing by livestock, Extensive grazing or undergrazing by livestock, Modification of hydrological flow	Changes to ground vegetation condition, groundwater dependent and is highly sensitive to hydrological changes.
[1029]	Freshwater Pearl Mussel (Margaritifera margaritifera)	The pressures facing this species come from a wide variety of sources (e.g. pollution from urban wastewater, development activities, farming and forestry), often quite removed from the species' habitat. Flow changes, caused by land drainage are also a significant pressure facing the species.	A26, A31, B23, B27, C05, D02, F12, F28, F31, F33	Agricultural activities generating diffuse pollution to surface or ground waters, Drainage for use as agricultural land, Forestry activities generating pollution to surface or ground waters, Modification of hydrological conditions, or physical alteration of water bodies and drainage for forestry (including dams), Peat extraction, Hydropower (dams, weirs, run-off-the-river), including infrastructure, Discharge of urban waste water (excluding storm overflows and/or urban run-offs) generating pollution to surface or ground water, Modification of flooding regimes, flood protection for residential or recreational development, Other modification of hydrological conditions for residential or recreational development, Abstraction of ground and surface waters (including marine) for public water supply and recreational use	Surface water dependent. Highly sensitive to hydrological change. Very highly sensitive to pollution.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
[1092]	White-clawed Crayfish (Austropotamobius pallipes)	The main pressures facing this species is related to the non-indigenous crayfish species (NICS) and Crayfish Plaque, a waterborne disease specific to freshwater crayfish.	I01, I05	Invasive alien species of Union concern, Plant and animal diseases, pathogens and pests	Invasive species, disease, surface water dependent. Highly sensitive to hydrological change. Very highly sensitive to pollution.
[1095]	Sea Lamprey(Petromyzon marinus)	Most of the pressures on Sea Lampreys are associated with hydropower infratructure, reduction of prey populations due to overharvesting, drainage and the use of both natural and synthetic fertilisers. Chenges in rainfall due to climate change is also consodered a significant pressure on the species.	A19, A20, A31, D02, G01, N01, N02, N03, Xo	Application of natural fertilisers on agricultural land, Application of synthetic (mineral) fertilisers on agricultural land, Drainage for use as agricultural land, Hydropower (dams, weirs, run-off-the-river), including infrastructure, Marine fishing and shellfish harvesting (professional, recreational) causing reduction of species/prey populations and disturbance of species, Temperature changes (e.g. rise of temperature & extremes) due to climate change, Increases or changes in precipitation due to climate change, Threats and pressures from outside the Member State	Marine water dependent. Low sensitivity to hydrological changes. Coastal development, trampling from recreational activity.
[1096]	Brook Lamprey (Lampetra planeri)	Most of the pressures on Brook Lampreys are associated with drainage	A19, A20, A31, B09, D02, F11,	Application of natural fertilisers on agricultural land, Application of synthetic (mineral) fertilisers on agricultural land, Drainage for use as agricultural land,	Surface water dependent. Highly sensitive to

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
		for agriculture, the use of both natural and synthetic fertilisers, tree removal. Infratructure related to hydropwer along with pollution to ground and surface water and the discharge of waste water are also considered pressures.	F12, N01, N02	Clear-cutting, removal of all trees, Hydropower (dams, weirs, run-off-the-river), including infrastructure, Pollution to surface or ground water due to urban runoffs, Discharge of urban waste water (excluding storm overflows and/or urban run-offs) generating pollution to surface or ground water, Temperature changes (e.g. rise of temperature & extremes) due to climate change	hydrological change. Availability of suitable spawning ground is a considerable issue for the species.
[1106]	Salmon (Salmo salar)	Known pressures include exploitation at sea in commercial fisheries, interceptory fisheries in coastal waters, aquaculture and predation. In addition, the negative incfluence of climate change on prey structure as well as alterations in habitat and water quality are also pressures on the species.	A25, A26, B23, D02, F12, F28, G11, G19, G20, I02, J01, K05, L06, N01	Agricultural activities generating point source pollution to surface or ground waters, Agricultural activities generating diffuse pollution to surface or ground waters, Forestry activities generating pollution to surface or ground waters, Hydropower (dams, weirs, run-off-the-river), including infrastructure, Discharge of urban waste water (excluding storm overflows and/or urban run-offs) generating pollution to surface or ground water, Modification of flooding regimes, flood protection for residential or recreational development, Illegal harvesting, collecting and taking, Other impacts from marine aquaculture, including infrastructure, Abstraction of water, flow diversion, dams and other modifications of hydrological conditions for freshwater aquaculture, Other invasive alien species (other than species of Union concern), Mixed source pollution to surface and ground waters (limnic and terrestrial),	Disease, parasites and barriers to movement.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
				Physical alteration of water bodies, Interspecific relations (competition, predation, parasitism, pathogens), Temperature changes (e.g. rise of temperature & extremes) due to climate change	
[1140]	Mudflats and sandflats not covered by seawater at low tide	Pressures on mudflats and sandflats are partly caused by pollution ffrom agricultural, forestry and wastewater sources, as well as impacts associated with marine aquaculture, particularly the Pacific oyster (Magallana gigas).	A28, F20, G16	Agricultural activities generating marine pollution, Residential or recreational activities and structures generating marine pollution (excl. marine macro- and micro- particular pollution, Marine aquaculture generating marine pollution	Surface and marine water dependent. Moderately sensitive to hydrological change. Moderate sensitivity to pollution. Changes to salinity and tidal regime. Coastal development.
[1160]	Large shallow inlets and bays	Pressures on the habitat include nutruent enrichment, dredging and invasive alien species.	A28, B23, F20, G01, G16, I02	Agricultural activities generating marine pollution, Forestry activities generating pollution to surface or ground waters, Residential or recreational activities and structures generating marine pollution (excl. marine macro- and micro- particular pollution, Marine fishing and shellfish harvesting (professional, recreational) causing reduction of species/prey populations and disturbance of species, Marine aquaculture generating marine pollution, Other invasive alien species (other than species of Union concern)	Inappropriate development, changes in turbidity, surface water runoff, discharge etc. On site management activities.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
[1170]	Reefs	The main pressures on reefs come from fishing methods that damage the seafloor.	G01, G03	Marine fishing and shellfish harvesting (professional, recreational) causing reduction of species/prey populations and disturbance of species, Marine fish and shellfish harvesting (professional, recreational) activities causing physical loss and disturbance of seafloor habitats	Sensitive to disturbance and pollution.
[1230]	Vegetated sea cliffs of the Atlantic and Baltic coasts	A number of significant pressures were indentified,including trampling by walkers, invasive non-native species, gravel extraction, and sea-level and wave exposure changes due to climate change.	C01, E01, F07, F08, I02, N03, N04	Extraction of minerals (e.g. rock, metal ores, gravel, sand, shell), Roads, paths, railroads and related infrastructure (e.g. bridges, viaducts, tunnels), Sports, tourism and leisure activities, Modification of coastline, estuary and coastal conditions for development, use and protection of residential, commercial, industrial and recreational infrastructure and areas (including sea defence or coast protection works and infrastructures), Other invasive alien species (other than species of Union concern), Increases or changes in precipitation due to climate change, Sea-level and wave exposure changes due to climate change	Land use activities such as tourism and/or agricultural practices. Direct alteration to the habitat or effects such as burning or drainage.
[1310]	Salicornia and other annuals colonising mud and sand	Pressures on salicornia mud are caused by alien species and overgrazing by livestock	A09, I02	Intensive grazing or overgrazing by livestock, Other invasive alien species (other than species of Union concern)	Marine water dependent. Medium sensitivity to hydrological change. Changes in salinity and tidal regime. Infilling, reclamation, invasive species.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
[1330]	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	The main pressures on Atlantic salt meadows are from agriculture, including ecologically unstable grazing regimes and land reclamation, and the invasive non-native species common cord-grass (Spartina anglica).	A09, A33, A36, F07, F08, I02	Intensive grazing or overgrazing by livestock, Modification of hydrological flow or physical alternation of water bodies for agriculture (excluding development and operation of dams), Agriculture activities not referred to above, Sports, tourism and leisure activities, Modification of coastline, estuary and coastal conditions for development, use and protection of residential, commercial, industrial and recreational infrastructure and areas (including sea defence or coast protection works and infrastructures), Other invasive alien species (other than species of Union concern)	Marine and groundwater dependent. Medium sensitivity to hydrological change. Changes in salinity and tidal regime. Overgrazing, erosion and accretion.
[1349]	Bottlenose Dolphin (Tursiops truncatus)	Pressures on this species in Irish waters mainly involve commercial vessel-based activities such as impacts arising from geophysical seismic exploration or from local/regional prey removal by fisheries.	C09, G01	Geotechnical surveying, Marine fishing and shellfish harvesting (professional, recreational) causing reduction of species/prey populations and disturbance of species	Large vessel movement effecting distributions. Prey availability, reduction in available habitat and water quality.
[1355]	Otter (Lutra lutra)	There are no pressures facing this species	Xxp, Xxt	No pressures, No threats	Surface and marine water dependent. Moderately sensitive to hydrological change. Sensitivity to pollution.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
[1364]	Grey Seal(Halichoerus grypus)	Pressures on this species in Irish waters mainly involve commercial vessel-based activities such as impacts arising from geophysical seismic exploration or from local/regional prey removal by fisheries or by-catch in fisheries.	C09, G01	Geotechnical surveying, Marine fishing and shellfish harvesting (professional, recreational) causing reduction of species/prey populations and disturbance of species	Prey availability, reduction in available habitat and water quality.
[1395]	Petalwort(Petalophyllum ralfsii)	There are no pressures facing this species.	Xxp, Xxt	No pressures, No threats	None identified.
[1528]	Marsh Saxifrage(Saxifraga hirculus)	Land abandonment, modification, land drainage and peat extraction are also considered pressures facing this species.	A06, A31, B27, C05	Abandonment of grassland management (e.g. cessation of grazing or of mowing), Drainage for use as agricultural land, Modification of hydrological conditions, or physical alteration of water bodies and drainage for forestry (including dams), Peat extraction	None identified.
[1833]	Slender Naiad(Najas flexilis)	The species is pressured by enrichment (eutrophication), acidification, peatland damage and the physical alteration of water bodies.	A25, A26, B23, C05, F12, F33, I02, K04, K05	Agricultural activities generating point source pollution to surface or ground waters, Agricultural activities generating diffuse pollution to surface or ground waters, Forestry activities generating pollution to surface or ground waters, Peat extraction, Discharge of urban waste water (excluding storm overflows and/or urban run-offs) generating pollution to surface or ground	Changes in management. Changes in nutrient or base status. Moderately sensitive to hydrological change.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
				water, Abstraction of ground and surface waters (including marine) for public water supply and recreational use, Other invasive alien species (other than species of Union concern), Modification of hydrological flow, Physical alteration of water bodies	
[2120]	Shifting dunes along the shoreline with white dunes(Ammophila arenaria)	Most of the pressures on marram dunes are caused by the interference on sediment dynamics due to recreation and coastal defences.	E01, E03, F01, F06, F07, F08, I02, L01	Roads, paths, railroads and related infrastructure (e.g. bridges, viaducts, tunnels), Shipping lanes, ferry lanes and anchorage infrastructure (e.g. canalisation, dredging), Conversion from other land uses to housing, settlement or recreational areas (excluding drainage and modification of coastline, estuary and coastal conditions), Development and maintenance of beach areas for tourism and recreation incl. beach nourishment and beach cleaning, Sports, tourism and leisure activities, Modification of coastline, estuary and coastal conditions for development, use and protection of residential, commercial, industrial and recreational infrastructure and areas (including sea defence or coast protection works and infrastructures), Other invasive alien species (other than species of Union concern), Abiotic natural processes (e.g. erosion, silting up, drying out, submersion, salinization)	Overgrazing, and erosion. Changes in management.
[2130]	Fixed coastal dunes with herbaceous vegetation (grey dunes)	Pressures on fixed dunes are associated with recreation and	A02, A09, A10, F07, F08, I02, L02	Conversion from one type of agricultural land use to another (excluding drainage and burning), Intensive grazing or overgrazing by livestock, Extensive grazing or undergrazing by livestock, Sports, tourism and leisure	Overgrazing, and erosion. Changes in management.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
		ecologically unsuitable grazing practices.		activities, Modification of coastline, estuary and coastal conditions for development, use and protection of residential, commercial, industrial and recreational infrastructure and areas (including sea defence or coast protection works and infrastructures), Other invasive alien species (other than species of Union concern), Natural succession resulting in species composition change (other than by direct changes of agricultural or forestry practices)	
[2150]	Atlantic decalcified fixed dunes (Calluno-Ulicetea)	The majority of pressures of this habitat are due to land abandonment, recreational activities and also bracken encroachment.	A06, F07, I04	Abandonment of grassland management (e.g. cessation of grazing or of mowing), Sports, tourism and leisure activities, Problematic native species	Overgrazing, and erosion. Changes in management.
[21A0]	Machairs (* in Ireland)	Pressures on the habitat include ecologically unsuitable grazing regimes and disturbance.	A02, A09, A10, A20, A30, F01, F07, L01	Conversion from one type of agricultural land use to another (excluding drainage and burning), Intensive grazing or overgrazing by livestock, Extensive grazing or undergrazing by livestock, Application of synthetic (mineral) fertilisers on agricultural land, Active abstractions from groundwater, surface water or mixed water for agriculture, Conversion from other land uses to housing, settlement or recreational areas (excluding drainage and modification of coastline, estuary and coastal conditions), Sports, tourism and leisure	Overgrazing, and erosion. Changes in management. Mismanaged recreational activity.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
				activities, Abiotic natural processes (e.g. erosion, silting up, drying out, submersion, salinization)	
[3110]	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)	This habitat is under significant pressure from eutrophication, and from drainage and other damage to peatland. Damage to peatland can result in hydrological chnages in lakes, increased organic matter, water colour and turbidity, changes in sediment characteristics, acidification and enrichment.	A26, A31, B23, B27, C05, F12	Agricultural activities generating diffuse pollution to surface or ground waters, Drainage for use as agricultural land, Forestry activities generating pollution to surface or ground waters, Modification of hydrological conditions, or physical alteration of water bodies and drainage for forestry (including dams), Peat extraction, Discharge of urban waste water (excluding storm overflows and/or urban run-offs) generating pollution to surface or ground water	Surface and groundwater dependant. Highly sensitive to hydrological changes. Highly sensitive to pollution.
[3150]	Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation	Most of the pressures on this habitat are as a result of pollution from agriculture, forestery activities and wastewater.	A25, A26, B23, C05, F11, F12, F13, K04, K05	Agricultural activities generating point source pollution to surface or ground waters, Agricultural activities generating diffuse pollution to surface or ground waters, Forestry activities generating pollution to surface or ground waters, Peat extraction, Pollution to surface or ground water due to urban runoffs, Discharge of urban waste water (excluding storm overflows and/or urban run-offs) generating pollution to surface or ground water, Plants, contaminated or abandoned industrial sites generating pollution to surface or ground water,	Surface and groundwater dependant. Highly sensitive to hydrological changes. Highly sensitive to pollution.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
				Modification of hydrological flow, Physical alteration of water bodies	
[3160]	Natural dystrophic lakes and ponds	The pressures on this habitat are associated with pollution from agricultural and forestry activities and also from drainage.	A26, A31, B23, B27, C05, D08	Agricultural activities generating diffuse pollution to surface or ground waters, Drainage for use as agricultural land, Forestry activities generating pollution to surface or ground waters, Modification of hydrological conditions, or physical alteration of water bodies and drainage for forestry (including dams), Peat extraction, Energy production and transmission activities generating pollution to surface or ground waters	Surface and groundwater dependant. Highly sensitive to hydrological changes. Highly sensitive to pollution
[3260]	Water courses of plain to montane levels with vegetation(Ranunculion fluitantis and Callitricho-Batrachion)	The majority of pressures on this habitat are caused by damage through hydrological and morphological change, eutrophicaton and other water pollution.	A25, A26, B23, C05, F11, F12, F13, K01, K04, K05	Agricultural activities generating point source pollution to surface or ground waters, Agricultural activities generating diffuse pollution to surface or ground waters, Forestry activities generating pollution to surface or ground waters, Peat extraction, Pollution to surface or ground water due to urban runoffs, Discharge of urban waste water (excluding storm overflows and/or urban run-offs) generating pollution to surface or ground water, Plants, contaminated or abandoned industrial sites generating pollution to surface or ground water, Abstraction from groundwater, surface water or mixed water, Modification of hydrological flow, Physical alteration of water bodies	Surface water dependent Highly sensitive to hydrological change and direct physical interactions.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
[4010]	Northern Atlantic wet heaths with Erica tetralix	Overgrazing,burning, wind farm development and erosion are the main pressures associated with this habitat, along with nitrogen deposition from agricultural activities that generate air pollution.	A09, A11, A27, B01, D01, L01, N01, N02	Intensive grazing or overgrazing by livestock, Burning for agriculture, Agricultural activities generating air pollution, Conversion to forest from other land uses, or afforestation (excluding drainage), Wind, wave and tidal power, including infrastructure, Abiotic natural processes (e.g. erosion, silting up, drying out, submersion, salinization), Temperature changes (e.g. rise of temperature & extremes) due to climate change	Surface and groundwater dependent. Highly sensitive to hydrological changes. Inappropriate management.
[4030]	European dry heaths	A number of significant pressures were recorded for this habitat in the current reporting period, particularlty overgrazing by sheep and burning for agriculture with afforestation and wind farms also being recognised as pressures.	A09, A11, B01, D01, N01, N02	Intensive grazing or overgrazing by livestock, Burning for agriculture, Conversion to forest from other land uses, or afforestation (excluding drainage), Wind, wave and tidal power, including infrastructure, Temperature changes (e.g. rise of temperature & extremes) due to climate change	Moderately sensitive to hydrological change. Changes in management. Changes in nutrient status.
[4060]	Alpine and Boreal heaths	Overgrazing by livestock, tourism (hill walking) and agricultural activities that cause air pollution are considered significant pressures for this habitat.	A09, A27, F07, N01, N02	Intensive grazing or overgrazing by livestock, Agricultural activities generating air pollution, Sports, tourism and leisure activities, Temperature changes (e.g. rise of temperature & extremes) due to climate change	Changes in management. Changes in nutrient or base status. Moderately sensitive to hydrological change.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
[5130]	Juniperus communis formations on heaths or calcareous grasslands	The pressures associated with this habitat are associated with overgrazing, eroision and scrub removal.	Xxp, Xxt	No pressures, No threats	Changes in management such as grazing regime. Changes in nutrient or base status. Changes to vegetation composition. Introduction of alien species.
[6510]	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	The main pressures associated with this habitat are due to agricultural intensification (fertiliser application) and changes in agricultural practices.	A02, A06, A14, A19, A20	Conversion from one type of agricultural land use to another (excluding drainage and burning), Abandonment of grassland management (e.g. cessation of grazing or of mowing), Livestock farming (without grazing), Application of natural fertilisers on agricultural land, Application of synthetic (mineral) fertilisers on agricultural land	Changes in management such as grazing regime. Changes in nutrient or base status. Changes to vegetation composition. Introduction of alien species.
[7110]	Active raised bogs	The main pressures on active raised bog are peat extraction, drainage, afforestation and burning.	A11, B01, C05, K02, N01	Burning for agriculture, Conversion to forest from other land uses, or afforestation (excluding drainage), Peat extraction, Drainage, Temperature changes (e.g. rise of temperature & extremes) due to climate change	Surface water interactions. Groundwater isolated system with sensitivities related to the bog basin. Drainage and land use

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
					management are the key things.
[7120]	Degraded raised bogs still capable of natural regeneration	The main pressure on degarded bogs come from peat extraction, drainage, afforestation and burning.	A11, B01, C05, K02, N01	Burning for agriculture, Conversion to forest from other land uses, or afforestation (excluding drainage), Peat extraction, Drainage, Temperature changes (e.g. rise of temperature & extremes) due to climate change	Surface water interactions. Groundwater isolated system with sensitivities related to the bog basin. Drainage and land use management are the key things.
[7130]	Blanket bogs (* if active bog)	The main pressures on blanket bogs are overgrazing, burning, afforestation, peat extraction, and agricultural activities causing nitrogen deposition. Erosion, drainage and wind farm construction are also pressures relating to this habitat.	A09, A11, A27, B01, C05, D01, K02, L01, N01, N02	Intensive grazing or overgrazing by livestock, Burning for agriculture, Agricultural activities generating air pollution, Conversion to forest from other land uses, or afforestation (excluding drainage), Peat extraction, Wind, wave and tidal power, including infrastructure, Drainage, Abiotic natural processes (e.g. erosion, silting up, drying out, submersion, salinization), Temperature changes (e.g. rise of temperature & extremes) due to climate change	Surface water interactions. Drainage and land use management are the key things.
[7140]	Transition mires and quaking bogs	The main pressures facing transition mires in	A06, A09, B01, C05,	Abandonment of grassland management (e.g. cessation of grazing or of mowing), Intensive grazing or	Surface water interactions.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
		Ireland are afforestation, water pollution, drainage and hydrological changes woth grazing/agricultural management also being a pressure.	J01, K01, K02, K04, L02	overgrazing by livestock, Conversion to forest from other land uses, or afforestation (excluding drainage), Peat extraction, Mixed source pollution to surface and ground waters (limnic and terrestrial), Abstraction from groundwater, surface water or mixed water, Drainage, Modification of hydrological flow, Natural succession resulting in species composition change (other than by direct changes of agricultural or forestry practices)	Groundwater isolated system with sensitivities related to the bog basin. Drainage and land use management are the key things.
[7150]	Depressions on peat substrates of the Rhynchosporion	The main pressures on the habitat are associated with impacts on the supporting bog habitats, especially overgrazing, burning, peat extraction, drainage and conversion to forestry.	A09, A11, B01, C05, K02, N01	Intensive grazing or overgrazing by livestock, Burning for agriculture, Conversion to forest from other land uses, or afforestation (excluding drainage), Peat extraction, Drainage, Temperature changes (e.g. rise of temperature & extremes) due to climate change	Surface and ground water interactions. Drainage and land use management are the key things.
[7230]	Alkaline fens	The main pressures facing this habitat are land abandonment (and associated succession), overgrazing, drainage and pollution.	A06, A09, A26, J01, K01, K02, K04, L02, N02, N03	Abandonment of grassland management (e.g. cessation of grazing or of mowing), Intensive grazing or overgrazing by livestock, Agricultural activities generating diffuse pollution to surface or ground waters, Mixed source pollution to surface and ground waters (limnic and terrestrial), Abstraction from groundwater, surface water or mixed water, Drainage, Modification of hydrological flow, Natural succession resulting in species composition change (other than by direct changes of	Surface and groundwater dependent. Highly sensitive to hydrological changes. Inappropriate management.

EU Code	Qualifying Interests	Article 17 Report Summary - Threats and Pressures	Threats and Pressures Codes	Known Threats and Pressures	Sensitivity of Qualifying Interests
				agricultural or forestry practices), Temperature changes (e.g. rise of temperature & extremes) due to climate change, Increases or changes in precipitation due to climate change	
[8110]	Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani)	The main pressures on siliceous scree come from overgrazing, undergrazing and succession.	A09, A10, L02	Intensive grazing or overgrazing by livestock, Extensive grazing or undergrazing by livestock, Natural succession resulting in species composition change (other than by direct changes of agricultural or forestry practices)	Erosion, overgrazing and recreation.
[8330]	Submerged or partially submerged sea caves	There are no pressures facing this habitat.	Xxp, Xxt	No pressures, No threats	There are no pressures acting on this resource.
[91A0]	Old sessile oak woods with Ilex and Blechnum in the British Isles	The significant pressure facinng this habitat are associated with invasive non-native species such as Rhododendron ponticum, cherry laurel (Prunus laurocerasus) and beech (Fagus sylvatica) and overgrazing by deer.	A09, B09, I02, I04, M07	Intensive grazing or overgrazing by livestock, Clear-cutting, removal of all trees, Other invasive alien species (other than species of Union concern), Problematic native species, Storm, cyclone	Changes in management. Changes in nutrient or base status. Introduction of alien species.

Further information on the Special Conservation Interests of SPAs that have undergone assessment

Special Conservation Interests and Vulnerabilities of SPAs that have undergone assessment

Species Code	Common Name	Scientific Name	Threats and Pressures Codes	Known Threats and Pressures
A003	Great northern diver	*Gavia immer*	C03, F02, G01, H03	Renewable abiotic energy use, Fishing and harvesting aquatic ressources, Outdoor sports and leisure activities, recreational activities, Marine water pollution
A009	Northern Fulmar	*Fulmarus glacialis*	C03, F02	Renewable abiotic energy use, Fishing and harvesting aquatic ressources
A015	Leach's Storm Petrel	*Oceanodroma leucorhoa*	C03, I01	Renewable abiotic energy use, Invasive non-native species
A061	Tufted Duck	*Aythya fuligula*	C03, F03, G01, H01, H07, M02	Renewable abiotic energy use, Hunting and collection of wild animals (terrestrial), Outdoor sports and leisure activities, recreational activities, Pollution to surface waters (limnic & terrestrial, marine & brackish), Other forms of pollution, Changes in biotic conditions
A069	Red-Breasted Merganser	*Mergus serrator*	C03, F01, F02, G01, H03	Renewable abiotic energy use, Marine and Freshwater Aquaculture, Fishing and harvesting aquatic ressources, Outdoor sports and leisure activities, recreational activities, Marine water pollution
A098	Merlin	*Falco columbarius*	A02, B01, B02, C03, M02	Modification of cultivation practices, Forest planting on open ground, Forest and Plantation management & use, Renewable abiotic energy use, Changes in biotic conditions
A122	Corn Crake	*Crex crex*	A03.01, A04.01, K03.04, M01.03	Intensive Mowing or intensification, Intensive grazing, Predation, Flooding and rising precipitations

Species Code	Common Name	Scientific Name	Threats and Pressures Codes	Known Threats and Pressures
A137	Common Ringed Plover	*Charadrius hiaticula*	C03, F01, F02, G01, H03, J02, J03, M01	Renewable abiotic energy use, Marine and Freshwater Aquaculture, Fishing and harvesting aquatic ressources, Outdoor sports and leisure activities, recreational activities, Marine water pollution, Human induced changes in hydraulic conditions, Other Ecosystem Modifications, Changes in abiotic conditions
A140	European Golden Plover	*Pluvialis apricaria*	A02, A04, B01, C01, C03, F01, G01, H03, J01, K03, M02	Modification of cultivation practices, Grazing, Forest planting on open ground, Mining and quarrying, Renewable abiotic energy use, Marine and Freshwater Aquaculture, Outdoor sports and leisure activities, recreational activities, Marine water pollution, Fire and Fire suppression, Interspecific faunal relations, Changes in biotic conditions
A141	Grey Plover	*Pluvialis squatarola*	C03, F01, F02, G01, H03, J02, J03, M01	Renewable abiotic energy use, Marine and Freshwater Aquaculture, Fishing and harvesting aquatic ressources, Outdoor sports and leisure activities, recreational activities, Marine water pollution, Human induced changes in hydraulic conditions, Other Ecosystem Modifications, Changes in abiotic conditions
A142	Northern Lapwing	*Vanellus vanellus*	A02, C03, F01, G01, H03	Modification of cultivation practices, Renewable abiotic energy use, Marine and Freshwater Aquaculture, Outdoor sports and leisure activities, recreational activities, Marine water pollution
A144	Sanderling	*Calidris alba*	C03, F01, G01, H03, M01	Renewable abiotic energy use, Marine and Freshwater Aquaculture, Outdoor sports and leisure activities, recreational activities, Marine water pollution, Changes in abiotic conditions
A149	Dunlin	*Calidris alpina*	C03, F01, F02, G01, H03, J02, J03, M01	Renewable abiotic energy use, Marine and Freshwater Aquaculture, Fishing and harvesting aquatic ressources, Outdoor sports and leisure activities, recreational activities, Marine water pollution, Human induced

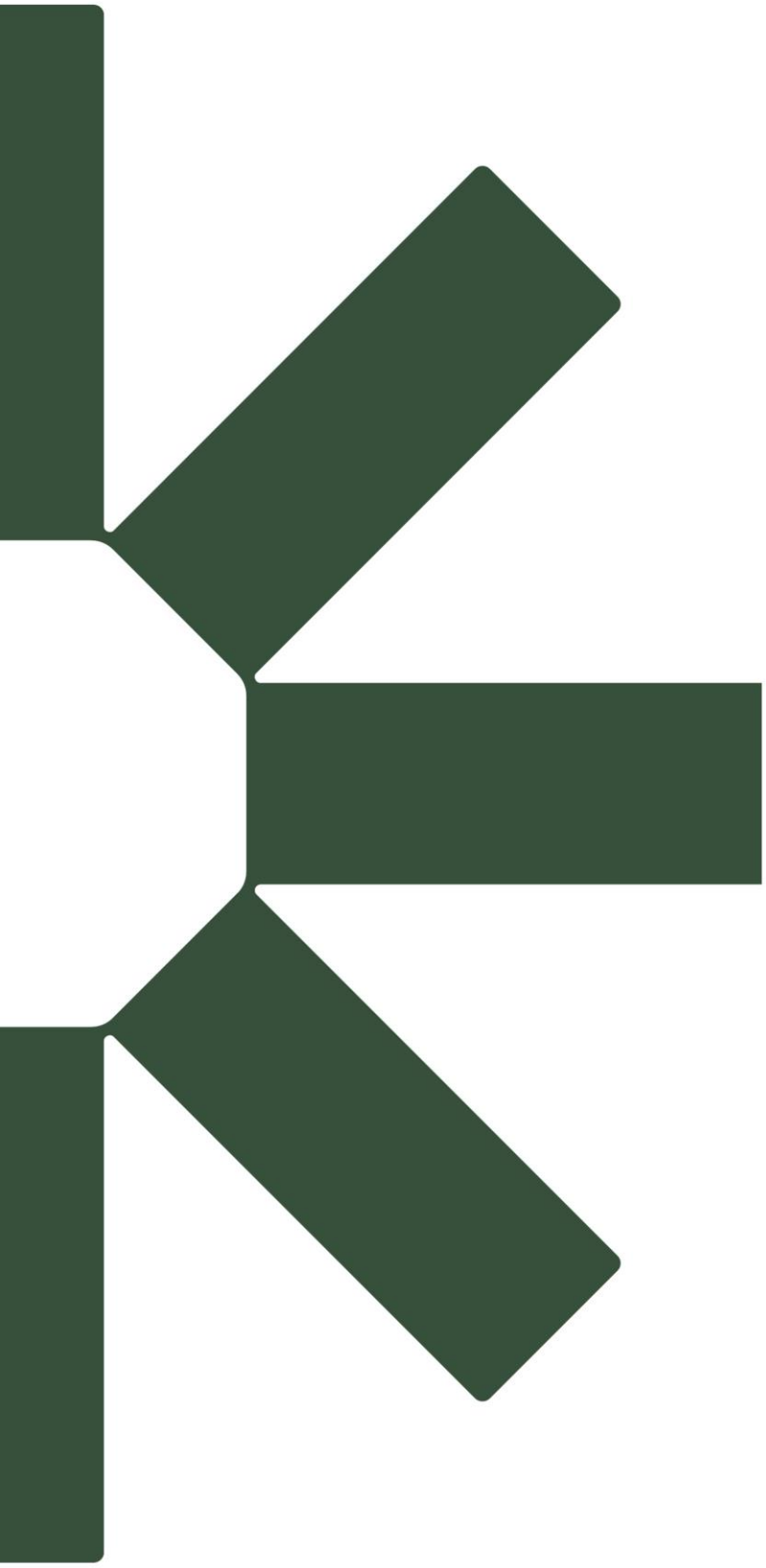
Species Code	Common Name	Scientific Name	Threats and Pressures Codes	Known Threats and Pressures
				changes in hydraulic conditions, Other Ecosystem Modifications, Changes in abiotic conditions
A157	Bar-Tailed Godwit	*Limosa lapponica*	C03, F01, F02, G01, H03, J02, J03, M01	Renewable abiotic energy use, Marine and Freshwater Aquaculture, Fishing and harvesting aquatic ressources, Outdoor sports and leisure activities, recreational activities, Marine water pollution, Human induced changes in hydraulic conditions, Other Ecosystem Modifications, Changes in abiotic conditions
A162	Common Redhank	*Tringa totanus*	C03, F01, F02, G01, H03, J02, J03, M01	Renewable abiotic energy use, Marine and Freshwater Aquaculture, Fishing and harvesting aquatic ressources, Outdoor sports and leisure activities, recreational activities, Marine water pollution, Human induced changes in hydraulic conditions, Other Ecosystem Modifications, Changes in abiotic conditions
A169	Ruddy Turnstone	*Arenaria interpres*	C03, F01, G01, H03, J03, M01	Renewable abiotic energy use, Marine and Freshwater Aquaculture, Outdoor sports and leisure activities, recreational activities, Marine water pollution, Other Ecosystem Modifications, Changes in abiotic conditions
A182	Common Gull	*Larus canus*	A04, C03, F02, H03, J03, M01	Grazing, Renewable abiotic energy use, Fishing and harvesting aquatic ressources, Marine water pollution, Other Ecosystem Modifications, Changes in abiotic conditions
A184	European Herring Gull	*Larus argentatus*	C03, F02, H03, J03	Renewable abiotic energy use, Fishing and harvesting aquatic ressources, Marine water pollution, Other Ecosystem Modifications
A191	Sandwich Tern	*Sterna sandvicensis*	C03, I01	Renewable abiotic energy use, Invasive non-native species

Species Code	Common Name	Scientific Name	Threats and Pressures Codes	Known Threats and Pressures
A194	Arctic Tern	*Sterna paradisaea*	C03, D01, G01, I01, M01	Renewable abiotic energy use, Roads, paths and railroads, Outdoor sports and leisure activities, recreational activities, Invasive non-native species, Changes in abiotic conditions
A346	Red-Billed Chough	*Pyrrhocorax pyrrhocorax*	A02, A04, E06, G01	Modification of cultivation practices, Grazing, Other urbanisation, industrial and similar activities, Outdoor sports and leisure activities, recreational activities
A395	Greater White-Fronted Goose	*Anser albifrons flavirostris*	A02, A04, A06, A11, B01, C03, D02, D05, F01, F03, G01, H03, H07, K03, M01, M02	Modification of cultivation practices, Grazing, Annual and perennial non-timber crops, Agriculture activities not referred to above, Forest planting on open ground, Renewable abiotic energy use, Utility and service lines, Improved access to site, Marine and Freshwater Aquaculture, Hunting and collection of wild animals (terrestrial), Outdoor sports and leisure activities, recreational activities, Marine water pollution, Other forms of pollution, Interspecific faunal relations, Changes in abiotic conditions, Changes in biotic conditions

Conservation objectives that have been considered by the assessment are included in the following NPWS/Department of Culture, Heritage and the Gaeltacht documents

- NPWS (2019) Conservation Objectives for Bellacorick Iron Flush SAC [IE0000466] Version 1.
- NPWS (2014) Conservation Objectives for Mullet/Blacksod Bay Complex SAC [IE0000470] Version 1.
- NPWS (2014) Conservation Objectives for Broadhaven Bay SAC [IE0000472] Version 1.
- NPWS (2017) Conservation Objectives for Carrowmore Lake Complex SAC [IE0000476] Version 1.
- NPWS (2013) Conservation Objectives for Duvillaun Islands SAC [IE0000495] Version 1.
- NPWS (2017) Conservation Objectives for Glenamoy Bog Complex SAC [IE0000500] Version 1.
- NPWS (2017) Conservation Objectives for Owenduff/Nephin Complex SAC [IE0000534] Version 1.
- NPWS (2016) Conservation Objectives for Slieve Fyagh Bog SAC [IE0000542] Version 1.
- NPWS (2017) Conservation Objectives for Doogort Machair/Lough Doo SAC [IE0001497] Version 1.
- NPWS (2016) Conservation Objectives for Erris Head SAC [IE0001501] Version 1.
- NPWS (2017) Conservation Objectives for Bellacorick Bog Complex SAC [IE0001922] Version 1.
- NPWS (2021) Conservation Objectives for Croaghaun/Slievemore SAC [IE0001955] Version 1.
- NPWS (2019) Conservation Objectives for Newport River SAC [IE0002144] Version 1.
- NPWS (2021) Conservation Objectives for Lough Dahybaun SAC [IE0002177] Version 1.
- NPWS (2016) Conservation Objectives for River Moy SAC [IE0002298] Version 1.
- NPWS (2015) Conservation Objectives for West Connacht Coast SAC [IE0002998] Version 1.
- NPWS (2022) Generic Conservation Objectives for Inishkea Islands SPA [IE0004004] Version 9.
- NPWS (2013) Conservation Objectives for Killala Bay/Moy Estuary SPA [IE0004036] Version 1.
- NPWS (2014) Conservation Objectives for Blacksod Bay/Broad Haven SPA [IE0004037] Version 1.
- NPWS (2022) Generic Conservation Objectives for Carrowmore Lake SPA [IE0004052] Version 9.
- NPWS (2022) Generic Conservation Objectives for Stags of Broad Haven SPA [IE0004072] Version 9.

- NPWS (2022) Generic Conservation Objectives for Illanmaster SPA [IE0004074] Version 9.
- NPWS (2022) Generic Conservation Objectives for Inishglora and Inishkeeragh SPA [IE0004084] Version 9.
- NPWS (2022) Generic Conservation Objectives for Termoncarragh Lake and Annagh Machair SPA [IE0004093] Version 9.
- NPWS (2022) Generic Conservation Objectives for Owenduff/Nephin Complex SPA [IE0004098] Version 9.
- NPWS (2022) Generic Conservation Objectives for Duvillaun Islands SPA [IE0004111] Version 9.
- NPWS (2022) Generic Conservation Objectives for Mullet Peninsula SPA [IE0004227] Version 9.
- NPWS (2022) Generic Conservation Objectives for Lough Conn and Lough Cullin SPA [IE0004228] Version 9.
- NPWS (2022) Generic Conservation Objectives for Doogort Machair SPA [IE0004235] Version 9.



Making Sustainability Happen

Appendix 7 Peatland Restoration Plan

AA Screening and Natura Impact Statement

Muingmore Wind Farm

RWE Renewables Ireland Limited

SLR Project No.: 501.065301.00001

Peatland Restoration Plan

RWE Renewables Ireland Limited

Prepared by: Ida Bailey

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SLR Project No.: 501.065301.00001

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Revision: 2

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01	27 February 2026	Ida Bailey	Andrew Torsney	Richard Arnold
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	Click to enter a date.			
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	Click to enter a date.			

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Executive Summary

The Muingmore Wind Farm Peatland Restoration Plan (PRP) and Habitat Management Plan (HMP – Appendix A) sets out a strategy to achieve a net-zero position for biodiversity and carbon impacts associated with the Proposed Development. The plans align with Irish, EU, and local policy frameworks, including the EU Nature Restoration Law (2024) and the National Peatland Strategy.

Purpose and Scope

The PRP report addresses the ecological and carbon implications of peatland habitats on-site, which include blanket bog (PB3), cutover bog (PB4), scrub (WS1) and Conifer Plantation (WD4) on deep peat. It is important to note that all PB3 and PB4 habitats align with the criteria for Annex I Blanket Bog [7130] – none of which was identified to be active/peat forming and therefore it is not priority status. Given the high carbon storage potential of peat soils, the Proposed Development aims to offset habitat loss and carbon emissions through extensive restoration by rewetting of previously drained and cutover bog habitats. The plan follows four key steps:

- Quantify biodiversity loss and restoration needs through detailed habitat surveys and metrics.
    - Assess carbon balance, including sequestration potential and re-use of excavated peat.
    - Determine restoration feasibility considering hydrology, infrastructure, and ecological constraints.
    - Define restoration areas and management actions in a Habitat Management Plan (HMP).

Key Findings

- Habitat Loss: 30 ha of Annex I blanket bog will be directly or indirectly affected by construction.
- Restoration Requirement: Current plans target ~200 ha, delivering 1:6 compensation (by restoration) ratio, resulting in an overall enhancement of biodiversity.
- Carbon Benefits: Reuse of excavated peat in bog restoration will mitigate the extent of CO_2e emissions released due to the Proposed Project via peat excavation by approximately c. 119.9 tCO_2e overall.
- Feasibility: Restoration of blanket bog is technically viable across most open ground and key-holed forestry areas, using ditch blocking, ground smoothing, scrub clearance, and hag / cutting-face re-profiling.
- Biodiversity Net Gain (BNG) Outcome: Application of the Scottish and Southern Energy (SSE) Biodiversity Metric[1] (see Section 3.4.2.3) indicates that considering all habitat losses and gains, a 32% net gain will be achieved overall, with additional gains for irreplaceable habitats.

[1] https://www.sserenewables.com/sustainability/nature-positive/

HMP

The HMP has the following Goals, and provides implementation and monitoring plans for the protection and restoration of nature and biodiversity on site in line with the mitigation measures set out in Chapter 5 of EIAR and PRP:

1. Minimise, as far as practicable, the removal of peat and bog vegetation from site during construction.
2. Compared to baseline, enhance the condition of peatlands outside afforested areas via restoration for the benefit of associated biodiversity, carbon storage and sequestration, and water management.
3. Eradicate, as far as practicable, invasive alien plant species from the site.
4. Maintain populations of breeding birds and bats, relative to natural variation.
5. Restore the over-run areas 1 and 2 to baseline or better habitat condition following the removal of temporary infrastructure.

The HMP is a live document that will be revised post planning consent to incorporate any relevant planning conditions to facilitate adaptive management of habitat restoration and enhancement work.

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Appendices

Appendix A **A. Habitat Management Plan**

Appendix B **B. Additional Figures**

1.0 Introduction

The purpose of this report is to set out a Peatland Restoration (PRP) and Habitat Management Plan (HMP) that robustly demonstrates how the Proposed Project – as defined in **Chapter 2** of the associated EIAR, can achieve a net-zero position in terms of biodiversity in line with relevant policy and guidance. Net-zero in this context is linked to the impacts identified in **Chapter 5** of the EIAR which identifies the loss of degraded habitat such as cutover bogs (PB4) and lowland blanket bog (PB3) which aligns with Annex I Blanket bog in unfavourable condition and the requirement to restore similarly degraded habitats to a higher ecological condition and favourable conservation status.

This plan covers:

- The Proposed Development Site including:
    - The Main Wind Farm Development Site: part of the Proposed Development Site which includes the proposed wind turbines and associated infrastructure.
    - Three over-run areas along the turbine delivery route (TDR) to the Proposed Development Site, and
    - The Habitat Enhancement Area in the NWQ (HEA), a small separate triangular area to the northwest of the Main Wind Farm Development Site, which will not include any infrastructure related to the Proposed Project other than that to enhance habitat.

Muingmore Wind Farm is a proposed 13 turbine wind farm and associated infrastructure in Ireland (the Proposed Development). All elements are described in **Chapter 2** of this EIAR.

Based on habitat surveys completed, the dominant habitats on the Main Wind Farm Development Site are peatlands including areas planted with conifer plantation and blanket bog. Bog is predominantly degraded blanket bog with priority lowland blanket bog largely limited to the HEA. Other habitats include wet grassland and scrub.

The wider area surrounding the Main Wind Farm Development Site is a mix of blanket bog and degraded (drained) blanket bog which provides largely uninterrupted habitat connectivity to the Wild Nephin National Park, the exceptions are roads and watercourses.

Key terminology includes avoidance, mitigation, compensation and enhancement, these are defined as set out in CIEEM's Key Principals of EcIA[2]:

- Avoidance: Seek options that avoid harm to ecological features (for example, by locating on an alternative site).
- Mitigation Negative effects should be avoided or minimised through mitigation measures, either through the design of the project or subsequent measures that can be guaranteed – for example, through a condition or planning obligation.
- Compensation[3] Where there are significant residual negative ecological effects despite the mitigation proposed, these should be offset by appropriate compensatory measures.
- Enhancement Seek to provide net benefits for biodiversity over and above requirements for avoidance, mitigation or compensation.

[2] https://cieem.net/wp-content/uploads/2018/08/EcIA-Guidelines-v1.3-Sept-2024.pdf

[3] In this context compensation does not relate to compensation for the purposes of article 6 (4) of the Habitats Directive.

1.1 The Carbon Implications of Bog Habitats on Site

Peat is a carbon store and blankets the majority of the Main Wind Farm Development Site at >50cm depth. Even a thin peat layer of 30cm has a carbon store equivalent to tropical rainforest ha/ha [4], and the 2006 IPPC guidance for National Greenhouse Gas Inventories considers organic soils (including peatlands) with a depth of >10cm. As the majority of the Main Wind Farm Development Site is peatland, it therefore contains significant stores of carbon.

As it stands, available national statistics suggest that near natural bog should remove 3.54tCO_2e per hectare from the atmosphere per year. However, as the bog on the Main Wind Farm Development Site is mostly drained (Figure 6) it could be a carbon source. Drained peat and peat planted with commercial forestry are often carbon sources as they dry the peat compared to its natural saturated state permitting oxidation of the stored carbon. Areas of priority Annex 1 bog, particularly those parts in good condition, where no peat extraction has been undertaken such as parts of the HEA may however be carbon sinks.

The construction of the Proposed Development will require some drainage and displacement of peat and peatland including blanket bog.

Therefore, in terms of land use change (not taking into account the carbon benefit of displacing fossil fuel electrical generation with wind), the Proposed Development would likely generate an increase in net greenhouse gas emissions, if it damages bog further, or a net sink, if bog condition is improved enough for peat forming to begin again as is planned via the PRP (see Section 3.5 for more details).

1.2 Level of Ambition

The Proposed Project will focus on peatland restoration in non-afforested areas. In summary, this involves considering restoration of all degraded/ drained peatland within the Main Wind Farm Development Site and HEA that is not currently under conifer plantation.

1.3 Scope

This peatland restoration study is split into four steps:

- **Step 1**: Determine the area of bog restoration required for compensation in terms of biodiversity (to reach at least no net loss for biodiversity), and therefore the potential for enhancement (net biodiversity gain) via restoration of additional areas; and detailed habitat surveys.
- **Step 1a:** Detailed habitat surveys.
- **Step 1b:** Calculation of biodiversity loss.
- **Step 1c:** Calculation of the area of peatland restoration required for biodiversity compensation and enhancement incl. which areas of the Main Wind Farm Development Site will be prioritised for this.
- **Step 2**: Accounting for carbon sequestration and storage by restored bog and re-use of excavated peat.
- **Step 3**: Determine the total area of bog that it is feasible to restore (re-wet) within the open ground on the Main Wind Farm Development Site and HEA, taking into account constraints such as infrastructure and ecological sensitivities.

[4] ICUN Peatland Programme. 2020. Position statement: Peatland and trees: https://www.iucn-uk-peatlandprogramme.org/sites/default/files/header-images/Resources/IUCN%20UK%20PP%20Peatlands%20and%20trees%20position%20statement%202020.pdf

- **Step 4**: Define the area of bog to be restored and provide an associated Habitat Management Plan (HMP).

The methodology and results for these steps are set out in the following Sections.

1.4 Relevant Policy and Legislation

The following policy and legislation is relevant to this report, particularly in relation to biodiversity, Annex 1 habitats, and peatland re-wetting and restoration.

- EU Habitats Directive (Council Directive 92/43/EEC), which aims to ensure the conservation of biodiversity across Europe by safeguarding natural habitats and species, in particular Annex I habitats (as amended).
- The EIA Directive (2011/92/EU) in relation to projects that might significantly affect the environment, including impacts on Annex I habitats (as amended).
- Ireland's national peatland strategy was published in 2015[25].
- The Mayo County Development Plan 2022-2028.
- The EU Nature Restoration Law[31] - approved in June 2024 and has requirements in relation to peat re-wetting.
- Project Ireland 2040: National Planning Framework (First revision – April 2025)[5].

1.5 The Project Team - Statement of Authority

This report was prepared by Ida Bailey, with support from SLR's wider biodiversity, hydrogeology, carbon and GIS teams. Qualifications and experience for key team members are provided below:

1.5.1.1 Ida Bailey, PhD, ACIEEM, CERPIT (Natural Capital)

Ida leads SLR's Nature and Natural Capital team in Europe. She has a PhD., and B.Sc. in biodiversity and natural sciences related fields. She is an Associate member of CIEEM, a certified ecological restoration practitioner in training (CERPIT) with the Society for Ecological Restoration and sits on the panel of academic specialist for the Biodiversity Futures Initiative. She has over 17 years of ecological consultancy and research experience both in the UK and overseas and specialises in innovative, multidisciplinary ecological restoration, nature positive, bio-credit and natural capital projects.

1.5.1.2 Andrew Torsney PhD, MRes, BSc. (Habitats and Ecology)

Andrew is a Technical Director in SLR's Ecology and Biodiversity technical discipline and manages the Irish Ecology team. Andrew has over 12 years' experience within the ecology and environmental sector. He has managed and undertaken ecological assessments at a range of scales including detailed Annex I habitat surveys. Andrew has also conducted research on the implications of habitat classification regarding conservation outcomes of Annex I habitats. Andrew is a technical botanical specialist with extensive planning experience regarding ecological assessments at all scales from local to national.

1.5.1.3 Adrian Cowe, MSc (Hydro-geology)

Adrian is an associate hydrologist. His key areas of experience and interest are in the areas of hydrological, hydrogeological and geological assessment for EIA and FRA, and quantitative water quality assessments. He holds expert knowledge and experience of

[5] https://cdn.npf.ie/wp-content/uploads/National-Planning-Framework-First-Revision-April-2025-1.pdf

surface and ground water sampling methodology, water quality monitoring instrumentation and data analysis. He has worked for a wide range of clients across a number of sectors including power, mining, water utilities and transport.

1.5.1.4 Chris Marshall, PhD, MSc (Peatland restoration)

Chris is a Principal Consultant specialising in peatland risk management, monitoring and restoration design. Chris has extensive experience in the characterization of peatland condition and developing monitoring solutions from the site to the national scale. Chris has spent more than a decade working in academia and industry on a variety of research projects in areas such as hydrocarbon exploration, sedimentology, engineering geology, climate reconstruction, remote sensing and peatland science working collaboratively with Govt, NGO's and private sector clients to deliver peer reviewed publications, reports including as a member of scientific advisory committees.

1.5.1.5 Luke Moseley, MSc. (Carbon)

Luke is an experienced sustainability and carbon management professional with a strong track record in corporate and project-level climate strategy. He has led the management and analysis of sustainability data, authored climate chapters for Environmental Impact Assessments (EIAs), conducted GHG emissions inventories across Scope 1, 2 and 3, and developed a deep working knowledge of relevant policies, frameworks, and regulatory requirements for carbon reduction. With a specialism in land-based emissions, his MSc research focused on the opportunities and challenges of measuring and reporting emissions from land use and land use change.

1.5.1.6 Joe O'Reilly, MSc. (GIS)

Joe is a Senior GIS Analyst with over 6 years of experience in the development and implementation of spatial solutions. His experience includes desk-based assessments of ecosystem services and biodiversity; feasibility studies and opportunity mapping for renewable energy sources requiring the development of a bespoke assessment methodology based on best practice and the aims of the project; the synthesis and analysis of a wide array of social, economic and environmental datasets; and the visualisation of project outputs in dynamic decision-making tools.

2.0 Methods

This peatland restoration study is split into four steps, as detailed in the next sections. It aligns with commitments made in Chapter 5 as part of the ecology impact assessment and RWE's ambitions to have net-zero carbon emissions; and to work towards a nature positive impact[6].

2.1 Step 1: Determine the area of bog restoration required for compensation in terms of biodiversity (to reach at least net zero); and detailed habitat surveys.

To reach no net biodiversity loss in terms of peatlands for the Proposed Development some bog restoration will be required. To give confidence of net zero, a calculated 10% net gain is required. The 10% threshold functions as a precautionary buffer, ensuring that developments deliver genuine, real-world- net gains once uncertainty in the accuracy of the metric is taken into account[7]. The same concept of a buffer beyond estimated net-zero before biodiversity gains can be claimed, is adopted by the ICUN[8].

The first task in this study is to estimate the area of peatland restoration that is needed to reach robustly justifiable net zero impact. This requires firstly to establish a robust definition of bogs and peatlands and the parameters that should be included in biodiversity loss and gain calculations.

Based on our previous experience, for biodiversity the area of restoration should be in the region of 3-to-10-times the area lost. Irish guidance is absent however, more recent UK guidance and legislation such as the Statutory BNG metric and NatureScot policy (see Section 3.4.2.1), supports the higher compensation requirement of around 1:10 or higher. The recently released TII metric[9] was not available in time to inform this project. The TII metric is Ireland specific and broadly based on the Statutory Biodiversity metric. It was released in December 2025. It is not a statutory requirement and was designed for linear infrastructure projects rather than large renewable or blanket bog areas such as the Proposed Development. For these reasons, and as at the time of its release BNG calculations for the Proposed Development were largely complete, we have not used in for our calculations assessment. We do however make reference to it where appropriate.

2.1.1 Defining Bog and Peatlands in Ireland

There are key differences between the definitions of bog (largely vegetation based with some consideration of peat depth) and peatland (based on peat depth/ soil carbon content). These terms are not fully interchangeable. The EU nature restoration law for example considers peatlands even where these have been converted to agriculture and no longer support bog vegetation.

Relevant literature has been relied upon to define the most appropriate definitions of peatlands, bogs and Annex 1 habitats in the context of the Proposed Development. Sources are set out in Table 3-1. These consist of:

- National Peatlands Strategy. 2015. National Parks & Wildlife Service. Dublin[10];

[6] https://www.rwe.com/en/responsibility-and-sustainability/environmental-protection/biodiversity/

[7] https://www.nao.org.uk/wp-content/uploads/2024/05/implementing-statutory-biodiversity-net-gain-summary.pdf

[8] https://iucn.org/sites/default/files/2025-12/the-nature-positive-goal-and-the-mitigation-hierarchy.pdf

[9] https://cdn.tii.ie/publications/GE-ENV-01112-01.pdf

[10] https://www.npws.ie/sites/default/files/publications/pdf/NationalPeatlandsStrategy2015EnglishVers.pdf

- Food and Agriculture Organisation of the United Nations. 2020. Peatland mapping and monitoring, recomendations and techincal overview[11].
- Fossit.2000. A Guide to Habitats in Ireland[12];
- EUR28. 2013. Interpretation Manual of European Habitats[13]; and
- European Parliament. 2024. Regulations of the European Parliament and Council on nature restoration and amending Regulation (EU) 2022/869[14].

2.1.2 Step 1a: Habitat Surveys

The Main Wind Farm Development Site was surveyed classified according to Fossitt (2000)[15] and mapped according to the good-practice measures outlined in Heritage Council guidance (Smith et al., 2011[16]). The locations of any rare, threatened, legally protected or invasive plant species were mapped – with specific reference to any Floral Protection Order species or Schedule III invasive species. Furthermore, each habitat was assessed with reference to Annex I definitions and their supporting diagnostic criteria as set out in the EC (2013[17]) guidelines.

Survey work was undertaken in two phases. The Main Wind Farm Development Site and HEA were surveyed by Dr Alex Fitzgerald (refer to **EIAR Appendix 5-1**), while the three overrun areas were surveyed by Dr Andrew Torsney (refer to **EIAR Appendix 5-6**). Habitat extents were mapped using GIS to calculate the area of each habitat type present.

2.1.2.1 Habitat Condition Assessments – and Biodiversity Net Gain

Subsequent surveys were then undertaken for all Annex I Blanket Bog habitats on site. For the Main Wind Farm Development Site these were undertaken on the 11th and the 14th of November 2024 by SLR's Technical Director Andrew Torsney. The overrun area data was collected between 7th and the 8th of January 2026 also by SLR's Technical Director Andrew Torsney.

All surveys were undertaken in accordance with Irish Wildlife Manual No 128[18] and No.79[19]; full details of the survey methods and results can be found in **EIAR Appendix 5-9.**

The data collected was used to better understand the restoration potential and to facilitate Biodiversity Net Gain (BNG) calculations. As there are no condition assessments for cutover bog published in the IWM[8], TII biodiversity metric [46] condition assessments were not

[11] https://catalogue.unccd.int/1446_fao_peatlands_CA8200EN.pdf

[12] https://www.npws.ie/sites/default/files/publications/pdf/A%20Guide%20to%20Habitats%20in%20Ireland%20-%20Fossitt.pdf

[13] https://www.mase.gov.it/sites/default/files/archivio/allegati/rete_natura_2000/int_manual_eu28.pdf

[14] https://data.consilium.europa.eu/doc/document/PE-74-2023-INIT/en/pdf

[15] Fossitt, J. A. (2000). *A guide to habitats in Ireland*. Kilkenny: Heritage Council.

[16] Smith, G. F., O'Donoghue, P., O'Hara, K. & Delaney, E. (2011) *Best Practice and Guidance for Habitat Surveying and Mapping*. Kilkenny: The Heritage Council

[17] European Commission (2013) Interpretation Manual of European Union Habitats – EUR28. Brussels: European Commission, DG Environment.

[18] Smith, G.F. & Crowley, W. (2020) The habitats of cutover raised bog. Irish Wildlife Manuals, No. 128. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

[19] Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

available at the time, and to facilitate a BNG assessment if desired, habitat condition data were collected at the plots according to the UK Gov. Statutory BNG metric guidance[20].

2.1.2.2 Survey Extent and Effort – Main Wind Farm Development Site

Approximately 185 ha of peatland habitat (PB3 and PB4) were identified within the Main Wind Farm Development Site. In line with Irish Wildlife Manual (IWM) guidance, 16 monitoring plots would have been sufficient at this scale; however, 28 no. 2 × 2 m quadrats were undertaken to provide a more spatially representative and defensible dataset (further details can be found in **Technical Appendix 5-6** specifically **Figure 5-1** of that appendix).

Fourteen plots were located within the proposed development footprint and fourteen outside it, enabling direct comparison between impacted and non-impacted areas. Plot placement reflected seven discrete impact locations, with two plots positioned within each potential impact area and additional plots in surrounding habitat to provide contextual baseline data.

2.1.2.3 Survey Extent and Effort – Overrun Areas

Approximately 14.7 ha of peatland habitat were identified across the overrun areas (Appendix B: **Figure 1**). Based on area thresholds, four quadrats were required.

- Over-run Area 1: 4 quadrats.
- Over-run Area 3: 8 quadrats (increased effort due to mapping under Article 17 data[21]).
- Over-run Area 2: No peatland habitats identified at this location; all of the habitats are mosaics with some peated soil indicators but no peatlands therefore no Annex I peatland habitats. As such no annex I habitat condition assessment required.

2.1.2.4 Condition Assessment Methodology

At each monitoring stop, a 2 × 2 m quadrat was surveyed using vegetative identification techniques. All vascular plant species were recorded (nomenclature following Stace, 4th edition) and percentage cover estimated.

Annex I Blanket Bog [7130] condition assessment criteria were recorded at each quadrat and assessed both within the plot and within a 20 m radius, following IWM methodology.

For the Main Wind Farm Development Site, a parallel condition assessment using the DEFRA biodiversity metric was also completed. Although vegetation composition in places aligned with mosaics of Northern Atlantic wet heath [4010] and European dry heath [4030] on deep peat, Blanket Bog was treated as the primary target habitat given substrate depth and higher conservation value. The management objective is to achieve favourable condition of Blanket Bog over a 35-year period.

Rare or legally protected species (Flora Protection Order 1999) and Red-listed species were specifically considered during surveys and details of the results are also reported below.

[20] July 2024. The Statutory Biodiversity Metric – Technical Anex 1: Condition Assessment Sheets and Methodology (v1.0.2).

[21] NPWS (2019) *Article 17 GIS and Metadata Downloads*. Department of Housing, Local Government and Heritage, Dublin. Available at: NPWS Article 17 GIS and Metadata Downloads (Accessed: 15 August 2026).

2.1.3 Step 1b: Calculation of biodiversity loss

2.1.3.1 Determining Impact and Restoration Buffers

Based on the NatureScot peatland restoration guidance[19] and on the technical expertise of wetland hydrology (see Section 3.3.1).

2.1.4 Step 1c: Calculation of the area of Peatland Restoration Required for Biodiversity Compensation and Enhancement inc. which areas of the site should be prioritised for this.

In Ireland, there is no standard guidance on the area of bog restoration expected to provide compensation for losses of these habitats due to developments such as wind farms. The Ireland Peatland Standard[22] was not considered appropriate as its focus is on voluntary carbon markets rather than planning and development.

To establish what would be reasonable in this instance, we therefore reviewed relevant policy in England and Scotland; specifically, the UK Gov Statutory BNG metric[23], and NatureScot's: Advising on peatland, carbon-rich soils and priority peatland habitats in development management[24].

There are known challenges to these from a wind industry perspective, in particular as they lack the flexibility to account for significant variation in the difficulty and time needed for bog restoration in different contexts. We have therefore additionally reviewed the SSE Biodiversity Tool kit[25], which allows for more flexible specification of the difficulty and timescales expected to be associated with site specific habitat restoration efforts, and literature on bog restoration timescales and success in similar contexts to the Proposed Development Site (ditch blocking, on flat land, at low elevation). See Section 3.4.2.1 for details on the metric selection process and outcome (SSE biodiversity metric).

2.2 Step 2: Determine Carbon Benefit: Accounting for Sequestration by Restored Bog and Re-use of Excavated Peat

In a similar manner to section Step 1c, Ireland does not have standard documentation for bog restoration and re-use of excavated peat. Note that the Peatland Standard for Ireland[26] was published part way through this review being undertaken, however as it largely references international standards that we have taken into consideration, it was not considered separately.

Therefore, we reviewed the standard policy documentation for the UK, and the International Union for Conservation of Nature (IUCN) National Committee UK has published a Peatland Code Standard[27] that we reviewed. The document specifies requirements for the validation and verification of greenhouse gas emissions reduced via peat restoration projects. The carbon units accounted for in the Peatland Code account specifically for both greenhouse

[22] https://peatlandfinance.ie/peatland-standard

[23] https://www.gov.uk/government/publications/statutory-biodiversity-metric-tools-and-guides

[24] https://www.nature.scot/doc/advising-peatland-carbon-rich-soils-and-priority-peatland-habitats-development-management

[25] https://www.sserenewables.com/sustainability/nature-positive/

[26] https://static1.squarespace.com/static/6453c38ea9ef3d5ed400982d/t/67c95dc94920d5365d5ac851/1741249993795/Peatland+Standard_V1.0+Doc+D.pdf

[27] Peatland Code V2.1 - Web Final-Sept 2025.pdf

gas emissions reduction from and sequestered by the restored peatland, excluding those already stored within the peatland, making it a suitable piece of guidance for these calculations.

Additionally, the IUCN has published the Peatland Code Field Protocol[28] which was reviewed. The standard guidance was found to be useful in further determining and validating the emission factors for the pre-restoration and post-restoration condition categories of the Proposed Development.

Finally, we have also reviewed the IUCN's Emission & Carbon Cost Calculator for bogs[29] which was found to be a satisfactory tool for completing the necessary calculations for the peat restoration, using the information from the Peatland Code Standard, Peatland Code Field Protocol and SSE Biodiversity Tool Kit reviewed in step 1c.

2.3 Step 3: Determine the total area that of bog that it is feasible to restore (re-wet) within the open ground on site, taking into account constraints such as infrastructure and ecological sensitivities.

This step was undertaken to determine the area of bog within the open areas of the Main Wind Farm Development Site and HEA (excluding forestry plantations), that it is realistic to restore to a better condition than recorded at baseline (Candidate Areas).

We reviewed the site hydrology including natural and artificial drainage. The Screening Process was prepared which involved reviewing available data against the following criteria within 250m of the Main Wind Farm Development Site and HEA boundary:

- Using the 5m Digital Terrain Model (DTM) data to identify areas where slopes are likely <4° for ideal conditions, below 6° for areas that benefit from restoration options and larger and linear areas greater than 6° which would provide limited restoration value;
- Natural waterbodies for consideration of mitigation requirements against any potential risk of working in the water environment;
- Infrastructure and associated drainage measures;
- Desk-based mapping of ditches and peat cutting faces from current aerial photography and validated it against historical aerial photography back to 1995 to identify features that would benefit from restoration methods; and
- The existing soil and peat data published and gathered during previous investigations to identify areas of peat in excess of 1 m deep.
    - To inform the peatland restoration plan, Candidate Areas were then screeded to determine the most appropriate restoration techniques to be adopted within each.

2.4 Step 4: Define the area of bog to be restored and provide an associated Habitat Management Plan.

We reviewed the outcomes of Steps 1 to 3 and used the information to produce a habitat management plan (HMP). This plan forms **Appendix A** to this document.

[28] FieldProtocol_V2.1_Final Website_0.pdf

[29] Protected - PC Bog Emissions & Carbon Costs Calculator PCv2.2 (Oct 25)_0.xlsx

3.0 Results

3.1 Step 1: Determine the area of bog restoration required for in-setting in terms of biodiversity (to reach at least net zero); and detailed habitat surveys.

3.1.1 Peatlands and Bogs Habitat Definitions

3.1.1.1 Overview

The terms peatlands and bogs are often used interchangeably. There are however important differences, and the definitions vary among associated legislation and guidance which further complicates the picture.

This section clarifies and justifies how we have defined peatlands and bogs habitats in the context of this report. The definitions from the key sources reviewed are provided in Table 3-1. They focus on the natural peatland habitats found on site, specifically blanket bog and wet heath.

Peatlands and Bog: The broad relationship between peatlands and bogs is illustrated in Figure 1. In general, “peatlands” refers to areas with peat/ peaty soils with any type of vegetation, and “bogs” refers to areas of peatland with only bog vegetation growing on it, thereby excluding areas of peatland that have for example been converted for agricultural or forestry use.

Deep Peat: The definitions of both peatlands and bogs can additionally rely on peat-depth depth thresholds for deep and shallow peat. Again, these thresholds vary among guidance documents even within the UK and Ireland. Deep peat definitions, in the context of ecology, range from a minimum depth of 30cm in England to 50cm in other regions e.g. Scotland. In Ireland it ranges from 30 to 50cm (general rule not strict threshold).

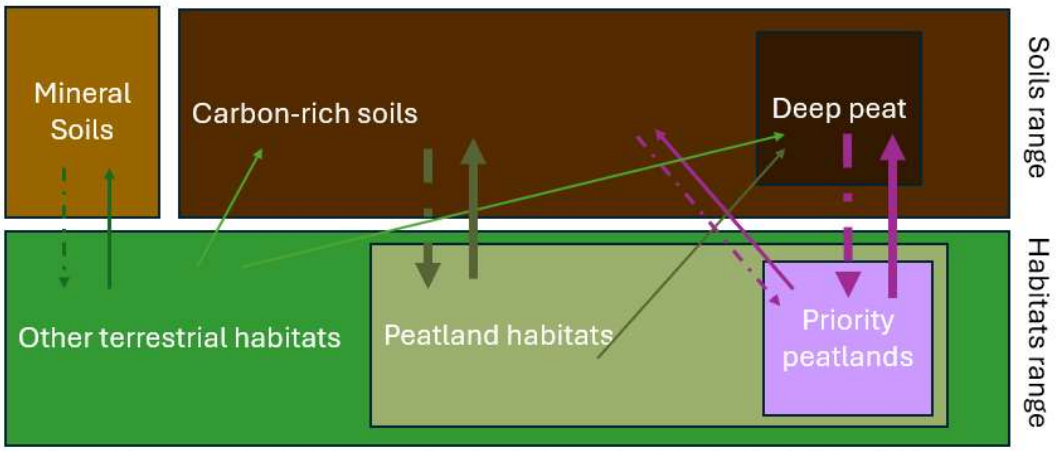

Figure 1: Illustration of Habitat and Soils Relationships

Table 3-1:Definitions of Peatlands and Bogs

Source	Term	Definition
National Peatland Strategy (NPS)[30]	Peat Soils	Soil that contains peat over a depth of at least 45 cm on undrained land and 30 cm on drained land; the depth requirement does not apply in the event that the peat layer is directly over bedrock.
	Active or peat forming	According to the Interpretation Manual of the Habitats Directive, the term Active must be taken to mean still supporting a significant area of vegetation that is normally peat forming.
	Peat	Sedentarily accumulated material consisting of at least 30% (dry mass) of dead organic material.
	Peatland	A geographical area (with or without vegetation) where peat soil occurs naturally. For mapping purposes, a peatland should cover a minimum spatial extent of 1 ha.
	Intact, pristine and virgin peatlands	The terms 'virgin', 'pristine' and 'intact' have been used in several studies in relation to sites that look unmodified, uncut (as visible to the eye) and where no obvious factor is currently degrading the peatland. These terms are best avoided for use of habitat description such as peatlands in an Irish context. Most Irish peatlands are 'humanised' landscapes that have evolved, indeed sometimes originated, in close association with land-use systems. It would be impossible to find an Irish peatland that has never been grazed or used in some way by humans (e.g. burning).
	Near-intact peatland	In this report (NPS), the terms 'near-intact' and 'natural' peatlands are interchangeable and are used to refer to peatlands that are hydrologically and ecologically intact, i.e. in which the eco-hydrology, in the recent past, has not been visibly affected by human activity and therefore includes active or peat-forming areas or is in the process of regenerating such a habitat. A natural peatland thus requires a combination of components to be present in order to carry out all the functions and ecosystem services usually attributed to such ecosystems.
	Priority habitat	A subset of the habitats listed in Annex I of the EU Habitats Directive. These are habitats that are in danger of disappearance and whose natural range mainly falls within the territory of the European Union. These habitats are of the highest conservation status and require measures to ensure that their favourable conservation status is maintained.
FOA[7]	Peatland	land with organic soil >0.1m depth with 12-18% carbon by weight and 20-30% organic matter.
A guide to habitats in Ireland[31]	Bogs	Peat depths can be used to differentiate blanket bog and heath in situations where the vegetation cover has been altered or removed (e.g. overgrazed or burnt). As a general rule, peat depths of greater than 0.5 m are indicative of blanket bog while those of less than 0.5 m are indicative of heath, but there are exceptions.

[30] National Peatlands Strategy. 2015. National Parks & Wildlife Service. Dublin. https://www.npws.ie/sites/default/files/publications/pdf/NationalPeatlandsStrategy2015EnglishVers.pdf

[31] Fossit.2000. https://www.npws.ie/sites/default/files/publications/pdf/A%20Guide%20to%20Habitats%20in%20Ireland%20-%20Fossitt.pdf

Source	Term	Definition
	Upland Blanket bog PB2	Vegetation is typically dominated by Deergrass (*Trichophorum caespitosum*), cottongrasses (*Eriophorum spp.*) and dwarf shrubs. Cover of Sphagnum mosses is usually high in areas of undamaged bog. Peat depths in **excess of 0.5 m** are **usually** indicative of blanket bog. Heath Rush (*Juncus squarrosus*) and Green-ribbed Sedge (*Carex binervis*) may occur in wet heath - HH3[32] but not in upland blanket bog.
	Lowland blanket bog PB3	Peat depths **vary considerably (1.5-7 m)** depending on the underlying topography, and are **usually** intermediate between those of raised bog - PB1 and upland blanket bog - PB2. As is the case with upland blanket bog, only the areas of uncut bog are included in this category; where part of the bog has been removed through turf cutting or any other form of peat extraction, this should be recorded as cutover bog - PB4.
	Cutover bog PB4	This category should be used in situations where part of the original mass of peat has been removed through turf cutting or other forms of peat extraction.
	Wet heath HH3	Heath includes areas where the vegetation is open and there is at least 25% cover of dwarf shrubs, or where mosses dominate in the case of some montane areas. If the underlying soil is peat, peat depths of **less than 0.5 m** are usually, but **not always**, indicative of heath.
Interpretation Manual of European Habitats[33]	Blanket bog – Annex 1	7130 Habitats Directive Annex 1[34] habitat (Priority if active). Extensive bog communities or landscapes on flat or sloping ground with poor surface drainage, in oceanic climates with heavy rainfall, characteristic of western and northern Britain and Ireland. In spite of some lateral water flow, blanket bogs are mostly ombrotrophic[35]. *Sphagna* play an important role in all of them but the cyperaceous component is greater than in raised bogs. The term "active" must be taken to mean still supporting a significant area of vegetation that is normally peat forming. *Note: the above definition does not reference a peat depth threshold*.
	Wet heath	4010 Northern Atlantic wet heaths with Erica tetralix: Humid, peaty or semi-peaty heaths, other than blanket bogs, of the Atlantic and sub-Atlantic domains. 4020 * Temperate Atlantic wet heaths with Erica ciliaris and Erica tetralix: Hygrophilous heaths of areas with a temperate oceanic climate, on semi-peaty or dried-out soils, with surface minerals in the case of peaty soils (hydromor), with vegetation of the alliances Genistion micrantho-anglicae and Ulicion minoris.

[32] HH3 = wet heath

[33] EUR28. 2013. Interpretation Manual of European Habitats. https://www.mase.gov.it/sites/default/files/archivio/allegati/rete_natura_2000/int_manual_eu28.pdf

[34] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, O.J. L206, 22.07.92

[35] Ombrotrophic = rain fed (not groundwater dependant)

Source	Term	Definition
		Note: the above definition does not reference a peat depth threshold. It clarifies that these habits may occur on semi-peat soils rather than being strictly restricted to peat habitats.
EU nature restoration law[36]	Peatland	The EU nature restoration law provides no clear definition of peatland but does refer to the definition in 2006 IPCC[37] guidance for National Greenhouse Gas Inventories. This IPCC guidance states that: "An organic soil is a soil with a high concentration of organic matter (see below). Every soil that is not an organic soil is classified as a mineral soil, following the 2006 IPCC Guidelines (Annex 3A.5, Chapter 3 in Volume 4). The Wetlands Supplement follows the definition of organic soils in the 2006 IPCC Guidelines (Annex 3A.5, Chapter 3 in Volume 4): Organic soils are identified on the basis of criteria 1 and 2, or 1 and 3 listed below (FAO 1998): 1. Thickness of organic horizon greater than or equal to 10 cm. A horizon of less than 20 cm must have 12 percent or more organic carbon when mixed to a depth of 20 cm. 2. Soils that are never saturated with water for more than a few days must contain more than 20 percent organic carbon by weight (i.e., about 35 percent organic matter). 3. Soils are subject to water saturation episodes and has either: a. At least 12 percent organic carbon by weight (i.e., about 20 percent organic matter) if the soil has no clay; or b. At least 18 percent organic carbon by weight (i.e., about 30 percent organic matter) if the soil has 60% or more clay; or c. An intermediate proportional amount of organic carbon for intermediate amounts of clay." The 2006 IPCC Guidelines largely follow the definition of Histosols by the Food and Agriculture Organization (FAO), but have omitted the thickness criterion from the FAO definition to allow for often historically determined, country-specific definitions of organic soils. There are no IPCC definitions for peat and peatland. Definitions of peatland and peat soil differ between countries in relation to the thickness of the peat layer required to be determined as a peatland or a peat soil. In addition, the definition of peat varies among countries and disciplines, especially with respect to the minimum percentage of organic matter the material is required to contain (Joosten and Clarke, 2002). In the Wetlands Supplement the concept of peatland is considered to be included in '(land with) organic soil'.

[36] Regulation (EU) 2024/1991 of the European Parliament and of the Council of 24 June 2024 on nature restoration and amending Regulation (EU) 2022/869 https://data.consilium.europa.eu/doc/document/PE-74-2023-INIT/en/pdf

[37] Intergovernmental Pannel on Climate Change

Source	Term	Definition
		It is good practice that, when a country uses another definition of organic soil in accordance with its national circumstances, the concept of organic soil (and its possible subdivisions) applied is clearly defined, and that the definition is applied consistently both across the entire national land area and over time [38].

[38] IPCC. 2013. Supplement to the 2006 IPCC Guidance for National Greenhouse Inventories: Wetlands: https://www.ipcc.ch/site/assets/uploads/2018/03/Wetlands_Supplement_Entire_Report.pdf

3.1.1.2 Definitions in Relation to this Proposed Development

Table 3-1 focuses on definitions of peatlands, bogs and associated terminology from relevant Irish and international legislation and associated guidance. Based on the information in those definitions we have defined peatlands, bogs and deep peat in relation to this project as follows:

Peatland

As the EU Nature Restoration law, via its reference to IPCC definitions of peatlands, supports using national definitions of peatland (Table 3-1)., this report bases its definitions of peatland/ peat soils on the National Peatland Strategy (for text see Table 3-1), as follows:

- Peatlands by this definition have no minimum depth over bedrock and a minimum depth of 30cm-45cm over sediments.

Note that as the Main Wind Farm Development Site and HEA are underlain by bedrock, anywhere that peat of any depth occurs is considered a peatland. The Main Wind Farm Development Site and HEA support peat and are therefore considered a peatland. In addition, at its shallowest the peat recorded is >45cm and therefore is considered peatland even were the peat to be underlain by sub-soil rather than bedrock. In general peat depth is in the range of 2m to 4m and in some places >6m deep.

Bog

Irish habitat classification guidance[26] permits for exceptions to a general rule of thumb of blanket bogs occurring on peat >50cm. In addition the Interpretation Manual of European Habitats, which is the source of definitions for Annex 1 habitats, has no minimum peat depth threshold in relation to bogs with key differences between bog and wet heath being reflected by vegetation composition as well as soil type and depth (Table 3-1). We have therefore taken the approach of not requiring a minimum peat depth for bog habitats as this approach definition is best aligned with definitions of Annex 1 habitats. Shallower areas of peat (<50cm), are classified as wet heath if they supported appropriate plant communities.

In reality, as the peat on the Main Wind Farm Development Site and HEA is a minimum of 50cm both the Irish habitat classification and Annex 1 definitions of bog are met anywhere there is bog vegetation.

- Bog = any depth of peat (but typically >50cm), supporting bog vegetation. Based on the description in Interpretation Manual of European Union Habitats (v., 28)[33] bog habitats (blanket bog, raised bog and lowland bog) are Annex 1 habitats, except perhaps in a few circumstances where they are so badly degraded that they could no longer support Sphagnum species. While the habitat description references other species/ communities/ characteristics that are “often” associated with blanket bogs, Sphagnum spp. are described as “playing an important role in all of them”.
- Priority Annex 1 bog = bog habitat “*supporting a significant area of vegetation that is normally peat forming*”[28, 16]. We have used the NatureScot guidance and the Interpretation Manual of European Union Habitats (v., 28)[39] to determine if habitats qualify as Priority Annex 1 bog[40]. Only those areas achieving near natural condition have been included.

[39] https://eunis.eea.europa.eu/references/2435

[40] https://www.nature.scot/sites/default/files/2023-02/Guidance-Peatland-Action-Peatland-Condition-Assessment-Guide-A1916874.pdf

3.2 Step 1a: Detailed habitat surveys

Survey work was undertaken in two phases (see Chapter 5). The main wind farm area was surveyed by Dr Alex Fitzgerald (refer to **EIAR Appendix 5-1**), while the three overrun areas were surveyed by Dr Andrew Torsney (refer to **EIAR Appendix 5-6**). For reference the locations of these areas are shown in Figure 2. Habitat extents were mapped using GIS to calculate the area of each habitat type within the Main Wind Farm Development Site.

Subsequent surveys were then undertaken for all Annex I Blanket Bog habitats on site. For the Main Wind Farm Development Site these were undertaken on the 11th and the 14th of November 2024 by SLR's Technical Director Andrew Torsney. The overrun area data was collected between 7th and the 8th of January 2026 also by SLR's Technical Director Andrew Torsney.

All surveys were undertaken in accordance with Irish Wildlife Manual No 128[41] and No.79[42]; full details of the survey methods and results can be found in **EIAR Appendix 5-9.**

The data collected was used to better understand the restoration potential and to facilitate Biodiversity Net Gain (BNG) calculations. As there are no condition assessments for cutover bog published in the IWM[8], TII biodiversity metric [46] condition assessments were not available at the time, and to facilitate a BNG assessment if desired, habitat condition data were collected at the plots according to the UK Gov. Statutory BNG metric guidance[43].

[41] Smith, G.F. & Crowley, W. (2020) The habitats of cutover raised bog. Irish Wildlife Manuals, No. 128. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

[42] Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

[43] July 2024. The Statutory Biodiversity Metric – Technical Anex 1: Condition Assessment Sheets and Methodology (v1.0.2).

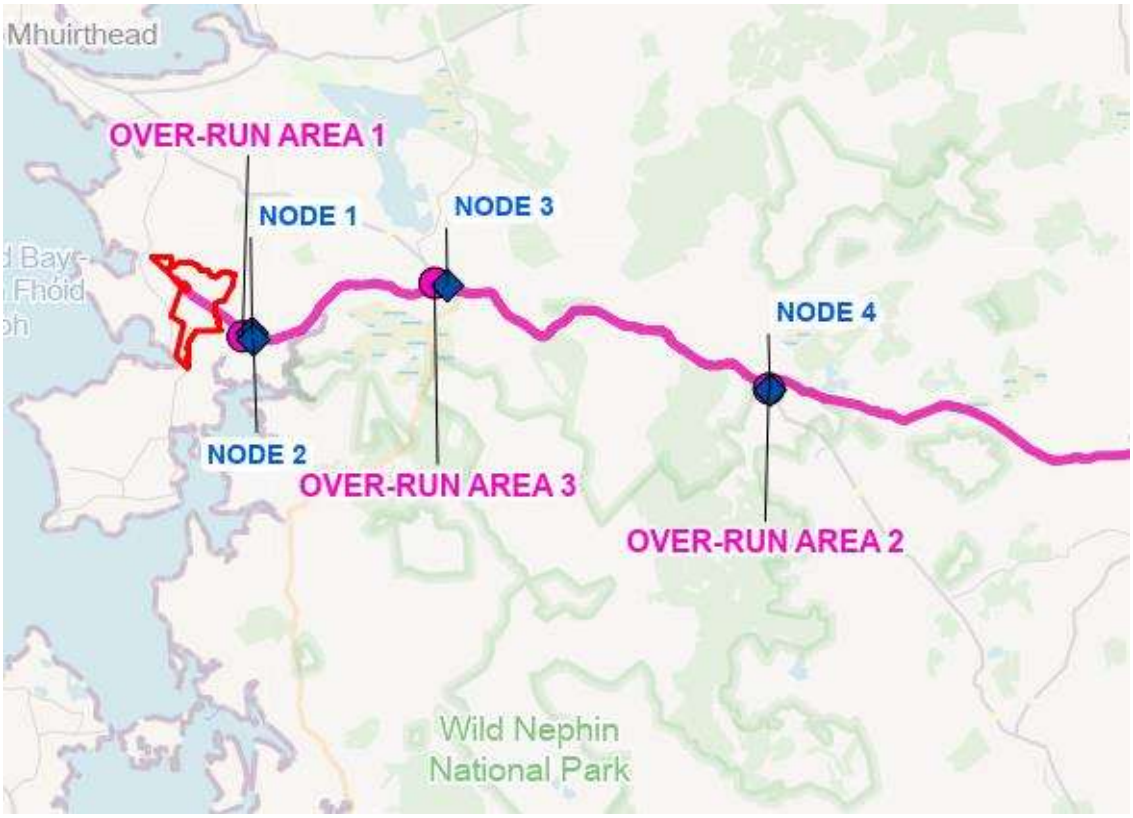

Figure 2: Site Location and over-run areas (see Chapter 2, Figure 2-4a for full details)

3.2.1 Peatland Habitat Types

Most of the open areas were mapped as cutover bog (PB4) according to the Fossitt system (Table 3-2; Drawing 1). Although, the community composition was initially noted to be more consistent with wet heath (HH3) than lowland blanket bog (PB3), on review in light of the drained condition of the area, the vegetation was mapped as PB4 (cutover bog) recognising that due to peat drying it represents highly modified PB3 vegetation that is restorable to good condition bog on re-wetting.

A summary of the habitats on the Main Wind Farm Development Site and HEA including blanket bog and other Annex I habitats is provided in Table 3-2. For ease of comparability, if desired, we have also provided a conversion to the UKHab vegetation classification codes [44]. Drawing 01, shows the distribution of habitats across the site.

The larger polygons of blanket bog within the turbine area are listed in Table 3-1 and separately to give a better understanding of the locations of habitat losses, other polygons are merged based on habitat type and condition.

A summary of the main habitats in the over-run areas is provided at the bottom of Table 3-2.

[44] https://www.ukhab.org/

Table 3-2: Summary of Habitats Recorded On the Main Wind Farm Development Site, HEA and Over Run Areas

Polygon (s)	Fossitt	UKHab (For mosaics the polygon is coded as the dominant habitat)	UKHab Condition[45]	Annex I	Priority Annex I	Total Area (ha)
57, 69	BL3 Buildings and artificial surfaces	U1b Develop land sealed surface	*NA*	No	No	1.25
27, 55	FL2 Acid oligotrophic lakes	R1c Oligotrophic and dystrophic lakes	*Moderate*	3110 3030	No	0.30
31, 60	FL8 Other artificial lakes and ponds	R1g Other standing water	*Moderate*	No	No	0.06
59, 61, 63 - 65	FS1 Reed and large sedge swamps	F2d Aquatic marginal vegetation	*Moderate*	No	No	0.36
67	FW1 Eroding/upland rivers	R2b Other rivers and streams	*Moderate*	No	No	0.37
56	GS3 Dry-humid acid grassland	G1b Upland acid grassland	*Moderate*	No	No	0.17
8-10, 19,24,35,36	GS4 Wet grassland	G3c8 Holcus Juncus Neutral Grassland (15)	*Moderate*	No	No	6.63
2	GS4 Wet grassland GS3 Dry-humid acid grassland	**G3c8 Holcus Juncus Neutral Grassland (15)** G1b Upland acid grassland	*Moderate*	No No	No	0.52
33	GS4 Wet grassland ED3 Recolonising bare ground WS1 Scrub	**G3c8 Holcus Juncus Neutral Grassland (10, 15, 510)** G3c (510) Other neutral grassland H3h Mixed scrub	*Moderate*	No No No	No	2.96
26	GS4 Wet grassland PB4 Cutover bog WS1 Scrub	**G3c8 Holcus Juncus Neutral Grassland (10, 15)** F1a6 Degraded blanket bog H3h Mixed scrub	*Moderate*	No **7130** No	No	2.11

[45] Classifications in italics are desk-based due to access issues the remainder are all field-based.

Polygon (s)	Fossitt	UKHab (For mosaics the polygon is coded as the dominant habitat)	UKHab Condition[45]	Annex I	Priority Annex I	Total Area (ha)
3	GS4 Wet grassland PF2 Poor fen and flush PB4 Cutover bog	**G3c8 Holcus Juncus Neutral Grassland (15)** F2a Lowland fens F1a6 Degraded blanket bog	*Moderate*	No No **7130**	No	0.65
4	GS4 Wet grassland WS1 Scrub	**G3c8 Holcus Juncus Neutral Grassland (10,15)** H3h Mixed scrub	*Moderate*	No No	No	2.05
29	GS4 Wet grassland WS1 Scrub HD1 Dense bracken	**G3c8 Holcus Juncus Neutral Grassland (10,15)** H3h Mixed scrub G1c Bracken	*Moderate*	No No No	No	1.78
18	HD1 Dense bracken WS1 Scrub GS4 Wet grassland	**G1c Bracken (10)** H3h Mixed scrub G3c8 Holcus Juncus Neutral Grassland (15)	*Poor*	No No No	No	1.21
1, 12, 14, 20, 25, 32	PB3 Lowland blanket bog	F1a5 Blanket bog	*Moderate*	**7130**	**Yes[46]**	22.55
37	PB4 Cutover bog	F1a6 Degraded blanket bog	*Poor*	**7130**	No	41.32
38	PB4 Cutover bog	F1a6 Degraded blanket bog	Moderate	**7130**	No	8.19
39	PB4 Cutover bog	F1a6 Degraded blanket bog	*Poor*	**7130**	No	15.51
41	PB4 Cutover bog	F1a6 Degraded blanket bog	*Poor*	**7130**	No	4.70
42	PB4 Cutover bog	F1a6 Degraded blanket bog	*Poor*	**7130**	No	5.88

[46] **PB3 – Priority Annex I status**: Where PB3 occurs in larger areas, is illustrated as Priority Annex I habitat in the Irish landcover database and we have confirmation of peat forming species from field survey this habitat is considered to be Priority Annex I habitat. Note however that the polygons of PB3 within the Main Wind Farm Development Site are not shown on the Irish landcover database, are small and therefore are not considered extensive enough to meet the definition of priority Annex I bog which is: *"still supporting a significant area of vegetation that is normally peat forming"*. The priority Annex I bog area is considered to be restricted to the triangle to the northwest where bog restoration work and no infrastructure is planned.

Polygon (s)	Fossitt	UKHab (For mosaics the polygon is coded as the dominant habitat)	UKHab Condition[45]	Annex I	Priority Annex I	Total Area (ha)
43	PB4 Cutover bog	F1a6 Degraded blanket bog	Moderate	**7130**	No	37.29
44	PB4 Cutover bog	F1a6 Degraded blanket bog	*Moderate*	**7130**	No	3.5
45	PB4 Cutover bog	F1a6 Degraded blanket bog	Poor	**7130**	No	21.35
46	PB4 Cutover bog	F1a6 Degraded blanket bog	Moderate	**7130**	No	30.84
47	PB4 Cutover bog	F1a6 Degraded blanket bog	Poor	**7130**	No	25.67
28, 40	PB4 Cutover bog	F1a6 Degraded blanket bog	*Moderate*	**7130**	No	0.98
50	PB4 Cutover bog WS1 Scrub	**F1a6 Degraded blanket bog (10)** H3h Mixed scrub	Moderate	**7130**	No	38.31
51 – 54, 66	PB4 Cutover bog WS1 Scrub	**F1a6 Degraded blanket bog (10)** H3h Mixed scrub	*Moderate*	**7130**	No	22.03
17,23, 62	PF3 Transition mire and quaking bog	F2c8 Transition mire and quaking bog	*Moderate*	**7140**	No	0.42
5 - 7	WD4 Conifer plantation	W2c Other coniferous woodland	*Poor*	No	No	59.09
16	WD4 Conifer plantation ED3 Recolonising bare ground GS4 Wet grassland	**W2c Other coniferous woodland (510)** G3c (510) Other neutral grassland G3c8 Holcus Juncus Neutral Grassland (15)	*Poor*	No No No	No	110.84
30, 34, 48, 49, 58	WS1 Scrub	**H3h Mixed scrub**	*Moderate*	No	No	4.78
11, 13	WS1 Scrub GS4 Wet grassland	**H3h Mixed scrub** G3c8 Holcus Juncus Neutral Grassland (15)	*Moderate*	No No	No	1.76
15	WS1 Scrub GS4 Wet grassland PB4 Cutover bog	**H3h Mixed scrub** G3c8 Holcus Juncus Neutral Grassland (15) F1a6 Degraded blanket bog	*Moderate*	No No **7130**	No	2.16
Over- run area 1	WS1 Scrub	**H3h Mixed scrub**	*Poor*	No	No	0.56

Polygon (s)	Fossitt	UKHab (For mosaics the polygon is coded as the dominant habitat)	UKHab Condition[45]	Annex I	Priority Annex I	Total Area (ha)
	PB3 Lowland blanket bog	F1a5 Blanket bog	*Good*	Yes	No	4.69
Over-run area 2	BL3 Buildings and artificial surfaces	U1b Develop land sealed surface	*NA*	No	No	0.817
	Mosaic - PB3 Lowland blanket bog/ GS2 - Dry meadows and grassy verges/ WS1 - Scrub	F1a5 Blanket bog	*Poor*	No	No	0.429
	GS2 Dry meadows and grassy verges	G1a Lowland dry acid grassland	*Poor*	No	No	0.089
	FW4 Drainage ditches		*poor*	No	No	0.214
Over-run area 3	PB4 Lowland blanket bog	F1a5 Blanket bog	*Good*	Yes	Yes	0.695

3.2.2 Habitat Condition

This Section refers to results of the survey undertaken using UK Gov. Statutory BNG metric guidance[22]. This method of condition assessment was adopted in this instance as it is the method set out in both the SSE and Statutory BNG metric guidance (see Section 3.4.2.1 for more information on BNG).

Based on the habitat condition report[47], blanket bog habitats on the Main Wind Farm Development Site are in Poor or Moderate Condition.

In addition, all of the blanket bog on the Main Wind Farm Development Site is considered to be drained according to NatureScot peatland condition criteria. Only one area where no habitat loss is expected is considered to be Priority Annex 1 blanket bog habitat, this is within the HEA.

Condition surveys were specifically targeted at bog habitats which are Annex 1 habitats (Table 3-2).

Condition data were not collected for other habitat types. Based on opportunistic field notes and photographs these habitats are considered to be in moderate condition, with the exception of habitats for which a moderate score is not achievable, including areas of bracken, commercial forestry and tracks/ buildings all of which are rated as Poor or condition assessment NA based on the UK Gov. Statutory BNG metric guidance[22].

For ease of reference a summary of the condition assessment results are set out in Table 3-3. Scoring of bog condition is defined as follows:

- Good Condition:
    - Passes 5 or 6 of 6 core criteria, INCLUDING essential core criterion 1; AND
    - Passes additional criterion 7a, 7b, 7c OR 7d where applicable.
    - Moderate Condition:
    - Passes 4 or 5 of 7 criteria; OR
    - Passes 6 of 7 criteria EXCLUDING either essential core criterion 1 or additional criterion 7.
- Poor Condition:
    - Passes 0, 1, 2 or 3 of 7 criteria.

The bog habitat on the Main Wind Farm Development Site passed 4 criteria at most locations, not including essential criterion 1. Most polygons are therefore in moderate condition. However, in a 4/8 polygons (Table 3-3), Sphagnum moss cover is particularly low e.g. 10-15% cover and therefore these polygons do not meet the criteria for frequent Sphagnum moss. These polygons are in poor condition.

Table 3-3: Uk Gov. Statutory BNG metric - Bog Habitat Condition Criteria

No.	Description	Achieved Y/N[48]	Notes
1	The water table is at or near the surface throughout the year, this could be open water or saturation of soil at the surface. There is no artificial drainage,	N (8/8)	Active drains are present

[47] SLR Consulting. 2024. Habitat Condition Assessment. Muingmore Windfarm. 501.V00727.00008 Rev. 00

[48] (x/x) = number of polygons assessed where this result was true. If not true, then the opposite e.g. No rather than yes was the outcome.

No.	Description	Achieved Y/N[48]	Notes
	unless specifically to maintain water levels as specified above. NB – this criterion is essential for achieving good condition.		
2	The appearance and composition of the vegetation closely matches characteristics of the specific wetland habitat type (see UKHab definition linked above). Indicator species for the specific wetland habitat type 1 are very clearly and easily visible.	Y (8/8)	Typically GB2E according to the IVC classification system - Calluna vulgaris–Eriophorum spp. Which aligns with M17 bog vegetation dominants: cross-leaved heath, hare's-tail bog-cotton, heather, purple moor-grass & bog-mosses (Sphagnum spp.).
3	The water supplies (groundwater, surface water and/or rainwater) to the wetland are of good water quality, with clear water (low turbidity) indicating no obvious signs of pollution.	Y (8/8)	
4	Cover of scrub and scattered trees less than 10%.	N (8/8)	
5	Cover of bare ground less than 5%.	Y (8/8)	
6	There is an absence of invasive non-native species (as listed on Schedule 9 of WCA, 1981) and species indicative of sub-optimal condition1 make up less than 5% of ground cover.	N (8/8)	
7	Sphagnum and cotton grasses are at least frequent. Cover of ericaceous dwarf-shrubs is less than 75%.	Y (4/8)	No = <15% cover of sphagnum

3.2.2.1 Habitat Condition: Over-run areas

3.2.2.2 Area 1

This area is PB3 blanket bog, however Sphagnum moss cover is too low for it to be considered in active condition, it is therefore considered Annex 1 but not priority Annex 1 habitat. Enough habitat condition criteria are met however for it to be considered to be in good condition.

Linear features in this area are fencelines or channels that are very minimal in dimension and are unlikely to be contributing to significant drainage of the area.

3.2.2.3 Area 2

Area 2 is not dominated by peatland or bog habitats. These habitats are a mosaic of disturbed or heavily modified habitats that have mixed sediment types included peated soils but the habitats do not align with peatland habitats. In line with survey notes indicate these habitats are in poor condition.

3.2.2.4 Area 3

Area 3 is largely mapped as cutover bog (PB4), it is de-vegetated (rotivated) and therefore assessed as being in poor condition. Desk study data show it is included in the area mapped under Article 17 as blanket bog, to reflect this in BNG calculations we have used a condition multiplier of three.

3.2.3 Restoration Potential

Drainage is likely responsible for the Main Wind Farm Development Site failing to meet the water table criteria (Criteria 1: Table 3-3) and consequently lower cover of Sphagnum than would be expected in wetter ground conditions. Ditch blocking is anticipated to rectify this. Other failures to meet condition criteria are in relation to cover of invasive species and scrub (Criteria 4 and 6). These can be removed, and re-wetting/ ditch blocking is likely to deter their growth. It is anticipated therefore be reasonably straight forward to get the Main Wind Farm Development Site to a state where it passes six to seven criteria Table 3-3 including critical criteria for the water table and Sphagnum cover and would therefore be in good condition.

An exception is the HEA where the drainage pattern is different. This area is PB3 lowland blanket bog that has been cutover bog rather than being drained by ditches. It is largely revegetated, restoration in this area would require re-profiling of the cutting faces (Section 3.6).

Restoration Potential: Over-run areas

3.2.3.1 Area 1

There is no clear restoration potential beyond reinstatement of any areas that are damaged due to the Proposed Development.

3.2.3.2 Area 2

This area represents a mosaic of grassland, scrub and heath habitats with some wetter areas, on mixed soils. It is heavily influenced by surrounding road infrastructure. Small biodiversity enhancements will be possible via floral enrichment from wildflower seeding and low-density scrub planting during the reinstatement process. Based on typical time to target conditions associated with the SSE metric and the conditions on site, we have assumed that **dry grassland** will reach **moderate compared to the current poor** condition post re-statement.

3.2.3.3 Area 3

It is unclear what restoration will be practical here as the wider area is undergoing a land-management transition. Consequently, we have assumed on a precautionary basis that no restoration will take place within Area 3. Therefore, loss due to the temporary track installed as part of the Project is treated as permanent. This is on a precautionary basis for the purpose of this assessment, even though the track is temporary and will be removed following completion of the construction phase.

3.3 Step 1b: Calculation of Habitat Loss and Restoration Areas

3.3.1 Habitat Loss

These calculations reflect potential loss of peatlands and other habitats. The calculations here are to provide an estimate of the likely extent of bog restoration required to compensate for loss of peatland and other habitats in relation to their biodiversity value and to achieve biodiversity enhancement at a site level.

3.3.1.1 Definitions of direct and indirect loss

Direct loss = habitat will be replaced by infrastructure.

Indirect loss/ degraded = habitat will be retained but is likely to be damaged e.g. by construction activities or degraded e.g. due to changes in hydrology/ drying caused by the construction of nearby infrastructure.

We have assumed that for bog habitats, the habitats will remain as the same habitat type rather than being lost or transitioning to another habitat type (e.g. from blanket bog to dry heath). As the majority of the Main Wind Farm Development Site is already highly drained blanket bog we consider this to be a realistic assumption. The condition may however be reduced due to drainage features associated with the infrastructure. Other habitats will return to their baseline condition following reinstatement works.

Condition is quantified as described in Section 3.2.2.

3.3.1.2 Impact Buffers

Where infrastructure requires excavations or loading of the peatland surface (e.g. with floating roads), this is likely to cause changes to the local hydrology, typically dewatering or diverting water from of surrounding peatland areas. The distance that this is likely to extend around the infrastructure needs to be estimated to inform indirect loss calculations.

NatureScot guidance[23] on the buffers of infrastructure state that the same buffers should be used for impact and restoration, it indicates that typically this is 30m but notes that topography, drain size and depth, and the presence of other drainage factors can have an influence (e.g. bulk density of peat and underlying geology). Based on our past experience of other wind farm projects in peatlands, 10m has been acceptable of areas of shallower or degraded peat.

In the case of the Main Wind Farm Development Site however, there are drainage ditches at roughly 5m spacing and peat within these ditches remains very wet. We therefore consider it unlikely that drainage impacts from infrastructure will extend much past 5m in any direction. Based on guidance and professional judgment, a 5m indirect loss buffer is appropriate in this instance.

3.3.1.3 Restoration Buffers

Similarly to the indirect impact buffer, with the exception of the outer most ditches, we consider it unlikely that the benefits of restoration of a single ditch will extend much past 5m in any direction due to the 5m ditch spacing. Based on guidance and professional judgment, a 5m restoration buffer is appropriate in this instance, with 30m applied to the outermost ditches where this lies within the Main Wind Farm Development Site.

In line with NatureScot guidance, re-wetting may not be fully effective within 30m of new and existing infrastructure due to their associated drainage features and that bog in these areas may not be practical. Areas within 30m of proposed infrastructure are therefore excluded from what is considered to be the restorable area. This is precautionary, as in reality, it is likely that these areas would experience some improvement in condition making this a precautionary approach.

An exception is the HEA to the northwest where the drainage pattern is different. This area is modified by cutover. Restoration in this area would require re-profiling of the cutting face to achieve an angle closer to 30 degrees, compacting the peat and stretching the vegetation layer across the face of the reprofiled area, compacting it to ensure a good contact between the roots and peat.

No impacts are anticipated in this area. The restoration buffer we have used reflects guidance on restoration buffers for hag re-profiling which is 30m either side from the cutting face.

3.3.1.4 Approach to Temporary Loss

Within the over-run areas the infrastructure will be temporary, its purpose is to facilitate delivery of materials and parts during construction and it will therefore be redundant post-construction. Note however that over-run Area 3 is to be treated a permanent loss see Section 3.2.3.

BNG guidance[49] advises the following in relation to temporary loss (Box 1). The BNG relevant construction period at Muingmore is expected to last 23 months (ground clearance to reinstatement). This means that even low distinctiveness, poor quality habitats, which have experienced direct-loss such as improved grassland will not have reached their baseline condition and type within the two BNG year exemption window. Areas of temporary loss will therefore be incorporated into BNG in a two stage (time window) process:

Stage 1 - **Baseline to during construction**: Loss (direct and indirect) will be entered into one spreadsheet to estimate losses.

Stage 2 **– End construction to post-restoration**: Habitat creation (reinstatement) and enhancements will be entered into one spreadsheet to estimate gains.

The Biodiversity Unit calculations from these spreadsheets were combined with the results from the Main Wind Farm Development Site and HEA to give an overall biodiversity change estimate for the Proposed Development.

Accounting for temporary losses

You do not need to record a habitat as lost when there are temporary impacts to a habitat and the area can be restored to both:

- *baseline habitat type within two years of the initial impact; and*
- *baseline condition within two years of the initial impact*

You can enter these habitats as 'enhanced' if there is action to enhance the habitat above its baseline type and condition. If you do, you should apply a 1- or 2-year delay in starting habitat creation or enhancement.

Box 1: BNG Guidance Temporary Loss

3.3.1.5 Indirect Loss/ Gain Buffer Assumptions: Over-run Areas

All areas of indirect loss/ gain are bounded by existing infrastructure such as roads.

Damage to habitats within 5m of infrastructure due to plant movements is anticipated both during construction and reinstatement, therefore no meaningful recovery of these areas is anticipated during Stage 1 (see Section 3.3.1.4 for a description of Stages).

See Section 3.4.2.2 for discussion on bog recovery timescales. Note that the areas in question are accessible and flat and are therefore considered to be straight-forward to restore compared to high-altitude or sloping sites, given the proper treatment.

[49] https://assets.publishing.service.gov.uk/media/689c5ee17b2e384441636196/The_Statutory_Biodiversity_Metric_-_User_Guide_-_July_2025.pdf

3.3.1.6 Area 1

This area is predominantly blanket bog in good condition. Although ditches are present, they are well spaced, insubstantial (barely noticeable on the ground) and run diagonally rather than parallel to the proposed temporary track, there is therefore opportunity for dewatering of bog between ditches due to changes in hydrology. Tracks will be floating so no excavation of peat or complete blocking/ diversion of hydrological flow paths is anticipated.

Normally in such circumstances a 30m indirect loss buffer would be appropriate in line with Scottish guidance and underlying evidence. However, as in this case the infrastructure will be temporary (c. 2 years), there will be less time for dewatering impacts to spread beyond the infrastructure and result in material changes to bog condition and vegetation composition. Additional degradation due to plant movements either side of the proposed infrastructure footprint are expected within 5m.

We have therefore used a **5m** indirect loss buffer assuming degradation of condition from good to moderate in Stage 1 and improvement from moderate to good in Stage 2 (see Section 3.3.1.4 for a description of Stages).

As bogs tend to be slow growing/ recovering habitats due both to vegetation species and underlying hydrology, recovery in Stage 2 is anticipated to take **10 years**.

3.3.1.7 Area 2

This area is bounded on all sides by existing roads or tracks. It has mixed soils and a mosaic of habitats as a result presumably of the adjacent road construction. Habitats include scrub, grassland and heath. A watercourse drains through the centre of the area.

Degradation of habitats due to plant movements either side of the proposed infrastructure footprint are expected within **5m**.

We have therefore used a **5m** indirect loss buffer assuming degradation of condition from moderate to poor in Stage 1 and improvement from poor to moderate in Stage 2 (see Section 3.3.1.4 for a description of Stages).

These habitats tend to recover from damage relatively quickly and recovery in Stage 2 is anticipated to take **5 years or under** (standard multipliers used).

3.3.1.8 Area 3

Due to limited restoration potential of the area (see Section 0), for the purpose of the calculations in this document, we have assumed permanent loss of the infrastructure footprint and a 5m buffer.

3.3.1.9 Summary of Terminology Assumptions

- Peatland = minimum peat depth of:
    - where the substrate is granular >45cm deep or >30cm deep where bog is drained, or
    - no minimum depth where peat it is over bedrock.
- Priority peatland = a peatland supporting Priority Annex 1 bog habitat.
- Priority Annex 1 bog = bog habitat "*supporting a significant area of vegetation that is normally peat forming*"[28].

- Indirect loss = temporary loss and recreation of the same habitat, with wetland/ bog habitats permanently degraded to a poorer condition post-restoration due to drainage features.
- Indirect loss buffer on peatlands with drainage ditches at 5m spacing = 5 m.
- Indirect loss buffer on other peatlands with ditches of other spacing = ditch spacing up to a max of 30m (e.g. for peripheral drains).
- Restoration buffers, 5m /or ditch spacing up to 30m, and for wetland habitats where restoration is not possible to within 30m of infrastructure due to drainage impacts.

3.3.1.10 Summary of Blanket Bog Habitat Loss Calculations (Main Wind Farm Development Site & HEA only)

Habitat loss calculations for all habitats are provided in Table 3-2 above. Excluding polygons where bog formed a minority element of mosaics, the total estimated loss of blanket bog is summarised in Table 3-4, 32.78 ha in total of which only 24.36 ha is direct, permanent loss.

Table 3-4: Summary of habitat loss estimate for the Main Wind Farm Development Site & HEA (Fossit habitat classification system)

Habitat	Total Area (ha)	Direct loss (ha)	Indirect & temporary loss (ha)	Total loss (ha)
PB3 (moderate condition)	22.55	0	0	0
BL3	1.25	0.21	0.23	0.43
GS4	16.7	0.17	0.10	0.27
PB4 (moderate condition)	119.11	13.06	6.5	17.66
PB4 (poor condition)	114.43	11.3	3.28	15.12
WD4	169.93	9.79	24.54 (forest to bog)	34.33
WS1	8.7	0.31	0.09	0.4

3.4 Step 1c: Calculation of the area of Peatland Restoration Required for Biodiversity Compensation and Enhancement inc. which areas of the Main Wind Farm Development Site & HEA should be prioritised for this.

This section draws on the bog restoration feasibility study Step 3.

3.4.1 Habitats to be Restored

The type of habitats to be restored will reflect those to be lost during the Proposed Development's construction and will aim to replace habitats lost with similar or higher value habitats. On this basis the HMP (**Appendix A**), is therefore largely focussed on peatland and bog habitats.

3.4.2 Bog Restoration Area Required for Biodiversity Compensation

Following ditch blocking and an associated change in the vegetation within the zone of influence around each ditch blocked (taken to be 5 m to 30m see Section 3.3.1.3), we expect bog habitat to reach good condition.

In keyholed forestry felling areas around turbines we expect forest to bog restoration to be successful but that bog will only reach poor/ moderate condition due to drainage influences from infrastructure and remaining forestry as well as potential issues with forest self-set and regeneration, poor condition has been assumed on a precautionary basis. In most of these keyhole locations ground smoothing will be undertaken making restoration to PB3 practical and success more likely than in the area around proposed turbine 10, where there is no agreement for bog restoration and therefore drained, drier conditions are likely to persist (PB4), and recovery may take significantly longer (we have assumed the default 30+ years, as per multipliers in the BNG metric)

3.4.2.1 The following sections explain the rationale behind the bog enhancement strategy. Approach to Calculation of Required Restoration Area (ha): Metric Selection

There is no standard compensation to restoration ratio for peatland loss set out in Irish guidance, this may be resolved to some extent in future by the recently released ITT metric if it is up-dated to reflect large area projects as well as linear infrastructure.. We have therefore drawn on guidance for similar contexts that is available for Scotland, England, and the SSER biodiversity tool kit (SEE metric) which is becoming increasingly widely accepted in Scotland and is more flexible and design more specifically for large-scale renewables projects than the English statutory metric (statutory metric).

Before choosing a metric as an approach to calculating habitat loss compensation ratios for the Proposed Development it is important to understand the likely difficulty and time to target condition in this context. Multipliers for these are used in both the statutory and SSE metrics. For both metrics the multipliers are the same for the same difficulty to time categories, however the SSE metric permits manual selection of which category is most suitable whereas this is fixed in the statutory metric.

3.4.2.2 Literature on Bog Restoration Timescales and Success

3.4.2.3 Time to Target Condition

Mounting evidence from Scottish sites indicates that the transition from moderate to good condition blanket bog via drain blocking is likely to be in the region of 5 - 15 years (Statutory metric multipliers = 0.837 to 0.586). For example, at Forsinard Flows Reserve Sphagnum cover increased from around 5% to around 20% in 14 years (1997 to 2011 (RSPB 2012)) following tree felling and ditch blocking. A broader study based on five sites in the Peak District National Park echoes this and indicates that the majority of bog condition indicators have reached levels expected of restored bog in 5-10 years[50] (Figure 3).

This study states that "*at timescales of around a decade these systems achieve a new steady state for most ecosystem functions.*"

We have therefore used a time to target condition multiplier that reflects a 10 year restoration timescale (multiplier = 0.700).

[50] Alderson, D.M., et.al. 2019. Trajectories of ecosystem change in restored blanket peatlands. Science of the Total Environment 665 (785-796).

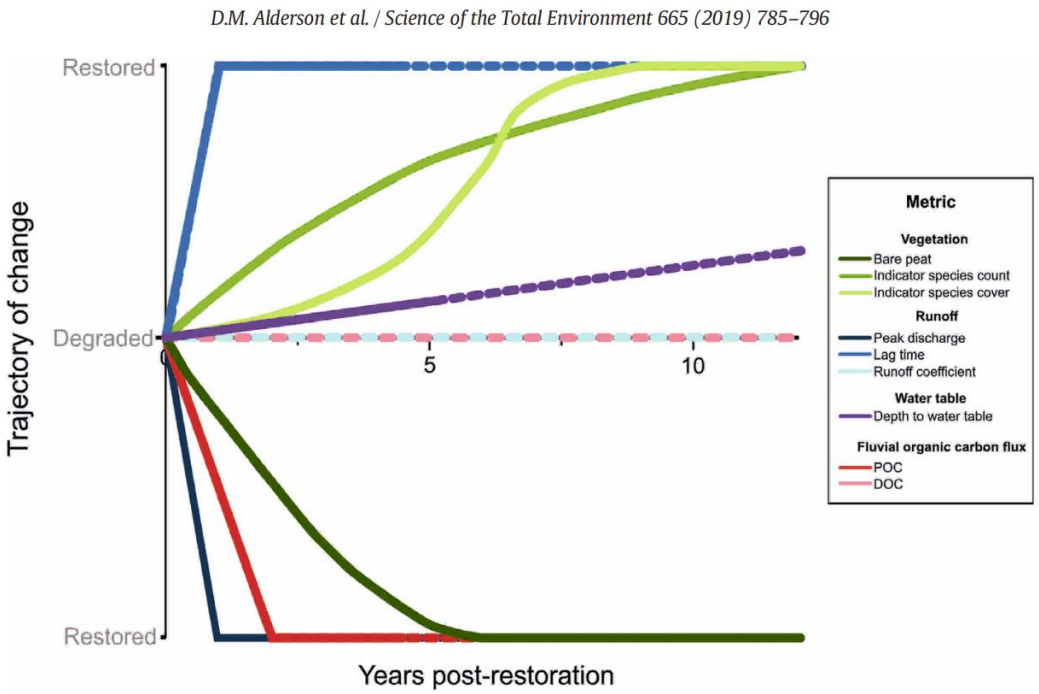

Figure 3: Bog restoration time scales. *Taken from Alderson et. al. 2019: Conceptual model of trajectory of change of key metrics representing ecosystem services in response to restoration. The extremes of the y axis represent a restored ecosystem.*

3.4.2.4 Difficulty of Restoration

The difficulty of habitat enhancement multiplier represents the risk of enhancement work failing to achieve the desired outcome based on a range of variables that influence restoration success including for example hydrological regimes, soil nutrients, and sources of biological material, and on-going management needs etc. We take the 0.33 high difficulty multiplier included in the Statutory Metric to infer that the two thirds of the restoration area is expected to fail to attain the desired condition within the relevant time to target condition.

The difficulty of peatland restoration varies greatly depending on the situation and restoration methods required, from more challenging areas being for example large expanses of bare peat at high altitude, on sloping ground; to more straightforward projects such as those involving ditch blocking at lower to moderate altitude on flat to gently sloping ground. The Statutory Metric does not distinguish between these.

The literature however suggests that bog-restoration via ditch blocking has a relatively high success rate where implemented following best-practice guidance (RSPB 2012). In addition, evidence complied by Artz et. al. 2018[51], indicates that rewetting (reflecting drain and gully block activities) across 15 sites extended to slightly beyond the area treated in the first year, with success stabilising at around 60% in the longer term (Figure 4).

[51] Artz, R. R.E., et. al. 2018. Peatland restoration – a comparative analysis of the costs and merits of different restoration methods. Climate x change: Scotland centre of expertise connecting climate change and policy. https://www.climatexchange.org.uk/wp-content/uploads/2023/09/peatland-restoration-methods-a-comparative-analysis.pdf

A multiplier for moderate difficulty of 0.67 is therefore more realistic in this instance, where ditch blocking is proposed on flat to gently sloping land, than the 0.33 multiplier would be.

We have therefore used a difficulty multiplier that reflects moderate difficulty (multiplier = 0.67).

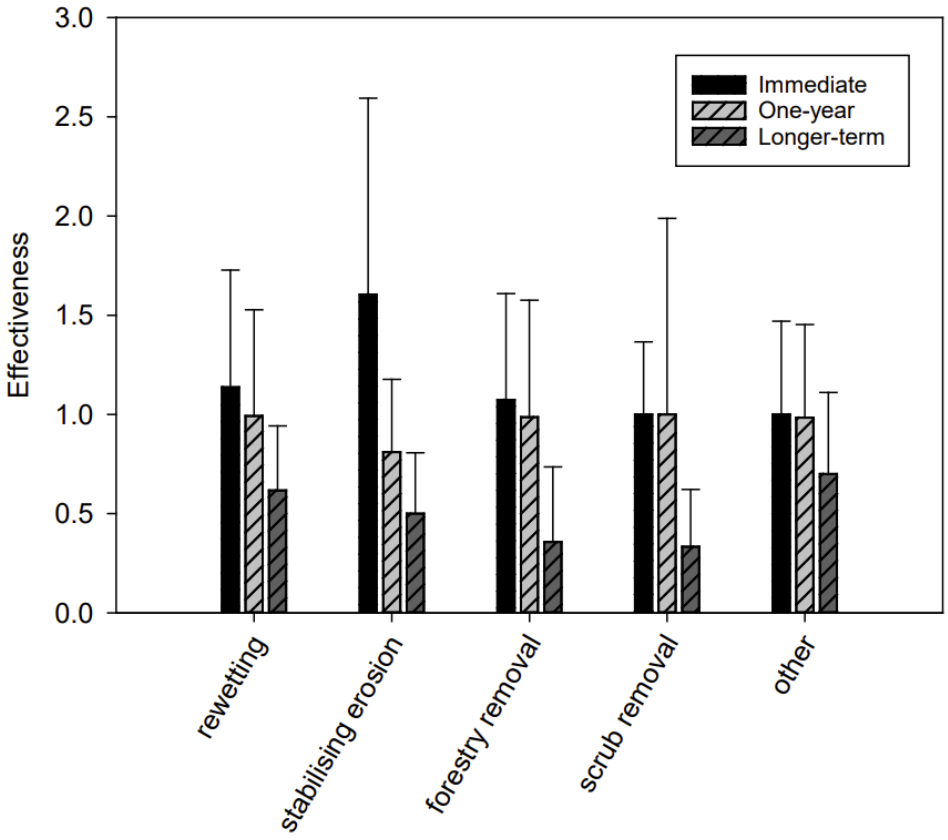

Figure 4: Bog restoration success. *Taken from Artz et. al. 2018: Perceived effectiveness of the restoration intervention types, based on 19 completed responses.* Effectiveness for rewetting = proportion of the intended area rewetted.

3.4.2.5 Bog Condition Enhancement & Forest to Bog Assumptions

Where cutover bog PB4 is to be rewetted by ditch blocking including replacing lost peat by infilling ditches with excavated peat, this has been entered into the metric as enhancement from PB4 to PB3 (lowland blanket bog). This in addition to condition enhancement from baseline to good condition. In both cases adjusting the area considered to exclude the 30m buffer of infrastructure which may not fully rewet.

Where forest will be felled but will not be replaced with infrastructure, in most locations ground smoothing will be undertaken. Here the end habitat is anticipated to be PB3. However, in the land-holding around T10 where ground smoothing will not be undertaken, the end habitat is anticipated to be PB4 as ditches and areas where peat has been removed will be left untreated. In this area recovery to bog habitat even in poor condition is expected to be slow and we have implemented the automatic time to target condition of 30+ years (as per default BNG metric time to target condition multipliers).

3.4.2.6 Metric and Policy Compensation and Calculations Comparison

3.4.2.7 Scottish Guidance

Scottish guidance[19] requires a blanket **1: 10.0** ratio of bog habitat loss to restoration, plus a 10% gain.

3.4.2.8 English Guidance

The application of Statutory BNG metric is mandatory for development projects such as wind farms in England. It is designed to calculate the value of habitats and to assess BNG for developments. Habitat value is based on its area * distinctiveness * condition and measured in biodiversity units (BU). The metric then uses two main multipliers to assess the area of habitat restoration required to compensate for any BU lost during construction. These multipliers relate to:

- The length of time a habitat is expected to take to reach the habitat type and condition desired relative to baseline (time to target condition); and
- How difficult it is to achieve successful restoration, e.g. risk of complete or partial restoration failure (difficulty of creation/enhancement).

The statutory metric assumes that c., 2/3rds of the bog restoration effort will fail (multiplier of 0.33) and that the time to target condition is in excess of 30 years for enhancement from poor or moderate to good condition (multiplier of 0.32) or 20 years for enhancement from poor to good condition (multiplier of 0.49).

Natural blanket bog is considered to be very-high distinctiveness (score = 8) and be an irreplaceable habitat for which bespoke compensation is required and BNG calculations cannot be undertaken if loss of these is involved. Degraded/ cut-over bog is considered high distinctiveness (6).

Statutory Metric Calculation = ((post-management: distinctiveness * condition * area) - (baseline: distinctiveness * condition * area)) * (difficulty of restoration e.g. 0.33 * time to target condition e.g. 0.32).

Using these multipliers and assuming that the area of bog lost is in the same condition as restoration area baseline, a restoration ratio of **1: 4.7** (enhancement from poor to good condition (time multiplier = 0.32)), **1: 6.2** (enhancement from poor to moderate condition (time multiplier = 0.49)) to **1: 18.9** (enhanced moderate to good condition (time multiplier = 0.32)), is required to reach a roughly net neutral position. Note this this only achieves net zero and in reality, a 10% gain is required based on the precautionary principle.

3.4.2.9 SSER Biodiversity Tool Kit (SSE metric)

The SSE metric is essentially a version of the statutory metric that has been modified by SSE to better reflect up-land areas and the renewables sector, this makes sense as the statutory metric was largely designed around the built environment sector in lowland England. Realistically, habitat distinctiveness, and creation and enhancement difficulty and timelines can be quite different between these different settings. Both metrics use the same multipliers e.g. 30+ year to target condition = 0.32.

Like the statutory metric, the SSE metric also differentiates between natural blanket bog (distinctiveness 8) and cut-over bog distinctiveness (6).

The SSE metric reflects this context dependence of habitats by permitting for adjustments for the difficulty of restoration and time to target condition multipliers, based on scientific evidence and professional judgement, these are fixed in the Statutory metric.

In addition, the SSE metric permits calculations involving blanket bog loss so long as it does not meet SSE's definition of irreplaceable habitat, which effectively requires the bog to be in priority Annex 1 condition (for more detail see Section 0).

Like the statutory metric the SSE metric requires bespoke compensation for loss of irreplaceable habitats.

3.4.2.10 Transport Infrastructure Ireland Biodiversity Metric Tool for Road, Greenway and Light Rail Projects: User Guide Document

This tool was released in December 2025[52], it is Ireland specific however its focus is on linear infrastructure projects. For this reason and as at the time of its release BNG calculations for the Proposed Development were largely complete, we have not used in in the assessment of the Proposed Development. We do however make reference to it where appropriate.

3.4.2.11 Summary

The use of a metric has merit in providing consistency and a well-recognised (in the GB and Ireland) standard approach to determining compensation requirements. Based on the above, it is considered that the Statutory metric calculation approach would not provide an accurate reflection of likely restoration conditions at the Proposed Development in particular as it will not permit calculations involving bog habits. Therefore, a more flexible metric like the SSE Metric is more appropriate in this case both for undertaking this calculation and in reflecting the project setting in its design.

Our approach to selecting the SSE metric rather than the statutory metric reflects the theme of proportionality in EIA as per CIEEM guidance[53], as well as good scientific practice in examining the appropriateness of model (metric) parameters for individual use cases.

At the Proposed Development the literature indicates that combining a '10 years to target' condition multiplier (0.7), with a moderate difficulty of habitat enhancement (0.67) multiplier.

Using these multipliers and assuming that the area of bog lost is in the same distinctiveness and condition as the restoration area baseline and is enhanced to better condition rather than an more distinctive bog habitat, a restoration ratio of **1:1.1** (enhancement from poor to good condition), **1:2.1** (enhancement from poor to moderate condition) to **1:4.26** (enhanced moderate to good condition), is required to reach a roughly net neutral position. Note this only achieves net zero and in reality 10% gain is required based on the precautionary principle. As the majority of bog at the Proposed Development is in moderate condition a c.10% gain would require a ratio of around **1:8**.

In this instance however, the potential to block and infill ditches additionally permits that it is realistic to assume PB4 bog (high distinctiveness) will be enhanced to PB3 bog (very high distinctiveness. Assuming enhancement from moderate condition PB4 to Good condition PB3 over 10 years a 10% gain will be achieved with a restoration ration of **1:3**.

As bog habitat loss is anticipated to be in the region of 30ha, this will require up to 99 ha to reach a 10% gain.

This assumes that restoration is from moderate to good condition. However as in some areas, restoration from poor to good condition is likely possible and here the area required will likely be slightly lower. See section 3.7.1 for BNG calculations and results.

[52] https://cdn.tii.ie/publications/GE-ENV-01112-01.pdf

[53] "The evaluation of significant effects should always be based on the best available scientific evidence proportionate to the severity of those effects"

Post-enhancement monitoring will be carried out to confirm the effectiveness of the bog restoration measures.

3.5 Step 2: Determine Carbon Balance: Accounting for Sequestration by Restored Bog and Re-use of Excavated Peat

3.5.1 Overview

The IUCN's Emission & Carbon Cost Calculator was completed with the required information from the SSE Biodiversity Tool Kit spreadsheet created for the Proposed Development, the Peatland Code and the Peatland Code Field Protocol. The SSE Biodiversity tool kit provided the area for each assessment unit of peatland that is to be restored. The Peatland Code and the Peatland Code Field Protocol provided the necessary carbon emission factors for pre-restoration and post-restoration condition categories, as well as the information to validate the correct pre-restoration and post-restoration categories.

Using this information, the emission reduction for each area unit was calculated. These were then cumulated into a final high claimable emission output for the project, assuming a total project length of 35 years. A low claimable emission output for the Proposed Development was also calculated, accounting for a risk buffer contribution of 5% and final carbon costs of circa 10,000 tCO2e for the Proposed Development.

3.5.1.1 Carbon sequestration via bog restoration

It is assumed that all areas will be rewetted and that the Proposed Project lifetime will be 35 years. 200 hectares of the Main Wind Farm Development Site and HEA will be rewetted via the following, details are provided in the HMP:

- Ditches blocking and in-filling within open habitats c. 162 ha (to reach good condition in 10 years).
- Ground smoothing in key-holed and other areas of forest felling c. 20.25ha (to reach poor condition in 10 years).
- Forest to bog in key-holed and other areas of forest felling near T10 c. 4.29ha (to re-ach poor condition in 10 years).
- Reprofiling of cutting faces in areas of peat extraction c. 14ha (to reach good condi-tion in 10 years).
- High level estimate:
- Gross emission estimate: 988.6 tCO_2e per year
- 35 years of sequestration = 34,603 tCO_2e
- **Low level estimate** (5% risk buffer per year and 10,000 tCO_2e carbon costs):
- Net emission estimate: 939.2 tCO_2e per year
- 35 years of sequestration – 10,000 tCO_2e carbon costs = 22,872 tCO_2e

3.5.2 Avoided Emissions via Excavated Peat Re-Use

3.5.2.1 Capacity for peat re-use on site

Within the peatland restoration area, there is a total drainage ditch length of 98 km (Figure 6). Survey data indicate ditches are typically 1 m in depth and 1.5 m wide resulting. Excluding lengths that are within 30 m of watercourses from those that are suitable for back filling leaves c. 80 km.

3.5.2.2 Peat excavation volumes and excesses

By keeping the excavation of peat on the Main Wind Farm Development Site as low as practical (125,180m^3), it has been practical to find ways to re-use all excavated peat on site (see **Technical Appendix 6.3**), with 107,080m^3 that may otherwise have been disposed of offsite potentially leading to oxidation and carbon emissions, being used for in-filling ditches.

Reuse of excavated peat in bog restoration therefore will mitigate the extent of CO_2e emissions released due to the project via peat excavation by approximately c. 119.9 tCO_2e for the project overall. This figure assumes a depth of 1m, does not take into account the emissions associated with excavation and transport and is based on a middle value of higher and lower estimates calculated in line with the methodology presented under Section 3.5.1.1.

3.6 Step 3: Determine the total area of bog that it is feasible to restore (re-wet) within the open ground on the Main Wind Farm Development Site & HEA, taking into account constraints such as infrastructure and ecological sensitivities.

3.6.1 Hydrology & Hydrogeology Setting and Screening

The Main Wind Farm Development Site is drained by three watercourse catchments:

- Doolough Stream to the northwest, which ultimately discharges to Blacksod Bay;
- Tristia to the east, which ultimately discharges to Tullaghan Bay; and
- An Ráith to the south, which ultimately discharges to Blacksod Bay.

Both the Tristia and An Ráith watercourses were classified by the Environment Protection Agency (EPA) as Good in the most recent (2019-2024 cycle) classification, whilst the Doolough Stream was classified as Poor, due to invertebrate status / potential with reported pressures from agriculture and peat extraction.

The hydrology of the Main Wind Farm Development Site has been altered significantly by an extensive network of drainage ditches across the entirety of the Main Wind Farm Development Site as illustrated in Photograph 1 and Photograph 2.

The HEA has historically been used for peat extraction and whilst vegetation has returned to the flat surfaces, the vertical cut faces are bare peat as illustrated in Photograph 3

Photograph 1: Aerial Photograph Illustrating Extent of Drainage Network Across Site

Photograph 2: Typical Ditch

Photograph 3: Peat Excavation Face

Historically ditches were installed by the landowner with the intention to lower groundwater levels in the peat soils to drain to watercourses in order to improve productivity of the soils for agriculture. These ditches provide the Proposed Project with an opportunity for ditch blocking and peatland re-wetting. Surface runoff from precipitation is routed via the network of drainage ditches to watercourses and infiltration to the soils to maintain high groundwater levels is hindered. This routing of runoff to watercourses, which would otherwise have infiltrated to the peat, results in a more flashy flow regime in watercourses where river levels rise and fall faster in response to precipitation events.

The degraded peatland habitats observed across the Main Wind Farm Development Site and HEA are a result of this lowering of groundwater levels and intervention presents opportunities to prevent further drying out of soils and to raise the groundwater levels within the peat, improving habitats and regulating flow to the water environment to offer improvements in water quality and flow through use of peatland habitat restoration methods.

Geological Survey Ireland (GSI) describe the bedrock that underlies the Main Wind Farm Development Site and HEA as foliated orthogneisses (**EIAR Figure 6-3**) derived from a sequence of trondhjemitic, granodioritic and granitic igneous precursors with localised migmatisation and potassium metasomatism. All are deformed to a variable degree, and metamorphosed and intruded by several ages.

The GSI record the foliated orthogneiss bedrock unit as a poor aquifer (**EIAR Figure 7-4**) which is generally unproductive except for local zones. The GSI report blanket peat lying directly on top of the bedrock. The low permeable nature of the bedrock beneath the Main Wind Farm Development Site and HEA is ideal for maintaining high groundwater levels and is not a constraint for peatland restoration.

The Environment Protection Agency (EPA) classify the ground waterbody at the Main Wind Farm Development Site (ground waterbody ID: Belmullet, **EIAR Figure 7-6**) as Good within their 2019-2024 cycle.

3.6.1.1 Screening Results

From review of the geology, hydrogeology, peat and drainage data for the Main Wind Farm Development Site the ditch network suitable for blocking is extensive (Figure 6), and the only constraints on site are:

- Larger slopes greater than 6°, which, where present, are generally associated with the banks of watercourses (Figure 5);
- Areas less than 1 m of peat depth (Figure 7);
- It is intended only keyhole felling is competed in the areas of forestry, the areas of forestry are not considered an ideal candidate for potential restoration whilst commercial forestry remains in place.
- Proposed infrastructure where a 30 m bog restoration effectiveness buffer has been assumed (Figure 8);
- Watercourses where a 30m buffer is not currently assumed to be necessary but may be required if during implementation, mitigation designed to protect the watercourse from bog-rewetting activities is not considered sufficient, based on live evidence at the time (Figure 8).

It is noted that some small, isolated areas of slopes greater than 6° exist on site as a result of the manmade features on site, however because of their isolated nature surrounded by flat topography they are not considered a constraint.

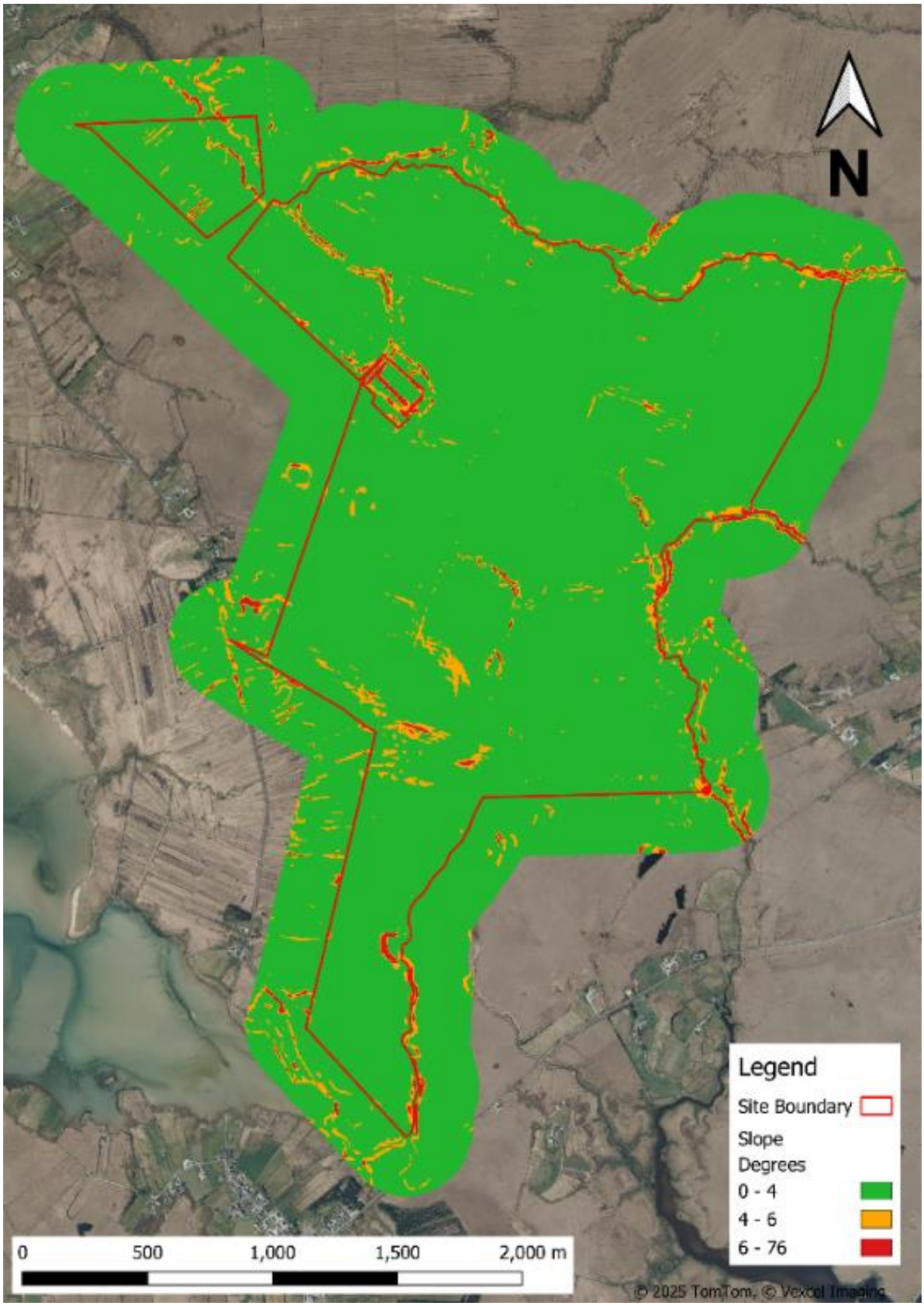

Figure 5: Slope (Site = Main Wind Farm Development Site & HEA)

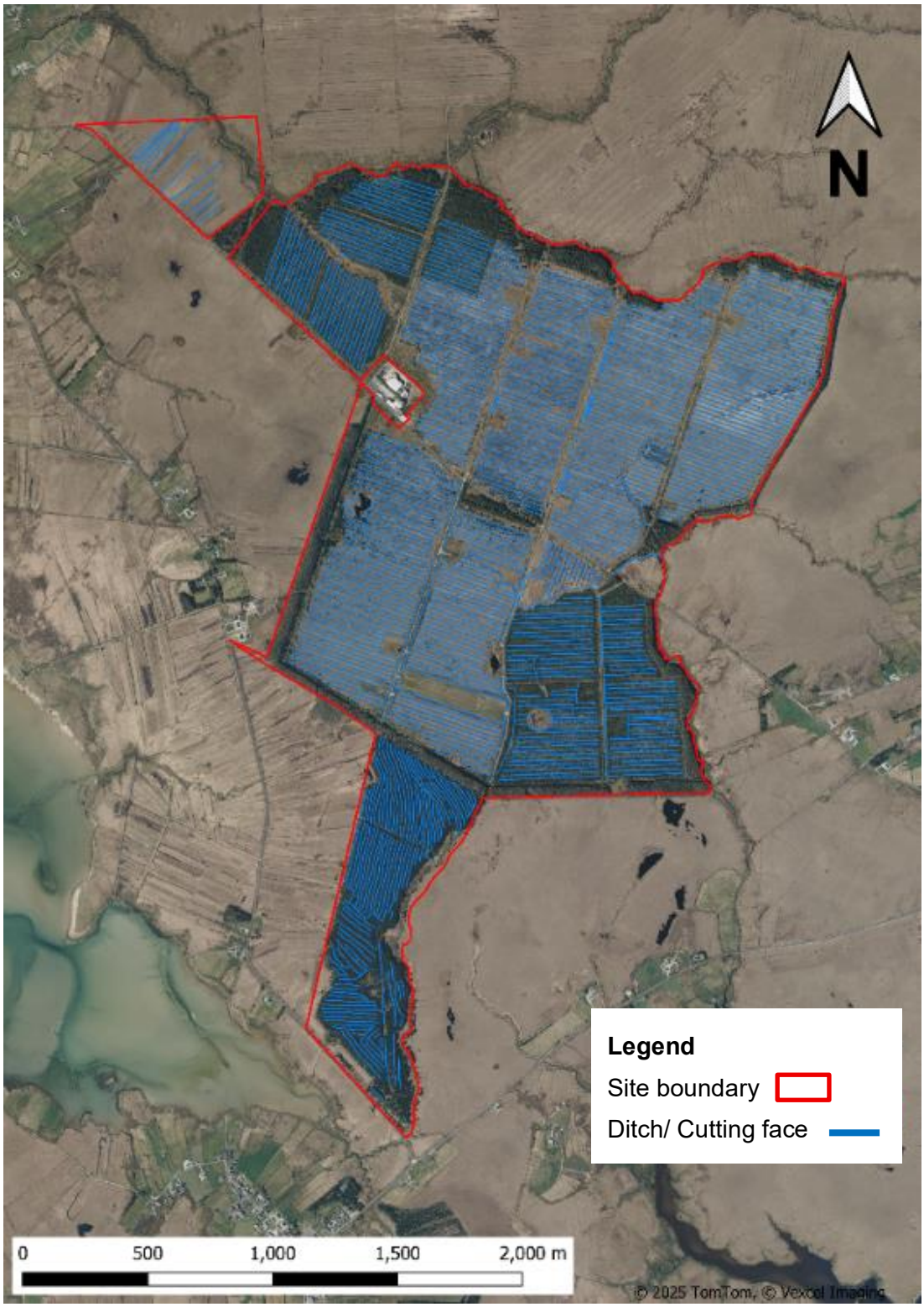

Figure 6: Ditches and Cutting faces (Site = Main Wind Farm Development Site & HEA)

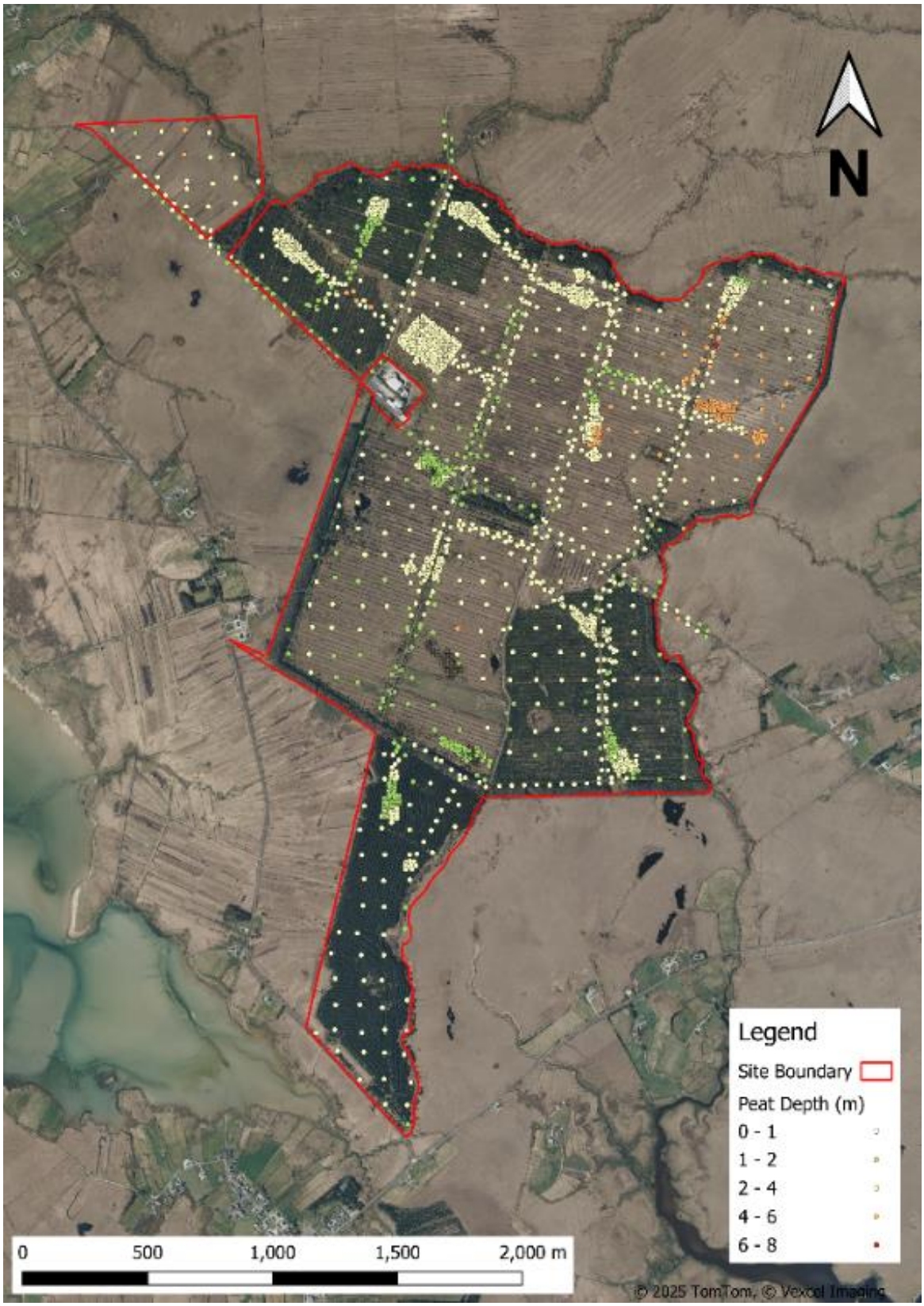

Figure 7: Peat Depth Data (Site = Main Wind Farm Development Site & HEA)

Potential Candidate Areas for the restoration of peatlands within the Main Wind Farm Development Site and HEA are illustrated in Figure 8.

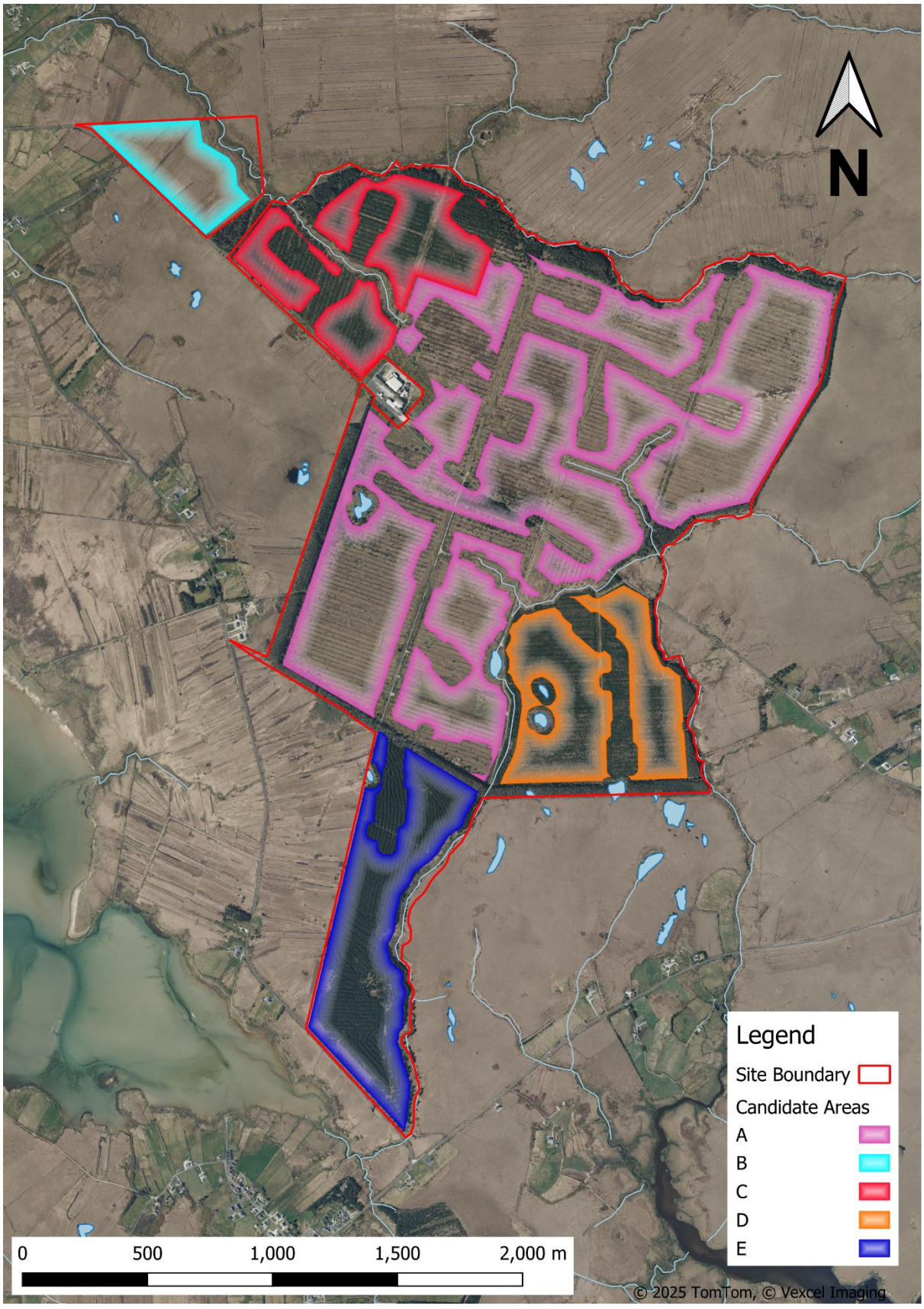

Figure 8: Potential Restoration Candidate Areas (Site = Main Wind Farm Development Site & HEA.)

This Figure shows a 30m buffer of infrastructure where re-wetting is less likely to be effective and a 30m restoration buffer of watercourses where infilling will not be undertaken but it has been assumed for purposes of this document that ditch blocking will be undertaken.

3.6.2 Infrastructure Constraints

Based on Nature Scot bog restoration guidance[19] to determine the distance for new and existing infrastructure where bog restoration may not be fully effective a 30m buffer was considered appropriate to reflect the distance into the bog over which the infrastructure associated drainage may limit re-wetting effectiveness.

No bog restoration will be undertaken in the land-holding around T10, in accordance with landowner agreements.

3.6.3 Ornithological Considerations

Peatland restoration at the Main Wind Farm Development Site will involve blocking the ditches with the aim of returning the water table to within 10cm of the peat surface enabling the growth of peat forming/ carbon sequestering species. This will enhance the condition of the bog habitats on the Main Wind Farm Development Site and make them more favourable for associated species of fauna including bird species that favour bog habitats such as waders where vegetation is shorter; and Hen Harrier, Merlin and their prey species such as meadow pipit where taller dwarf-shrubs and Molinia dominate.

However, based on the findings of the ornithological surveys carried out at the Main Wind Farm Development Site, it is unlikely that significant numbers of high collision risk bird species would be attracted into the Main Wind Farm Development Site (**See Chapter 5: Biodiversity** of the EIAR for more details).

In addition, the operational turbines will act as a continuous source of disturbance. As such, any displacement effects on birds are likely to persist once the habitat enhancements have taken effect.

Therefore, the improvements to habitat quality will not attract birds back to the area in a way that would significantly increase collision risk (See **Technical Appendix 5-8 Avian Collision Risk Model** report in Volume 3 of the EIAR for more details).

Overall, the ecological and ornithological benefits of rewetting peat include providing additional habitat for open-ground bog species and will outweigh any slight increase in collision risk that improved habitat condition near to turbines may entail which is not likely to be significant in the context of the EIA Regulations.

3.6.4 Potential Restoration Methods

3.6.4.1 Scrub Clearance

Scrub vegetation is present and widespread throughout the Main Wind Farm Development Site. As scrub contributes to drying of peatland, removing it can aid re-wetting and promote growth of Sphagnum mosses. Sphagnum mosses are a critical part of any peatland restoration effort due to their ability to absorb and retain moisture, acidify the surrounding environment and thus, slow plant decay and allow greater carbon storage in the soil. Scrub clearance will therefore be undertaken and included as one element of the HMP.

At the Main Wind Farm Development Site, this will be most effectively achieved by using a brush cutter and chainsaw with vegetation being cut up into smaller, more manageable pieces before being mulched. Sections too large to be cut by a chainsaw will be left on the

bog surface to promote biodeterioration, biofragmentation and ultimately assimilation into the underlying peat.

Scrub clearance is not confined by the buffers associated with proposed infrastructure as it is will not substantially impact the water environment, however it remains subject to ecological constraints including nesting birds, reptiles, etc.

3.6.4.2 Ground/Surface Smoothing

Again, owing to the widespread legacy ditch network that has lowered groundwater levels at the Main Wind Farm Development Site from the ridge/furrow pattern across much of the site, ground/surface smoothing would aid the regeneration of the peatland environment by encouraging water table rebound and vegetation recovery, particularly in areas of keyhole felling. Ground smoothing will be carried out in these keyhole areas.

By manipulating the topography and creating a more uniform surface, it allows the natural hydrological function of the area to be restored and encourage growth of advantageous peat-forming vegetation like Sphagnum mosses. The primary means of ground/surface smoothing are inverting any tree stumps within the candidate areas, ditch blocking, compacting the land with machinery, covering the surface with mulch, and infilling drains.

Ground/surface smoothing is not confined by the buffers associated with proposed infrastructure or the water environment unless combined with ditch blocking, however remain subject to ecological constraints including ground nesting birds, reptiles, etc.

3.6.4.3 Ditch Blocking

This method involves creating a blockage (or dam) within a ditch, preventing the drainage channel acting as a conduit for water flow and draining the peat soils, thus raising the water table. As part of the earthworks associated with the Proposed Development, peat will be excavated during construction of hardstanding and other elements of infrastructure.

There are three approaches for ditch blocking that will be implement on the Main Wind Farm Development Site, generally constrained by the width of the drainage channel:

- Dams (wooden and/or peat) with infilling from excess peat on all ditches;
- Zipping / zippering on ditches <1.5 m wide; and
- Dams (wooden and/or peat) on all ditches.

The management of the peat during excavation and storage will be delivered by the Peat Management Plan (PMP) (**Technical Appendix 6.3** of the EIAR). The excavated peat provides a great opportunity for the improvement of hydrogeology and peatland habitats at the Main Wind Farm Development Site.

At the Main Wind Farm Development Site it is intended that suitable ditches (those not within the buffer of natural watercourses) are entirely backfilled with excavated peat from earthworks within the development area. Due to the length of ditches to be infilled, dams will be placed at routine 10-20m intervals to maximise stability and water retention of the peat within the legacy ditch. Alternating wooden and peat dams will be used at the Main Wind Farm Development Site owing to their greater longevity in the acidic peat environment and very low slopes observed on the Main Wind Farm Development Site whilst providing a resource efficient solution. Peat dams are generally unsuitable where the depth of solid peat at the base of the drain is ≤50cm.

Ditches will have surface vegetation removed from the sides and base of the ditch prior to the emplacement of excavated peat and any vegetation will be placed on any bare peat. Dams will be keyed (extended), into the deep peat at either side of the ditch to provide the

best watertight seal that can be achieved whist ensuring stability. When using peat to form the dam, this will be done up to a maximum ditch width of 1.5m and depth of 1.2m.Dried out or unconsolidated peat will never be used, only highly humified, fully waterlogged peat should be used. As the peat is inserted into the drain, it will be compacted and upon completion the dams top will be extend approximately 30cm above the surface of the bog and covered with a living layer of peatland vegetation.

Ditches will be infilled up to a 30m buffer from proposed watercourses. The end point of the infilling will be secured with a dam to maximise stability.

Should it be impractical to infill the ditches within the Candidate Areas, zipping / zippering and ditch blocking using wooden dams or peat recovered from a small borrow pit near to the planned ditch dam will be used as to raise groundwater levels.

Zipping is a form of re-profiling that is typically used in conjunction with wave damming. Dams are formed every 8 m with the remaining drain line between each dam “zipped”. Unlike other forms of re-profiling, this technique completely in-fills the drain void and therefore natural surface flow path ways are instantly restored. Zipping will be prioritised on ditches <1.5 m wide to reserve peat infilling on ditches wider than 1.5 m in the unlikely event that there is insufficient peat to infill all ditches within the Candidate Area.

Dams without the associated backfilling with peat will follow the same construction methodology and criteria as those ditches for peat infilling however these will retain water behind the dams, with excess water encouraged to spread out over the surface of the peatland. Vegetation within the ditches will be left in place while these dams are put in place and water levels rise.

In terms of re-wetting potential current BNG calculations assume a 30 m buffer from infrastructure for condition enhancement due to its drainage influences, and no buffer from watercourses (assuming ditch blocking but not infilling within the 30m watercourse buffer).

3.6.4.4 Hag Reprofiling

The HEA has historically been used for the removal of peat, with bare faces of peat exposed at the edges of where peat was cut away remaining (Photograph 3). The angle the peat face here is too great for vegetation to establish and reprofiling is needed to achieve an appropriate angle to encourage vegetation to return whilst minimising erosion. Here the layer of live vegetation including its roots will be removed (but retained for later use) back far enough to allow the reprofiled face to maintain an angle of around 30 degrees (typically around 2 m).

The peat face will be reprofiled to 30 degrees and compacted to ensure there are no air pockets or cavities where water could escape. The reserved vegetation will then be stretched out across the reprofiled face. If there is insufficient vegetation to provide a cover of the reprofiled face, then vegetation will be recovered from areas of excavation in the main site or by creating a small borrow pit near the reprofiled area and transferring vegetation from the borrow pit to the reprofiled face, stretching the adjacent vegetation over the borrow pit area to ensure it also has been protected. The layer of vegetation will then be compacted into the peat to ensure a good contact of roots with the underlying peat.

A restoration buffer of 30m should be applied to both sides of the re-profiled hag to estimate the area that will benefit from the restoration work, this equates to 14.7ha.(**Figure 6**).

Note that the cutting faces were mapped remotely (c. 4.61km in total), and should be mapped in the field during post-consent production of the next iteration of the habitat management plan to further refine the estimate of the restorable area.

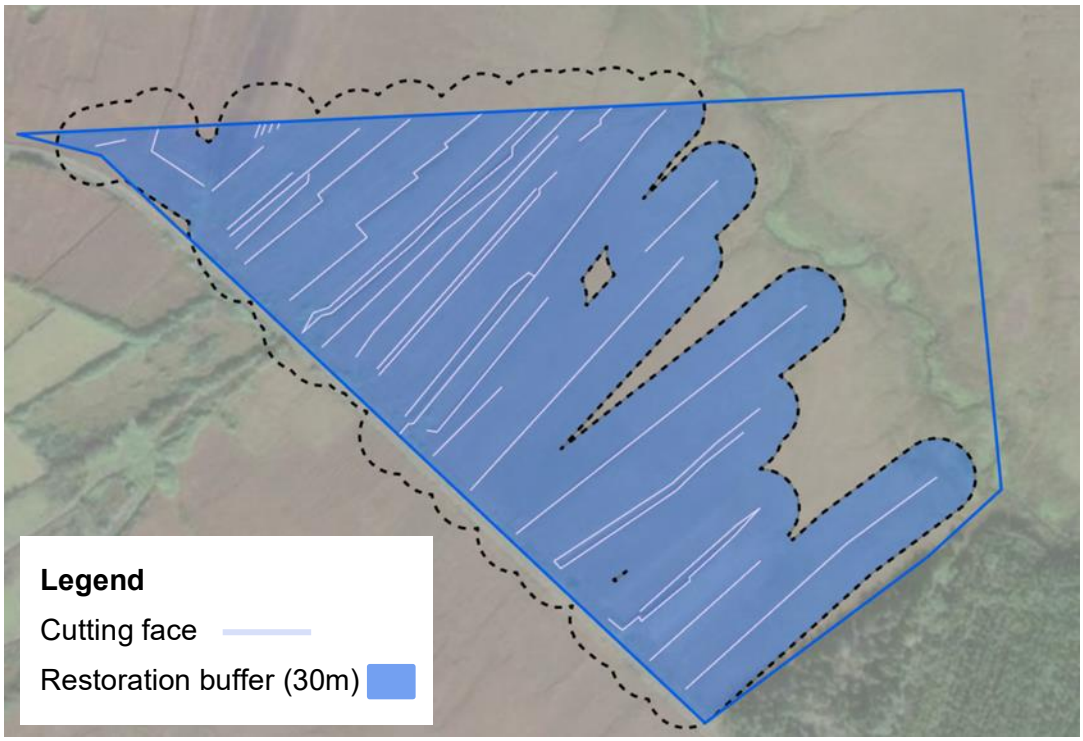

Figure 9: Estimated restorable area via cutting face re-profiling

3.6.5 General feasibility

Regarding topography and peat depths, there are very few constraints on the Main Wind Farm Development Site or HEA for peatland habitat restoration including the re-use of excavated peat from the development. The area within the Main Wind Farm Development Site & HEA is generally flat with very limited areas where slopes are greater than recommended for peatland habitat restoration (slopes greater than 6 degrees), all of which are bound to the larger ditches on site and would not be considered suitable for peatland habitat restoration due to their proximity of natural watercourses regardless. Peat depths across the Main Wind Farm Development Site & HEA and have been surveyed over a series of peat probing exercises, which have confirmed peat depths across the site are almost entirely in excess of 1m and therefore not a constraint for peatland habitat restoration methods including ditch blocking, which is the preferred restoration approach here.

3.6.6 Area available for restoration

All open areas within the Main Wind Farm Development Site & HEA and the key holed areas within forestry are suitable for bog restoration, via:

- Scrub clearance across the entire Main Wind Farm Development Site;
- Ground smoothing within key-holed areas in forestry, except around T10 (Candidate Areas C, D and E);
- Ditch blocking and infilling in open areas within the Main Wind Farm Development Site (Candidate Areas A and B); and
- Cutting-face re-profiling within the HEA , where peat cutting has historically taken place (Candidate Area B).

Details on re-wetting buffers and associated restoration area calculations are provided above.

In line with NatureScot guidance, re-wetting may not be fully effective within 30m of new and existing infrastructure due to their associated drainage features and that meaningful enhancement of bog condition in these areas may not be practical. Therefore, these areas have been excluded from calculations of the restorable area (they are treated as retained, minus any direct loss to infrastructure).

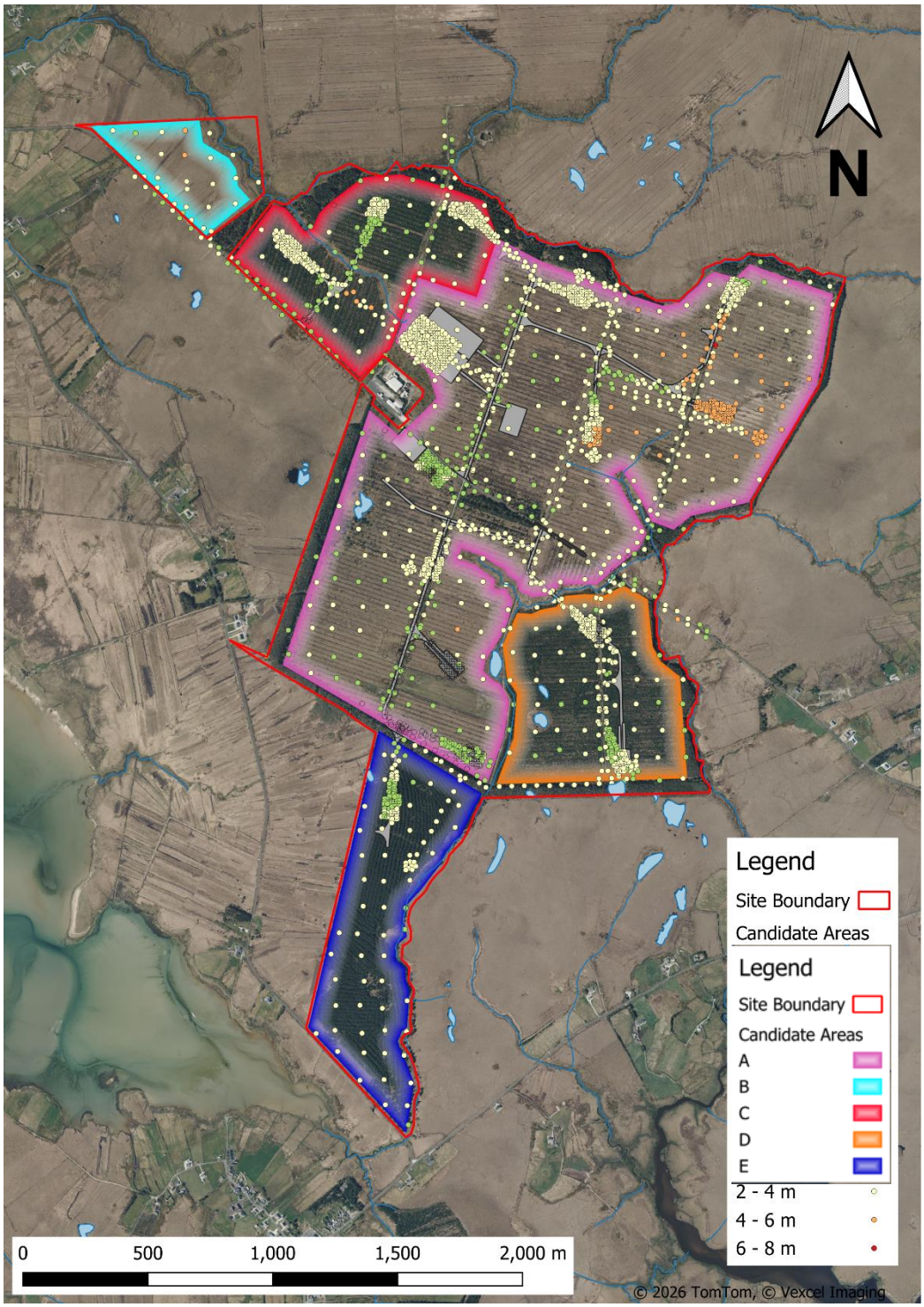

Figure 10: Restoration Feasibility Candidate Areas, and Peat Probe Locations (dots)

3.7 Step 4: Define the area of bog to be restored and provide an associated Habitat Management Plan.

See Section 3.1, which discuss and define the area of bog to be restored. The associated habitat management plan can be found in Appendix A.

3.7.1 SSE Metric – BNG Calculation Methods for Muingmore

3.7.1.1 Approach to Irreplaceable Habitats (active / priority annex 1 bog)

SSE guidance[54] states that: "*Where designated sites, legally protected species or irreplaceable habitats are being negatively affected, project wide claims should not be made, even if these impacts are compensated for. In these situations, projects should aim to achieve net gains in other non-irreplaceable habitats*."

Irreplaceable habitats are noted by SSE to "*include all areas of active blanket bog or raised bog*". Based on the EUNIS definition[55] this would be equivalent to priority Annex 1 bog where "*active*" is taken to mean "*still supporting a significant area of vegetation that is normally peat forming*".

The SSE guidance additionally states that: "*Irreplaceable peatland in Scotland has been considered by SSE as all areas of blanket bog or raised bog where the condition score cannot be increased e.g. good condition, which is assumed to mean 'active' blanket bog/raised bog*." Although this is Scotland specific there is no ecological reason why the same approach should not be applicable in Ireland.

In addition, the TII Irish metric[46] currently only considers bog which is mapped under Article 17 to be irreplaceable habitat.

"*Irreplaceable habitat layers and protected site boundaries are sourced from the National Parks and Wildlife Service (NPWS) data webpage[1] to inform the Options Appraisal process. Irreplaceable habitat layers are sourced from Article 17 spatial data for 2019. These layers comprise Raised bog, blanket bogs, machair, turloughs, limestone pavement and ancient long established woodland*;"

3.7.1.2 Main Site

Within the Main Wind Farm Development Site & HEA, the SSE definition of irreplaceable habitat applies only to larger areas of PB3 Lowland blanket bog not the majority of the site which is drained (PB4).

Note that the polygons of PB3 do exist within the Main Wind Farm Development Site but are small and therefore do not meet the definition of priority annex 1 bog.

The priority Annex 1 bog area associated with the Proposed Development is therefore considered to be restricted to the HEA, where bog restoration work and no infrastructure is planned. This area is also mapped under Article 17 and therefore included in the Favourable Reference Area for blanket bog in Ireland[56].

On this basis the Proposed Development will not have any negative impacts on irreplaceable habitats. Only positive impacts are planned in separate the northwest area (HEA).

3.7.1.3 Over-run Areas

Area 1: This is an area of PB3 blanket bog, however it is not considered to be active due to low cover of Sphagnum moss and is not mapped as Article 17 habitat. It is therefore **not** considered to constitute **irreplaceable habitat**.

Area 2: Is not a bog area and **does not** contain any habitats that are considered to be **irreplaceable habitats**.

[54] https://www.sserenewables.com/media/iz2jbehn/sser-bng-toolkit-user-guide_v2-2.pdf

[55] https://cdr.eionet.europa.eu/help/natura2000/Documents/Int_Manual_EU28.pdf

[56] https://www.npws.ie/sites/default/files/publications/pdf/article-17-report-2025-volume-2.pdf

Area 3: This area currently de-vegetated peatland. It is largely within an area mapped as Article 17 habitat and is therefore in BNG calculations **treated as irreplaceable habitat**.

We have undertaken BNG habitat loss calculations for Area 3 to inform a discussion of what degree of bespoke compensation may be appropriate to compensate for losses in this area.

3.7.1.4 SSER Metric Calculations

All habits anticipated to experience indirect loss were entered to the SSE Metric, as lost and re-created as the same habitat type (Creation).

Within areas of indirect loss, target condition assumptions for bog and wetland habitats as follows, other habitats are assumed to retain their baseline condition:

- If a wetland habitat in an area of indirect loss is in moderate condition at baseline, based on professional judgement we have assumed it will be in poor condition post construction.
- If a wetland habitat in an area of indirect loss is in poor condition at baseline, based on professional judgement we have assumed that while construction may further reduce condition, the habitat will not transition to another habitat type and will therefore be retained in poor condition as there is no lower condition category.

The areas to be included in the metric as areas for bog-restoration/ condition enhancement are discussed in Section 0.

We used the standard time to target condition and difficulty of restoration multipliers for all habitats other than bog where the justification above was used to select 10 years to target condition and moderate difficulty.

- Areas within 30m of infrastructure were excluded from bog enhancement areas.
- Within the approximately 24ha of felling buffer around turbines/ tracks, bog restoration to poor condition is realistic.

3.7.1.5 SSE Metric Results & Summary

Overall we anticipate a 32% gain for non-irreplaceable habitats and an 8% gain for irreplaceable habitats.

Table 3-9 provides a summary of the data for the Main Wind Farm Development Site & HEA entered into the SSE metric using the Fossit Habitat classification system, and its outputs. Similar data for the over-run areas is presented in Table 3-7, Table 3-8 & Table 3-9.

For some habitats, there are multiple rows for that habitat at baseline depending on the expected post-management outcome for that area e.g. loss and creation of a new habitat, or habitat enhancement.

3.7.1.6 Non-Irreplaceable Habitats

Overall, the project will result in a **+ 32%** net gain of **non-irreplaceable habitats**:

- Baseline (development site 2889.9 BU) + (over run areas 130.84) = 3,020.74 BU
- Combined development site and over-run area gain = (987.18 - 16.88) = 970.30 BU
- Combined gain = 32%

3.7.1.7 Irreplaceable Habitats

- Restoration of the HEA adjacent to the Main Wind Farm Development Site is estimated to deliver a gains of 60BU of irreplaceable habitat (lowland blanket bog).

- Proposed work in Over-run Area 3, taking into account the assumptions for this area set out earlier in this document, will result in a loss of 23 BU of irreplaceable habitat.
- Overall, this results in a **gain of 37BU of irreplaceable habitat** (8% gain).

Table 3-5: BNG Summary Main Wind Farm Development Site & HEA (over-run areas not included)

Habitat Type	Baseline Units	Post Development Units	Net Change	% Change in Units
Non-IRR	2889.9	3877.77	+ 987.18	+34%
IRR[57]	396.7	457.37	+ 60.74	+15%

Table 3-6: Over-run BNG summary - Baseline to Post - construction

Habitat Type	Area	Baseline Units	Post Development Units	Net Change	% Change in Units
Non-IRR	1	126.32	103.87	-22.45	-18%
	2	4.16	3.99	-0.17	-4%
	3	0	0	0	0
	Total	**130.48**	**107.86**	**-22.62**	**-17%**
IRR[58]	3	23.23	0	-23.23	-100%

Table 3-7: Over-run BNG summary - Post - construction to Post-reinstatement

Habitat Type	Area	Post Development Units	Post Reinstatement Units	Net Change	% Change in Units
Non-IRR	1	107.11	112.98	5.87	5%
	2	4.16	4.03	-0.13	-3%
	Total	**111.27**	**117.01**	**5.74**	**5%**

Table 3-8: Over-run Areas BNG summary – Total (Combined outcome Table 3-7 & Table 3-8)

Habitat Type	Net Change
Non-IRR	-16.88
IRR[59]	-23.23

The trading rules[60] are included alongside unit change calculations that projects must comply with in order to make BNG claims. In this case, for high distinctiveness habitats the trading rules are met (compensation is like for like or like for better condition). For medium and low distinctiveness these habitats represent an area that would historically have been bog.

[57] Irreplaceable habitats

[58] Irreplaceable habitats

[59] Irreplaceable habitats

[60] Trading rules govern what sort of habitats can be used to compensate for the loss of other habitats. For example, it is not permitted to compensate for loss of small areas of very high distinctiveness habits with larger areas of low distinctiveness habits (this would be an example of trading down).

Therefore, enhancement via trading up to a better distinctiveness habitat via bog restoration is entirely appropriate.

In summary therefore, the approach taken to bog habitat restoration set out in this report (enhancement or creation) with over c. **200 ha**, in compensation for direct and indirect loss of c. **30ha** of bog and additional enhancements. This is equivalent to an overall c. **1:6 compensation ratio.** Note that this compensation/ restoration area also accounts for the loss of 36 ha of other habitats, which are mostly 34 ha of commercial forestry, of which 24.54ha will be lost to bog restoration.

3.7.1.8 Limitations

These calculations were undertaken as far as practical using the site layout and habitat data. Therefore, the following measures will be implemented:

Pre-construction:

- Spot checks will be undertaken to determine any changes in habits since baseline surveys;
- The area where peat cutting face re-profiling in the HEA will have a confirmatory field survey undertaken to confirm the restorable area;
- The baseline situation is up-dated;
- The results will be integrated into the next iteration of the HMP plan.

Post-construction:

- The areas of habitat loss and restoration are captured accurately to take account of design flexibility.
- The BNG calculation is up-dated and integrated into the live version of the HMP.

Table 3-9: Habitat Loss, Enhancement and Creation - SSER Metric Summary for the Development Site and Adjacent Area (Over run areas excluded)

Baseline											Post-construction									Net change in units	
Habitat	Area (ha)	Condition	Connectivity	Strategic significance	IRR Habitat	Distinctiveness	IRR Units	Other habitats Units	Area Retained	Area Removed	Action	Habitat	Area (ha) created or enhanced	Condition	Connectivity	Strategic significance	Distinctiveness	Action difficulty	Time to target condition (years)	IRR Units	Other habitats Units
BL3 Buildings and artificial surfaces	1.25	N/A - Other	Low	Low	No	Very Low	-	0.0	0.8	0.4	Creation	BL3 Buildings and artificial surfaces	20.58	N/A - Other	Low	Low	Very Low	Low	0.0	-	0.0
FL2 Acid oligotrophic lakes	0.3	Moderate	Moderate	Low	No	High	-	4.0	0.3	0.0	NA	FL2 Acid oligotrophic lakes								-	0.0
FL8 Other artificial lakes and ponds	0.06	Moderate	Low	Low	No	Low	-	0.2	0.1	0.0	NA	FL8 Other artificial lakes and ponds								-	0.0
FS1 Reed and large sedge swamps	0.36	Moderate	Low	Low	No	High	-	4.3	0.4	0.0	NA	FS1 Reed and large sedge swamps								-	0.0
GS3 Dry-humid acid grassland	0.17	Moderate	Moderate	Low	No	Very High	-	3.0	0.2	0.0	NA	GS3 Dry-humid acid grassland								-	0.0
GS4 Wet grassland	16.6	Moderate	Low	Low	No	Medium	-	132.8	16.4	0.2	NA	GS4 Wet grassland								-	-1.4
GS4 Wet grassland	0.1	Moderate	Low	Low	No	Medium	-	0.8	0.0	0.1	Creation	GS4 Wet grassland	0.1	Moderate	Low	Low	Medium	Low	7.0	-	-0.8
HD1 Dense bracken	1.21	N/A - Other	Low	Low	No	Low	-	0.0	1.2	0.0	NA	HD1 Dense bracken								-	0.0
PB3 Lowland blanket bog	0.01	Moderate	Moderate	Low	No	Very High	-	0.2	0.0	0.0	NA	PB3 Lowland blanket bog								-	0.0
PB4 Cutover bog	3.82	Poor	Moderate	Low	No	High	-	25.2	0.0	3.8	Creation	PB4 Cutover bog	3.82	Poor	Moderate	Low	High	Medium	12.0	-	-14.2
PB4 Cutover bog	3.2	Moderate	Moderate	Low	No	High	-	42.2	0.0	3.2	Creation	PB4 Cutover bog	3.2	Poor	Moderate	Low	High	Medium	12.0	-	-33.0
PF2 Poor fen and flush	0.42	Moderate	Moderate	Low	No	Very High	-	7.4	0.4	0.0	NA	PF2 Poor fen and flush								-	0.0
WD4 Conifer plantation	135.6	Poor	Low	Low	No	Low	-	271.2	135.6	0.0	NA	WD4 Conifer plantation								-	0.0
PB3 Lowland blanket bog	22.54	Moderate	Moderate	Low	Yes	Very High	396.7	-	22.5	0.0	Enhancement	PB3 Lowland blanket bog	14.7	Good	Moderate	Low	Very High	Medium	10.0	60.7	-
PB4 Cutover bog	80.64	Poor	Moderate	Low	No	High	-	532.2	80.6	0.0	Enhancement	PB3 Lowland blanket bog	80.64	Good	Moderate	Low	Very High	Medium	10.0	-	748.8
PB4 Cutover bog	82.15	Moderate	Moderate	Low	No	High	-	1084.4	82.2	0.0	Enhancement	PB3 Lowland blanket bog	82.15	Good	Moderate	Low	Very High	Medium	10.0	-	508.6
WS1 Scrub	8.67	Moderate	Low	Low	No	Medium	-	69.4	8.7	0.0	NA	WS1 Scrub							5.0	-	0.0
WD4 Conifer plantation	1.64	Poor	Low	Low	No	Low	-	3.3	0.0	1.6	Creation	BL3 Buildings and artificial surfaces	1.64	N/A - Other	Low	Low	Very Low	Low	0.0	-	-3.3
WD4 Conifer plantation	4.29	Poor	Low	Low	No	Low	-	8.6	0.0	4.3	Creation	PB4 Cutover bog	4.29	Poor	Moderate	Low	High	Medium	30+	-	-2.5
WD4 Conifer plantation	6.48	Poor	Low	Low	No	Low	-	13.0	0.0	6.5	Creation	BL3 Buildings and artificial surfaces	6.48	N/A - Other	Low	Low	Very Low	Low	0.0	-	-13.0
WD4 Conifer plantation	20.25	Poor	Low	Low	No	Low	-	40.5	0.0	20.3	Creation	PB3 Lowland blanket bog	20.25	Poor	Moderate	Low	Very High	Medium	12.0	-	37.3
PB4 Cutover bog	1.83	Poor	Moderate	Low	No	High	-	12.1	0.0	1.8	Creation	FL8 Other artificial lakes and ponds	1.83	Poor	Low	Low	Low	Low	1.0	-	-8.5
WS1 Scrub	0.03	Moderate	Low	Low	No	Medium	-	0.2	0.0	0.0	Creation	WS1 Scrub	0.03	Moderate	Low	Low	Medium	Low	7.0	-	-0.1
PB4 Cutover bog	2.58	Moderate	Moderate	Low	No	High	-	34.1	0.0	2.6	Creation	FL8 Other artificial lakes and ponds	2.58	Poor	Low	Low	Low	Low	1.0	-	-29.1
WD4 Conifer plantation	1.67	Poor	Low	Low	No	Low	-	3.3	0.0	1.7	Creation	FL8 Other artificial lakes and ponds	1.67	Poor	Low	Low	Low	Low	1.0	-	-0.1
PB4 Cutover bog	28.15	Poor	Moderate	Low	No	High	-	185.8	18.7	9.5	NA	PB4 Cutover bog								-	-62.7
PB4 Cutover bog	31.2	Moderate	Moderate	Low	No	High	-	411.8	20.7	10.5	NA	PB4 Cutover bog								-	-138.3

Appendix A Habitat Management Plan

RWE Renewables Ireland Limited

SLR Project No.: 501.065301.00001

27 February 2026

Habitat Management Plan

RWE

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SLR Consulting Limited

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SLR Project No.: 501.065301.00001

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Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
01	4 March 2026	Ida Bailey	Richard Arnold	Richard Arnold
02	19 April 2026	Ida Bailey	Richard Arnold/ Gareth Hughes	Richard Arnold/ Gareth Hughes
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			

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Executive Summary

The Habitat Management Plan (HMP) has the following goals, and provides implementation and monitoring plans for the protection and restoration of nature and biodiversity at the Proposed Development in line with the mitigation measures set out in Chapter 5 of the EIAR and the Peatland Restoration Plan (PRP):

1. Minimise, as far as practicable, the removal of peat and bog vegetation from site during construction.
2. Compared to baseline, enhance the condition of peatlands outside afforested areas via restoration for the benefit of associated biodiversity, carbon storage and sequestration, and water management.
3. Eradicate, as far as practicable, invasive alien plant species from the Main Wind Farm Development Site.
4. Maintain populations of breeding birds and bats, relative to natural variation.
5. Restore the over-run areas 1 and 2 to baseline or better habitat condition following the removal of temporary infrastructure.

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Acronyms and Abbreviations

HMP	Habitat Management Plan
HMG	Habitat Management Group
PRP	Peatland Restoration Plan

1.0 Introduction

The purpose of this report is to define the goals, objectives, management and monitoring that will achieve the commitments to nature and biodiversity mitigation, compensation and enhancement as set out the Biodiversity Chapter and associated Peatland Restoration Plan (PRP).

1.1 The Proposed Development

The Proposed Development is located in the coastal region of Mayo and will occupy two areas of peatlands and partially forested lands bisected by a local road L-5252 (Figure 01).

The Proposed Development, if consented, comprises of 13 wind turbines, and associated infrastructure.

A single 110kV Grid Connection Route (GCR) is assessed as part of this EIAR but is not the subject of this planning application. This will be the subject of a later application which will require works along public roadways to facilitate a 110kV underground Grid Connection to Bellacorick Substation. This in addition to the Proposed Development is described as the Proposed Project. A full detailed description of the Proposed Project is in **Chapter 2** of this EIAR, with a list of defined terms in **Chapter 1** of this EIAR.

1.2 Document Scope and Purpose

This document provides an overview of the planned habitat management and biodiversity monitoring. It will serve as a live document which will be updated following planning consent as the project moves towards implantation and post-construction monitoring. Any subsequent iterations will consider planning conditions, confirmatory and monitoring survey results that will become available over those timeframes.

This HMP sets out the habitat restoration work that will achieve the level of compensation and enhancement that the project has committed to in the Peatland Restoration Plan, as well as other mitigation and monitoring committed to in Chapter 5 of the EIAR – Biodiversity.

Key terminology includes avoidance, mitigation, compensation and enhancement, these are defined as set out in CIEEM's Key Principals of EcIA[1]:

- Mitigation Negative effects should be avoided or minimised through mitigation measures, either through the design of the project or subsequent measures that can be guaranteed – for example, through a condition or planning obligation.
- Compensation[2] Where there are significant residual negative ecological effects despite the mitigation proposed, these should be offset by appropriate compensatory measures.
- Enhancement Seek to provide net benefits for biodiversity over and above requirements for avoidance, mitigation or compensation.

This plan covers:

- The Proposed Development Site including:.
    - The Main Wind Farm Development Site: part of the Proposed Development Site which includes the proposed wind turbines and associated infrastructure.

[1] https://cieem.net/wp-content/uploads/2018/08/EcIA-Guidelines-v1.3-Sept-2024.pdf

[2] In this context compensation does not relate to compensation as defined in article 6.4 of the Habitats Directive.

- Over-run areas one and two along the turbine delivery route (TDR) to the Proposed Development Site, and
- The Habitat Enhancement Area in the NWQ (HEA), a small separate triangular area to the northwest of the Main Wind Farm Development Site, which will not include any infrastructure related to the Proposed Project other than that to enhance habitat.

1.3 The Carbon Implications of Bog Habitats on Site

Muingmore Wind Farm is a proposed 13 turbine site in Ireland. Based on recent habitat surveys (see Chapter 5), the dominant habitat on site is degraded blanket bog, with priority blanket bog also present but largely limited to the HEA, wet grassland, and conifer plantation on peat >50cm deep (Figure 01).

The wider area appears to be a mix of blanket bog and degraded (drained) blanket bog which provides largely uninterrupted habitat connectivity to the Wild Nephin National Park, the interruptions are roads and watercourses.

Peat is a carbon store and blankets the majority of the Main Wind Farm Development Site and HEA at >50cm depth. Even a thin peat layer of 30cm has a carbon store equivalent to tropical rainforest ha/ha [3], and the 2006 IPPC guidance for National Greenhouse Gas Inventories considers organic soils (including peatlands) with a depth of >10cm. As the majority of the Main Wind Farm Development Site and HEA is peatland, it therefore contains significant stores of carbon.

As it stands, available national statistics suggest that near natural bog should remove 3.54tCO2e per hectare from the atmosphere per year. However, as the bog on the Main Wind Farm Development Site is mostly drained (Figure 02.) it could be a carbon source. Drained peat and peat planted with commercial forestry are often carbon sources as they dry the peat compared to its natural saturated state permitting oxidation of the stored carbon. Areas of priority Annex 1 bog, particularly those parts in good condition in the HEA, where no peat extraction has been undertaken may however be carbon sinks.

The construction of the Proposed Development will require some drainage and displacement of peat and peatland including blanket bog.

Therefore, in terms of land use change (not taking into account the carbon benefit of displacing fossil fuel electrical generation with wind), the Proposed Development would likely generate an increase in net greenhouse gas emissions, if it damages bog further, or a potentially a net sink, if bog condition is improved enough for peat forming to begin again as is planned via the PRP.

1.4 The Biodiversity Implications of Bog Habitats on Site

Bog habitats are the habitats on site which are identified as having the highest ecological importance in terms of distinctiveness and extent. In terms of area, the next most dominate habitat is non-native commercial conifer forestry which has low biodiversity value (Figure 01). The bog habitats align with the Annex I criteria for Blanket bogs. In terms of conservation value these areas of bog can be split into broadly three categories:

[3] ICUN Peatland Programme. 2020. Position statement: Peatland and trees: https://www.iucn-uk-peatlandprogramme.org/sites/default/files/header-images/Resources/IUCN%20UK%20PP%20Peatlands%20and%20trees%20position%20statement%202020.pdf

- The majority of the area is PB4 (cutover blanket bog). This area is degraded due to the extensive drainage network in this area, the percentage of sphagnum moss cover is less than 40% within these areas. The low sphagnum cover means that these areas are identified as being in poor-moderate condition and do not meet the criteria for the Priority type of this Annex I habitat; “still supporting a significant area of vegetation that is normally peat forming”.
- There are a few ‘polygons’ of Lowland Blanket Bog (PB3 in the Fossitt classification system) within the Main Wind Farm Development Site. However, these are not shown on the Irish landcover database (Article 17). In addition these areas are small and are therefore not considered extensive enough to meet the definition of priority Annex I Blanket bogs.
- A more extensive area of PB3 exists in the HEA where we have confirmation of peat forming species from field survey. This area is the Priority type of this Annex I habitat. This area is also identified as Priority Annex 1 habitat in the Irish landcover database (Article 17). Peat cutting face reprofiling is planned in this area as part of restoration work.

1.5 Background

In order to compensate for direct and indirect loss of biodiversity and carbon rich soils (peat) as a result of the construction of new infrastructure, the remaining habitats on site will be restored (e.g. drain blocking in bog habitats) or new habitats will be created (e.g. forest conservation bog habitats) to add biodiversity and carbon storage/ sequestration value. This Habitat Management Plan sets out how this will be achieved.

The approach taken to quantification of biodiversity and carbon for loss and gain calculations is set out in the Peatland Restoration Plan.

2.0 Evidence of Technical Competence

The HMP has been written by Ida Bailey, with peatland restoration technical expertise provided by Adrian Cowe, and review by Andrew Torsney. Additional support has been provided by SLR's wider biodiversity, hydrogeology and GIS teams. Bios for key team members are provided below:

Ida Bailey, PhD., ACIEEM, CERPIT

Ida leads SLR's Nature and Natural Capital team in Europe. She has a PhD., and B.Sc. in biodiversity and natural sciences related fields. She is an Associate member of CIEEM, a certified ecological restoration practitioner in training (CERPIT) with the Society for Ecological Restoration and sits on the panel of academic specialist for the Biodiversity Futures Initiative. She has over 17 years of ecological consultancy and research experience both in the UK and overseas and specialises in innovative, multidisciplinary ecological restoration, nature positive, bio-credit and natural capital projects.

The project was led by Ida Bailey, with support from SLR's wider biodiversity, hydrogeology, carbon and GIS teams. Bios for key team members are provided below:

Andrew Torsney PhD, MRes, BSc. (Habitats and Ecology)

Andrew is a Technical Director in SLR's Ecology and Biodiversity technical discipline and manages the Irish Ecology team. Andrew has over 12 years' experience within the ecology and environmental sector. He has managed and undertaken ecological assessments at a range of scales including detailed Annex I habitat surveys. Andrew has also conducted research on the implications of habitat classification regarding conservation outcomes of Annex I habitats. Andrew is a technical botanical specialist with extensive planning experience regarding ecological assessments at all scales from local to national.

Adrian Cowe, MSc (Hydro-geology)

Adrian is an associate hydrologist. His key areas of experience and interest are in the areas of hydrological, hydrogeological and geological assessment for EIA and FRA, and quantitative water quality assessments. He holds expert knowledge and experience of surface and ground water sampling methodology, water quality monitoring instrumentation and data analysis. He has worked for a wide range of clients across a number of sectors including power, mining, water utilities and transport.

Chris Marshall, PhD., MSc (Peatland restoration)

Chris is a Principal Consultant specialising in peatland risk management, monitoring and restoration design. Chris has extensive experience in the characterization of peatland condition and developing monitoring solutions from the site to the national scale. Chris has spent more than a decade working in academia and industry on a variety of research projects in areas such as hydrocarbon exploration, sedimentology, engineering geology, climate reconstruction, remote sensing and peatland science working collaboratively with Govt, NGO's and private sector clients to deliver peer reviewed publications, reports including as a member of scientific advisory committees.

Luke Moseley, Msc. (Carbon)

Luke is an experienced sustainability and carbon management professional with a strong track record in corporate and project-level climate strategy. He has led the management and analysis of sustainability data, authored climate chapters for Environmental Impact Assessments (EIAs), conducted GHG emissions inventories across Scope 1, 2 and 3, and

developed a deep working knowledge of relevant policies, frameworks, and regulatory requirements for carbon reduction. With a specialism in land-based emissions, his MSc research focused on the opportunities and challenges of measuring and reporting emissions from land use and land use change.

Joe O'Reilly, MSc. (GIS)

Joe is a Senior GIS Analyst with over 6 years of experience in the development and implementation of spatial solutions. His experience includes desk-based assessments of ecosystem services and biodiversity; feasibility studies and opportunity mapping for renewable energy sources requiring the development of a bespoke assessment methodology based on best practice and the aims of the project; the synthesis and analysis of a wide array of social, economic and environmental datasets; and the visualisation of project outputs in dynamic decision-making tools.

3.0 Key Stakeholders and Consultees

This HMP is a live document that will be agreed, reviewed and up-dated by key stakeholders working together as a Habitat Management Group (HMG). The group will be led by the wind farm developer/ owner and their ecologist, and the following additional stakeholders as a minimum will be invited to participate:

- The local planning authority; and
- The landowner.

4.0 Targets, Goals and Objectives

4.1 Terminology

The following definitions are taken from the International Standards for Habitat Restoration[4]:

- The **Scope** is the broad geographic or thematic focus of a project.
- The **Vision** is a general summary of the desired condition one is trying to achieve through the work of the project. A good vision is relatively general, visionary (inspiring), and brief.
- The **Targets** identify the native ecosystems to be restored at a site as informed by the reference model, along with any social outcomes or constraints expected of the project.
- **Goals** are formal statements of the medium to long-term desired ecological or social condition, including the level of recovery sought. Goals must be clearly linked to targets, measurable, time-limited, and specific.
- **Objectives** are formal statements of the interim outcomes along the trajectory of recovery. Objectives must be clearly linked to targets and goals, and be measurable, time-limited, and specific.
- **Indicators** are specific, quantifiable measures of attributes that directly connect longer-term goals and shorter-term objectives. Ecological indicators are variables that are measured to assess changes in the physical (e.g., turbidity units), chemical (e.g., nutrient concentration), or biotic (e.g., species abundance) ecosystem attributes as guided by the reference model. Social-ecological or cultural indicators measure changes in human wellbeing such as participation in traditional practices, governance, language and education.

4.2 Scope

The spatial scope of the HMP is all areas within the Main Wind Farm Development Site, the HEA, and over-run areas 1 and 2 (Figure 02), collectively the Habitat Management Area (HMA).

The HMP will be valid for the duration of the wind farm's operation, unless stated otherwise for specific goals or objectives, or unless subsequently agreed via the HMG.

4.3 Vision

To compensate for the loss of blanket-bog and other biodiversity on site due to the construction of the wind farm through restoring the area, volume and condition of remaining peat and peatlands on site for the benefit of biodiversity, carbon storage and sequestration and other associated ecosystem services such as water storage, regulation and filtration; and appropriate management and monitoring of other habitats and biodiversity.

[4] Society For Ecological Restoration. 2019. "International Principles and Standards for the Practice of Ecological Restoration."

4.4 Targets

4.4.1 Target Features

The targets of the HMP have been chosen based on the assessment in the Biodiversity Chapter of the Environmental Impact Assessment Report. They reflect those habitats or species for which impacts are expected to be greatest, and those habitats or species where restoration or conservation efforts offer the greatest, practical opportunity to restore and enhance the biodiversity of the Proposed Development. They are set out in **Table 4-1**.

Table 4-1: HMP Target Features

Target Feature	Rationale
Bog habitats: PB4 Cutover bog and PB3 Lowland blanket bog and peatland habitats typically associated with blanket bog PF3 Transition mire and quaking bog, PF2 Poor fen and flush	• The predominant semi-natural habitat on site is PB4 (cutover bog) in poor to moderate condition due to drainage. • This is a non-priority Annex I habitat. • Without any compensation, mitigation and enhancement measures, there will be a loss of c. 33ha of this habitat due to construction of the wind farm - this would have a significant impact (see Chapter 5)
Other natural/ semi-natural habitats	• Loss of small areas of hedgerows, treelines, grassy verges, wet grassland, and scrub (inc. mosaics) without any compensation, mitigation and enhancement measures would be expected to have a significant impact (see Chapter 5).
Invasive alien plant species	• Without mitigation, the construction of the wind farm has the potential to accelerate the spread of invasive alien plant species such as *Rhododendron ponticum*, e.g. by improving growing conditions via additional drainage and by accidental spreading of seeds and vegetive material e.g. in plant tracks.
Kestrel	• Without mitigation, significant impacts on kestrel are possible due to collision with turbines as Kestrel may move into the newly felled keyholed areas around turbines to forage.
Other birds at risk of collision	• No significant collision mortality for any species is anticipated, • Monitoring for bird collisions will be carried out at the wind farm to verify the effectiveness to account for any changes to species populations, distribution or flight/ migration patterns.
Breeding bird assemblages of open and semi- open/ forest edge habitats	• Habitat loss leading to indirect disturbance / displacement, especially of breeding Eurasian woodcock, yellowhammer, skylark, willow warbler and meadow pipit, could, in the absence of mitigation/ compensation result in significant impacts on populations.
Snipe	• Without mitigation, enhancement or compensation measures, loss of one pair of snipe is anticipated due to habitat loss.
Bats	• Significant collision mortality for some species of bat is anticipated without mitigation.

4.4.2 Goals

The HMP has the following goals:

1. Minimise, as far as practicable, the removal of peat and bog vegetation from site during construction.
2. Compared to baseline, enhance the condition of peatlands outside afforested areas via restoration for the benefit of associated biodiversity, carbon storage and sequestration, and water management.
3. Eradicate, as far as practicable, invasive alien plant species from the site.
4. Maintain populations of breeding birds and bats, relative to natural variation.
5. Restore the over-run areas 1 and 2 to baseline or better habitat condition following the removal of temporary infrastructure.

4.4.3 Objectives

The objectives relating to each of the goals set out in Section 4.4.2 are summarised in Table 2. These objectives will remain in place for the duration of the wind farm's operation, unless otherwise agreed via the HMG.

Where relevant, the objectives include a summary of management requirements to meet them. A high-level summary of relevant indicators is also provided for each. Additional details on management requirement and monitoring are set out in Sections 6.0 and 7.0 respectively.

Justification for the scale of work required to meet Goal 2 which relates to blanket bog restoration is set out in Section 4.5.

Table 4-2: Goals & Objectives

No.	Objective	Relevant targets(s)	Amount/ location	Action	Timing	Indicators
Goal 1: Minimise, as far as practicable, the removal of peat and bog vegetation from Main Wind Farm Development Site during construction						
1.1	As far as practical retain excavated peat on site	Bog habitats	All peat excavated during construction – expected to be 125,180 m^3	Re-use excavated peat for on-site bog restoration and reinstatement work See Peat Management Plan (PMP) Technical Appendix 6-3, for a breakdown of volumes and details of handling requirements.	During construction See note in PMP, Technical Appendix 6-3 for details on timing for storage and re-use	Volume of excavated peat used in bog-restoration is 107,080m^3 or higher. Remaining excavated peat is used in reinstatement. Excavated peat used in peatland reinstatement and bog restoration is placed in conditions that prevent drying and associated carbon loss.
Goal 2: Compared to baseline, enhance the condition of peatlands outside afforested areas via restoration for the benefit of associated biodiversity, carbon storage and sequestration, and water management.						
2.1	Raise the water table in blanket bog habitat	Bog habitats	200 ha: All ditches within open habitats, outside infrastructure buffer areas as mapped on Figure 2 c. 162ha.[5] Keyholed and other areas of forest felling c. 24ha.	Block & infill ditches. Ground-smooth former forestry areas. Re-profile cutting faces. Restore / re-vegetate temporary areas such as the temporary construction compounds.	During or within two years of construction with repair as required for the duration of the HMP.	Water table is within 10cm of the surface on average (with a lower limit of 20cm depth e.g. during dry conditions), within the appropriate buffer distance of all blocked ditches (see peat restoration plan). Bog (inc. PB4, PB3, PF3 and PF2) vegetation in restored areas is in an improved condition compared to baseline data and more similar to that in a control site, as measured using suitable condition criteria.

[5] To be confirmed in post-consent for example depending on the final buffer distances of infrastructure and watercourses agreed on.

No.	Objective	Relevant targets(s)	Amount/ location	Action	Timing	Indicators
			Areas of historic peat extraction (c. 14ha).			Peat/ carbon accumulation as determined by depth measurements and presence of peat forming vegetation.
2.2	Reduce the risk of bog habitat transitioning to woodland and associate peat drying	Bog habitats	Areas where scrub is found within blanket bog habitat	Remove scrub. Pulling or cutting with brash removed from site.	During or within two years of construction with maintenance as required for the duration of the HMP.	Scrub is removed, with follow up-removal of any regenerating scrub if require. Areas identified as scrub removal areas remain scrub free.
Goal 3: Eradicate, as far as practicable, invasive alien plant species from the Main Wind Farm Development Site & HEA						
3.1	Remove and thereby reduce the risk of non-native species (inc., *Gunnera tinctoria, Aluns cordata, Cocosmia sp, Gaultheria mucronata* and *Rhododendron ponticum)* from displacing native species / natural and semi-natural habitats.	Bog habitats Other natural/ semi-natural habitats.	Everywhere they are found to occur on site.	Remove. Pulling or cutting/ digging with brash/ debris including soil potentially contaminated with roots or seed removed from site and disposed of appropriately.	During construction with maintenance as required for the duration of the HMP.	Non-native species are removed from site via appropriate methods. Follow up-treatments are applied as necessary. The site is free from invasive alien plant species.
Goal 4: Maintain populations of breeding birds and bats, relative to natural variation on the Main Wind Farm Development Site & HEA						
4.1a	Safeguard the population of kestrel by managing habitat structure to minimise structural diversity and vegetation height (create uniform short vegetation) in high collision risk areas to reduce suitability as prey habitat and deter foraging.	Kestrel	In keyholed areas of forestry around turbines.	Undertake ground smoothing as already planned for bog restoration in these areas.	See Goal 2.	See Goal 2, and Vegetation is short and uniform.
				Monitor prey abundance and kestrel activity and further manage	As part of wider bird activity and vegetation monitoring – See	Prey abundance is ≤ the density in open habitats elsewhere on site. Kestrel activity ≤ that in open habitats elsewhere on site.

No.	Objective	Relevant targets(s)	Amount/ location	Action	Timing	Indicators
				vegetation if required e.g. via infrequent mowing or strimming.	Goal 2 and Objective 4.2.	Kestrel collision mortality detected is < than expected without mitigation.
4.1b	Enhance nesting opportunities for kestrel	Kestrel	2-3 nest boxes	Mounted 4–6 m above ground, ideally on isolated trees, poles, or suitable structures that offer clear flight access, facing east or southeast, away from high disturbance areas.	Install- pre-construction if locations are not within the construction disturbance zone or within 1 year post construction in other areas. Monitor annually.	Nest boxes are installed. Kestrel use and fledge young from the nest boxes - nest box monitoring.
4.2	Safeguard the population of other birds (other than kestrel), at collision risk	Other birds at risk of collision	Within the site	Undertake bird activity and carcass searching to determine if collision risk and mortality are higher than predicted in the Chapter 5 (EIAR), e.g. due to changes in populations or flight patterns	Years 1, 2 and 3 post construction – continuing if required	Collision mortality detected is ≤ than expected Activity is ≤ to baseline
4.5a	Safeguard populations of breeding bird assemblages of open and semi- open/ forest edge habitats	Breeding bird assemblages : breeding **snipe** and Eurasian woodcock, yellow-hammer, skylark, willow	See Goal 2	Bog restoration is anticipated to increase invertebrate abundance and therefore foraging opportunities for these species. Noting that open ground species like snipe and meadow	See Goal 2	Breeding bird surveys Species diversity and populations are similar to baseline relative to natural regional variation – especially for those species associated of bog habitats.

No.	Objective	Relevant targets(s)	Amount/ location	Action	Timing	Indicators
		warbler and meadow pipit		pipit will likely benefit more than forest edge species like woodcock and willow warbler.		
4.6	Safeguard populations of bats that are at risk of collision mortality from turbines.	Bats at risk of collision: Common, Nathusius' and soprano pipistrelle, and Leisler's bat	Within the Main Wind Farm Development Site	Bat buffers will be implemented to reduce collision risk (key holing around turbines). Bat activity monitoring	Activity years 1, 2 and 3 post construction – continuing if required Carcass searching – if required	Activity levels are similar or< during EIAR surveys. If not, then other mitigation e.g. curtailment and carcass searching has been implemented as appropriate.
Goal 5: Restore the over-run areas 1 and 2 to baseline or better habitat condition following the removal of temporary infrastructure						
5.1	In over-run Area 1: Reinstate blanket bog to good condition in all areas impacted by the development following removal of temporary infrastructure	Bog habitats	Over-run Area 1, all areas impacted by the development	Ground smoothing and re-vegetation	Commencing within 1 year following removal of temporary infrastructure	Bog vegetation in restored areas is in a similar or improved condition compared to baseline data as measured using suitable bog condition criteria.
5.2	In over-run Area 2: Reinstate a mosaic of habitats as observed at baseline favouring those with higher biodiversity value such as dry grassland[6]	Other natural/ semi-natural habitats	Over-run Area 2	Seeding of reinstatement areas with suitable wildflower mix of local (Irish) origin Scrub planting to match the species present at baseline (low density 200 -	Commencing within 1 year following removal of temporary infrastructure	All habitats are reinstated to the same habitat type as baseline during reinstatement Within 10 years all habitats reach the same condition as baseline Within 10 years reinstated dry grassland habitats reach moderate condition, compared to poor condition at baseline via wildflower seeding.

[6] Note that the surrounding roads and substrate make this area largely unsuitable for bog or wetland restoration or creation.

No.	Objective	Relevant targets(s)	Amount/ location	Action	Timing	Indicators
				400 stems per ha in an organic pattern according to ground conditions)		

4.5 Justification for the scale of Bog Restoration (Goal 2)

Full workings and justification for the scale of blanket bog restoration required to result in enhancement of blanket bog biodiversity value compared to baseline are set out in the Peatland Restoration Plan (PRP).

In summary, calculations undertaken using the SSER biodiversity tool kit (SSE metric), indicated that a 32% net gain in habitat value (Biodiversity Net Gain, BNG) on site, can be achieved. This will involve restoration and creation c. **200 ha** of bog habitats in compensation for direct and indirect loss of c. **30 ha** of blanket bog and c. 36ha of other habitats predominantly commercial forestry (34ha). This is over the minimum 10% gain expected as a buffer in biodiversity net gain guidance, to avoid net-loss.

The calculations use time to target condition multiplier for bog restoration of 10 years and a difficulty of restoration multiple of moderate. This is based on the best available evidence for similar restoration projects.

In addition, bog restoration will benefit a range of species including amphibians and birds and bat species that favour these wet open habits, such as snipe, meadow pipit, sky lark and Leisler's bat. Water quality in adjacent watercourses may also be improved for fish and freshwater life as erosion of peat should be reduced, reducing particulate organic carbon in the connected watercourses.

Limitations

The BNG calculations were undertaken using the planning application site layout and habitat data. In addition, while multipliers for time to target condition and difficulty of restoration have been selected based on the best available scientific evidence, it is possible that conditions at the Proposed Development may result in restoration progress in faster, slower, or more or less effective than anticipated.

The following actions will therefore be undertaken:

Pre-construction:

- Habitat surveys are undertaken to determine any changes in habits since baseline,
- The area where peat cutting face re-profiling is proposed to the northwest of the site has a confirmatory field survey undertaken to confirm the restorable area,
- The baseline situation is up-dated.
- The results are integrated into the HMP.

Post-construction:

- The BNG calculation is up-dated and integrated into the habitat management plan.

The effectiveness of the restoration measures will be monitored in accordance with this HMP, and any revisions that are identified as required will be agreed with the HMG.

5.0 Baseline Conditions

Baseline conditions are set out in the EIAR, in particular the following documents:

- Technical Appendix 2-3: Forestry report
- Chapter 5: Biodiversity and associated Appendices:
  - Technical Appendix 5-1: Technical Habitat Report
  - Technical Appendix 5-2: Bird survey report
  - Technical Appendix 5-3: Bat survey report
  - Technical Appendix 5-4: Aquatic survey reports
  - Appendix 5-5: Appendix 5.5: Peatland Restoration (PRP) and Habitat Management Plan (HMP) – this document.
  - Technical Appendix 5-6: Habitat Condition Assessment Report
  - Technical Appendix 5-7: Marsh Fritillary Survey report
  - Technical Appendix 5-8: Avian Collision Risk Model Report
- Chapter 6 and associated Appendices:
  - Technical Appendix 6-2: Peat Landslide Hazard Risk Assessment
  - Technical Appendix 6-3: Peat Management Plan
- Chapter 8: Air Quality and Climate

5.1 Control Area

Ideally, a control plot of good condition blanket bog that the habitats within the bog restoration area that could reasonably be expected to revert to following drain blocking will be identified within the Main Wind Farm Development Site or HEA and monitored to aid in evaluation of bog restoration success and in setting of site-specific vegetation targets for bog habitats (e.g., % cover of sphagnum etc.). If a suitable area cannot be found the bog habitat condition criteria from the Irish Habitats Wildlife Manual or similar will be used instead.

6.0 Implementation Methods

6.1 Bog Restoration Including Re-use of Excavated Peat

6.1.1 Scrub Clearance

Scrub vegetation is present and widespread throughout all the site's Candidate Areas (areas of bog earmarked for restoration), colonising the ground from the areas of commercial forestry. As scrub is of limited conservation value in the context of the Main Wind Farm Development Site and contributes to drying of peatland, removing it is considered desirable to aid peat re-wetting and promote growth of Sphagnum mosses. Sphagnum mosses are a critical part of any peatland restoration effort due to their ability to absorb and retain moisture, acidify the surrounding environment and thus, slow plant decay and allow greater carbon storage in the soil. Therefore, scrub clearance will be undertaken as part of the planned HMP works.

For the Proposed Development, this will be achieved by using a brush cutter and chainsaw and managed by being cut up into smaller, more manageable pieces before being mulched. For sections too large to be cut by a chainsaw, they will be left on the bog surface to promote biodeterioration, biofragmentation and ultimately assimilation into the underlying peat. It is unlikely that other conventional scrub clearance methods, such as hand pulling or herbicide spraying, would achieve an acceptable return on investment at this site.

6.1.1.1 Conifer and Scrub Regeneration Control

It is expected that following ground smoothing and ditch blocking, shrub and conifer regeneration will be reduced due to the higher water table making growing conditions less suitable.

However, due to the presence of conifer plantation and scrub areas within areas adjacent to the peatland restoration area, some conifer and scrub regeneration is expected. Therefore, all regeneration will be monitored, and the removal carried out when required, to maintain open vegetation and avoid the area transitioning to forest/ scrub. The frequency at which regeneration would need to be removed will be subject to the speed of regeneration and will be determined following post-implementation monitoring (Section 7.9.2).

6.1.2 Ground/Surface Smoothing

This method is proposed for areas where felling of conifer plantations is undertaken as part of the works for the Main Wind Farm Development Site. Note however that it will also be considered in areas where the ground is rough due to for example the presence of stumps, ridge and furrow or piles of formally excavated peat which reduce the effectiveness of re-wetting via ditch blocking alone.

Again, owing to the widespread legacy ditch network that has lowered groundwater levels at Muingmore from the ridge/furrow pattern across much of the site, ground/surface smoothing will aid the regeneration of the peatland environment by encouraging water table rebound and vegetation recovery. Additionally, in the areas where conifer plantations have been cultivated, the ridge/furrow pattern across the legacy forestry area will benefit significantly from ground smoothing.

By manipulating the topography and creating a more uniform surface, it allows the natural hydrological function of the area to be restored and encourage growth of advantageous peat-forming vegetation like Sphagnum mosses. The primary means of ground/surface

smoothing that will be implemented are inverting any tree stumps within the candidate areas, ditch blocking, compacting the land with machinery, covering the surface with mulch, and infilling drains.

6.1.2.1 Re-vegetation

Re vegetation is not anticipated to be necessary in open areas of the site where PB4 vegetation will transition naturally to PB3 vegetation as the water-table rises.

In those areas where vegetation is absent or has been removed, for example following tree clearance and ground smoothing, the area will be allowed to revegetate naturally as it is anticipated that there will be a sufficient seed bank available from the large expanse of blanket bog adjacent. In addition, there are likely to be viable heather seeds (and seeds of other Ericoids) within the existing seedbank from before the area was planted with trees. Relatively large heather seed banks can survive beneath conifer plantations for 40 years and under some circumstances for more than 70 years[7].

Restoration projects on other afforested sites have had success without using re-seeding/re-vegetation methods[13], and re-seeding/re-vegetation is only reported to be necessary in restoration of bare peat areas with significant erosion[13].

On the basis of the above, there is a high likelihood that the natural regeneration of bog vegetation will be successful. However, this will be monitored and in the unlikely event that the natural regeneration of bog vegetation does not take place within a reasonable timescale, remedial measures such as seeding or plug planting will be considered in consultation with the HMG and implemented where required.

6.1.3 Ditch Blocking and Re-use of Excavated Peat

This method involves creating a blockage (or dam) within a ditch, preventing the drainage channel acting as a conduit for water flow and draining the peat soils, thus raising the water table. As part of the earthworks associated with the Proposed Development, peat will be excavated from areas of hardstanding.

There are three approaches for ditch blocking that will be implement on the Main Wind Farm Development Site, generally constrained by the width of the drainage channel:

- Dams (wooden and/or peat) with infilling from excess peat on all ditches;
- Zipping / zippering on ditches <1.5 m wide; and
- Dams (wooden and/or peat) on all ditches.

The management of the peat during excavation and storage will be delivered by the Peat Management Plan (PMP) (**Technical Appendix 6-3** of the EIAR). The excavated peat provides a great opportunity for the improvement of hydrogeology and peatland habitats at the Main Wind Farm Development Site.

At the Main Wind Farm Development Site it is intended that suitable ditches (those not within the buffer of natural watercourses) are entirely backfilled with excavated peat from earthworks within the development area. Due to the length of ditches to be infilled, dams will be placed at routine 10-20m intervals to maximise stability and water retention of the peat within the legacy ditch. Alternating wooden and peat dams will be used at the Main Wind

[7] Pywell, R.F., Pakeman, R.J., Allchin, E.A., Bourn, N.A.D., Warman, E.A.., Walker, K.J (2002) The potential for lowland heath regeneration following plantation removal. *Biological Conservation*, Volume 108, Issue 2, pp247-258.

Farm Development Site owing to their greater longevity in the acidic peat environment and very low slopes observed on the Main Wind Farm Development Site whilst providing a resource efficient solution. Peat dams are generally unsuitable where the depth of solid peat at the base of the drain is ≤50cm.

Ditches will have surface vegetation removed from the sides and base of the ditch prior to the emplacement of excavated peat and any vegetation will be placed on any bare peat. Dams will be keyed (extended), into the deep peat at either side of the ditch to provide the best watertight seal that can be achieved whist ensuring stability. When using peat to form the dam, this will be done up to a maximum ditch width of 1.5m and depth of 1.2m. Dried out or unconsolidated peat will never be used, only highly humified, fully waterlogged peat will be used. As the peat is inserted into the drain, it will be compacted and upon completion the dams top will be extend approximately 30cm above the surface of the bog and covered with a living layer of peatland vegetation.

Ditches will be infilled up to a 30m buffer from proposed watercourses. The end point of the infilling will be secured with a dam to maximise stability.

Should it be impractical to infill the ditches within the Candidate Areas, zipping / zippering and ditch blocking using wooden dams or peat recovered from a small borrow pit near to the planned ditch dam will be used as to raise groundwater levels.

Zipping is a form of re-profiling that is typically used in conjunction with wave damming. Dams are formed every 8 m with the remaining drain line between each dam “zipped”. Unlike other forms of re-profiling, this technique completely in-fills the drain void and therefore natural surface flow path ways are instantly restored. Zipping will be prioritised on ditches <1.5 m wide to reserve peat infilling on ditches wider than 1.5 m in the unlikely event that there is insufficient peat to infill all ditches within the Candidate Area.

Dams without the associated backfilling with peat will follow the same construction methodology and criteria as those ditches for peat infilling however these will retain water behind the dams, with excess water encouraged to spread out over the surface of the peatland. Vegetation within the ditches will be left in place while these dams are put in place and water levels rise.

In terms of re-wetting potential current BNG calculations assume a 30 m buffer from infrastructure for condition enhancement due to its drainage influences, and no buffer from watercourses (assuming ditch blocking but not infilling within the 30m watercourse buffer).

6.1.4 Hag Reprofiling

The HEA to northwest of the Main Wind Farm Development Site, has historically been used for the removal of peat, with bare faces of peat exposed at the edges of where peat was cut away remaining. The angle of the peat face here is too great for vegetation to establish and reprofiling is needed to achieve an appropriate angle to encourage vegetation to return whilst minimising erosion. Here, the layer of live vegetation including its roots will be removed back far enough to allow the reprofiled face maintains and angle around 30 degrees (typically around 2 m).

The peat face will be reprofiled to 30 degrees and compacted so there are no air pockets or cavities where water could escape. The reserved vegetation will then be stretched out across the reprofiled face. If there is insufficient vegetation to provide a cover of the reprofiled face then vegetation will be recovered from areas of excavation in the Main Wind Farm Development Site or by creating a small pit near the reprofiled area and transferring vegetation from the pit to the reprofiled face, stretching the adjacent vegetation over the pit area to so it also has been protected. The layer of vegetation will then be compacted into the peat to providing good contact of roots with the underlying peat.

6.2 Kestrel Nestbox Installation and Cleaning

Three kestrel nest boxes will be installed on site to support kestrel breeding opportunities. Boxes will be mounted 4–6 m above ground, on isolated trees, poles, or other suitable structures that offer clear flight access. The entrance will face east or southeast to avoid prevailing winds and excessive rain exposure while providing morning warmth. Boxes will be positioned with an open outlook over existing peatland – or open grassland - away from high disturbance areas and maintained to ensure continued suitability.

At least one nest boxes will be installed pre-construction away from the disturbance zone. The remaining two will be installed at the same time if locations are not within the construction disturbance zone or within 1 year post construction in other areas.

Depending on use (see monitoring Section 7.10.3), by kestrel or other birds such as jackdaw, the boxes will be cleaned out to maintain their suitability for kestrel nesting.

6.3 Fencing

Due to the current lack of grazing pressure at the Main Wind Farm Development Site, fencing will not be required to protect the regenerating habitats within the habitat management area from sheep or native herbivores such as deer. Should livestock grazing be proposed in this area at any point, the potential requirement will be reviewed in consultation with the HMG and included in the HMP if required.

6.4 Temporary Construction Compound Restoration

Only materials arising from the excavations will be utilised as part of the restoration scheme for the Temporary Construction Compound. Based on the existing habitats present across the Main Wind Farm Development Site these materials are very likely to be suitable for blanket bog restoration if they are handled and stored appropriately, and most should contain an existing bog vegetation seedbank. Proposal for blanket bog restoration within these areas will be provided in the HMP, post-construction based on fine-grained observations of the area at that time.

6.5 Invasive Alien Plant Species Control

Invasive species can spread rapidly and form dominant stands that exclude most other plant species, causing large scale ecological damage.

Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species, as amended, together with Commission Implementing Regulation (EU) 2016/1141 and Implementing Regulation (EU) 2019/1262, mandate measures to prevent introduction, monitor and eradicate or control certain non-native invasive species i.e. those identified in the commission implementing regulations, which provide the list of 114 invasive alien species of Union concern. In addition, there are another six implementing regulations[8].

Specific Irish legislation relating to invasive alien species includes:

- S.I. No. 477/2011 - European Communities (Birds and Natural Habitats) Regulations 2011, as amended.
- The European Union (Invasive Alien Species) Regulations 2024 (S.I. No. 374 of 2024)

[8] https://environment.ec.europa.eu/topics/nature-and-biodiversity/invasive-alien-species_en

The invasive alien plant species recorded at the Main Wind Farm Development Site are:

- Rhododendron (*Rhododendron ponticum*) and *Gunnera tinctoria* (Giant Rhubarb), listed as Invasive Alien Plant Species (IAPS) on,
    - The 3rd Schedule of S.I. No. 477/2011 - European Communities (Birds and Natural Habitats) Regulations 2011, and
    - The 1st schedule of The European Union (Invasive Alien Species) Regulations 2024 (S.I. No. 374 of 2024)
- Prickly heath (*Gaultheria mucronata*)
    - Not listed in the legalisation above but is on the Amber list of invasive species Ireland9.

Plants of IAPS identified during EIAR baseline surveys and any additional IAPS plants on Site that have established since habitat surveys were undertaken will be removed to prevent further spread that would harm the ecosystem.

6.5.1.1 Methods

Removal will be undertaken following applicable best practice guidance[10,11,]. Due to the small size of the stands, mechanical, non-chemical methods may be sufficient, however if there are more plants by the time removal works are undertaken chemical methods may be necessary. Clearance will be carried out in spring before the plants flower. Biosecurity measures to limit the risk of spread during construction will be set out in the CEMP.

Vegetation monitoring for the HMP will be used to determine the need for additional treatments/ removals.

[9] https://invasivespeciesireland.com/wp-content/uploads/wp-post-to-pdf-enhanced-cache/1/amber-list-recorded-species.pdf

[10] SEPA (2020) *Water Use Supporting Guidance (WAT-SG-18) Control of Plants in or Near to Water*.

[11] Invasive non-native species | Scottish Environment Protection Agency (SEPA) (accessed Sep 2025)

7.0 Outline Monitoring Plan

All monitoring will be undertaken by suitably qualified and experienced technical experts.

7.1 Good Practice Data Collection, Management Analysis & Reporting

This HMP will run for a duration of 35 years, the lifetime of the wind farm. During its lifetime it may pass between multiple ecological constants and site owners etc.

The accuracy of monitoring and therefore the quality of adaptive management decision based on the evidence collected will depend on consistent comparable methodology.

This HMP when refined post-consent, will provide transparent methodology with clear sampling locations, timings and protocols that can without prior experience be accurately replicated by a suitably competent technical expert.

It will also provide a set of standardised data collection forms, database structure, and data analysis protocols and reporting templates.

All data from all years will be collated in a single database held by the Proposed Development operator to permit for continuity and ease of data analysis. This can be made available to which ever consultancy is undertaking monitoring in any given year.

This will mean that year on year data and statistics will be comparable, suitable for detecting change over time and decision useful.

The purpose of the proposed monitoring of bog habitats is to determine whether the restoration work is on track to meeting its targets, goals, and objectives, or needs adjustment. Monitoring will reflect the key ecosystem attributes as summarised in **Table 7-1.**

7.2 Ecosystem Level Considerations

Table 7-1sets out the key areas of ecosystem condition, structure and function that will be considered in habitat restoration projects as set out by the Society for Ecological Restoration[12]. It additionally provides site specific consideration for Muingmore.

Table 7-1: Monitoring Considerations

Attribute	Relevance to The Proposed Development	Monitoring Requirement
Absence of threats	Potential threats include: conifer regeneration, drainage, grazing (currently low), construction work, fire.	Signs of conifer regeneration, fire, ground disturbance and grazing impacts will be recorded during vegetation monitoring.
Physical conditions	Regeneration of target of bog will require removal of overshading conifers and management of water levels within the peat.	Confirm completion of ditch blocking, cutting face re-profiling, felling, and ground smoothing in appropriate locations. Monitor water table levels in peat at both pre-felling and post-restoration stages.
Species composition	Species composition should be similar to areas of existing target habitats within	Information on species composition and how reference and restored areas

[12] https://www.ser.org/general/custom.asp?page=serstandards

Attribute	Relevance to The Proposed Development	Monitoring Requirement
	or adjacent to the peatland restoration area.	compare to each other in terms of blanket bog and heath condition will be made possible via vegetation monitoring.
Structural diversity	As re-establishing habitat matures, different canopy levels should develop (including moss and dwarf shrub layers).	Information on vegetation structure will be recorded during vegetation monitoring.
Ecosystem function	The habitat should be self-perpetuating over time with little or no active management and should start to sequester carbon/ accumulate peat.	A record of management requirements will be kept, this can be used to illustrate declining intervention needs over time. Peat accumulation data or other measures of peatland productivity will be taken to assess if the habitat is healthy enough to sequester carbon.
External exchanges	The habitat should be connected to the wider habitat network e.g. via habitat links, gene flows and landscape flows	This will have largely been achieved via choosing which locations to restore bog in, and enhancing them to a better condition more reflective of the wider bog landscape.

The ecological recovery wheel could be used to visualise and track progress against these criteria over time Diagram 1 1. Resources to support this including blank wheel excel templates, details of the rating system and attributes tables can be found on the SER website: https://www.ser.org/page/Standards-Tool.

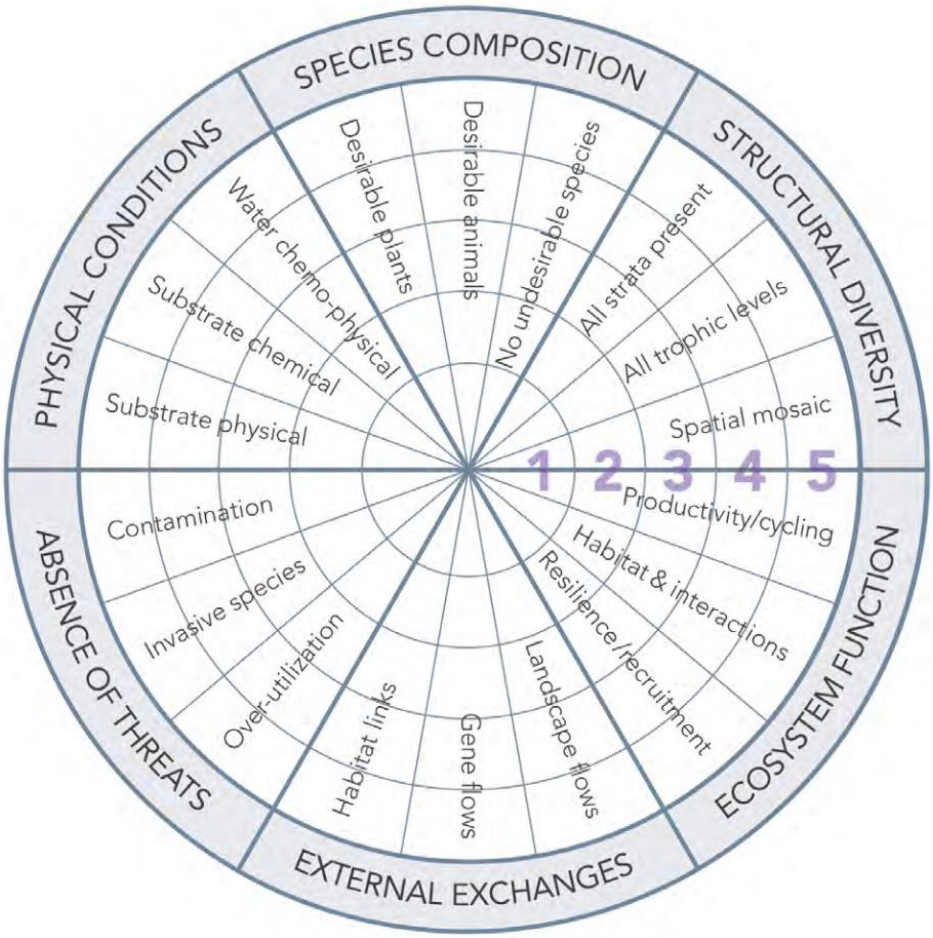


Diagram 1: SER 5 Star Ecological Recovery Wheel[13]

7.3 Indicators

Indicators are specific, quantifiable measures of attributes that directly connect longer-term goals and shorter-term objectives. Ecological indicators are variables that are measured to assess changes in the physical, chemical, or biotic ecosystem attributes as guided by the reference model.

The following indicators are cited in Table 2 as required to monitor progress toward achieving the HMP goals and objectives:

- Bog habitat condition;
- Bog restoration maintenance requirements;
- Vegetation structure;
- Presence of scrub in bog habitats;
- Water table depth;
- Peat accumulation;

[13] https://www.ser.org/page/standardsguidelinesprinciples

- Presence of non-native species;
- Kestrel breeding and nest-box use;
- Kestrel prey abundance;
- Breeding bird diversity and abundance;
- Bird and bat flight activity;
- Bird and bat collision mortality.

7.4 Monitoring Methods Summary

The methods that are proposed to monitor the above indicators set out in following Sections.

Depending on the results of these surveys, additional monitoring approaches will be required to assess progress toward objectives and inform management. For example, if herbivore impacts are highlighted as a potential issue during habitat monitoring, then grazing impact surveys will be implemented alongside other measures such as reduced stocking or fencing as appropriate at the time. Any such measures will be agreed with the HMG as part of the HMP review process (See Table 8-1).

Confirmatory vegetation surveys, bat activity surveys and dipwell monitoring will commence pre-construction to provide an updated baseline.

7.5 Pre-implementation Confirmatory Peatland Surveys & Detailed Bog Restoration Plan

7.5.1 Restoration Planning

Prior to restoration work a more detailed plan of ditch block spacing and locations will be developed including details of which sections will be infilled.

7.5.2 Peat cutting face mapping

A mapping exercise of the peat cutting faces will be undertaken within the HEA. These data will include dimensions of the cutting faces and their hydrological setting. This will highlight any constraints to the proposed restoration measures in the area.

7.6 Ditch Restoration Effectiveness Checks

7.6.1 Ditch blocks

These surveys will provide data in relation to the following indicators:

- Water table

For the bog restoration to be successful the dams of drains that are created during the restoration process need to remain effective. During drain blocking, all of the dam locations will be recorded. In the first two monitoring years, all the dam locations will be checked for signs of effectiveness, damage and requirements for maintenance. In subsequent monitoring years, especially if dam performance has been good with little maintenance requirement, then it may be appropriate to spot check only a proportion of dam locations.

7.6.2 Ground Smoothing

These areas will be checked at least monthly in the first six months and then at a frequency dependant on findings and re-vegetation progress for any signs of erosion to inform the need for surface protection during the revegetation process.

7.6.3 Cutting Face Reprofiling

These areas will be checked at least monthly in the first six months and then at a frequency dependant on findings and re-vegetation progress for any sings of erosion to inform the need for surface protection during the revegetation process, or additional re-profiling effort.

7.7 Water Table Monitoring - Dipwells

These surveys will provide data in relation to the following indicators:

- Water table

Dipwells, or a similar method for monitoring water table levels, will be installed within the bog restoration area during baseline monitoring to provide an overview of water table level fluctuations across the area. Locations will give representative coverage of the bog restoration area and control area, a minimum of twenty monitoring locations will be selected. The locations of these monitoring sites will coincide with some of the vegetation quadrat locations to improve the interpretability of the vegetation data set. The grid reference for each monitoring location will be recorded to allow relocation.

Unless the water table monitoring method selected allows for continuous data logging at set intervals, quarterly monitoring of dipwells will be undertaken in each monitoring year, to measure water levels and assess if they are high enough to promote bog vegetation growth.

Dipwells show the highest water level and lowest water level experienced since the last time the data was recorded. There are two foam balls which are moved by the water level, when a high level is recorded the top foam ball moves up and stays there unless the water level exceeds this measurement, similarly the other foam piece shows the lowest water level recorded. When taking water level data from a dipwell the difference between the distance from the top of the tubes to ground level and the distance from the top of the tubes to water level is calculated to determine the below ground water level.

7.8 Peat Accumulation

A range of approaches to monitoring peatland productivity are available[14], for the purposes of the Proposed Development, the following methods that will be considered in consultation with the HMG, in addition to vegetation surveys include:

- Erosion pins, these are placed in the ground and the distance from the ground surface to the top of the pin is measured[15]; and

[14] Short, R.,Robson, P. (2016) An innovative approach to landscape-scale peatland restoration. CIEEM In-Practice, Issue 93, September 2016

[15] Natural England (2011) A Review of Techniques for Monitoring the Success of Peatland Restoration. Natural England Commissioned Report NECR086.

- Sediment cores, here a core of the soil/ peat will be taken and the distance from the layer containing forestry debris (baseline) to the soil surface measured[16].

A combination of the above methods may provide the most reliable results. Measurements will be taken quarterly in each monitoring year, at the same times as water table monitoring to allow for contraction and expansion of peat through seasonal cycles.

7.9 Bog Habitat Mapping and Condition Monitoring

Botanical monitoring will be undertaken during the optimal survey period for plant species (May – August inclusive). The first year of botanical monitoring will be undertaken during the summer prior to bog-restoration to provide a baseline. Further monitoring (to assess changes to the baseline) would then take place annually in the first three years following restoration, and then again in year five and ten post-restoration, with the need for further monitoring determined in year ten.

These surveys will provide data in relation to the following indicators:

- Habitat extent/ mapping.
- Bog habitat condition.
- Kestrel prey abundance.
- Vegetation structure in relation to foraging habitat suitability for bats and kestrel.

7.9.1.1 Habitat Surveys and Kestrel Prey Abundance

To permit accurate mapping of vegetation cover and change over time, aerial imagery of a suitable resolution will also be obtained, ideally for the same month but at least for the same season, in each monitoring year. Potential sources of imagery include satellite data, and specially commissioned drone.

The methods of botanical monitoring will be refined in the post-consent version of the HMP and will allow for the specific monitoring against the HMP objectives, as well as being based on the standard guidelines set out in 'Best Practice Guidance for Habitat Survey and Mapping' developed by the Heritage Council of Ireland [17]. Habitats will be classified using habitat descriptions and codes published by the Heritage Council in 'A Guide to Habitat Types in Ireland'[18].

To assess the conservation status (condition), of bog habitats a series of 2x2 m plots will be assessed across he proposed bog habitats within the HMA to provide more fine scale evidence of the habitat type. The distribution of plots is yet to be confirmed but will aim to capture the broad variation in conditions across the whole restoration area, a W transect is often suitable in these circumstances. Habitat mapping and quadrata data collection will cover the keyhole areas around turbines to enable data collection in relation to bat and kestrel foraging habitat suitability, and ground smoothing bog-restoration success.

At each of these monitoring plots all species within the plot will be identified and the percentage cover of each species, in particular Sphagnum moss species will be recorded. In

[16] Lucchese, M., Waddington, J. M., Poulin, M., Pouliot, R., Rochefort, L., & Strack, M. (2010) Organic matter accumulation in a restored peatland: evaluating restoration success. Ecological Engineering 36. PP: 482-488.

[17] Smith, George F., et al. "Best practice guidance for habitat survey and mapping." The Heritage Council: Ireland (2011)

[18] Fossitt, J.A., 2000. A guide to habitats in Ireland. Heritage Council/ Chomhairle Oidhreacht

addition, habitat condition criteria will be assessed within each plot and a 20m radius according to the relevant IWM assessment methods. To assess if the goals and objectives of the HMP are being met, the criteria recorded will include:

- Signs of threats such as grazing or ground disturbance or fire;
- Vegetation structure;
- Vegetation species composition;
- Signs of kestrel prey e.g. number of vole latrines;
- Cover/ presence absence of regenerating scrub or invasive alien plant species .

7.9.1.2 Bat and Kestrel habitat management monitoring in keyhole areas

Bat mitigation buffers will be monitored in years 1, 2 and 3 following construction to ensure vegetation clearance and management measures have resulted in the desired habitat conditions. Once these conditions have been achieved, habitats will be maintained in this manner for the duration of the operational phase.

This vegetation monitoring programme will be captured within the wider vegetation and habitat monitoring surveys and will help ensure there are no significant adverse effects on bats.

7.9.2 Scrub monitoring

In addition to recording scrub in the habitat mapping & condition surveys a combined drive over and scrub quadrat survey will be undertaken. Areas of scrub will be roughly mapped during a site drive around.

In areas where scrub removal is planned to enhance bog condition 50 x 50 m quadrats will be set up to capture c. 20% to the total scrub area. Within these the density and height of scrub will be recorded.

Surveys will be undertaken prior to works and subsequently to determine the requirement for follow-up management actions (Table 8-1).

7.9.3 Non-native species (NNIS) surveys

In addition to recording any IAPS during habitat mapping and condition surveys, areas where NNIS have been record historically will be revisited during monitoring surveys (see Table 8-1), and the area and distribution of plants within these carefully documented.

Plans for the removal of these will be written up and implemented (see Section 6.5), subsequent monitoring rounds these areas will be resurveyed to check to any regeneration.

7.10 Birds

7.10.1 Breeding bird diversity and abundance

For comparability, these surveys will reflect the baseline survey methodology.

In designated survey years (see Table 8-1), a total of three survey visits will be conducted in each survey year between April and July. Surveys will be carried out within the Main Wind Farm Development Site & HEA following:

- ,
  The O'Brien and Smith (1992) methodology which is suitable diurnal species and lowland sites[1523].
- Dusk surveys to record crepuscular and nocturnal species, including woodcock and owls. These surveys will be conducted following the methodology outlined by Gilbert et al.[12] for Eurasian woodcock and modified for collection of data on other nocturnal species observed.

7.10.2 Flight Activity and Carcass Searching

Based on current best-practice guidelines (SNH, 2009) and in accordance with EC Recommendation (C/2022/3219), a targeted range of flight activity surveys and collision monitoring (carcass searching) will be undertaken during the breeding and non-breeding seasons in years 1, 2 and 3 post construction, to monitor the rate of avian turbine collisions.[19] Six hours of survey per vantage point per month will be carried out for flight activity surveys and one round of carcass searches per turbine per month will be carried out. These surveys will be carried out by qualified ecologists. The results of each year of monitoring will be presented in a report that will be submitted to the competent authority and NPWS. The need for further monitoring thereafter will be agreed with the competent authority and in consultation with the NPWS.

7.10.3 Kestrel Nesting Success

Kestrel next boxes will be monitored for use by kestrel or other species. Monitoring will be timed to capture nest box use and likely fledging success (1-2 survey visits/ monitoring year).

Boxes will be monitored annually inform nestbox cleaning and maintenance needs.

7.11 Bats

7.11.1 Pre-Construction

To confirm the accuracy of the baseline results a year of confirmatory surveys will be undertaken for bats immediately prior to construction within the Main Wind Farm Development Site. This will involve three rounds of static detector surveys (spring, summer and autumn) as per the latest NatureScot (2021) guidance.

The results of these surveys will be used to provide an updated baseline environment, for bats, and will form the basis of the post-construction monitoring programme. For example, in the event of high levels of activity at certain locations across the Main Wind Farm Development Site, post-construction monitoring will be adapted to pay particular attention to this location.

[19] Scottish Natural Heritage. (2009). *Monitoring the impact of onshore wind farms on birds*. SNH Guidance Document. Inverness: Scottish Natural Heritage.

Following this additional year of pre-construction monitoring, the results will be used to assess the precise requirements for post-construction monitoring, including methods, timing and duration.

7.11.2 Post-Construction

7.11.2.1 Activity and fatality monitoring

Post-construction monitoring will be carried out in line with commitments made in respect of the Proposed Project and in accordance with EC Recommendation (C/2022/3219) and will be seen as an opportunity to obtain data on bat/turbine interactions and to allow adaptive management of the proposed mitigation measures.

The post-construction monitoring programme will consist of:

- Static detector surveys: these surveys will allow for a valid comparison of bat activity and Main Wind Farm Development Site usage with pre-construction levels. Following NatureScot (2021) guidance, the surveys are to be conducted during years 1, 2 and 3 post construction to allow for annual variation and cumulative effects. Reports will be submitted to the competent authority and NPWS following each year of surveys. Surveys will follow baseline survey methods, as outlined in NatureScot (2021) guidance. After three years of post-construction surveys, the monitoring programme may be extended or halted based on the results and following agreement with the competent authority and NPWS.
- Fatality monitoring: if this is determined to be required following the additional year of pre-construction monitoring (i.e. due to high levels of bat activity), this will initially be conducted during years 1, 2 and 3 post construction to allow for annual variation and cumulative effects. The comprehensive fatality monitoring programme for birds as described above will be extended and duplicated to bats for the first three years per the post-construction monitoring requirements recommended by NatureScot (2021). After three years of post-construction surveys, the monitoring programme may be extended or halted following agreement with the competent authority and NPWS.

The results of the post-construction monitoring surveys will be used to determine whether further mitigation measures are required.

7.12 External Factors

It is important to note that external factors such as climate change and herbivore and wild bird and bat populations can influence habitat restoration success and species use of the site. Over the lifetime of the Proposed Project it is possible that climate change will affect the habitats on site and in the surrounding area. This will be taken into account during monitoring and reporting and is another reason why a control site in relation to bog restoration is important.

7.13 On-going Management and Maintenance

The requirement for on-going management and maintenance will be determined based on survey results. Requirements may include:

- Repair of dams etc., in the peat restoration areas.

- Scrub control.
- Non-native species control.
- Nest- box maintenance.

8.0 Schedule

An outline timetable for the implementation and monitoring works set out in this HMP is provided in **Table 8-1**.

Table 8-1: Outline Schedule of Works (Required, as needed based on monitoring results)

Task	Pre-construction	Construction	Year 1	Year 2	Year 3	Year 4	Year 5	Year 10	Year 15	Year 20	Year 25	Year 30	Year 35
Enabling Tasks													
Form HMP working group (HMG)													
Refine HMP in preparation for implementation													
Capital Works													
Re-use of excavated peat													
Bog restoration													
Temporary construction compound restoration													
Scrub control													
Non-native species control													
Kestrel nest box installation/ cleaning													
Monitoring & Associated Reporting													
Habitat mapping and Condition Surveys													
Dipwells[20]													

[20] Monitoring for baseline will be undertaken pre-bog restoration ideally over two years. Subsequent monitoring will commence post-bog restoration which could be anytime between year 1 and 4.

Task	Pre-construction	Construction	Year 1	Year 2	Year 3	Year 4	Year 5	Year 10	Year 15	Year 20	Year 25	Year 30	Year 35
Bog Restoration Checks (Drain Blocking, Ground smoothing, Hag-reprofiling)[13]													
Scrub surveys													
Non-native species surveys													
Kestrel nest-box surveys													
Bird Flight Activity and Carcass Searching													
Bat activity pre-construction													
Bat activity post-construction													
Bat carcass searching													
HMP Review and Adaptation													
HMP review and updates													
Ongoing adaptive management via agreement with HMG													

9.0 Evaluation of Performance against Goals and Objectives

Progress toward achieving the goals and objectives set out in Section 4.0 of this HMP will be evaluated using a traffic light system (see Table 9-1 and Table 9-2 for a template and hypothetical examples).

Evaluation of progress towards the HMP goals and objectives will be undertaken every five years as part of the HMP review/ adaptive management approach. This will be the responsibility of the windfarm operator. All goals and objectives will be considered to apply to the lifetime of the Proposed Development unless otherwise agreed by the HMG or set out in the schedule of works (for outline see Table 8-1).

Table 9-1: Traffic Light System

Met	Goal/ Objective has been met overall e.g., in all management areas or in terms of total figures across the site.
Partially met	Goal/ Objective has been partially met, e.g., it has been met in some areas but not others or progress overall is in the correct direction but has not reached the desired conditions.
Not met	Goal/ Objective has not been met, e.g., the objective has not been achieved in any area or, overall there has been no or negative progress toward meeting desired conditions.
Unclear / No data	Goal/ Objective has not clearly been met, e.g., because there are insufficient data to assess progress.

Table 9-2: Progress against Goals and Objectives Template with Hypothetical Examples

Relevant targets(s)	Amount/ location	Action	Timing	Indicators	Progress (with example classification & text)
Goal 1: Minimize, as far as practicable, the removal of peat and bog vegetation from site during construction					
Objective: 1.1 As far as practical re-wet and retain excavated peat on site					
Bog habitats	All peat excavated during construction – 80,167 m^3	Re-use excavated peat for on-site bog restoration and reinstatement work See Technical Appendix 6.3, for a breakdown of volumes and details of handling requirements.	During construction See note in Technical Appendix 6.3 for details on timing for storage and re-use	Volume of excavated peat used in bog-restoration is 58,000m^3 or higher. Remaining excavated peat is used in reinstatement. Excavated peat used in peatland reinstatement and bog restoration is placed in conditions that prevent drying	e.g. *The estimated volume of peat has been used at the planned locations within the planned timescale*

Relevant targets(s)	Amount/ location	Action	Timing	Indicators	Progress (with example classification & text)
				and associated carbon loss.	
Goal 2: Enhance the condition of remaining peatlands out with afforested areas to result in enhancement of blanket bog biodiversity value compared baseline.					
Objective: 2.1 Raise the water table in blanket bog habitat					
Bog habitats	177 ha: All ditches within open habitats, outwith infrastructure buffer areas as mapped on Figure 02 c. 139ha. Keyholed and other areas of forest felling c. 24ha. Areas of historic peat extraction (c. 14ha).	Block & infill ditches. Ground-smooth former forestry areas. Re-profile cutting faces. Restore / re-vegetate temporary areas such as the temporary construction compound.	During or within two years of construction with repair as required for the duration of the HMP	Water table is within 10cm of the surface on average (with a lower limit of 20cm depth e.g. during dry conditions), within the appropriate buffer distance of all blocked ditches (see peat restoration plan). Bog (inc. PB4, PB3, PF3 and PF2) vegetation in restored areas is in an improved condition compared to baseline data and more similar to that in a control site, as measured using suitable condition criteria. Peat/ carbon accumulation as determined by depth measurements and presence of peat forming vegetation.	*e.g. Ditch blocking ground smoothing and re-profiling were completed on time in most areas except for xxx however bad weather had delayed work and pushed completion back by a season.*
Objective 2.2: Reduce the risk of bog habitat transitioning to woodland and associate peat drying					
Bog habitats	Areas where scrub is found within blanket bog habitat	Remove scrub. Pulling or cutting with brash removed from site.	During or within two years of construction with maintenance as required for the duration of the HMP	Scrub is removed, with follow up-removal of any regenerating scrub if require. Areas identified as scrub removal areas remain scrub free	*e.g. Scrub control has not yet been started due to contractual issues. Completion is now a year overdue.*

Appendix A Figures 01

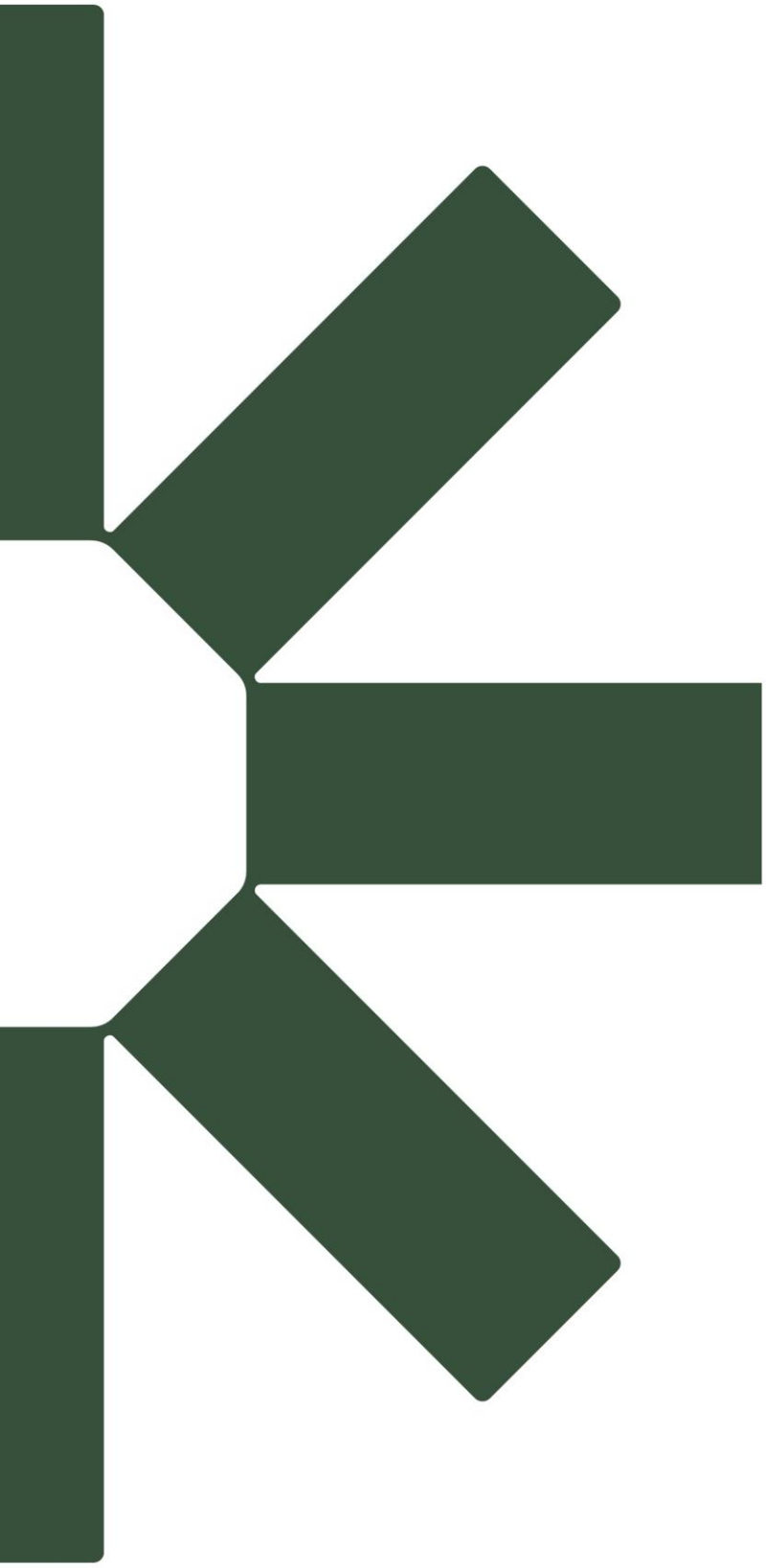
Muingmore Wind Farm

Habitat Management Plan

RWE

SLR Project No.: 501.065301.00001

28 November 2025



Making Sustainability Happen

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Gweesalia

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TCC1

1 2 3

1 PB3; 2 GS4/GS3; 3 GS4/PF2/HH3; 4 FW1; 5 WD4; 6 WD4; 7 WD4; 8 GS4; 9 GS4; 10 GS4; 11 WS1/GS4; 12 FW1; 13 ED3; 14 ED3; 15 ED3; 16 ED3; 17 BL3; 18 HD1/WS1/GS4; 19 GS4; 20 PB3; 21 WD4; 22 WD4; 23 PF3; 24 GS4; 25 PB3; 26 GS4/HH3/WS1; 27 FL2; 28 PB4; 29 GS4/WS1/HD1; 30 WS1; 31 FL8; 32 PB3; 33 GS4/ED3/WS1; 34 WS1; 35 GS4; 36 GS4; 37 PB4; 38 PB4; 39 PB4; 40 PB4; 41 PB4; 42 PB4; 43 PB4; 44 PB4; 45 PB4; 46 PB4; 47 PB4; 48 WS1; 49 WS1; 50 PB4/WS1; 51 PB4/WS1; 52 PB4/WS1; 53 PB4/WS1; 54 PB4/WS1; 55 FL2; 56 GS3; 57 BL3; 58 WS1; 59 FS1; 60 FL8; 61 FS1; 62 PF3; 63 FS1; 64 FS1; 65 FS1; 66 PB4/WS1; 67 WD4

Béal an Mhuirthead

Blacksod Bay / Cuan an Fhoid Duibh

LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Site Access Location
- Proposed Met Mast Location
- Proposed New Access Track
- Proposed Upgraded Access Track
- Proposed Grid Connection Route (Subject to Separate Planning Application)
- Proposed Crane Pad
- Proposed Substation
- Proposed Battery Energy Storage System (BESS) Compound
- Proposed Attenuation Basin

Fossit Habitats (Linear)

- BL3 - Buildings and Artificial Surfaces
- ED3 - Recolonising Bare Ground
- FW1 - Eroding / Upland Rivers

Fossit Habitats (Areas)

- BL3 - Buildings and Artificial Surfaces
- FL2 - Acid Oligotrophic Lake
- FL8 - Other Artifical Lakes and Ponds
- FS1 - Reed and Large Sedge Swamps
- FW1 - Eroding/Upland Rivers
- GS3 - Dry-humid Acid Grassland
- GS4 - Wet Grassland
- GS4/ED3/WS1 - Wet Grassland / Recolonising Bareground / Scrub
- GS4/GS3 - Wet Grassland / Dry-humid Acid Grassland
- GS4/HH3/WS1 - Wet Grassland / Wet Heath / Scrub
- GS4/PF2/HH3 - Wet Grassland / Poor Fen and Flush / Wet Heath
- GS4/WS1 - Wet Grassland / Scrub
- GS4/WS1/HD1 - Wet Grassland / Scrub / Dense Bracken
- HD1/WS1/GS4 - Dense Bracken / Scrub / Wet Grassland
- PB3 - Lowland Blanket Bog
- PB4 - Cutover Bog
- PB4/WS1 - Cutover Bog / Scrub
- PF3 - Transition Mire and Quaking Bog
- WD4 - Conifer Plantation
- WD4/ED3/GS4 - Conifer Plantation / Recolonising Bareground / Wet Grassland
- WS1 - Scrub
- WS1/GS4 - Scrub / Wet Grassland
- WS1/GS4/HH3 - Scrub / Wet Grassland / Wet Heath

RWE

SLR

MUINGMORE WIND FARM

HABITAT MANAGEMENT PLAN

HABITAT FOSSIT PLAN MAIN WIND FARM DEVELOPMENT SITE BOUNDARY

FIGURE 1a

Scale	Date
1:18,000 @ A3	APRIL 2026

402.064443.00001.0190.0 Habitat Plan

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478000 478250 478500 478750

821750

821500

N

70 WS1

71 PB3

72 PB3

73 WS1

0 50 100

Metres

LEGEND

Proposed Development Site Boundary

Proposed Over-run Area Access Track

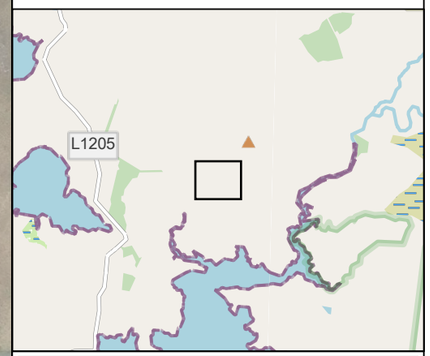
Proposed Turbine Delivery Route (TDR)

Fossitt Habitat Survey Area

Fossit Habitats (Area)

PB3 - Lowland Blanket Bog

WS1 - Scrub



RWE

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MUINGMORE WIND FARM

HABITAT MANAGEMENT PLAN

HABITAT FOSSITT PLAN OVER-RUN AREA 1

FIGURE 1b

Scale 1:3,000 @ A3

Date MAY 2026

402.064443.00001.0192.0 Habitat Plan ORA

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497500

497750

819750

819500

81 BL3

86 FW4

85 BL3

83 GS2

84 BL3

82

81 BL3

N

LEGEND

Proposed Development Site Boundary

Proposed Over-run Area Access Track

Proposed Turbine Delivery Route (TDR)

Fossitt Habitat Survey Area

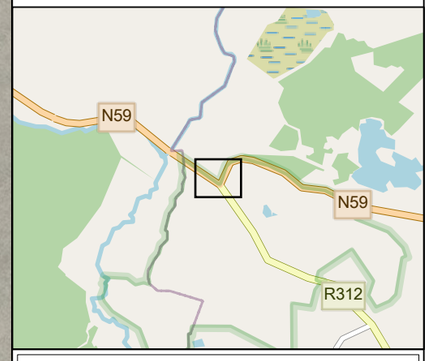
Fossit Habitats (Area)

PB3 / GS2 / WS1- Lowland Blanket Bog / Dry Meadow and Grassy Verge / Scrub

BL3 - Buildings and Artifical Surfaces

FW4 - Drainage Ditches

GS2 - Dry Meadows & Grassy Verges



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Metres

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MUINGMORE WIND FARM

HABITAT MANAGEMENT PLAN

HABITAT FOSSITT PLAN OVER-RUN AREA 2

FIGURE 1c

Scale 1:2,000 @ A3

Date MAY 2026

402.064443.00001.0192.0 Habitat Plan ORA

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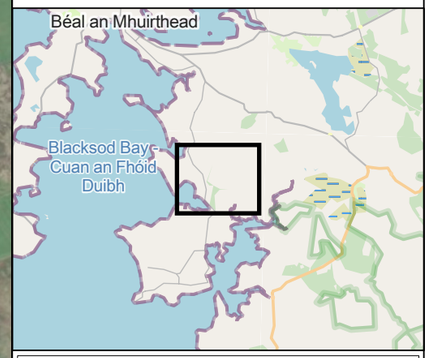
LEGEND

- Proposed Development Site Boundary
- Survey Boundary
- Proposed Turbine Location
- Proposed Site Access Location
- Proposed New Access Track
- Proposed Upgraded Access Track
- Proposed Grid Connection Route (Subject to Seperate Planning Application)
- Proposed Crane Pad
- Proposed Substation
- Battery Energy Storage System (BESS) Compound
- Proposed Temporary Construction Compound (TCC)
- Proposed Attenuation Basin
- Combined Infrastructure 30 m Buffer – Rewetting Anticipated to be less Effective due to Infrastructure Drainage Influences
- Ditch Blocking and Infilling
- Watercourse 30 m Buffer - Ditch Blocking Only as Appropriate to Protect the Water Environment
- Ground Smoothing and Bog Creation
- Bog to Forest Transition
- Peat Cuttingface Reprofiling and 30 m Restoration Buffer
- Scrub Clearance
- Gunnera tinctoria
- Rhododendron ponticum

Note:
Vegetation management in keyhole areas around proposed turbines to deter foraging by kestrels.
Three kestrel nest boxes to be installed, locations to be determined.
Over-Run Area 3 is not considered in this assessment.



RWE

SLR

MUINGMORE WIND FARM

HABITAT MANAGEMENT PLAN

INTERVENTION LOCATIONS
MAIN WIND FARM DEVELOPMENT
SITE BOUNDARY

FIGURE 2a

Scale 1:16,000 @ A3

Date MAY 2026

402.064443.00001.0193.0 HMP

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LEGEND
Proposed Development Site Boundary
Proposed Over-run Area Access Track
Proposed Turbine Delivery Route (TDR)
L1205
RWE
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MUINGMORE WIND FARM
HABITAT MANAGEMENT PLAN
INTERVENTION LOCATIONS OVER-RUN AREA 1
FIGURE 2b
Scale 1:3,000 @ A3
Date APRIL 2026
402.064443.00001.0194.0 HMP ORA
Microsoft, Vantor, Map data © OpenStreetMap contributors, Microsoft, Facebook, Google, Esri Community Maps contributors, Map layer by Esri Aerial Imagery [2023] Source: Maxar, Microsoft, Map Data © OpenStreetMap contributors, Microsoft, Facebook, Inc. and its affiliates, Esri Community Maps Contributors, Map layer by Esri
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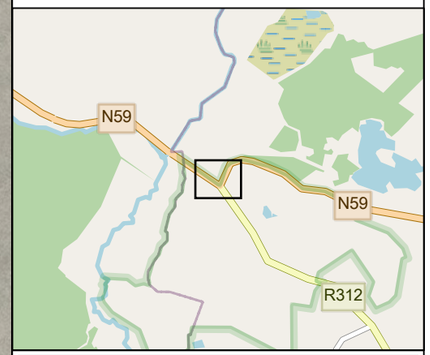
LEGEND

Proposed Development Site Boundary

Proposed Over-run Area Access Track

Proposed Turbine Delivery Route (TDR)



0 50 100

Metres

RWE

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HABITAT MANAGEMENT PLAN

INTERVENTION LOCATIONS OVER-RUN AREA 2

FIGURE 2c

Scale 1:2,000 @ A3

Date APRIL 2026

402.064443.00001.0194.0 HMP ORA

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Appendix B Additional Figures

RWE Renewables Ireland Limited

SLR Project No.: 501.065301.00001

27 February 2026

474000
476000
478000
824000
822000
402.064443.00001.0188.0 Habitat Plan

N

Doolough
Tristia
Gweesalia
TCC1

T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13

1 2 3

0 1 2
Kilometres

Béal an Mhuirthead
Blacksod Bay / Cuan an Fhoid Duibh

LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Site Access Location
- Proposed Met Mast Location
- Proposed New Access Track
- Proposed Upgraded Access Track
- Proposed Grid Connection Route (Subject to Separate Planning Application)
- Proposed Crane Pad
- Proposed Substation
- Proposed Battery Energy Storage System (BESS) Compound
- Proposed Attenuation Basin

Fossit Habitats (Linear)

- BL3 - Buildings and Artificial Surfaces
- ED3 - Recolonising Bare Ground
- FW1 - Eroding / Upland Rivers

Fossit Habitats (Areas)

- BL3 - Buildings and Artificial Surfaces
- FL2 - Acid Oligotrophic Lake
- FL8 - Other Artifical Lakes and Ponds
- FS1 - Reed and Large Sedge Swamps
- FW1 - Eroding/Upland Rivers
- GS3 - Dry-humid Acid Grassland
- GS4 - Wet Grassland
- GS4/ED3/WS1 - Wet Grassland / Recolonising Bareground / Scrub
- GS4/GS3 - Wet Grassland / Dry-humid Acid Grassland
- GS4/HH3/WS1 - Wet Grassland / Wet Heath / Scrub
- GS4/PF2/HH3 - Wet Grassland / Poor Fen and Flush / Wet Heath
- GS4/WS1 - Wet Grassland / Scrub
- GS4/WS1/HD1 - Wet Grassland / Scrub / Dense Bracken
- HD1/WS1/GS4 - Dense Bracken / Scrub / Wet Grassland
- PB3 - Lowland Blanket Bog
- PB4 - Cutover Bog
- PB4/WS1 - Cutover Bog / Scrub
- PF3 - Transition Mire and Quaking Bog
- WD4 - Conifer Plantation
- WD4/ED3/GS4 - Conifer Plantation / Recolonising Bareground / Wet Grassland
- WS1 - Scrub
- WS1/GS4 - Scrub / Wet Grassland
- WS1/GS4/HH3 - Scrub / Wet Grassland / Wet Heath

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PEAT RESTORATION PLAN

HABITAT FOSSIT PLAN
MAIN WIND FARM DEVELOPMENT SITE BOUNDARY

FIGURE 1a

Scale	Date
1:18,000 @ A3	APRIL 2026

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478000 478250 478500 478750

821750

821500

N

70 WS1

71 PB3

72 PB3

73 WS1

0 50 100

Metres

LEGEND

Proposed Development Site Boundary

Proposed Over-run Area Access Track

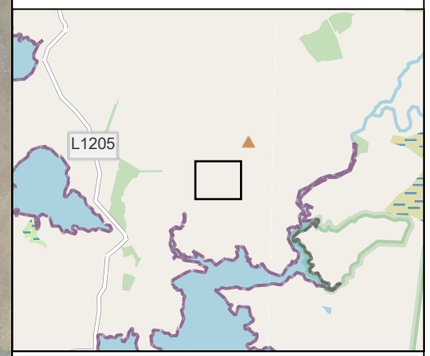
Proposed Turbine Delivery Route (TDR)

Fossitt Habitat Survey Area

Fossit Habitats (Area)

PB3 - Lowland Blanket Bog

WS1 - Scrub



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PEAT RESTORATION PLAN

HABITAT FOSSITT PLAN: OVER-RUN AREA 1

FIGURE 1b

Scale 1:3,000 @ A3

Date MAY 2026

402.064443.00001.0189.0 Habitat Fossitt Map ORA

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497500

497750

819750

819500

81 BL3

86 FW4

85 BL3

83 GS2

84 BL3

82

81 BL3

N

0 50 100

Metres

LEGEND

Proposed Development Site Boundary

Proposed Over-run Area Access Track

Proposed Turbine Delivery Route (TDR)

Fossitt Habitat Survey Area

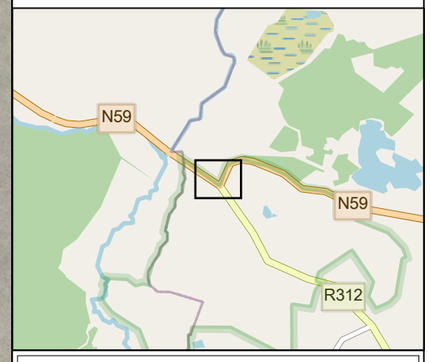
Fossit Habitats (Area)

PB3 / GS2 / WS1- Lowland Blanket Bog / Dry Meadow and Grassy Verge / Scrub

BL3 - Buildings and Artifical Surfaces

FW4 - Drainage Ditches

GS2 - Dry Meadows & Grassy Verges



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PEAT RESTORATION PLAN

HABITAT FOSSITT PLAN: OVER-RUN AREA 2

FIGURE 1c

Scale 1:2,000 @ A3

Date MAY 2026

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485000 485250 485500 485750

823750

823500

N

75
87 GS4
79 FW2
88 GS4
74 PB4
77 PB4
76 BL3
80 GS4
78 PB3
89 WS1

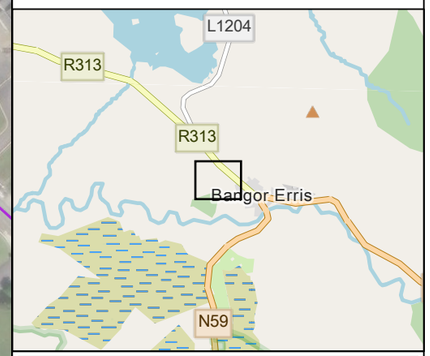
0 50 100
Metres

LEGEND

- Proposed Development Site Boundary
- Proposed Over-run Area Access Track
- Proposed Turbine Delivery Route (TDR)
- Fossitt Habitat Survey Area

Fossit Habitats (Area)

- PB3 / GS2 / WS1- Lowland Blanket Bog / Dry Meadow and Grassy Verge / Scrub
- BL3 - Buildings and Artifical Surfaces
- FW2- Depositing Lowland Rivers
- GS4 - Wet Grassland
- PB3 - Lowland Blanket Bog
- PB4 - Cutover Bog
- WS1 - Scrub



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PEAT RESTORATION PLAN

HABITAT FOSSITT PLAN: OVER-RUN AREA 3

FIGURE 1d

Scale 1:2,500 @ A3

Date MAY 2026

402.064443.00001.0189.0 Habitat Fossitt Map ORA

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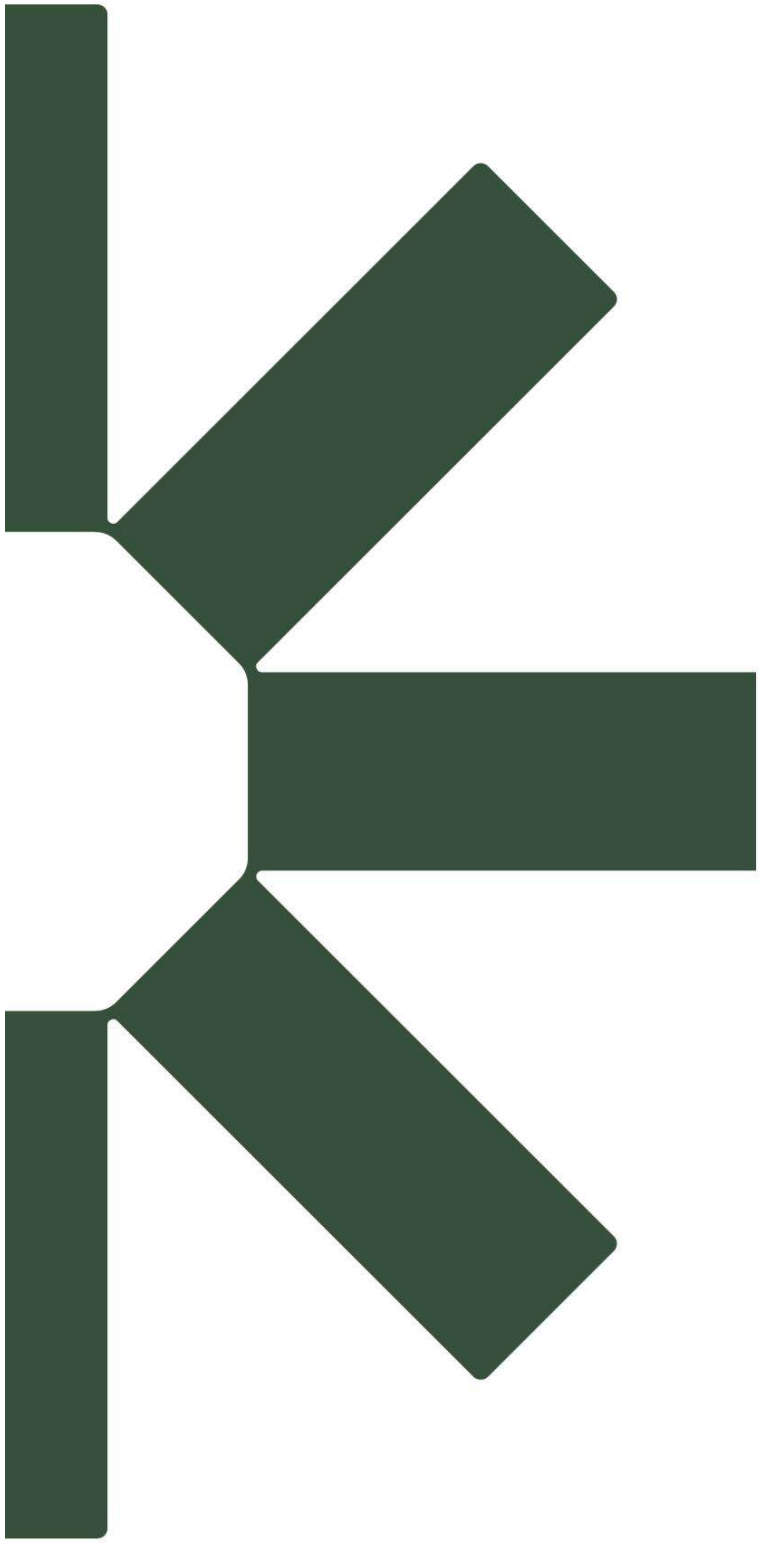

Making Sustainability Happen

Appendix 8 Collision Risk Model Report

AA Screening and Natura Impact Statement

Muingmore Wind Farm

RWE Renewables Ireland Limited

SLR Project No.: 501.065301.00001

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
0	9 July 2025	Jonathon Dunn	Michael Austin	Jonathon Dunn
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			
	Click to enter a date.			

Basis of Report

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Executive Summary

The aim of this report is to describe the collision risk modelling process undertaken for the Muingmore Wind Farm project in Co. Mayo, and to provide outputs such that any potentially significant collision-related effects on birds can be identified in the accompanying EIAR and NIS reports. Modelling was undertaken based on ornithological data collected by Woodrow over the period from April 2021 to May 2024 for 19 bird species and three candidate turbine models. The model chosen was a random (i.e. non-directional) model and was implemented following NatureScot (2024) best-practice guidance. In general, the probability of collision risk was highest for the Nordex N163 candidate turbine model for all bird species. Common kestrel had the highest level of collision risk, followed by greylag goose and lesser black-backed gull. While the model outputs provide a theoretical estimate of collision risk, they do not directly reflect whether collision is likely to have significant effects on avian populations. Furthermore, the modelling is subject to several limitations and qualifications, which are discussed in the report.

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Appendix A NatureScot Spreadsheets – Vestas V150

Appendix B NatureScot Spreadsheets – Nordex N163

Appendix C NatureScot Spreadsheets – Nordex N149

Acronyms and Abbreviations

CIEEM	Chartered Institute of Ecologists and Environmental Managers
CRM	Collision Risk Model
GIS	Geographical Information Systems
MW	Megawatt
NS	NatureScot
PCH	Potential Collision Heights
RWE	RWE Renewables Ireland Ltd
SCI	Special Conservation Interest
SPA	Special Protection Area
The Project	Muingmore Wind Farm
VP	Vantage Point
WP	Wind Farm Polygon

1.0 Introduction

This report presents the results of Collision Risk Modelling (CRM) undertaken for 19 bird species to inform the assessment of potential ornithological impacts relating to the proposed Muingmore Wind Farm (hereafter "the Project"), which has a layout comprising 13 turbines in one array.

As advised by RWE Renewables Ireland Ltd (hereafter "RWE"), modelling was based on the use of three turbine models:

- Vestas V150 turbine type: 6 MW, each with a rotor diameter of 150 m, tip height of 180 m, and hub height of 105 m;
- Nordex N163 turbine type: 7 MW, each with a rotor diameter of 163 m, tip height of 180 m, and hub height of 98.5 m; and
- Nordex N149 turbine type: 5.7 MW, each with a rotor diameter of 149 m, tip height of 179 m, and hub height of 104.5 m.

The CRM was undertaken in accordance with current NatureScot (NS) (formerly Scottish Natural Heritage guidance[1], which is recognised as standard best practice guidance through the UK and Ireland to inform impact assessment for onshore wind farms. Further details regarding the methodology used, including details of assumptions used and any corrections applied, are provided in section 2.0. The modelling results are presented in section 3.0 and copies of the modelling calculations for each species modelled are included in Appendix A, Appendix B and Appendix C.

[1] NatureScot (2024). Guidance on using an updated collision risk model to assess bird collision risk at onshore wind farms. NatureScot, Battleby, Scotland.

2.0 Methods

2.1 Statement of Authority

The modelling and report writing were conducted by Dr Jonathon Dunn MCIEEM. Jonathon is an Associate Ornithologist with SLR and has over 10 years' experience in the environmental sector and has completed CRM training delivered by CIEEM. He has conducted CRMs for several onshore wind farms in Ireland.

Quality assurance and technical review were provided by Michael Austin MCIEEM. Michael is an Associate Ornithologist with SLR and has over 10 years' experience undertaking CRM. He was trained in CRM at RPS and has taken a lead role in CRM at SLR having conducted many CRMs for onshore wind farms in the UK and Ireland.

2.2 Primary Target Species

Target species for the surveys were defined by legal and/ or conservation status and vulnerability to impacts caused by wind turbines, as defined in NS (2025) guidance[2]. Bird species of high conservation importance are those which are Annex I species and other species of high conservation importance which are vulnerable to impacts from wind farm developments. The following species are therefore considered relevant as primary target species:

- Annex I raptor species;
- All red-listed non-passerine species; and
- Special Conservation Interests (SCIs) of Special Protection Areas (SPAs) within 20 km of the Project.

2.3 Overview of CRM Process

The updated Band CRM (Band et. al. 2024[3]) was used to estimate collision risk based on recorded primary target species activity levels and flight behaviour, proposed turbine numbers and specifications, and the relevant species biometrics and flight characteristics. Modelling collision risk under the Band CRM[3] is summarised below:

- Stage A uses bird survey data to establish the density of flying birds in the vicinity of the turbines, and the proportion flying at a risk height, between the lowest and highest points of the rotors;
- Stage B provides an estimate, based on the bird density and proportion at risk height, of the potential number of bird passages through rotors in the period in question;
- Stage C calculates the probability of collision during a single bird rotor transit;
- Stage D estimates the potential collision rate for a bird species, assuming current levels of bird use of the site, allowing for the proportion of time that turbines are not operational; and
- Stage E takes account of the proportion of birds likely to avoid the wind farm or its turbines, either because they have been displaced from the site or because they take

[2] NatureScot (2025). Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms. Version 2

[3] Band, W. 2024. Using a collision risk model to assess bird collision risks for onshore wind farms. NatureScot Research Report 909.

evasive action or are attracted to the wind farm, e.g. in response to changing habitats.

A full description of the different stages of the CRM are given in the NS (2024)[1] guidance.

We have employed a non-directional (i.e. randomly distributed flights) CRM. The modelling was carried out using the spreadsheet supplied with the NS (2024)[1] guidance.

The data used for the different stages of CRM are outlined below.

2.4 Stage A

2.4.1 Viewshed Data

Four vantage points (VPs) were used for flight activity surveys.

Viewshed data, i.e., the area visible from each VP within each wind farm polygon (WP)[4], are summarised in Table 2-1. Separate analyses were undertaken for each turbine model as follows.

For the Vestas V150 and Nordex N149, based on an offset of 30 m, the combined viewshed area (minus overlap) from VPs 1 - 4 (V150: 7,076,331 m^2; N149: 7,069,378 m^2) represents 100% of the survey WP for the V150 and N149 models, respectively (V150: 7,076,331 m^2; N149: 7,069,378 m^2) (Table 2-1).

For the Nordex N163, based on an offset of 17 m, the combined viewshed area (minus overlap) from VPs 1 - 4 (7,122,924 m^2) represents 99.9% of the survey WP (7,132,836 m^2) (Table 2-1).

Table 2-1: VP Viewshed Data

VP / Viewshed Number	WGS 84 Coordinates (x,y)	Area of visibility[5] (m^2)		
		Vestas V150	Nordex N163	Nordex N149
VP 1	54.142541, -9.893851	4,030,074	4,069,129	4,023,863
VP 2	54.134320, -9.893301	4,473,766	4,502,369	4,471,909
VP 3	54.138095, -9.903836	5,270,414	4,390,366	5,266,706
VP 4	54.129013, -9.888069	2,922,095	2,978,745	2,920,231
VPs 1-4 viewshed combined (minus overlap)		7,076,331	7,122,924	7,069,378

[4] The survey wind farm polygon (WP) includes the area within 500 m of the turbine blades, extending from within each turbine, also known as 'the turbine envelope'. Thus, the size of the WP considers both rotor blade length and potential spatial errors in flight recording accuracy.

[5] Areas calculated in GIS using offset of 17 m above ground level for Nordex 164, and 30 m for Vestas V150 and Nordex 149

2.4.2 Seasonal Definitions

The periods used in the flight activity survey design broadly equate to the breeding and non-breeding season periods for most bird species, defined as April – August (breeding season) and September – March (non-breeding season).

Additional survey effort was undertaken for spring (March and April) and autumn (September and October) migration periods; however, unless otherwise specified, the migration period survey effort and flight activity results have been subsumed into the breeding and non-breeding season categories for CRM.

2.4.3 Year 1, Year 2 and Year 3 Flight Activity Survey Data

Flight activity data from the four VPs described in section 2.4.1 were collected during baseline surveys carried out by Woodrow during April 2021 to May 2024 over a period of three years, comprising three breeding and three non-breeding periods, including one additional partially completed breeding season.

The total number of hours of survey are as shown in Table 2-2 (Woodrow, 2024[6]), which are far in excess of the minimum of 144 per VP over a two-year period required by NS guidance[2].

Table 2-2: VP Surveys undertaken at the Project, April 2021 to May 2024

VP Number	Hours of Survey Completed per Survey Period							
	Apr – Aug 2021	**Sep 2021 – Mar 2022**	**Apr – Aug 2022**	**Sep 2022 – Mar 2023**	**Apr – Aug 2023**	**Sep 2023 – March 2024**	**Apr – May 2024**	**Total**
1	38.00	40.50	36.00	60.00	48.00	62.50	12.00	**297.00**
2	36.00	42.50	36.00	58.50	53.00	63.00	9.00	**298.00**
3	36.00	40.60	39.00	63.00	45.00	64.00	9.00	**296.50**
4	36.00	40.50	36.00	60.00	48.00	59.75	9.00	**289.25**

The raw number of flight lines, cumulative number of birds and flying time in each height category per VP for each survey period is shown below in Table 2-3. Note that only data for survey periods and VPs where flight activity was recorded are shown for brevity.

Table 2-3: Details of Raw Flight Lines Recorded at the Project, Both Inside and Outside WP

Species	Survey Period	VP No.	No. of Flight Lines	No. of Birds	Total Flying Time (s)	Time in height category (s)		
						0-10 m	10 – 150 m	>150 m
Black-headed gull	Breeding 2021	1	4	4	178	101	77	0
		2	6	7	609	0	609	0
		3	19	20	863	132	731	0

[6] Woodrow APEM Group (2024). Ornithology Results Report for Muingmore Wind Farm 2021- 24. EIAR Technical Appendix. Woodrow APEM Report P00008408. RWE, December 2024

Species	Survey Period	VP No.	No. of Flight Lines	No. of Birds	Total Flying Time (s)	Time in height category (s)		
						0-10 m	10 – 150 m	>150 m
		4	18	19	769	99	670	0
	Breeding 2022	1	2	4	180	0	180	0
		2	1	1	70	0	70	0
		3	1	2	0	0	0	0
		4	2	3	260	0	260	0
	Non-breeding 2022/23	4	3	4	100	0	100	0
	Breeding 2023	2	3	3	161	0	161	0
		3	5	5	335	0	335	0
		4	4	5	2670	2520	150	0
	Non-breeding 2023/24	2	1	1	20	0	20	0
Black-legged kittiwake	Breeding 2023	2	1	1	40	0	40	0
Common gull	Breeding 2021	4	1	2	580	0	580	0
	Non-breeding 2022/23	4	2	3	109	0	109	0
	Non-breeding 2023/24	3	1	1	10	0	10	0
Common kestrel	Breeding 2021	1	15	16	818	0	818	0
		2	6	6	668	0	668	0
		3	17	17	1486	33	1453	0
		4	10	10	807	397	410	0
	Non-breeding 2021/22	1	10	10	452	0	452	0
		3	4	4	93	0	93	0
		4	1	1	47	0	47	0
	Breeding 2022	1	15	20	1043	0	1043	0
		2	11	18	4384	0	2324	2060
		3	3	4	285	0	285	0
		4	1	1	20	0	20	0
	Non-breeding 2022/23	1	20	25	2500	385	2115	0
		2	6	7	495	0	495	0
		3	6	6	440	15	425	0
		4	3	3	155	80	75	0
		1	25	29	1814	10	1804	0

Species	Survey Period	VP No.	No. of Flight Lines	No. of Birds	Total Flying Time (s)	Time in height category (s)		
						0-10 m	10 – 150 m	>150 m
	Breeding 2023	2	3	3	125	0	125	0
		3	3	3	35	0	35	0
		4	2	2	105	0	105	0
	Non-breeding 2023/24	1	7	8	220	5	215	0
		3	3	3	70	0	70	0
		4	1	1	160	0	160	0
Common snipe	Non-breeding 2021/22	1	1	1	5	5	0	0
		2	3	3	33	0	33	0
		3	1	1	12	0	12	0
	Non-breeding 2022/23	1	1	5	425	0	425	0
		2	3	4	285	0	285	0
		3	2	38	980	0	980	0
		4	2	3	150	0	150	0
	Breeding 2023	2	1	1	30	0	30	0
		3	1	2	16	0	16	0
		4	5	6	154	0	154	0
	Non-breeding 2023/24	1	1	2	60	0	60	0
		2	1	1	8	0	8	0
Common tern	Breeding 2022	3	2	2	54	0	54	0
Eurasian teal	Breeding 2021	2	1	1	12	0	12	0
	Non-breeding 2022/24	3	1	2	40	40	0	0
	Breeding 2023	4	1	5	75	0	75	0
Eurasian woodcock	Non-breeding 2021/22	1	2	2	21	0	21	0
		3	1	1	9	9	0	0
		4	1	1	5	5	0	0
European golden plover	Breeding 2023	4	1	3	36	0	36	0
Great cormorant	Non-breeding 2022/23	1	1	1	160	0	160	0
		2	1	1	165	0	165	0
		3	1	1	115	0	115	0
		4	2	2	70	0	70	0

Species	Survey Period	VP No.	No. of Flight Lines	No. of Birds	Total Flying Time (s)	Time in height category (s)		
						0-10 m	10 – 150 m	>150 m
Greenland white-fronted goose	Non-breeding 2022/23	2	1	18	1080	0	1080	0
Greylag goose	Non-breeding 2022/23	3	1	17	4335	0	4335	0
Hen harrier	Breeding 2022	1	1	1	210	0	210	0
		3	1	1	15	0	15	0
	Non-breeding 2022	2	2	2	450	450	0	0
		4	3	3	240	160	80	0
	Non-breeding 2023_24	2	1	1	40	40	0	0
		4	1	1	20	20	0	0
Herring gull	Breeding 2021	1	1	1	9	0	9	0
		2	5	5	233	0	233	0
		4	9	11	334	0	334	0
	Breeding 2022	1	2	2	215	0	215	0
		2	3	3	136	0	136	0
		3	15	17	353	23	330	0
		4	9	9	132	0	132	0
	Non-breeding 2022_23	3	1	1	55	0	55	0
		4	2	2	115	0	115	0
	Breeding 2023	3	5	12	367	0	367	0
		4	8	17	584	0	584	0
	Non-breeding 2023_24	2	2	2	95	0	95	0
Lesser black-backed gull	Breeding 2021	1	18	20	1094	29	1065	0
		2	7	11	759	78	681	0
		3	15	16	588	64	524	0
		4	13	13	586	0	586	0
	Breeding 2022	1	3	3	127	0	127	0
		2	1	1	70	0	70	0
		3	4	5	85	0	85	0
		4	2	3	285	45	240	0
	Non-breeding 2022/23	1	1	2	250	0	250	0
	Breeding 2023	1	1	2	8	0	8	0
		2	4	7	1230	90	1140	0

Species	Survey Period	VP No.	No. of Flight Lines	No. of Birds	Total Flying Time (s)	Time in height category (s)		
						0-10 m	10 – 150 m	>150 m
		3	5	6	290	0	290	0
		4	2	5	245	0	245	0
	Non-breeding 2023/24	1	2	2	110	0	110	0
		2	1	1	50	0	50	0
		4	2	2	220	0	220	0
Mallard	Breeding 2021	3	4	4	90	44	46	0
	Breeding 2022	1	1	1	45	0	45	0
		3	3	4	88	0	88	0
		4	4	4	145	0	145	0
	Non-breeding 2022/23	3	1	3	45	45	0	0
		4	1	4	40	0	10	0
	Breeding 2023	3	3	4	50	10	40	0
		4	1	4	400	0	400	0
	Non-breeding 2023/24	4	1	2	60	0	60	0
Merlin	Non-breeding 2021/22	1	1	1	26	0	26	0
	Non-breeding 2022/23	3	1	1	30	30	0	0
	Breeding 2023	4	2	2	23	23	0	0
	Non-breeding 2023/24	4	1	1	35	35	0	0
Peregrine falcon	Non-breeding 2022/23	3	4	4	240	0	240	0
		4	5	5	205	0	205	0
Whooper swan	Non-breeding 2021/22	3	1	3	120	0	120	0
	Non-breeding 2022/23	1	1	5	875	0	875	0

2.4.4 Flight Selection for CRM

To select flights liable to incur a potential risk of collision, i.e., within the areas occupied by proposed turbines, the CRM used only observations collected within the WP[4]. It is known that bird detection rates vary between species. To ensure the CRM used robust measures of flight activity, a 2 km distance truncation was used in the viewshed from each VP, i.e., only flights within 2 km of each VP were included (as per NS 2025 guidance[2]).

Analysis in Excel and GIS identified those flights described in Table 2-3 above that were within the WP.

The proportion of each clipped flight line inside vs. outside the WP was also calculated using GIS.

This was undertaken for all primary target species regardless of the number of flight lines or cumulative numbers of birds.

2.4.5 Bird Density

Flying time estimated to occur within the survey recording height bands was used to determine the period that target species were at risk of collision with the rotors.

This was undertaken as follows. First, the time spent flying was estimated from interval data for flight lines that entered the WP. Second, these flight times were then multiplied by the proportion of each flight line length within the WP. Third, these flight times were then multiplied by the total number of individuals recorded per flight line to identify the total flying time in bird-seconds.

The total flying time (aggregated across all survey height bands) of species taken forward to CRM are given in Table 2-4 to Table 2-6, as split by survey period and VP number. As this step only involves flights within the WP, there may be some differences in Table 2-4 to Table 2-6 vs. Table 2-3, which displays all flights, regardless of whether they are within the WP or not.

2.4.5.1 Total Flying Time

Vesta V150

Table 2-4: Total Flying Time – Vestas V150

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
Black-headed gull	Breeding 2021	1	150.00
		2	569.54
		3	525.88
		4	509.57
	Breeding 2022	1	224.34
		2	70.00
		4	52.64
	Breeding 2023	2	143.15
		3	228.64
		4	5136.44
	Non-breeding 2023/24	2	11.14
Black-legged kittiwake	Breeding 2023	2	40.00
Common gull	Breeding 2021	4	594.49

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
	Breeding 2023	2	107.83
Common kestrel	Breeding 2021	1	355.72
		2	614.87
		3	715.02
		4	807.00
	Non-breeding 2021/22	1	317.67
		3	64.41
	Breeding 2022	1	1058.37
		2	7517.81
		3	266.79
		4	10.55
	Non-breeding 2022/23	1	1550.81
		2	273.09
		3	256.08
		4	100.40
	Breeding 2023	1	1772.29
		2	110.37
		3	23.30
		4	34.62
	Non-breeding 2023/24	1	188.53
		3	43.01
		4	45.75
Common snipe	Non-breeding 2021/22	2	31.84
	Non-breeding 2022/23	1	1942.48
		2	291.84
		3	2542.64
		4	57.91
	Breeding 2023	2	30.00
	Non-breeding 2023/24	1	120.00
		2	8.00

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
Common tern	Breeding 2022	3	18.76
Eurasian teal	Breeding 2021	2	12.00
	Non-breeding 2022/23	3	4.53
	Breeding 2023	4	129.49
Eurasian woodcock	Non-breeding 2021/22	1	21.00
		3	1.83
		4	5.00
European golden plover	Breeding 2023	4	12.32
Great cormorant	Non-breeding 2022/23	1	139.49
		2	132.68
		3	68.88
		4	38.80
Greenland white-fronted goose	Non-breeding 2022/23	2	7395.11
Greylag goose	Non-breeding 2022/23	3	64827.33
Hen harrier	Breeding 2022	1	210.00
	Non-breeding 2022/24	2	448.38
		4	173.19
	Non-breeding 2023/24	2	40.00
		4	20.00
Herring gull	Breeding 2021	1	9.00
		2	184.44
		4	243.09
	Breeding 2022	1	160.86
		2	126.88
		3	80.53
		4	37.85

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
	Non-breeding 2022/23	4	72.60
	Breeding 2023	3	603.33
		4	1374.35
	Non-breeding 23023/24	2	92.26
Lesser black-backed gull	Breeding 2021	1	952.33
		2	1275.88
		3	264.26
		4	413.01
	Breeding 2022	1	72.32
		2	70.00
		3	52.18
	Non-breeding 2022/23	1	443.53
	Breeding 2023	1	12.81
		2	2159.12
		3	141.97
		4	122.16
	Non-breeding 23023/24	1	74.49
		2	50.00
		4	209.91
Mallard	Breeding 2021	3	28.62
	Breeding 2022	1	35.69
		3	64.18
		4	67.63
	Breeding 2023	3	35.46
		4	1053.74
Merlin	Non-breeding 2021/22	1	26.00
	Breeding 2023	4	7.37

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
Peregrine falcon	Non-breeding 2022/23	3	176.22
		4	88.09
Whooper swan	Non-breeding 2021/22	3	237.31
	Non-breeding 2022/23	1	3281.94

Nordex N163

Table 2-5: Total Flying Time – Nordex N163

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
Black-headed gull	Breeding 2021	1	151.16
		2	580.75
		3	539.91
		4	513.69
	Breeding 2022	1	228.75
		2	70.00
		4	58.64
	Breeding 2023	2	143.78
		3	232.61
		4	5137.00
	Non-breeding 2023/24	2	11.23
Black-legged kittiwake	Breeding 2023	2	40.00
Common gull	Breeding 2021	4	599.06
	Breeding 2023	2	108.00
Common kestrel	Breeding 2021	1	373.31
		2	617.02
		3	742.37
		4	807.00
		1	320.51

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
	Non-breeding 2021/22	3	66.02
	Breeding 2022	1	1075.34
		2	7550.57
		3	268.73
		4	10.70
	Non-breeding 2022/23	1	1599.16
		2	277.84
		3	260.10
		4	101.13
	Breeding 2023	1	1805.97
		2	110.70
		3	23.81
		4	35.79
	Non-breeding 2023/24	1	191.76
		3	43.56
		4	52.28
Common snipe	Non-breeding 2021/22	1	0.18
		2	32.15
	Non-breeding 2022/23	1	1949.12
		2	294.95
		3	2599.86
		4	59.58
	Breeding 2023	2	30.00
	Non-breeding 2023/24	1	120.00
		2	8.00
Common tern	Breeding 2022	3	20.11
Eurasian teal	Breeding 2021	2	12.00
	Non-breeding 2022/23	3	6.30

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
	Breeding 2023	4	133.05
Eurasian woodcock	Non-breeding 2021/22	1	21.00
		3	1.95
		4	5.00
European golden plover	Breeding 2023	4	13.15
Great cormorant	Non-breeding 2022/23	1	140.09
		2	133.67
		3	69.78
		4	39.37
Greenland white-fronted goose	Non-breeding 2022/23	2	7506.41
Greylag goose	Non-breeding 2022/23	3	65177.37
Hen harrier	Breeding 2022	1	210.00
	Non-breeding 2022/24	2	448.67
		4	177.01
	Non-breeding 2023/24	2	40.00
		4	20.00
Herring gull	Breeding 2021	1	9.00
		2	186.68
		4	247.36
	Breeding 2022	1	169.19
		2	127.50
		3	114.49
		4	38.70
	Non-breeding 2022/23	4	72.97
	Breeding 2023	3	627.26
		4	1385.50

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
	Non-breeding 23023/24	2	92.41
Lesser black-backed gull	Breeding 2021	1	965.30
		2	1283.65
		3	268.50
		4	414.64
	Breeding 2022	1	73.17
		2	70.00
		3	53.81
	Non-breeding 2022/23	1	447.52
	Breeding 2023	1	12.98
		2	2165.95
		3	148.67
		4	123.40
	Non-breeding 23023/24	1	74.68
		2	50.00
		4	210.33
Mallard	Breeding 2021	3	29.41
	Breeding 2022	1	35.97
		3	65.36
		4	68.15
	Breeding 2023	3	37.62
		4	1076.59
Merlin	Non-breeding 2021/22	1	26.00
	Breeding 2023	4	11.32
Peregrine falcon	Non-breeding 2022/23	3	177.80
		4	88.96
Whooper swan	Non-breeding 2021/22	3	238.76

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
	Non-breeding 2022/23	1	3293.00

Nordex N149

Table 2-6: Total Flying Time – Nordex N149

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
Black-headed gull	Breeding 2021	1	150.00
		2	569.54
		3	525.88
		4	509.57
	Breeding 2022	1	224.34
		2	70.00
		4	52.64
	Breeding 2023	2	143.15
		3	228.64
		4	5136.44
	Non-breeding 2023/24	2	11.14
Black-legged kittiwake	Breeding 2023	2	40.00
Common gull	Breeding 2021	4	594.49
	Breeding 2023	2	107.83
Common kestrel	Breeding 2021	1	355.72
		2	614.87
		3	715.02
		4	807.00
	Non-breeding 2021/22	1	317.67
		3	64.41
	Breeding 2022	1	1058.37
		2	7517.81

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
		3	266.79
		4	10.55
	Non-breeding 2022/23	1	1550.81
		2	273.09
		3	256.08
		4	100.40
	Breeding 2023	1	1772.29
		2	110.37
		3	23.30
		4	34.62
	Non-breeding 2023/24	1	188.53
		3	43.01
		4	45.75
Common snipe	Non-breeding 2021/22	2	31.84
	Non-breeding 2022/23	1	1942.48
		2	291.84
		3	2542.64
		4	57.91
	Breeding 2023	2	30.00
	Non-breeding 2023/24	1	120.00
		2	8.00
Common tern	Breeding 2022	3	18.76
Eurasian teal	Breeding 2021	2	12.00
	Non-breeding 2022/23	3	4.53
	Breeding 2023	4	129.49
Eurasian woodcock	Non-breeding 2021/22	1	21.00
		3	1.83
		4	5.00

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
European golden plover	Breeding 2023	4	12.32
Great cormorant	Non-breeding 2022/23	1	139.49
		2	132.68
		3	68.88
		4	38.80
Greenland white-fronted goose	Non-breeding 2022/23	2	7395.11
Greylag goose	Non-breeding 2022/23	3	64827.33
Hen harrier	Breeding 2022	1	210.00
	Non-breeding 2022/24	2	448.38
		4	173.19
	Non-breeding 2023/24	2	40.00
		4	20.00
Herring gull	Breeding 2021	1	9.00
		2	184.44
		4	243.09
	Breeding 2022	1	160.86
		2	126.88
		3	80.53
		4	37.85
	Non-breeding 2022/23	4	72.60
	Breeding 2023	3	603.33
		4	1374.35
	Non-breeding 23023/24	2	92.26
Lesser black-backed gull	Breeding 2021	1	952.33
		2	1275.88
		3	264.26
		4	413.01

Species	Survey Period	VP No.	Total Flying Time (bird-secs)
	Breeding 2022	1	72.32
		2	70.00
		3	52.18
	Non-breeding 2022/23	1	443.53
	Breeding 2023	1	12.81
		2	2159.12
		3	141.97
		4	122.16
	Non-breeding 23023/24	1	74.49
		2	50.00
		4	209.91
Mallard	Breeding 2021	3	28.62
	Breeding 2022	1	35.69
		3	64.18
		4	67.63
	Breeding 2023	3	35.46
		4	1053.74
Merlin	Non-breeding 2021/22	1	26.00
	Breeding 2023	4	7.37
Peregrine falcon	Non-breeding 2022/23	3	176.22
		4	88.09
Whooper swan	Non-breeding 2021/22	3	237.31
	Non-breeding 2022/23	1	3281.94

2.4.5.2 Bird Density Results

Next, bird density was calculated by dividing flying time by the period of the watch in seconds multiplied by the area of the WP visible within each viewshed. This was undertaken using the flight time data above, the total survey effort given in section 2.4.3 and viewshed data given in section 2.4.1.

These data were calculated for each month, VP number and survey period per species. They were then averaged across VP number as outlined in NS (2024) guidance[1] for each species, season and month to provide a mean figure of bird density per month per season, along with the standard deviation.

As there were significant differences in the area covered by VPs with the viewshed from VP4 covering much less than those for other VPs (see Table 2-1), the mean density figure was weighted by the area observed and the duration of the VP watches.

This was calculated using the following formula where b_i = the number of flight seconds from each vantage point, t_i = the time in seconds that the vantage point was watched and A_i was the area of the vantage point viewshed in km^2:

$$\frac{\sum b_i \cdot \frac{\sqrt{t_i . A_i}}{t_i . A_i}}{\sum \sqrt{t_i . A_i}}$$

In most instances, this only resulted in relatively minor differences in bird density compared to those given by the straight mean.

There were no notable differences between underlying habitats in each VP viewshed (i.e. conifer plantation and peat habitats), so a turbine-weighted average bird density was not used.

The results of this process are given in Table 2-7, Table 2-8 and Table 2-9. Note that months are represented numerically from 1 (January) to 12 (December), and that only months with a mean density of >0 birds/km^2 are shown for brevity.

Vestas V150

Table 2-7: Bird Density Results – Vestas V150

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
Black-headed gull	Breeding_2021	6	0.003460769	0.002050878	0.003242273
		7	0.000437971	0.000616288	0.000420247
	Breeding_2022	5	0.000181097	0.00025611	0.0001867
		6	0.000833938	0	0.000833938
		7	0.002577209	0	0.002577209
	Breeding_2023	5	0.00096807	0	0.00096807
		6	0.018445926	0.031010254	0.015538876
		7	0.000410408	0	0.000410408
	Non-breeding_2023_2024	11	5.76258E-05	0	5.76258E-05
Common gull	Breeding_2021	7	0.004347158	0	0.004347158
	Breeding_2023	7	0.001115879	0	0.001115879
Common tern	Breeding_2022	6	0.000109866	0	0.000109866
Cormorant		1	0.001373074	0	0.001373074

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
	Non-breeding_2022_2023	3	0.000403352	0	0.000403352
		10	0.000554285	0.000349199	0.000574088
Golden plover	Breeding_2023	7	0.000195241	0	0.000195241
Greenland white-fronted goose	Non-breeding_2022_2023	10	0.038263782	0	0.038263782
Greylag goose	Non-breeding_2022_2023	3	0.379636882	0	0.379636882
Hen harrier	Breeding_2022	8	0.000804139	0.001137225	0.000693077
	Non-breeding_2022_2023	2	0.001948817	0.001618612	0.002070231
		3	0.001537541	0	0.001537541
	Non-breeding_2023_2024	10	0.000206968	0	0.000206968
Herring gull	Breeding_2021	6	0.001148449	0.001523953	0.000986587
		7	0.000719683	0	0.000719683
	Breeding_2022	4	9.27179E-05	0.000131123	9.8311E-05
		5	0.00025871	0.000365871	0.000266715
		6	0.00042753	6.23319E-05	0.000438276
		7	0.000688057	0.001010237	0.000763888
		10	0.000287549	0.000406656	0.000245454
	Breeding_2023	4	0.000358405	0	0.000358405
		6	0.001329198	0	0.001329198
		7	0.012181812	0.009732725	0.011174327
	Non-breeding_2023_2024	11	0.000477346	0	0.000477346
Kestrel	Breeding_2021	4	0.003962356	0.004319645	0.003706242
		5	0.000374777	0	0.000374777
		6	0.000843963	0.000797673	0.000883602
		7	0.000830764	0	0.000830764
		8	0.002509285	0.002194929	0.002454848
	Non-breeding_2021_2022	1	0.000547907	0	0.000547907
		2	8.04139E-05	0	8.04139E-05
		3	0.001259912	0.001634055	0.001182519
		9	0.003078705	0	0.003078705
		10	6.58409E-06	9.3113E-06	7.54795E-06
		11	0.000165703	0.000234339	0.000193354

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
	Breeding_2022	4	0.013793004	0.023508402	0.015530291
		5	0.0075507	0	0.0075507
		6	0.000275842	0.000251926	0.000258705
		7	0.001890988	0.002294825	0.001719294
		8	0.010927905	0	0.010927905
	Non-breeding_2022_2023	1	0.007277256	0.010291594	0.00786088
		2	0.001060451	0	0.001060451
		3	0.002477972	0.001568112	0.002232842
		9	4.9168E-06	6.9534E-06	5.24613E-06
		10	0.000365803	0.000285829	0.000379341
	Breeding_2023	4	0.000399603	0.000500053	0.000376775
		5	0.002120771	0	0.002120771
		6	0.002487577	0.002542309	0.002440647
		7	0.007911552	0	0.007911552
		8	0.000695272	0.000578072	0.000679031
	Non-breeding_2023_2024	2	0.00080314	0	0.00080314
		3	0.000589526	0	0.000589526
		9	0.000154992	0.000169439	0.000146967
		11	0.000362412	0	0.000362412
		12	0.000307447	0	0.000307447
Kittiwake	Breeding_2023	4	0.000177401	0	0.000177401
Lesser black-backed gull	Breeding_2021	4	0.003068269	0.000957742	0.003139925
		5	0.003076192	0.003702159	0.002969001
		6	0.003254804	0.003374114	0.003197155
		7	0.000624355	0.000246425	0.000593497
		8	0.000356661	0.00034983	0.000352243
		6	0.000465187	0.000384156	0.000469607
	Non-breeding_2022_2023	1	0.005095179	0	0.005095179
	Breeding_2023	4	0.001082606	0.000162424	0.001099146
		5	0.005939583	0.007843614	0.00585845
		6	0.000201763	0.000193299	0.000218459
	Non-breeding_2023_2024	9	0.00096067	0.000993055	0.000904355
		10	0.000215861	6.05974E-05	0.000217205
Mallard	Breeding_2021	4	0.000292846	0	0.000292846

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
		8	6.99719E-05	0	6.99719E-05
	Breeding_2022	4	0.000359319	0.000289174	0.000368735
		5	0.000279756	0.000395635	0.000238802
		8	0.000273318	0	0.000273318
	Breeding_2023	4	0.004173725	0.005902539	0.003562723
		8	0.000311457	0	0.000311457
Merlin	Non-breeding_2021_2022	2	0.00029868	0	0.00029868
	Breeding_2023	4	5.83951E-05	0	5.83951E-05
Peregrine	Non-breeding_2022_2023	1	0.000337772	0.000477681	0.000288324
		9	0.000420999	0.000595383	0.000482631
		10	0.000142471	0	0.000142471
		11	0.000375728	0	0.000375728
Snipe	Non-breeding_2021_2022	2	0.000277728	0	0.000277728
		10	1.37979E-05	2.38986E-05	1.3641E-05
	Non-breeding_2022_2023	1	0.00094419	0	0.00094419
		2	0.00019221	0	0.00019221
		10	0.005750404	0.006249263	0.006070521
		11	0.000675774	0	0.000675774
		6	0.000206968	0	0.000206968
	Non-breeding_2023_2024	10	0.000703927	0	0.000703927
		11	4.13936E-05	0	4.13936E-05
Teal	Breeding_2021	7	6.77349E-05	0	6.77349E-05
	Non-breeding_2022_2023	3	2.65004E-05	0	2.65004E-05
	Breeding_2023	7	0.002051545	0	0.002051545
Whooper swan	Non-breeding_2021_2022	12	0.002084537	0	0.002084537
	Non-breeding_2022_2023	1	0.037701965	0	0.037701965
Woodcock	Non-breeding_2021_2022	1	0.000120023	5.77071E-05	0.000127358
		12	1.60586E-05	0	1.60586E-05

Nordex N163

Table 2-8: Bird Density Results – Nordex N163

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
Black-headed gull	Breeding_2021	6	0.003685193	0.002137879	0.003447005
		7	0.000441699	0.000616768	0.000438122
	Breeding_2022	5	0.000179946	0.000254483	0.000193993
		6	0.000911416	0	0.000911416
		7	0.002602642	0	0.002602642
	Breeding_2023	5	0.00116908	0	0.00116908
		6	0.018134629	0.030391052	0.015875473
		7	0.000412223	0	0.000412223
	Non-breeding_2023_2024	11	5.77558E-05	0	5.77558E-05
Common gull	Breeding_2021	7	0.004297224	0	0.004297224
	Breeding_2023	7	0.001110507	0	0.001110507
Common tern	Breeding_2022	6	0.00014136	0	0.00014136
Cormorant	Non-breeding_2022_2023	1	0.001374485	0	0.001374485
		3	0.000490523	0	0.000490523
		10	0.000551444	0.000347135	0.000570547
Golden plover	Breeding_2023	7	0.00020444	0	0.00020444
Greenland white-fronted goose	Non-breeding_2022_2023	10	0.038592915	0	0.038592915
Greylag goose	Non-breeding_2022_2023	3	0.458195792	0	0.458195792
Hen harrier	Breeding_2022	8	0.000796421	0.00112631	0.000724212
	Non-breeding_2022_2023	2	0.001934718	0.001613529	0.002052132
		3	0.001560435	0	0.001560435
	Non-breeding_2023_2024	10	0.000205653	0	0.000205653
Herring gull	Breeding_2021	6	0.001150618	0.00151859	0.000991641
		7	0.000717864	0	0.000717864
	Breeding_2022	4	9.4273E-05	0.000133322	0.000104384
		5	0.000257066	0.000363547	0.000277133
		6	0.000593565	0.000298793	0.000634929
		7	0.000714702	0.001053775	0.000815593

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
	Non-breeding_2022_2023	10	0.000283531	0.000400973	0.00025612
	Breeding_2023	4	0.000361327	0	0.000361327
		6	0.001319513	0	0.001319513
		7	0.012723101	0.008638924	0.01213255
	Non-breeding_2023_2024	11	0.000475109	0	0.000475109
Kestrel	Breeding_2021	4	0.004702738	0.005565441	0.004215527
		5	0.000453726	0	0.000453726
		6	0.000874231	0.000803065	0.000934014
		7	0.000837407	0	0.000837407
		8	0.002549685	0.002069189	0.002539191
	Non-breeding_2021_2022	1	0.000545235	0	0.000545235
		2	7.96421E-05	0	7.96421E-05
		3	0.001294464	0.001632912	0.001272533
		9	0.003049156	0	0.003049156
		10	8.53981E-06	1.20771E-05	9.36539E-06
		11	0.000201626	0.000285142	0.000225778
	Breeding_2022	4	0.013811996	0.023461693	0.016004839
		5	0.007553639	0	0.007553639
		6	0.000309739	0.000283271	0.000300441
		7	0.002243035	0.002793008	0.001940713
		8	0.010858481	0	0.010858481
	Non-breeding_2022_2023	1	0.007252116	0.010256041	0.007816505
		2	0.001047842	0	0.001047842
		3	0.002574091	0.001506576	0.002396023
		9	8.01665E-06	1.13373E-05	8.16891E-06
		10	0.00051199	0.000248415	0.000515326
	Breeding_2023	4	0.000409283	0.000512137	0.000386199
		5	0.002111342	0	0.002111342
		6	0.00248956	0.002551312	0.002443939
		7	0.008064996	0	0.008064996
		8	0.000713138	0.000557344	0.000714783
	Non-breeding_2023_2024	2	0.000816265	0	0.000816265
		3	0.000592242	0	0.000592242
		9	0.000160493	0.000163167	0.000158302

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
		11	0.000406308	0	0.000406308
		12	0.000369074	0	0.000369074
Kittiwake	Breeding_2023	4	0.000176274	0	0.000176274
Lesser black-backed gull	Breeding_2021	4	0.003326478	0.00062739	0.003394389
		5	0.003121584	0.003625383	0.003137728
		6	0.003243318	0.003358081	0.003258239
		7	0.000645826	0.000210286	0.00062674
		8	0.000359827	0.000343718	0.000367386
	Breeding_2022	6	0.000482657	0.000375274	0.000495482
	Non-breeding_2022_2023	1	0.005091594	0	0.005091594
	Breeding_2023	4	0.001074414	0.000163251	0.001090676
		5	0.005972607	0.007749996	0.006151401
		6	0.000230691	0.000242239	0.000242831
	Non-breeding_2023_2024	9	0.000945259	0.00097477	0.000891617
		10	0.00021476	5.98306E-05	0.000216052
Mallard	Breeding_2021	4	0.000358025	0	0.000358025
		8	8.7377E-05	0	8.7377E-05
	Breeding_2022	4	0.000422358	0.000377392	0.000421187
		5	0.000275309	0.000389345	0.000248693
		8	0.000272816	0	0.000272816
	Breeding_2023	4	0.004183132	0.005915842	0.003778729
		8	0.000396663	0	0.000396663
Merlin	Non-breeding_2021_2022	2	0.000295814	0	0.000295814
	Breeding_2023	4	8.79937E-05	0	8.79937E-05
Peregrine	Non-breeding_2022_2023	1	0.000335803	0.000474897	0.000303339
		9	0.000510076	0.000721356	0.000559387
		10	0.000172334	0	0.000172334
		11	0.000370937	0	0.000370937
Snipe	Non-breeding_2021_2022	2	0.00027915	0	0.00027915
		10	1.42585E-05	2.32864E-05	1.4531E-05
	Non-breeding_2022_2023	1	0.000961501	0	0.000961501
		2	0.000191704	0	0.000191704
		10	0.006368714	0.007043557	0.006583098
		11	0.000675785	0	0.000675785

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
	Breeding_2023	6	0.000205653	0	0.000205653
	Non-breeding_2023_2024	10	0.000697171	0	0.000697171
		11	4.11306E-05	0	4.11306E-05
Teal	Breeding_2021	7	6.73046E-05	0	6.73046E-05
	Non-breeding_2022_2023	3	4.43102E-05	0	4.43102E-05
	Breeding_2023	7	0.002067919	0	0.002067919
Whooper swan	Non-breeding_2021_2022	12	0.002517681	0	0.002517681
	Non-breeding_2022_2023	1	0.037465884	0	0.037465884
Woodcock	Non-breeding_2021_2022	1	0.000118498	5.76809E-05	0.000125735
		12	2.05486E-05	0	2.05486E-05

Nordex N149

Table 2-9: Bird Density Results – Nordex N149

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
Black-headed gull	Breeding_2021	6	0.003463056	0.002051901	0.003244781
		7	0.000438166	0.000616533	0.000420464
	Breeding_2022	5	0.000181172	0.000256216	0.000186791
		6	0.00083447	0	0.00083447
		7	0.002581187	0	0.002581187
	Breeding_2023	5	0.000968752	0	0.000968752
		6	0.018457655	0.031030086	0.015548365
		7	0.000410579	0	0.000410579
	Non-breeding_2023_2024	11	5.76497E-05	0	5.76497E-05
Common gull	Breeding_2021	7	0.004349933	0	0.004349933
	Breeding_2023	7	0.001116343	0	0.001116343
Common tern	Breeding_2022	6	0.000109944	0	0.000109944
Cormorant	Non-breeding_2022_2023	1	0.001373644	0	0.001373644
		3	0.000403636	0	0.000403636
		10	0.000555002	0.000349935	0.00057479

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
Golden plover	Breeding_2023	7	0.000195366	0	0.000195366
Greenland white-fronted goose	Non-breeding_2022_2023	10	0.038279671	0	0.038279671
Greylag goose	Non-breeding_2022_2023	3	0.379904163	0	0.379904163
Hen harrier	Breeding_2022	8	0.00080538	0.00113898	0.000693981
	Non-breeding_2022_2023	2	0.001949716	0.001619157	0.002071234
		3	0.001538522	0	0.001538522
	Non-breeding_2023_2024	10	0.000207054	0	0.000207054
Herring gull	Breeding_2021	6	0.00114916	0.001524932	0.000987351
		7	0.000719982	0	0.000719982
	Breeding_2022	4	9.27564E-05	0.000131177	9.83585E-05
		5	0.000258817	0.000366023	0.000266844
		6	0.000427819	6.23936E-05	0.000438575
		7	0.000689053	0.001011842	0.000764828
	Non-breeding_2022_2023	10	0.000287733	0.000406915	0.000245615
	Breeding_2023	4	0.000358634	0	0.000358634
		6	0.001330046	0	0.001330046
		7	0.012189762	0.009738691	0.01118177
	Non-breeding_2023_2024	11	0.000477545	0	0.000477545
Kestrel	Breeding_2021	4	0.00396492	0.004322705	0.003709214
		5	0.000375041	0	0.000375041
		6	0.000844723	0.00079833	0.000884411
		7	0.000832046	0	0.000832046
		8	0.0025108	0.002196385	0.002456299
	Non-breeding_2021_2022	1	0.000548753	0	0.000548753
		2	8.0538E-05	0	8.0538E-05
		3	0.001261813	0.001636639	0.001184056
		9	0.003083457	0	0.003083457
		10	6.58872E-06	9.31786E-06	7.55315E-06
		11	0.00016582	0.000234504	0.000193524
	Breeding_2022	4	0.013798774	0.023518128	0.015540058

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
		5	0.007562355	0	0.007562355
		6	0.00027619	0.000252377	0.000258989
		7	0.001892432	0.002296282	0.001720966
		8	0.010932443	0	0.010932443
	Non-breeding_2022_2023	1	0.007288488	0.010307479	0.007871376
		2	0.001061128	0	0.001061128
		3	0.002480175	0.001569127	0.00223483
		9	4.92026E-06	6.95829E-06	5.25085E-06
		10	0.00036613	0.000285933	0.000379714
	Breeding_2023	4	0.000400194	0.000500862	0.00037723
		5	0.002124044	0	0.002124044
		6	0.002491027	0.002546783	0.002443508
		7	0.007923764	0	0.007923764
		8	0.000696122	0.0005791	0.000679779
	Non-breeding_2023_2024	2	0.00080438	0	0.00080438
		3	0.000590436	0	0.000590436
		9	0.000155217	0.000169721	0.000147153
		11	0.000362643	0	0.000362643
		12	0.000307663	0	0.000307663
Kittiwake	Breeding_2023	4	0.000177475	0	0.000177475
Lesser black-backed gull	Breeding_2021	4	0.003072002	0.000960639	0.003143734
		5	0.003077536	0.003703602	0.002970491
		6	0.003257055	0.003375295	0.003199721
		7	0.000624895	0.000246685	0.000593977
		8	0.000357001	0.00035006	0.000352582
	Breeding_2022	6	0.000465637	0.000384601	0.000470019
	Non-breeding_2022_2023	1	0.005103043	0	0.005103043
	Breeding_2023	4	0.001083164	0.000162339	0.001099701
		5	0.005942106	0.007846791	0.00586134
		6	0.000201906	0.000193411	0.000218625
	Non-breeding_2023_2024	9	0.0009614	0.000993524	0.000905216
		10	0.000216048	6.04846E-05	0.000217402
Mallard	Breeding_2021	4	0.000293052	0	0.000293052
		8	7.00211E-05	0	7.00211E-05

Species	Survey Period	Month	Bird Density (birds / km^2)		
			Mean	**Standard Deviation**	**Weighted Mean**
	Breeding_2022	4	0.000359567	0.000289385	0.000368987
		5	0.000279935	0.000395888	0.000238959
		8	0.000273739	0	0.000273739
	Breeding_2023	4	0.004176389	0.005906307	0.003565064
		8	0.000311676	0	0.000311676
Merlin	Non-breeding_2021_2022	2	0.000299141	0	0.000299141
	Breeding_2023	4	5.84324E-05	0	5.84324E-05
Peregrine	Non-breeding_2022_2023	1	0.000337987	0.000477986	0.000288514
		9	0.000421296	0.000595802	0.000482964
		10	0.000142572	0	0.000142572
		11	0.000375968	0	0.000375968
Snipe	Non-breeding_2021_2022	2	0.000277843	0	0.000277843
		10	1.38036E-05	2.39085E-05	1.36497E-05
	Non-breeding_2022_2023	1	0.000944583	0	0.000944583
		2	0.000192332	0	0.000192332
		10	0.005756763	0.006256402	0.006076295
		11	0.000676055	0	0.000676055
	Breeding_2023	6	0.000207054	0	0.000207054
	Non-breeding_2023_2024	10	0.000705014	0	0.000705014
		11	4.14108E-05	0	4.14108E-05
Teal	Breeding_2021	7	6.77631E-05	0	6.77631E-05
	Non-breeding_2022_2023	3	2.65191E-05	0	2.65191E-05
	Breeding_2023	7	0.002052854	0	0.002052854
Whooper swan	Non-breeding_2021_2022	12	0.002086005	0	0.002086005
	Non-breeding_2022_2023	1	0.03776016	0	0.03776016
Woodcock	Non-breeding_2021_2022	1	0.000120172	5.78469E-05	0.000127516
		12	1.60699E-05	0	1.60699E-05

2.4.6 Proportion of Birds Flying at Risk Height

The baseline surveys utilised the following three height bands:

1. 0-10 m;
2. 10 – 150 m; and

3. >150 m.

2.4.6.1 Vestas V150

The potential collision heights (PCH) for the Vestas V150 turbines are 30 m to 180 m, based on a tip height of 180 m, hub height of 105 m and rotor diameter of 150 m. As such, all flight lines with a survey PCH of 30 to 180 m must be included for CRM.

Thus, the proportion of flights within each of the relevant height bands within the WP were calculated based on PCH, as shown in Table 2-10.

For example, 120 m of the 30-180 m PCH span falls within the 10-150 m height range (height band 2), so 120/140 of birds flying within that height range would be at rotor risk height. The remaining 30 m of the PCH span is within the >150 m height range (height band 3), so 100% of flights at band 3 would also fall within rotor risk height (see section 3.4 for further discussion on this as a limitation). As none of the PCH span falls within the 0-10 m height range (band 1), none of the birds flying within that height range would be at rotor risk height.

To account for a rotor diameter of 150 m, the model adjusted the occupancy by rotor diameter as a proportion of survey risk height as described in NS (2024) guidance[1]. This assumes that in each of the height ranges within which flight height was classified, flight heights were distributed uniformly.

Note that data have been aggregated by year and season as has been done in NS (2024) guidance[1]. Only seasons where flight time is >0 have been included for brevity.

Table 2-10: Proportion of Flights at PCH – Vestas V150

Species	Season	Duration of flights observed within WP across all viewsheds (s)	% of flight durations observed within WP			% of flight durations at PCH (17 – 180 m) within WP
			Height band 1 (0 – 10 m)	**Height band 2 (10 – 150 m)**	**Height band 3 (>150 m)**	
Black-headed gull	Breeding_2021	2419	13.72	86.28	0.00	73.95
	Breeding_2022	510	0.00	100.00	0.00	85.71
	Breeding_2023	3166	79.60	20.40	0.00	17.49
	Non-breeding_2022_2023	100	0.00	100.00	0.00	85.71
	Non-breeding_2023_2024	20	0.00	100.00	0.00	85.71
Common gull	Breeding_2021	580	0.00	100.00	0.00	85.71
	Breeding_2023	109	0.00	100.00	0.00	85.71
	Non-breeding_2023_2024	10	0.00	100.00	0.00	85.71
Common tern	Breeding_2022	54	0.00	100.00	0.00	85.71
Cormorant	Non-breeding_2022_2023	510	0.00	100.00	0.00	85.71

Species	Season	Duration of flights observed within WP across all viewsheds (s)	% of flight durations observed within WP			% of flight durations at PCH (17 – 180 m) within WP
			Height band 1 (0 – 10 m)	**Height band 2 (10 – 150 m)**	**Height band 3 (>150 m)**	
Golden plover	Breeding_2023	36	0.00	100.00	0.00	85.71
Greenland white-fronted goose	Non-breeding_2022_2023	1080	0.00	100.00	0.00	85.71
Greylag goose	Non-breeding_2022_2023	4335	0.00	100.00	0.00	85.71
Hen harrier	Breeding_2022	225	0.00	100.00	0.00	85.71
Hen harrier	Non-breeding_2022_2023	690	88.41	11.59	0.00	9.94
Hen harrier	Non-breeding_2023_2024	60	100.00	0.00	0.00	0.00
Herring gull	Breeding_2021	576	0.00	100.00	0.00	85.71
	Breeding_2022	836	2.75	97.25	0.00	83.36
	Breeding_2023	951	0.00	100.00	0.00	85.71
	Non-breeding_2022_2023	170	0.00	100.00	0.00	85.71
	Non-breeding_2023_2024	95	0.00	100.00	0.00	85.71
Kestrel	Breeding_2021	3779	11.38	88.62	0.00	75.96
	Breeding_2022	5732	0.00	64.06	35.94	90.85
	Breeding_2023	2079	0.48	99.52	0.00	85.30
	Non-breeding_2021_2022	592	0.00	100.00	0.00	85.71
	Non-breeding_2022_2023	3590	13.37	86.63	0.00	74.25
	Non-breeding_2023_2024	450	1.11	98.89	0.00	84.76
Kittiwake	Breeding_2023	40	0.00	100.00	0.00	85.71
Lesser black-backed gull	Breeding_2021	3027	5.65	94.35	0.00	80.87
	Breeding_2022	567	7.94	92.06	0.00	78.91
	Breeding_2023	1773	5.08	94.92	0.00	81.36
	Non-breeding_2022_2023	250	0.00	100.00	0.00	85.71
	Non-breeding_2023_2024	380	0.00	100.00	0.00	85.71
Mallard	Breeding_2021	90	48.89	51.11	0.00	43.81

Species	Season	Duration of flights observed within WP across all viewsheds (s)	% of flight durations observed within WP			% of flight durations at PCH (17 – 180 m) within WP
			Height band 1 (0 – 10 m)	**Height band 2 (10 – 150 m)**	**Height band 3 (>150 m)**	
	Breeding_2022	278	0.00	100.00	0.00	85.71
	Breeding_2023	450	2.22	97.78	0.00	83.81
	Non-breeding_2022_2023	85	52.94	47.06	0.00	40.34
	Non-breeding_2023_2024	60	0.00	100.00	0.00	85.71
Merlin	Breeding_2023	23	100.00	0.00	0.00	0.00
	Non-breeding_2021_2022	26	0.00	100.00	0.00	85.71
	Non-breeding_2022_2023	30	100.00	0.00	0.00	0.00
	Non-breeding_2023_2024	35	100.00	0.00	0.00	0.00
Peregrine	Non-breeding_2022_2023	445	0.00	100.00	0.00	85.71
Snipe	Breeding_2023	200	0.00	100.00	0.00	85.71
	Non-breeding_2021_2022	50	10.00	90.00	0.00	77.14
	Non-breeding_2022_2023	1840	0.00	100.00	0.00	85.71
	Non-breeding_2023_2024	68	0.00	100.00	0.00	85.71
Teal	Breeding_2021	12	0.00	100.00	0.00	85.71
	Breeding_2023	75	0.00	100.00	0.00	85.71
	Non-breeding_2022_2023	40	100.00	0.00	0.00	0.00
Whooper swan	Non-breeding_2021_2022	120	0.00	100.00	0.00	85.71
	Non-breeding_2022_2023	875	0.00	100.00	0.00	85.71
Woodcock	Non-breeding_2021_2022	35	40.00	60.00	0.00	51.43

2.4.6.2 Nordex N163

The potential collision heights (PCH) for the Nordex N163 turbines is 17 m to 180 m, based on a tip height of 180 m, hub height of 98.5 m and rotor diameter of 163 m. As such, all flight lines with a survey PCH of 17 to 180 m must be included for CRM.

Thus, the proportion of flights within each of the relevant height bands within the WP were calculated based on PCH, as shown in Table 2-11.

For example, 133 m of the 17-180 m PCH span falls within the 10-150 m height range (height band 2), so 133/140 of birds flying within that height range would be at rotor risk height. The remaining 30 m of the PCH span is within the >150 m height range (height band 3), so 100% of flights at band 3 would also fall within rotor risk height (see section 3.4 for further discussion on this as a limitation). As none of the PCH span falls within the 0-10 m height range (band 1), none of the birds flying within that height range would be at rotor risk height.

To account for a rotor diameter of 163 m, the model adjusted the occupancy by rotor diameter as a proportion of survey risk height as described in NS (2024) guidance[1]. This assumes that in each of the height ranges within which flight height was classified, flight heights were distributed uniformly.

Note that data have been aggregated by year and season as has been done in NS (2024) guidance[1]. Only seasons where flight time is >0 have been included for brevity.

Table 2-11: Proportion of Flights at PCH – Nordex N163

Species	Season	Duration of flights observed within WP across all viewsheds (s)	% of flight durations observed within WP			% of flight durations at PCH (17 – 180 m) within WP
			Height band 1 (0 – 10 m)	**Height band 2 (10 – 150 m)**	**Height band 3 (>150 m)**	
Black-headed gull	Breeding_2021	2419	13.72	86.28	0.00	81.96
	Breeding_2022	510	0.00	100.00	0.00	95.00
	Breeding_2023	3166	79.60	20.40	0.00	19.38
	Non-breeding_2022_2023	100	0.00	100.00	0.00	95.00
	Non-breeding_2023_2024	20	0.00	100.00	0.00	95.00
Common gull	Breeding_2021	580	0.00	100.00	0.00	95.00
	Breeding_2023	109	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Non-breeding_2023_2024	10	0.00	100.00	0.00	95.00
Common tern	Breeding_2022	54	0.00	100.00	0.00	95.00
Cormorant	Non-breeding_2022_2023	510	0.00	100.00	0.00	95.00
Golden plover	Breeding_2023	36	0.00	100.00	0.00	95.00
Greenland white-fronted goose	Non-breeding_2022_2023	1080	0.00	100.00	0.00	95.00

Species	Season	Duration of flights observed within WP across all viewsheds (s)	% of flight durations observed within WP			% of flight durations at PCH (17 – 180 m) within WP
			Height band 1 (0 – 10 m)	**Height band 2 (10 – 150 m)**	**Height band 3 (>150 m)**	
Greylag goose	Non-breeding_2022_2023	4335	0.00	100.00	0.00	95.00
Hen harrier	Breeding_2022	225	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	690	88.41	11.59	0.00	11.01
	Non-breeding_2023_2024	60	100.00	0.00	0.00	0.00
Herring gull	Breeding_2021	576	0.00	100.00	0.00	95.00
	Breeding_2022	836	2.75	97.25	0.00	92.39
	Breeding_2023	951	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	170	0.00	100.00	0.00	95.00
	Non-breeding_2023_2024	95	0.00	100.00	0.00	95.00
Kestrel	Breeding_2021	3779	11.38	88.62	0.00	84.19
	Breeding_2022	5732	0.00	64.06	35.94	96.80
	Breeding_2023	2079	0.48	99.52	0.00	94.54
	Non-breeding_2021_2022	592	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	3590	13.37	86.63	0.00	82.30
	Non-breeding_2023_2024	450	1.11	98.89	0.00	93.94
Kittiwake	Breeding_2023	40	0.00	100.00	0.00	95.00
Lesser black-backed gull	Breeding_2021	3027	5.65	94.35	0.00	89.63
	Breeding_2022	567	7.94	92.06	0.00	87.46
	Breeding_2023	1773	5.08	94.92	0.00	90.18
	Non-breeding_2022_2023	250	0.00	100.00	0.00	95.00
	Non-breeding_2023_2024	380	0.00	100.00	0.00	95.00
Mallard	Breeding_2021	90	48.89	51.11	0.00	48.56
	Breeding_2022	278	0.00	100.00	0.00	95.00
	Breeding_2023	450	2.22	97.78	0.00	92.89
	Non-breeding_2022_2023	85	52.94	47.06	0.00	44.71

Species	Season	Duration of flights observed within WP across all viewsheds (s)	% of flight durations observed within WP			% of flight durations at PCH (17 – 180 m) within WP
			Height band 1 (0 – 10 m)	**Height band 2 (10 – 150 m)**	**Height band 3 (>150 m)**	
	Non-breeding_2023_2024	60	0.00	100.00	0.00	95.00
Merlin	Breeding_2023	23	100.00	0.00	0.00	0.00
	Non-breeding_2021_2022	26	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	30	100.00	0.00	0.00	0.00
	Non-breeding_2023_2024	35	100.00	0.00	0.00	0.00
Peregrine	Non-breeding_2022_2023	445	0.00	100.00	0.00	95.00
Snipe	Breeding_2023	200	0.00	100.00	0.00	95.00
	Non-breeding_2021_2022	50	10.00	90.00	0.00	85.50
	Non-breeding_2022_2023	1840	0.00	100.00	0.00	95.00
	Non-breeding_2023_2024	68	0.00	100.00	0.00	95.00
Teal	Breeding_2021	12	0.00	100.00	0.00	95.00
	Breeding_2023	75	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	40	100.00	0.00	0.00	0.00
Whooper swan	Non-breeding_2021_2022	120	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	875	0.00	100.00	0.00	95.00
Woodcock	Non-breeding_2021_2022	35	40.00	60.00	0.00	57.00

2.4.6.3 Nordex N149

The potential collision heights (PCH) for the Nordex V150 turbines is 30 m to 179 m, based on a tip height of 179 m, hub height of 104.5 m and rotor diameter of 149 m. As such, all flight lines with a survey PCH of 30 to 179 m must be included for CRM.

Thus, the proportion of flights within each of the relevant height bands within the WP were calculated based on PCH, as shown in Table 2-12.

For example, 120 m of the 30-179 m PCH span falls within the 10-150 m height range (height band 2), so 120/140 of birds flying within that height range would be at rotor risk height. The remaining 29 m of the PCH span is within the >150 m height range (height band

3), so 100% of flights at band 3 would also fall within rotor risk height (see section 3.4 for further discussion on this as a limitation). As none of the PCH span falls within the 0-10 m height range (band 1), none of the birds flying within that height range would be at rotor risk height.

To account for a rotor diameter of 150 m, the model adjusted the occupancy by rotor diameter as a proportion of survey risk height as described in NS (2024) guidance[1]. This assumes that in each of the height ranges within which flight height was classified, flight heights were distributed uniformly.

Note that data have been aggregated by year and season as has been done in NS (2024) guidance[1]. Only seasons where flight time is >0 have been included for brevity.

Table 2-12: Proportion of Flights at PCH – Nordex N149

Species	Season	Duration of flights observed within WP across all viewsheds (s)	% of flight durations observed within WP			% of flight durations at PCH (17 – 180 m) within WP
			Height band 1 (0 – 10 m)	**Height band 2 (10 – 150 m)**	**Height band 3 (>150 m)**	
Black-headed gull	Breeding_2021	2419	13.72	86.28	0.00	81.96
	Breeding_2022	510	0.00	100.00	0.00	95.00
	Breeding_2023	3166	79.60	20.40	0.00	19.38
	Non-breeding_2022_2023	100	0.00	100.00	0.00	95.00
	Non-breeding_2023_2024	20	0.00	100.00	0.00	95.00
Common gull	Breeding_2021	580	0.00	100.00	0.00	95.00
	Breeding_2023	109	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Non-breeding_2023_2024	10	0.00	100.00	0.00	95.00
Common tern	Breeding_2022	54	0.00	100.00	0.00	95.00
Cormorant	Non-breeding_2022_2023	510	0.00	100.00	0.00	95.00
Golden plover	Breeding_2023	36	0.00	100.00	0.00	95.00
Greenland white-fronted goose	Non-breeding_2022_2023	1080	0.00	100.00	0.00	95.00
Greylag goose	Non-breeding_2022_2023	4335	0.00	100.00	0.00	95.00
Hen harrier	Breeding_2022	225	0.00	100.00	0.00	95.00

Species	Season	Duration of flights observed within WP across all viewsheds (s)	% of flight durations observed within WP			% of flight durations at PCH (17 – 180 m) within WP
			Height band 1 (0 – 10 m)	**Height band 2 (10 – 150 m)**	**Height band 3 (>150 m)**	
	Non-breeding_2022_2023	690	88.41	11.59	0.00	11.01
	Non-breeding_2023_2024	60	100.00	0.00	0.00	0.00
Herring gull	Breeding_2021	576	0.00	100.00	0.00	95.00
	Breeding_2022	836	2.75	97.25	0.00	92.39
	Breeding_2023	951	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	170	0.00	100.00	0.00	95.00
	Non-breeding_2023_2024	95	0.00	100.00	0.00	95.00
Kestrel	Breeding_2021	3779	11.38	88.62	0.00	84.19
	Breeding_2022	5732	0.00	64.06	35.94	96.80
	Breeding_2023	2079	0.48	99.52	0.00	94.54
	Non-breeding_2021_2022	592	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	3590	13.37	86.63	0.00	82.30
	Non-breeding_2023_2024	450	1.11	98.89	0.00	93.94
Kittiwake	Breeding_2023	40	0.00	100.00	0.00	95.00
Lesser black-backed gull	Breeding_2021	3027	5.65	94.35	0.00	89.63
	Breeding_2022	567	7.94	92.06	0.00	87.46
	Breeding_2023	1773	5.08	94.92	0.00	90.18
	Non-breeding_2022_2023	250	0.00	100.00	0.00	95.00
	Non-breeding_2023_2024	380	0.00	100.00	0.00	95.00
Mallard	Breeding_2021	90	48.89	51.11	0.00	48.56
	Breeding_2022	278	0.00	100.00	0.00	95.00
	Breeding_2023	450	2.22	97.78	0.00	92.89
	Non-breeding_2022_2023	85	52.94	47.06	0.00	44.71
	Non-breeding_2023_2024	60	0.00	100.00	0.00	95.00
Merlin	Breeding_2023	23	100.00	0.00	0.00	0.00

Species	Season	Duration of flights observed within WP across all viewsheds (s)	% of flight durations observed within WP			% of flight durations at PCH (17 – 180 m) within WP
			Height band 1 (0 – 10 m)	**Height band 2 (10 – 150 m)**	**Height band 3 (>150 m)**	
	Non-breeding_2021_2022	26	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	30	100.00	0.00	0.00	0.00
	Non-breeding_2023_2024	35	100.00	0.00	0.00	0.00
Peregrine	Non-breeding_2022_2023	445	0.00	100.00	0.00	95.00
Snipe	Breeding_2023	200	0.00	100.00	0.00	95.00
	Non-breeding_2021_2022	50	10.00	90.00	0.00	85.50
	Non-breeding_2022_2023	1840	0.00	100.00	0.00	95.00
	Non-breeding_2023_2024	68	0.00	100.00	0.00	95.00
Teal	Breeding_2021	12	0.00	100.00	0.00	95.00
	Breeding_2023	75	0.00	100.00	0.00	95.00
	Non-breeding_2022_2023	40	100.00	0.00	0.00	0.00
Whooper swan	Non-breeding_2021_2022	120	0.00	100.00	0.00	95.00
Whooper swan	Non-breeding_2022_2023	875	0.00	100.00	0.00	95.00
Woodcock	Non-breeding_2021_2022	35	40.00	60.00	0.00	57.00

2.5 Stages B - D

For stages B-D, the following parameters were entered into the NS (2024) guidance[1] modelling spreadsheet:

- Day time bird density D_A for each month aggregated by each survey year, season and VP (taken from section 2.4.5);
- The proportion of flights at risk height Q_{2R} aggregated by each survey year and season (taken from section 2.4.6);
- Species-specific bird parameters (Table 2-13); and
- Wind farm parameters (Table 2-14).

2.5.1 Bird Parameters

Measurements and flight speeds of the species for which CRM was undertaken were derived from British Trust for Ornithology (BTO)[7], Cochran & Applegate (1986)[8], Cramp & Simmons (1977-1994)[9], Provan & Whitfield (2007)[10], Bruderer & Boldt (2001)[11] and Alerstram et al. (2007)[12]. The avoidance rates for these species are taken from NS (2018)[13]. Where species do not have a defined avoidance rate, the default avoidance rate of 98% has been applied.

Flight type was obtained based on knowledge of the bird and empirical data collected during surveys. In the absence of any additional data, flapping flights were selected as a precaution, as this option results in a higher probability of collision than gliding flight.

For wildfowl (i.e., Eurasian teal, Greenland-white fronted goose, mallard and whooper swan), and waders (i.e., common snipe and Eurasian woodcock), which could be active nocturnally, an additional 25% (and 50% in the case of Eurasian woodcock) of nocturnal hours were added to the daylight hours to give a more accurate representation of the available hours for these species (as per Band et al., 2024[3]).

Details of these species-specific parameters are given in Table 2-13.

Table 2-13: Bird Biometrics, Flight Type, Nocturnal Activity and Avoidance Rates used in CRM

Common Name	Bird Length (m)	Wingspan (m)	Flight Speed (m/s)	Flight Type (0 or 1)[14]	Nocturnal Activity Factor (1-5)[15]	Avoidance Rate (%)
Black-headed gull	0.355	1.05	11.9	0	1	98.0
Black-legged kittiwake	0.39	1.075	13.1	0	1	98.0
Common gull	0.41	1.15	13.4	0	1	98.0
Common tern	0.33	0.875	10.2	0	1	98.0

[7] https://www.bto.org/understanding-birds/birdfacts [Accessed in November 2024].

[8] William W. Cochran and Roger D. Applegate. (1986). TheCondor 88:398-401 The Cooper Ornithological Society

[9] Cramp, S. and Simmon, S.E.L. (197-1994). Birds of the Western Palearctic. Oxford University Press.

[10] Provan, S. and Whitfield, D.P. (2007) Avian flight speeds and biometrics for use in collision risk modelling. Report to Scottish Natural Heritage.

[11] Bruderer, B. and Bolt, A. (2001) Flight characteristics of birds: 1. Radar measurements of speeds, Ibis, 143. 178 – 204.

[12] Alerstam T, Rosén M, Bäckman J, Ericson PG, Hellgren O. (2007). Flight speeds among bird species: allometric and phylogenetic effects. PLoS Biol.

[13] SNH (2018) Avoidance rates for the onshore SNH wind farm collision risk model. https://www.nature.scot/doc/wind-farm-impacts-birds-use-avoidance-rates-naturescot-wind-farm-collision-risk-model#:~:text=2.%20Recommended%20avoidance%20rates%20%20%20Species%20,%20SNH%20%282013% [Accessed in November 2024].

[14] Key: 0=flapping and 1=gliding

[15] Key: 1=0%, 2=25%, 3=50%, 4=75% and 5=100% of daytime activity

Common Name	Bird Length (m)	Wingspan (m)	Flight Speed (m/s)	Flight Type (0 or 1)[14]	Nocturnal Activity Factor (1-5)[15]	Avoidance Rate (%)
Common kestrel	0.34	0.755	12.7	0	1	95.0
Common snipe	0.26	0.455	16.0	0	2	98.0
Eurasian teal	0.39	0.55	19.7	0	2	98.0
Eurasian woodcock	0.28	0.6	3.33	0	3	98.0
European golden plover	0.275	0.715	13.7	0	2	98.0
Great cormorant	0.9	1.45	14.5	0	1	98.0
Greenland white-fronted goose	0.71	1.47	16.1	0	2	99.8
Greylag goose	0.83	1.64	17.1	0	2	99.8
Hen harrier	0.48	1.1	8	0	1	99.0
Herring gull	0.61	1.465	12.8	1	1	98.0
Lesser black-backed gull	0.6	1.45	13.1	1	1	98.0
Mallard	0.58	0.9	22	0	2	98.0
Merlin	0.275	0.56	13.47	0	1	98.0
Peregrine falcon	0.42	1.025	12.1	0	1	98.0
Whooper swan	1.525	2.305	17.3	0	2	99.5

2.5.2 Wind Farm Parameters

The wind turbine parameters used in the CRM are detailed in Table 2-14, based on the information provided by RWE.

The theoretical time that birds could be active with potential for turbine collisions was assumed to be the period between sunrise and sunset within each survey period using the latitude of the Project and was calculated using NS's (2024) guidance[1] spreadsheet.

The Project was not considered to be a large array and so no 'large array correction' was applied.

Table 2-14: Wind Farm and Turbine Parameters

Parameter	Value		
	Vestas V150	**Nordex N163**	**Nordex N149**
Wind farm width (km)	2	2	2
Number of turbines	13	13	13
Rotor radius / diameter (m)	75 / 150	81.5 / 163	74.5 / 149
Hub height (m)	105	98.5	104.5
Maximum blade chord width (m)	4.2	4.15	4.15
Blade pitch (°)	15	15	15
Rotation speed (r.p.m)	8.8	8.8	9.2
Turbine operation time (%)	85	85	85

3.0 Results

Table 3-1 to Table 3-3 summarises the predicted collision rates for the 19 species under consideration using the avoidance rates given in Table 2-13 for each candidate turbine model. Copies of the NS model calculations for each species are included in Appendix A to Appendix C.

In addition to collision risk estimates for each period of analysis, mean annual risk estimates have also been presented. For resident species, mean annual risk estimates are based on all breeding and non-breeding season data, and for non-resident species, mean annual risk estimates are based on all instances of the relevant season. E.g. for whooper swan, which is a winter visitor, only the non-breeding seasons have been considered.

To calculate mean annual collision risk estimates for resident species, the modelled predictions were averaged for each season type (e.g. breeding vs. non-breeding season). These seasonal averages were then summed to create annual averages.

Note that the NS spreadsheet output is restricted to two decimal places for monthly collision estimates and one decimal place for aggregated collision risk estimates. Therefore, it is possible in some cases that collision estimates presented below as zero collisions per year are in fact negligible, non-zero values. Where possible we have summed the monthly collision estimates (two decimal places) to give the period of analysis collision estimate, rather than use the per period estimate given in the spreadsheet (one decimal place).

3.1 Vestas V150 Results

Table 3-1: Summary of CRM Outputs – Vestas V150

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
Black-headed gull	Breeding 2021	0.08	12.50	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.06 (0.04)	16.67 (25.00)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.08	12.50			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.08	12.50			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Black-legged kittiwake	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023 and 2024	0.00	N/A
	Breeding 2022	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Breeding 2024	0.00	N/A			
Common gull	Breeding 2021	0.12	8.33	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.04 (0.06)	26.67 (17.61)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2023	0.03	33.33			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Common kestrel	Breeding 2021	0.41	2.44	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	1.05 (1.01)	0.95 (0.99)
	Non-breeding 2021/20	0.22	4.55			
	Breeding 2022	2.10	0.48			
	Non-breeding 2022/23	0.34	2.94			
	Breeding 2023	0.83	1.20			
	Non-breeding 2023/24	0.09	11.11			
	Breeding 2024	0.00	N/A			
Common snipe	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.07 (0.08)	15.19 (12.37)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.17	5.88			
	Breeding 2023	0.01	100.00			
	Non-breeding 2023/24	0.02	50.00			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2024	0.00	N/A			
Common tern	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023 and 2024	0.00	N/A
	Breeding 2022	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Breeding 2024	0.00	N/A			
Eurasian teal	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.02 (0.04)	50.00 (25.00)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.08	12.50			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Eurasian woodcock	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00	N/A
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
European golden plover	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00 (0.01)	400.00 (200.00)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.01	100.00			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Great cormorant	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.02 (0.02)	60.00 (42.43)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.05	20.00			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
Greenland white-fronted goose	Non-breeding 2021/22	0.00	N/A	Non-breeding 2021/22, 2022/23 and 2023/24	0.04 (0.06)	25.00 (17.68)
	Non-breeding 2022/23	0.12	8.33			
	Non-breeding 2023/24	0.00	N/A			
Greylag goose	Non-breeding 2021/22	0.00	N/A	Non-breeding 2021/22, 2022/23 and 2023/24	0.48 (0.67)	2.10 (1.48)
	Non-breeding 2022/23	1.43	0.70			
	Non-breeding 2023/24	0.00	N/A			
Hen harrier	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00 (0.01)	400.00 (200.00)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.01	100.00			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Herring gull	Breeding 2021	0.05	20.00	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22,	0.12 (0.19)	8.11 (5.38)
	Non-breeding 2021/20	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2022	0.04	25.00	2022/23 and 2023/24		
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.39	2.56			
	Non-breeding 2023/24	0.01	100.00			
	Breeding 2024	0.00	N/A			
Lesser black-backed gull	Breeding 2021	0.27	3.70	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.15 (0.17)	6.67 (6.05)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.01	100.00			
	Non-breeding 2022/23	0.07	14.29			
	Breeding 2023	0.20	5.00			
	Non-breeding 2023/24	0.02	50.00			
	Breeding 2024	0.00	N/A			
Mallard	Breeding 2021	0.01	100.00	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.05 (0.07)	20.00 (14.54)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.04	25.00			
	Non-breeding 2022/23	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2023	0.15	6.67			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Merlin	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00	N/A
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Peregrine falcon	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00 (0.00)	300 (212.13)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.01	100.00			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2024	0.00	N/A			
Whooper swan	Non-breeding 2021/22	0.02	50.00	Non-breeding 2021/22, 2022/23 and 2023/24	0.13 (0.17)	7.69 (5.89)
	Non-breeding 2022/23	0.37	2.70			
	Non-breeding 2023/24	0.00	N/A			

3.2 Nordex N163 Results

Table 3-2: Summary of CRM Outputs – Nordex N163

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
Black-headed gull	Breeding 2021	0.09	11.11	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.08 (0.05)	13.33 (19.74)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.11	9.09			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.10	10.00			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
	Breeding 2021	0.00	N/A		0.00	N/A

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
Black-legged kittiwake	Breeding 2022	0.00	N/A	Breeding 2021, 2022, 2023 and 2024		
	Breeding 2023	0.00	N/A			
	Breeding 2024	0.00	N/A			
Common gull	Breeding 2021	0.14	7.14	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.05 (0.07)	22.22 (15.13)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.04	25.00			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Common kestrel	Breeding 2021	0.50	2.00	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	1.19 (1.13)	0.84 (0.88)
	Non-breeding 2021/20	0.25	4.00			
	Breeding 2022	2.35	0.43			
	Non-breeding 2022/23	0.39	2.56			
	Breeding 2023	0.95	1.05			
	Non-breeding 2023/24	0.09	11.11			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2024	0.00	N/A			
Common snipe	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.09 (0.09)	11.65 (10.53)
	Non-breeding 2021/20	0.01	100.00			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.21	4.76			
	Breeding 2023	0.01	100.00			
	Non-breeding 2023/24	0.03	33.33			
	Breeding 2024	0.00	N/A			
Common tern	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023 and 2024	0	N/A
	Breeding 2022	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Breeding 2024	0.00	N/A			
Eurasian teal	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.02 (0.05)	44.44 (22.22)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.09	0.02			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Eurasian woodcock	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00	N/A
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
European golden plover	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00 (0.01)	400.00 (200.00)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.01	100.00			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
Great cormorant	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.02 (0.03)	42.86 (30.30)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.07	14.29			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Greenland white-fronted goose	Non-breeding 2021/22	0.14	7.14	Non-breeding 2021/22, 2022/23 and 2023/24	0.05 (0.07)	21.43 (15.15)
	Non-breeding 2022/23	0.0	N/A			
	Non-breeding 2023/24	0.0	N/A			
Greylag goose	Non-breeding 2021/22	0.00	N/A	Non-breeding 2021/22, 2022/23 and 2023/24	0.65 (0.91)	1.55 (1.10)
	Non-breeding 2022/23	1.94	0.52			
	Non-breeding 2023/24	0.00	N/A			
Hen harrier	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22,	0.00 (0.01)	400.00 (200.00)
	Non-breeding 2021/20	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2022	0.01	100.00	2022/23 and 2023/24		
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Herring gull	Breeding 2021	0.05	20.00	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.15 (0.23)	6.49 (4.39)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.06	16.67			
	Non-breeding 2022/23	0.01	100.00			
	Breeding 2023	0.48	2.08			
	Non-breeding 2023/24	0.01	100.00			
	Breeding 2024	0.00	N/A			
Lesser black-backed gull	Breeding 2021	0.33	3.03	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.18 (0.20)	5.50 (5.00)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.02	50.00			
	Non-breeding 2022/23	0.09	11.11			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2023	0.23	4.35			
	Non-breeding 2023/24	0.02	50.00			
	Breeding 2024	0.00	N/A			
Mallard	Breeding 2021	0.01	100.00	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.06 (0.09)	16.67 (11.32)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.04	25.00			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.19	5.26			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Merlin	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00 (0.00)	N/A (N/A)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2024	0.00	N/A			
Peregrine falcon	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.01 (0.01)	150.00 (106.07)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.02	50.00			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Whooper swan	Non-breeding 2021/22	0.03	33.33	Non-breeding 2021/22, 2022/23 and 2023/24	0.15 (0.20)	6.52 (5.10)
	Non-breeding 2022/23	0.43	2.33			
	Non-breeding 2023/24	0.0	N/A			

3.3 Nordex N149 Results

Table 3-3: Summary of CRM Outputs – Nordex N149

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
Black-headed gull	Breeding 2021	0.08	12.50	Breeding 2021, 2022, 2023,	0.06 (0.04)	16.00 (23.85)

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Non-breeding 2021/20	0.00	N/A	2024 and non-breeding 2021/22, 2022/23 and 2023/24		
	Breeding 2022	0.09	11.11			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.08	12.50			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Black-legged kittiwake	Breeding 2021			Breeding 2021, 2022, 2023 and 2024	0.00	N/A
	Breeding 2022	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Breeding 2024	0.00	N/A			
Common gull	Breeding 2021	0.12	8.33	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.04 (0.06)	26.67 (17.61)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.03	33.33			
	Non-breeding 2023/24	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2024	0.00	N/A			
Common kestrel	Breeding 2021	0.41	2.44	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	1.06 (1.03)	0.94 (0.97)
	Non-breeding 2021/20	0.22	4.55			
	Breeding 2022	2.14	0.47			
	Non-breeding 2022/23	0.34	2.94			
	Breeding 2023	0.84	1.19			
	Non-breeding 2023/24	0.09	11.11			
	Breeding 2024	0.00	N/A			
Common snipe	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.07 (0.08)	15.19 (12.37)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.17	2.94			
	Breeding 2023	0.01	100.00			
	Non-breeding 2023/24	0.02	50.00			
	Breeding 2024	0.00	N/A			
Common tern	Breeding 2021	0.00	N/A		0.00	N/A

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2022	0.00	N/A	Breeding 2021, 2022, 2023 and 2024		
	Breeding 2023	0.00	N/A			
	Breeding 2024	0.00	N/A			
Eurasian teal	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.02 (0.04)	50.00 (25.00)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.08	12.50			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Eurasian woodcock	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00	N/A
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Breeding 2024	0.00	N/A			
European golden plover	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00 (0.01)	400.00 (200.00)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.01	100.00			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Great cormorant	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.02 (0.02)	60.00 (42.43)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.05	20.00			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Greenland white-	Non-breeding 2021/22	0.00	N/A	Non-breeding 2021/22,	0.04 (0.06)	25.00 (17.68)

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
fronted goose	Non-breeding 2022/23	0.04	8.33	2022/23 and 2023/24		
	Non-breeding 2023/24	0.00	N/A			
Greylag goose	Non-breeding 2021/22	0.00	N/A	Non-breeding 2021/22, 2022/23 and 2023/24	0.48 (0.67)	2.10 (1.48)
	Non-breeding 2022/23	1.43	N/A			
	Non-breeding 2023/24	0.00	N/A			
Hen harrier	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00 (0.01)	400.00 (200.00)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.01	100.00			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Herring gull	Breeding 2021	0.05	20.00	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.12 (0.19)	8.11 (5.38)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.04	25.00			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.39				
	Non-breeding 2023/24	0.01	100.00			
	Breeding 2024	0.00	N/A			
Lesser black-backed gull	Breeding 2021	0.27	3.70	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.15 (0.17)	6.52 (5.89)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.01	100.00			
	Non-breeding 2022/23	0.08	12.50			
	Breeding 2023	0.20	5.00			
	Non-breeding 2023/24	0.02	50.00			
	Breeding 2024	0.00	N/A			
Mallard	Breeding 2021	0.01	100.00	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.05 (0.07)	20.00 (14.54)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.04	25.00			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.15	6.67			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Merlin	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00	N/A
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.00	N/A			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			
Peregrine falcon	Breeding 2021	0.00	N/A	Breeding 2021, 2022, 2023, 2024 and non-breeding 2021/22, 2022/23 and 2023/24	0.00 (0.00)	300.00 (212.13)
	Non-breeding 2021/20	0.00	N/A			
	Breeding 2022	0.00	N/A			
	Non-breeding 2022/23	0.01	100.00			
	Breeding 2023	0.00	N/A			
	Non-breeding 2023/24	0.00	N/A			
	Breeding 2024	0.00	N/A			

Common Name	Collision Estimates Per Period			Mean (Standard Deviation) Collision Estimates Per Year		
	Period	Collisions Per Year	No. Years Per Collision	Period	Collisions Per Year	No. Years Per Collision
Whooper swan	Non-breeding 2021/22	0.02	50.00	Non-breeding 2021/22, 2022/23 and 2023/24	0.13 (0.17)	7.50 (5.73)
	Non-breeding 2022/23	0.38	2.63			
	Non-breeding 2023/24	0.00	N/A			

3.4 Comparison of Results by Candidate Turbine Model

Table 3-4 provides a summary comparison of the modelled collision estimates for all species by candidate turbine model.

In almost all cases, the modelled collision results from the N163 candidate turbine were larger than for the V150 and N149 models. This is perhaps unsurprising given that the N163 candidate turbine has the largest swept height range. The results where this turbine has been considered should be interpreted as a 'worst-case' scenario. The other two candidate turbines have smaller swept height ranges, resulting in a greater ground clearance, and so collision risk estimates are less, especially for lower flying birds. The results for the V150 and N163 turbines are almost identical.

Table 3-4: Comparison of Collision Estimates Between Candidate Turbines

Species	Mean Collisions per Year			Mean Years per Collision		
	V150	**N163**	**N149**	**V150**	**N163**	**N149**
Black-headed gull	0.06	0.08	0.06	16.67	13.33	16.00
Black-legged kittiwake	0.00	0.00	0.00	N/A	N/A	N/A
Common gull	0.04	0.05	0.04	26.67	22.22	26.67
Common kestrel	1.05	1.19	1.06	0.95	0.84	0.94
Common snipe	0.07	0.09	0.07	15.19	11.65	15.19
Common tern	0.00	0.00	0.00	N/A	N/A	N/A
Eurasian teal	0.02	0.02	0.02	50.00	44.44	50.00

Species	Mean Collisions per Year			Mean Years per Collision		
	V150	**N163**	**N149**	**V150**	**N163**	**N149**
Eurasian woodcock	0.00	0.00	0.00	N/A	N/A	N/A
European golden plover	0.00	0.00	0.00	400.00	400.00	400.00
Great cormorant	0.02	0.02	0.02	60.00	42.86	60.00
Greenland white-fronted goose	0.04	0.05	0.04	25.00	21.43	25.00
Greylag goose	0.48	0.65	0.48	2.10	1.55	2.10
Hen harrier	0.00	0.00	0.00	400.00	400.00	400.00
Herring gull	0.12	0.15	0.12	8.11	6.49	8.11
Lesser black-backed gull	0.15	0.18	0.15	6.67	5.50	6.52
Mallard	0.05	0.06	0.05	20.00	16.67	20.00
Merlin	0.00	0.00	0.00	N/A	N/A	N/A
Peregrine falcon	0.00	0.01	0.00	300.00	150.00	300.00
Whooper swan	0.13	0.15	0.13	7.69	6.25	7.50

3.5 Uncertainty in Outputs

It should be acknowledged that there are several uncertainties in the collision risk outputs. While the results presented here are ‘best estimates’, there is natural variability in the data, with collision risk estimates differing per period of analysis for many species. To this end we have presented measures of variability (standard deviation) for our collision risk estimates for each species.

Some likely sources of variability or uncertainty in the data are as follows:

- Uncertainty in flight activity data including imprecision on flight height estimates and lack of knowledge regarding night-time behaviour for all species; and
- Inherent limitations within the collision-risk model itself including the variability of bird dimensions and flight speed, and the simplification in shape of a bird and turbine blades.

There was a limitation in the way the flight height data were collected during surveys, as the third height band was for all flights >150 m; however, the turbine tip heights for all three candidate turbine models were >150 m also. This meant that all flights from the third height band had to be included in the modelling, which likely has resulted in an overestimate of true collision risk.

Finally, it should be acknowledged that the collision risk outputs presented here do not directly identify whether collision is likely to have significant effects on avian populations. Further assessment must be undertaken to contextualise the outputs presented here in this manner.

Appendix A NatureScot Spreadsheets – Vestas V150

Avian Collision Risk Report

Muingmore Wind Farm

RWE Renewables Ireland Ltd

SLR Project No.: 501.065301.00001

9 July 2025

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0.003242	0.00042	0					0.0003
Proportion at rotor risk height	Q_{2R}	73.95%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	11.9	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	80.5	10.5	0.0	0.0	0.0	0.0	0.0	91

Stage C

No of blades	b	3		Bird length	l	0.355	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.05	m
Rotor radius	R	75	m	Bird flight speed	v	11.9	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.11%
	downwind	3.09%
	weighted mean	5.10%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
Collision rates before avoidance													
	0.00	0.00	0.00	0.00	0.00	3.49	0.45	0.00	0.00	0.00	0.00	0.00	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	3.49	0.45	0.00	0.00	0.00	0.00	0.00	3.9
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.00	3.49	0.45	0.00	0.00	0.00	0.00	0.00	3.9
		100.00%	0.00	0.00	0.00	0.00	0.00	3.49	0.45	0.00	0.00	0.00	0.00	0.00	3.9

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0.000187	0.000834	0.002577	0					0.0003
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	11.9	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	5.2	24.0	74.6	0.0	0.0	0.0	0.0	0.0	104

Stage C

No of blades	b	3		Bird length	l	0.355	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.05	m
Rotor radius	R	75	m	Bird flight speed	v	11.9	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.11%
	downwind	3.09%
	weighted mean	5.10%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.23	1.04	3.23	0.00	0.00	0.00	0.00	0.00	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.23	1.04	3.23	0.00	0.00	0.00	0.00	0.00	4.5
98.00%		100.00%	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.23	1.04	3.23	0.00	0.00	0.00	0.00	0.00	4.5
		100.00%	0.00	0.00	0.00	0.00	0.23	1.04	3.23	0.00	0.00	0.00	0.00	0.00	4.5

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0.000968	0.015539	0.00041	0					0.0014
Proportion at rotor risk height	Q_{2R}	17.49%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	11.9	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	5.5	91.3	2.4	0.0	0.0	0.0	0.0	0.0	99

Stage C

No of blades	b	3		Bird length	l	0.355	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.05	m
Rotor radius	R	75	m	Bird flight speed	v	11.9	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
	upwind	7.11%
	downwind	3.09%
	weighted mean	5.10%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

Collision rates before avoidance													year total
0.00	0.00	0.00	0.00	0.24	3.96	0.10	0.00	0.00	0.00	0.00	0.00		4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.24	3.96	0.10	0.00	0.00	0.00	0.00	0.00	4.3
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.24	3.96	0.10	0.00	0.00	0.00	0.00	0.00	4.3
		100.00%	0.00	0.00	0.00	0.00	0.24	3.96	0.10	0.00	0.00	0.00	0.00	0.00	4.3

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0	0.0000576	0	0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	11.9	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	1

Stage C

No of blades	b	3		Bird length	l	0.355	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.05	m
Rotor radius	R	75	m	Bird flight speed	v	11.9	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	
upwind	7.11%
downwind	3.09%
weighted mean	5.10%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Great cormorant	
Bird length	L	0.9	m
Wingspan	W	1.45	m
Bird flight speed	v	14.5	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.001373	0	0.000403						0	0.000574	0	0	0.0002
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	14.5	m s^{-1}														
		Projected number of rotor transits			23.3	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0	12.9	0.0	0.0	46

Stage C

No of blades	b	3		Bird length	l	0.9	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m
Rotor radius	R	75	m	Bird flight speed	v	14.5	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	8.10%
	downwind	4.62%
	weighted mean	6.36%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		1.26	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	3

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	1.26	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	2.5
		100.00%	1.26	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	2.5
		100.00%	1.26	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	2.5
	98.00%	100.00%	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common gull	
Bird length	L	0.41	m
Wingspan	W	1.15	m
Bird flight speed	v	13.4	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0.004347	0					0.0004
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.4	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	141.6	0.0	0.0	0.0	0.0	0.0	142

Stage C

No of blades	b	3		Bird length	l	0.41	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.15	m
Rotor radius	R	75	m	Bird flight speed	v	13.4	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.96%
	downwind	3.26%
	weighted mean	5.11%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
Collision rates before avoidance													
	0.00	0.00	0.00	0.00	0.00	0.00	6.15	0.00	0.00	0.00	0.00	0.00	6

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	6.15	0.00	0.00	0.00	0.00	0.00	6.1
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	6.15	0.00	0.00	0.00	0.00	0.00	6.1
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	6.15	0.00	0.00	0.00	0.00	0.00	6.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common gull	
Bird length	L	0.41	m
Wingspan	W	1.15	m
Bird flight speed	v	13.4	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0.001116	0					0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.4	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	36.4	0.0	0.0	0.0	0.0	0.0	36

Stage C

No of blades	b	3		Bird length	l	0.41	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.15	m
Rotor radius	R	75	m	Bird flight speed	v	13.4	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.96%
	downwind	3.26%
	weighted mean	5.11%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	1.58	0.00	0.00	0.00	0.00	0.00	2

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	1.58	0.00	0.00	0.00	0.00	0.00	1.6
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	1.58	0.00	0.00	0.00	0.00	0.00	1.6
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	1.58	0.00	0.00	0.00	0.00	0.00	1.6

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Common tern	
Bird length	L	0.33	m
Wingspan	W	0.875	m
Bird flight speed	v	10.2	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}				0	0	0.00011	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	10.2	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	3

Stage C

No of blades	b	3		Bird length	l	0.33	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.875	m
Rotor radius	R	75	m	Bird flight speed	v	10.2	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
	upwind	7.47%
	downwind	3.05%
	weighted mean	5.26%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.1
	100.00%	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.1
	100.00%	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.1
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Greylag goose	
Bird length	L	0.83	m
Wingspan	W	1.64	m
Bird flight speed	v	17.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0.379637						0	0	0	0	0.0316
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	17.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	14035.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14036

Stage C

No of blades	b	3		Bird length	l	0.83	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.64	m
Rotor radius	R	74.5	m	Bird flight speed	v	17.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.54%
	downwind	4.44%
	weighted mean	5.99%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	714.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	715

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled		Collision rates allowing for avoidance												
	100.00%	0.00	0.00	714.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	715.0
	100.00%	0.00	0.00	714.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	715.0
	100.00%	0.00	0.00	714.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	715.0
99.80%	100.00%	0.00	0.00	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.4

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Golden plover	
Bird length	L	0.275	m
Wingspan	W	0.715	m
Bird flight speed	v	13.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A	birds/km^2				0	0	0	0.000195	0					0.0000
Proportion at rotor risk height	Q_{2R}	85.71%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

No of turbines	T	13													
Rotor radius	R	75	m												
		Total rotor frontal area m^2	229729												
Nocturnal activity factor	f_{night}	25%													
Bird flight speed	v	13.7	m s^{-1}	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		0.0	0.0	0.0	0.0	0.0	0.0	7.2	0.0	0.0	0.0	0.0	0.0	7

Stage C

No of blades	b	3		Bird length	l	0.275	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.715	m
Rotor radius	R	75	m	Bird flight speed	v	13.7	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	
upwind	6.30%
downwind	2.66%
weighted mean	4.48%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

Collision rates before avoidance													year total
0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00		0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.3
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.3
98.00%		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.0
99.80%		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0.000987	0.00072	0					0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	30.6	22.4	0.0	0.0	0.0	0.0	0.0	53

Stage C

No of blades	b	3		Bird length	l	0.61	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.465	m
Rotor radius	R	75	m	Bird flight speed	v	12.8	m s^{-1}
Max blade width	C	4.2	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.62%
	downwind	3.79%
	weighted mean	5.70%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	1.48	1.09	0.00	0.00	0.00	0.00	0.00	3

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	0.00	0.00	0.00	0.00	0.00	1.48	1.09	0.00	0.00	0.00	0.00	0.00	2.6
			100.00%	0.00	0.00	0.00	0.00	0.00	1.48	1.09	0.00	0.00	0.00	0.00	0.00	2.6
			100.00%	0.00	0.00	0.00	0.00	0.00	1.48	1.09	0.00	0.00	0.00	0.00	0.00	2.6
		98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A	birds/km^2				0.0000983	0.000267	0.000438	0.000764	0					0.0001
Proportion at rotor risk height	Q_{2R}	83.36%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

No of turbines	T	13													
Rotor radius	R	75	m												
		Total rotor frontal area m^2	229729												
Nocturnal activity factor	f_{night}	0%													
Bird flight speed	v	12.8	m s^{-1}	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		0.0	0.0	0.0	2.4	7.8	13.2	23.1	0.0	0.0	0.0	0.0	0.0	47

Stage C

No of blades	b	3		Bird length	l	0.61	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.465	m
Rotor radius	R	75	m	Bird flight speed	v	12.8	m s^{-1}
Max blade width	C	4.2	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.62%
	downwind	3.79%
	weighted mean	5.70%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.12	0.38	0.64	1.12	0.00	0.00	0.00	0.00	0.00	2

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.12	0.38	0.64	1.12	0.00	0.00	0.00	0.00	0.00	2.3
		100.00%	0.00	0.00	0.00	0.12	0.38	0.64	1.12	0.00	0.00	0.00	0.00	0.00	2.3
		100.00%	0.00	0.00	0.00	0.12	0.38	0.64	1.12	0.00	0.00	0.00	0.00	0.00	2.3
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A	birds/km^2				0.000358	0	0.001329	0.011174	0					0.0011
Proportion at rotor risk height	Q_{2R}	85.71%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

No of turbines	T	13													
Rotor radius	R	75	m												
		Total rotor frontal area m^2	229729												
Nocturnal activity factor	f_{night}	0%													
Bird flight speed	v	12.8	m s^{-1}	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		0.0	0.0	0.0	9.1	0.0	41.2	347.8	0.0	0.0	0.0	0.0	0.0	398

Stage C

No of blades	b	3		Bird length	l	0.61 m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.465 m
Rotor radius	R	75	m	Bird flight speed	v	12.8 m s^{-1}
Max blade width	C	4.2	m	Flight type		gliding
Pitch	λ	15	degrees	% of flights upwind/downwind		50% 50%
Blade profile		see Blade profile sheet				

Single transit risk		
upwind		7.62%
downwind		3.79%
weighted mean		5.70%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.44	0.00	2.00	16.86	0.00	0.00	0.00	0.00	0.00	19

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.44	0.00	2.00	16.86	0.00	0.00	0.00	0.00	0.00	19.3
		100.00%	0.00	0.00	0.00	0.44	0.00	2.00	16.86	0.00	0.00	0.00	0.00	0.00	19.3
		100.00%	0.00	0.00	0.00	0.44	0.00	2.00	16.86	0.00	0.00	0.00	0.00	0.00	19.3
	98.00%	100.00%	0.00	0.00	0.00	0.01	0.00	0.04	0.34	0.00	0.00	0.00	0.00	0.00	0.4

COLLISION RISK MODEL

Required input data is in **orange** boxes
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Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0.000245	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	0.0	5

Stage C

No of blades	b	3		Bird length	l	0.61	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.465	m
Rotor radius	R	75	m	Bird flight speed	v	12.8	m s^{-1}
Max blade width	C	4.2	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.62%
	downwind	3.79%
	weighted mean	5.70%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.2
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.2
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.2
		98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0	0.000477	0	0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4	0.0	7

Stage C

No of blades	b	3		Bird length	l	0.61	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.465	m
Rotor radius	R	75	m	Bird flight speed	v	12.8	m s^{-1}
Max blade width	C	4.2	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.62%
	downwind	3.79%
	weighted mean	5.70%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.4
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.4
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.4
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Hen harrier	
Bird length	L	0.48	m
Wingspan	W	1.1	m
Bird flight speed	v	8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0	0.000693					0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.1	0.0	0.0	0.0	0.0	12

Stage C

No of blades	b	3		Bird length	l	0.48	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.1	m
Rotor radius	R	75	m	Bird flight speed	v	8	m s^{-1}
Max blade width	C	4.2	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	9.26%
	downwind	4.31%
	weighted mean	6.78%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.7
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.7
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.7
	99.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Hen harrier	
Bird length	L	0.48	m
Wingspan	W	1.1	m
Bird flight speed	v	8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0.00207	0.001538						0	0	0	0	0.0003
Proportion at rotor risk height	Q_{2R}	9.94%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	8	m s^{-1}														
		Projected number of rotor transits			0.0	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5

Stage C

No of blades	b	3		Bird length	l	0.48	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.1	m
Rotor radius	R	75	m	Bird flight speed	v	8	m s^{-1}
Max blade width	C	4.2	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	9.26%
	downwind	4.31%
	weighted mean	6.78%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Collision rates before avoidance														year total
		0.00	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.00	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
		100.00%	0.00	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
		100.00%	0.00	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
	99.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.003706	0.000375	0.000884	0.000831	0.002455					0.0007
Proportion at rotor risk height	Q_{2R}	75.96%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	82.8	9.9	24.1	22.7	60.3	0.0	0.0	0.0	0.0	200

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755	m
Rotor radius	R	75	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
	upwind	6.71%
	downwind	2.86%
	weighted mean	4.78%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	3.37	0.40	0.98	0.92	2.45	0.00	0.00	0.00	0.00	8

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	3.37	0.40	0.98	0.92	2.45	0.00	0.00	0.00	0.00	8.1
	95.00%	100.00%	0.00	0.00	0.00	0.17	0.02	0.05	0.05	0.12	0.00	0.00	0.00	0.00	0.4
		100.00%	0.00	0.00	0.00	3.37	0.40	0.98	0.92	2.45	0.00	0.00	0.00	0.00	8.1
		100.00%	0.00	0.00	0.00	3.37	0.40	0.98	0.92	2.45	0.00	0.00	0.00	0.00	8.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.01553	0.007551	0.000259	0.001719	0.010928					0.0030
Proportion at rotor risk height	Q_{2R}	90.85%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	415.1	237.8	8.4	56.3	320.8	0.0	0.0	0.0	0.0	1038

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755	m
Rotor radius	R	75	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.71%
	downwind	2.86%
	weighted mean	4.78%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	16.88	9.67	0.34	2.29	13.04	0.00	0.00	0.00	0.00	42

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	16.88	9.67	0.34	2.29	13.04	0.00	0.00	0.00	0.00	42.2
	95.00%	100.00%	0.00	0.00	0.00	0.84	0.48	0.02	0.11	0.65	0.00	0.00	0.00	0.00	2.1
		100.00%	0.00	0.00	0.00	16.88	9.67	0.34	2.29	13.04	0.00	0.00	0.00	0.00	42.2
		100.00%	0.00	0.00	0.00	16.88	9.67	0.34	2.29	13.04	0.00	0.00	0.00	0.00	42.2

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}				0.000377	0.002121	0.002441	0.007912	0.000679					0.0011
Proportion at rotor risk height	Q_{2R}	85.30%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	9.5	62.7	74.7	243.2	18.7	0.0	0.0	0.0	0.0	409

Stage C						
No of blades	b	3		Bird length	l	0.34 m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755 m
Rotor radius	R	75	m	Bird flight speed	v	12.7 m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping
Pitch	λ	15	degrees	% of flights upwind/downwind		50% 50%
Blade profile		see Blade profile sheet				
		Single transit risk	upwind	6.71%		
			downwind	2.86%		
			weighted mean	4.78%		

Stage D		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.38	2.55	3.03	9.88	0.76	0.00	0.00	0.00	0.00	17

Stage E					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Allow for large array correction?		No															
Width of windfarm	w	2	km														
			large array correction	Collision rates allowing for avoidance													
Avoidance rates modelled			100.00%		0.00	0.00	0.00	0.38	2.55	3.03	9.88	0.76	0.00	0.00	0.00	0.00	16.6
		95.00%	100.00%		0.00	0.00	0.00	0.02	0.13	0.15	0.49	0.04	0.00	0.00	0.00	0.00	0.8
			100.00%		0.00	0.00	0.00	0.38	2.55	3.03	9.88	0.76	0.00	0.00	0.00	0.00	16.6
			100.00%		0.00	0.00	0.00	0.38	2.55	3.03	9.88	0.76	0.00	0.00	0.00	0.00	16.6

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.000548	0.0000804	0.001183						0.003079	0.00000755	0.000193	0	0.0004
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			8.1	1.3	26.0	0.0	0.0	0.0	0.0	0.0	70.8	0.1	3.0	0.0	109

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755	m
Rotor radius	R	75	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.71%
	downwind	2.86%
	weighted mean	4.78%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.33	0.05	1.06	0.00	0.00	0.00	0.00	0.00	2.88	0.01	0.12	0.00	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.33	0.05	1.06	0.00	0.00	0.00	0.00	0.00	2.88	0.01	0.12	0.00	4.4
	95.00%	100.00%	0.02	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.01	0.00	0.2
		100.00%	0.33	0.05	1.06	0.00	0.00	0.00	0.00	0.00	2.88	0.01	0.12	0.00	4.4
		100.00%	0.33	0.05	1.06	0.00	0.00	0.00	0.00	0.00	2.88	0.01	0.12	0.00	4.4

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}	0.007861	0.00106	0.002233						0.00000525	0.000379	0	0	0.0010
Proportion at rotor risk height	Q_{2R}	74.25%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			101.3	15.0	42.5	0.0	0.0	0.0	0.0	0.0	0.1	6.5	0.0	0.0	165

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755	m
Rotor radius	R	75	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.71%
	downwind	2.86%
	weighted mean	4.78%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		4.12	0.61	1.73	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	7

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	4.12	0.61	1.73	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	6.7
	95.00%	100.00%	0.21	0.03	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.3
		100.00%	4.12	0.61	1.73	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	6.7
		100.00%	4.12	0.61	1.73	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	6.7

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0.000803	0.00059						0.000147	0	0.000362	0.000307	0.0002
Proportion at rotor risk height	Q_{2R}	84.76%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	13.0	12.8	0.0	0.0	0.0	0.0	0.0	3.3	0.0	5.5	4.2	39

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755	m
Rotor radius	R	75	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.71%
	downwind	2.86%
	weighted mean	4.78%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.53	0.52	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.23	0.17	2

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.53	0.52	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.23	0.17	1.6
	95.00%	100.00%	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.1
		100.00%	0.00	0.53	0.52	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.23	0.17	1.6
		100.00%	0.00	0.53	0.52	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.23	0.17	1.6

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Black-legged kittiwake	
Bird length	L	0.39	m
Wingspan	W	1.075	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.000177	0	0	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5

Stage C

No of blades	b	3		Bird length	l	0.39	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.075	m
Rotor radius	R	75	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
	upwind	6.93%
	downwind	3.16%
	weighted mean	5.05%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

Collision rates before avoidance	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
	98.00%	100.00%	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
		100.00%	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.00314	0.002969	0.003197	0.000593	0.000352					0.0009
Proportion at rotor risk height	Q_{2R}	80.87%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	77.1	85.8	95.6	17.8	9.5	0.0	0.0	0.0	0.0	286

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m
Rotor radius	R	75	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.2	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.49%
	downwind	3.73%
	weighted mean	5.61%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	3.68	4.09	4.56	0.85	0.45	0.00	0.00	0.00	0.00	14

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	3.68	4.09	4.56	0.85	0.45	0.00	0.00	0.00	0.00	13.6
		100.00%	0.00	0.00	0.00	3.68	4.09	4.56	0.85	0.45	0.00	0.00	0.00	0.00	13.6
		100.00%	0.00	0.00	0.00	3.68	4.09	4.56	0.85	0.45	0.00	0.00	0.00	0.00	13.6
	98.00%	100.00%	0.00	0.00	0.00	0.07	0.08	0.09	0.02	0.01	0.00	0.00	0.00	0.00	0.3

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0.00047	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	78.91%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	13.7	0.0	0.0	0.0	0.0	0.0	0.0	14

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m
Rotor radius	R	75	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.2	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.49%
	downwind	3.73%
	weighted mean	5.61%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.7
		100.00%	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.7
		100.00%	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.7
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.001099	0.005858	0.000218	0	0					0.0006
Proportion at rotor risk height	Q_{2R}	81.36%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	27.1	170.4	6.6	0.0	0.0	0.0	0.0	0.0	0.0	204

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m
Rotor radius	R	75	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.2	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.49%
	downwind	3.73%
	weighted mean	5.61%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	1.29	8.13	0.31	0.00	0.00	0.00	0.00	0.00	0.00	10

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	0.00	0.00	0.00	1.29	8.13	0.31	0.00	0.00	0.00	0.00	0.00	0.00	9.7
			100.00%	0.00	0.00	0.00	1.29	8.13	0.31	0.00	0.00	0.00	0.00	0.00	0.00	9.7
			100.00%	0.00	0.00	0.00	1.29	8.13	0.31	0.00	0.00	0.00	0.00	0.00	0.00	9.7
		98.00%	100.00%	0.00	0.00	0.00	0.03	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.2

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.005095	0	0						0	0	0	0	0.0004
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			78.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	78

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m
Rotor radius	R	75	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.2	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.49%
	downwind	3.73%
	weighted mean	5.61%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		3.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled				Collision rates allowing for avoidance												
			100.00%	3.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.7
			100.00%	3.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.7
			100.00%	3.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.7
		98.00%	100.00%	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0.000904	0.000217	0	0	0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.4	4.4	0.0	0.0	26

Stage C

No of blades	b	3		Bird length	l	0.6	m	
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m	
Rotor radius	R	75	m	Bird flight speed	v	13.1	m s^{-1}	
Max blade width	C	4.2	m	Flight type		gliding		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	7.49%
	downwind	3.73%
	weighted mean	5.61%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.02	0.21	0.00	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.02	0.21	0.00	0.00	1.2
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.02	0.21	0.00	0.00	1.2
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.02	0.21	0.00	0.00	1.2
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Mallard	
Bird length	L	0.58	m
Wingspan	W	0.9	m
Bird flight speed	v	22	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.000293	0	0	0	0.00007					0.0000
Proportion at rotor risk height	Q_{2R}	43.81%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	22	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	7.7	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	10

Stage C

No of blades	b	3		Bird length	l	0.58	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.9	m
Rotor radius	R	75	m	Bird flight speed	v	22	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
upwind	5.91%	
downwind	3.57%	
weighted mean	4.74%	

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.4
		100.00%	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.4
		100.00%	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.4
	98.00%	100.00%	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Mallard	
Bird length	L	0.58	m
Wingspan	W	0.9	m
Bird flight speed	v	22	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.000369	0.000239	0	0	0.000273					0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	22	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	19.0	13.8	0.0	0.0	15.1	0.0	0.0	0.0	0.0	48

Stage C

No of blades	b	3		Bird length	l	0.58	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.9	m
Rotor radius	R	75	m	Bird flight speed	v	22	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.91%
	downwind	3.57%
	weighted mean	4.74%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.77	0.56	0.00	0.00	0.61	0.00	0.00	0.00	0.00	2

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.77	0.56	0.00	0.00	0.61	0.00	0.00	0.00	0.00	1.9
		100.00%	0.00	0.00	0.00	0.77	0.56	0.00	0.00	0.61	0.00	0.00	0.00	0.00	1.9
		100.00%	0.00	0.00	0.00	0.77	0.56	0.00	0.00	0.61	0.00	0.00	0.00	0.00	1.9
	98.00%	100.00%	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Mallard	
Bird length	L	0.58	m
Wingspan	W	0.9	m
Bird flight speed	v	22	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.003563	0	0	0	0.000311					0.0003
Proportion at rotor risk height	Q_{2R}	83.81%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	22	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	179.4	0.0	0.0	0.0	16.8	0.0	0.0	0.0	0.0	196

Stage C

No of blades	b	3		Bird length	l	0.58	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.9	m
Rotor radius	R	75	m	Bird flight speed	v	22	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
	upwind	5.91%
	downwind	3.57%
	weighted mean	4.74%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	7.23	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00	8

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	7.23	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00	7.9
		100.00%	0.00	0.00	0.00	7.23	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00	7.9
		100.00%	0.00	0.00	0.00	7.23	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00	7.9
	98.00%	100.00%	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.2

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Merlin	
Bird length	L	0.275	m
Wingspan	W	0.56	m
Bird flight speed	v	13.47	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.0000584	0	0	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	0.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B																
No of turbines	T	13														
Rotor radius	R	75	m													
		Total rotor frontal area m^2	229729													
Nocturnal activity factor	f_{night}	0%														
Bird flight speed	v	13.47	m s^{-1}	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Stage C							
No of blades	b	3		Bird length	l	0.275	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.56	m
Rotor radius	R	75	m	Bird flight speed	v	13.47	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					
		Single transit risk	upwind	6.26%			
			downwind	2.58%			
			weighted mean	4.42%			

Stage D		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E																
Allow for large array correction?		No														
Width of windfarm	w	2	km													
			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Merlin	
Bird length	L	0.275	m
Wingspan	W	0.56	m
Bird flight speed	v	13.47	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0.000299	0						0	0	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.47	m s^{-1}														
		Projected number of rotor transits			0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5

Stage C

No of blades	b	3		Bird length	l	0.275	m	
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.56	m	
Rotor radius	R	75	m	Bird flight speed	v	13.47	m s^{-1}	
Max blade width	C	4.2	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	6.26%
	downwind	2.58%
	weighted mean	4.42%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
		100.00%	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
		100.00%	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		nd white-fronted goose	
Bird length	L	0.71	m
Wingspan	W	1.47	m
Bird flight speed	v	16.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0.038264	0	0	0.0032
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1258.6	0.0	0.0	1259

Stage C

No of blades	b	3		Bird length	l	0.71 m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.47 m
Rotor radius	R	75	m	Bird flight speed	v	16.1 m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping
Pitch	λ	15	degrees	% of flights upwind/downwind		50% 50%
Blade profile		see Blade profile sheet				
		Single transit risk	upwind	7.27%		
			downwind	4.09%		
			weighted mean	5.68%		

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.80	0.00	0.00	61

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.80	0.00	0.00	60.8
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.80	0.00	0.00	60.8
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.80	0.00	0.00	60.8
	99.80%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Peregrine falcon	
Bird length	L	0.42	m
Wingspan	W	1.025	m
Bird flight speed	v	12.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.000288	0	0						0.000483	0.000142	0.000376	0	0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.1	m s^{-1}														
		Projected number of rotor transits			4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	2.7	5.5	0.0	23

Stage C

No of blades	b	3		Bird length	l	0.42	m	
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.025	m	
Rotor radius	R	75	m	Bird flight speed	v	12.1	m s^{-1}	
Max blade width	C	4.2	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	7.23%
	downwind	3.25%
	weighted mean	5.24%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.12	0.25	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.12	0.25	0.00	1.0
		100.00%	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.12	0.25	0.00	1.0
		100.00%	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.12	0.25	0.00	1.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}				0	0	0.000207	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	8.8	0.0	0.0	0.0	0.0	0.0	0.0	9

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.455	m
Rotor radius	R	75	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.76%
	downwind	2.56%
	weighted mean	4.16%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.3
	100.00%	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.3
	100.00%	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.3
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}	0	0.000278	0						0	0.0000136	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	77.14%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	7

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.455	m
Rotor radius	R	75	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.76%
	downwind	2.56%
	weighted mean	4.16%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.3
	100.00%	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.3
	100.00%	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.3
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}	0.000944	0.000192	0						0	0.006071	0.000676	0	0.0007
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			26.5	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	198.4	19.1	0.0	249

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.455	m
Rotor radius	R	75	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.76%
	downwind	2.56%
	weighted mean	4.16%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.94	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.01	0.67	0.00	9

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.94	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.01	0.67	0.00	8.8
	100.00%	0.94	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.01	0.67	0.00	8.8
	100.00%	0.94	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.01	0.67	0.00	8.8
98.00%	100.00%	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.01	0.00	0.2

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0.000704	0.0000414	0	0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0	1.2	0.0	24

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.455	m
Rotor radius	R	75	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.76%
	downwind	2.56%
	weighted mean	4.16%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.04	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.04	0.00	0.9
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.04	0.00	0.9
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.04	0.00	0.9
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Eurasian teal	
Bird length	L	0.39	m
Wingspan	W	0.55	m
Bird flight speed	v	19.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A	birds/km^2				0	0	0	0.0000677	0					0.0000
Proportion at rotor risk height	Q_{2R}	85.71%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

No of turbines	T	13													
Rotor radius	R	75	m												
		Total rotor frontal area m^2	229729												
Nocturnal activity factor	f_{night}	25%													
Bird flight speed	v	19.7	m s^{-1}	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	4

Stage C

No of blades	b	3		Bird length	l	0.39 m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.55 m
Rotor radius	R	75	m	Bird flight speed	v	19.7 m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping
Pitch	λ	15	degrees	% of flights upwind/downwind		50% 50%
Blade profile		see Blade profile sheet				
		Single transit risk	upwind	5.63%		
			downwind	3.02%		
			weighted mean	4.32%		

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.1
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.1
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.1
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Eurasian teal	
Bird length	L	0.39	m
Wingspan	W	0.55	m
Bird flight speed	v	19.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A	birds/km^2				0	0	0	0.002052	0					0.0002
Proportion at rotor risk height	Q_{2R}	85.71%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	19.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	109.2	0.0	0.0	0.0	0.0	0.0	109

Stage C

No of blades	b	3		Bird length	l	0.39	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.55	m
Rotor radius	R	75	m	Bird flight speed	v	19.7	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.63%
	downwind	3.02%
	weighted mean	4.32%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	4.01	0.00	0.00	0.00	0.00	0.00	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	4.01	0.00	0.00	0.00	0.00	0.00	4.0
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	4.01	0.00	0.00	0.00	0.00	0.00	4.0
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	4.01	0.00	0.00	0.00	0.00	0.00	4.0
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
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green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Eurasian teal	
Bird length	L	0.39	m
Wingspan	W	0.55	m
Bird flight speed	v	19.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A	birds/km^2	0	0	0.0000265						0	0	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	0.00%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

No of turbines	T	13													
Rotor radius	R	75	m												
		Total rotor frontal area m^2	229729												
Nocturnal activity factor	f_{night}	25%													
Bird flight speed	v	19.7	m s^{-1}	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Stage C

No of blades	b	3		Bird length	l	0.39 m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.55 m
Rotor radius	R	75	m	Bird flight speed	v	19.7 m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping
Pitch	λ	15	degrees	% of flights upwind/downwind		50% 50%
Blade profile		see Blade profile sheet				

Single transit risk	upwind	5.63%
	downwind	3.02%
	weighted mean	4.32%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Eurasian woodcock	
Bird length	L	0.28	m
Wingspan	W	0.6	m
Bird flight speed	v	3.33	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		3	
Nocturnal activity factor	f_{night}	50%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.000127	0	0						0	0	0	0.0000161	0.0000
Proportion at rotor risk height	Q_{2R}	51.43%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	50%															
Bird flight speed	v	3.33	m s^{-1}														
		Projected number of rotor transits			0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1

Stage C

No of blades	b	3		Bird length	l	0.28	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.6	m
Rotor radius	R	75	m	Bird flight speed	v	3.33	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	14.78%
	downwind	8.65%
	weighted mean	11.72%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
			100.00%	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
			100.00%	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
		98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Whooper swan	
Bird length	L	1.525	m
Wingspan	W	2.304	m
Bird flight speed	v	17.3	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0	0	0.002085	0.0002
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	17.3	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.3	61

Stage C

No of blades	b	3		Bird length	l	1.525	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	2.304	m
Rotor radius	R	75	m	Bird flight speed	v	17.3	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
	upwind	9.18%
	downwind	6.21%
	weighted mean	7.69%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
Collision rates before avoidance													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.01	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.01	4.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.01	4.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.01	4.0
	99.50%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Whooper swan	
Bird length	L	1.525	m
Wingspan	W	2.304	m
Bird flight speed	v	17.3	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		V150	
Hub height		105	m
Rotor radius	R	75	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.2	m
Blade pitch	λ	15	degrees
Risk height range		30-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.037702	0	0						0	0	0	0	0.0031
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	75	m														
		Total rotor frontal area m^2		229729													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	17.3	m s^{-1}														
		Projected number of rotor transits			1146.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1146

Stage C

No of blades	b	3		Bird length	l	1.525	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	2.304	m
Rotor radius	R	75	m	Bird flight speed	v	17.3	m s^{-1}
Max blade width	C	4.2	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
upwind		9.18%
downwind		6.21%
weighted mean		7.69%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

	Collision rates before avoidance												year total
	74.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	75

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	74.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	74.9
		100.00%	74.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	74.9
		100.00%	74.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	74.9
	99.50%	100.00%	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.4

Appendix B NatureScot Spreadsheets – Nordex N163

Avian Collision Risk Report

Muingmore Wind Farm

RWE Renewables Ireland Ltd

SLR Project No.: 501.065301.00001

9 July 2025

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0.003447	0.000438	0					0.0003
Proportion at rotor risk height	Q_{2R}	81.96%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	11.9	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	103.1	13.2	0.0	0.0	0.0	0.0	0.0	116

Stage C

No of blades	b	3		Bird length	l	0.355	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.05	m
Rotor radius	R	81.5	m	Bird flight speed	v	11.9	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.74%
	downwind	2.88%
	weighted mean	4.81%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	4.22	0.54	0.00	0.00	0.00	0.00	0.00	5

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	4.22	0.54	0.00	0.00	0.00	0.00	0.00	4.8
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.08	0.01	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.00	4.22	0.54	0.00	0.00	0.00	0.00	0.00	4.8
		100.00%	0.00	0.00	0.00	0.00	0.00	4.22	0.54	0.00	0.00	0.00	0.00	0.00	4.8

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0.000194	0.000911	0.002603	0					0.0003
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	11.9	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	6.5	31.6	90.7	0.0	0.0	0.0	0.0	0.0	129

Stage C

No of blades	b	3		Bird length	l	0.355	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.05	m
Rotor radius	R	81.5	m	Bird flight speed	v	11.9	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.74%
	downwind	2.88%
	weighted mean	4.81%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.27	1.29	3.71	0.00	0.00	0.00	0.00	0.00	5

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.27	1.29	3.71	0.00	0.00	0.00	0.00	0.00	5.3
		100.00%	0.00	0.00	0.00	0.00	0.01	0.03	0.07	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.27	1.29	3.71	0.00	0.00	0.00	0.00	0.00	5.3
		100.00%	0.00	0.00	0.00	0.00	0.27	1.29	3.71	0.00	0.00	0.00	0.00	0.00	5.3

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0.001169	0.015875	0.000412	0					0.0015
Proportion at rotor risk height	Q_{2R}	19.38%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	11.9	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	8.0	112.3	2.9	0.0	0.0	0.0	0.0	0.0	123

Stage C

No of blades	b	3		Bird length	l	0.355	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.05	m
Rotor radius	R	81.5	m	Bird flight speed	v	11.9	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.74%
	downwind	2.88%
	weighted mean	4.81%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.33	4.59	0.12	0.00	0.00	0.00	0.00	0.00	5

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.33	4.59	0.12	0.00	0.00	0.00	0.00	0.00	5.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.01	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.33	4.59	0.12	0.00	0.00	0.00	0.00	0.00	5.0
		100.00%	0.00	0.00	0.00	0.00	0.33	4.59	0.12	0.00	0.00	0.00	0.00	0.00	5.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0	5.77558E-05	0	0.0000
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	11.9	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1

Stage C

No of blades	b	3		Bird length	l	0.355	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.05	m
Rotor radius	R	81.5	m	Bird flight speed	v	11.9	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.74%
	downwind	2.88%
	weighted mean	4.81%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Great cormorant	
Bird length	L	0.9	m
Wingspan	W	1.45	m
Bird flight speed	v	14.5	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.001374	0	0.000491						0	0.000571	0	0	0.0002
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	14.5	m s^{-1}														
		Projected number of rotor transits			28.1	0.0	14.8	0.0	0.0	0.0	0.0	0.0	0.0	15.5	0.0	0.0	58

Stage C

No of blades	b	3		Bird length	l	0.9	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m
Rotor radius	R	81.5	m	Bird flight speed	v	14.5	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.74%
	downwind	4.36%
	weighted mean	6.05%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		1.44	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	3

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	1.44	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	3.0
		100.00%	1.44	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	3.0
		100.00%	1.44	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	3.0
	98.00%	100.00%	0.03	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common gull	
Bird length	L	0.41	m
Wingspan	W	1.15	m
Bird flight speed	v	13.4	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0.004297	0					0.0004
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.4	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	168.6	0.0	0.0	0.0	0.0	0.0	169

Stage C

No of blades	b	3		Bird length	l	0.41	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.15	m
Rotor radius	R	81.5	m	Bird flight speed	v	13.4	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.58%
	downwind	3.00%
	weighted mean	4.79%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	6.86	0.00	0.00	0.00	0.00	0.00	7

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	6.86	0.00	0.00	0.00	0.00	0.00	6.9
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	6.86	0.00	0.00	0.00	0.00	0.00	6.9
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	6.86	0.00	0.00	0.00	0.00	0.00	6.9

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common gull	
Bird length	L	0.41	m
Wingspan	W	1.15	m
Bird flight speed	v	13.4	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0.001111	0					0.0001
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.4	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	43.6	0.0	0.0	0.0	0.0	0.0	44

Stage C

No of blades	b	3		Bird length	l	0.41	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.15	m
Rotor radius	R	81.5	m	Bird flight speed	v	13.4	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.58%
	downwind	3.00%
	weighted mean	4.79%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	1.77	0.00	0.00	0.00	0.00	0.00	2

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	1.77	0.00	0.00	0.00	0.00	0.00	1.8
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	1.77	0.00	0.00	0.00	0.00	0.00	1.8
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	1.77	0.00	0.00	0.00	0.00	0.00	1.8

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Common tern	
Bird length	L	0.33	m
Wingspan	W	0.875	m
Bird flight speed	v	10.2	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}				0	0	0.000141	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	10.2	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0	4

Stage C

No of blades	b	3		Bird length	l	0.33	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.875	m
Rotor radius	R	81.5	m	Bird flight speed	v	10.2	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.10%
	downwind	2.91%
	weighted mean	5.01%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.2
	100.00%	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.2
	100.00%	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.2
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Greylag goose	
Bird length	L	0.83	m
Wingspan	W	1.64	m
Bird flight speed	v	17.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0.458196						0	0	0	0	0.0382
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	17.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	20540.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20540

Stage C

No of blades	b	3		Bird length	l	0.83	m	
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.64	m	
Rotor radius	R	81.5	m	Bird flight speed	v	17.1	m s^{-1}	
Max blade width	C	4.15	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						
		Single transit risk	upwind	7.03%				
			downwind	4.08%				
			weighted mean	5.56%				

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	970.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	970

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	970.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	970.4
		100.00%	0.00	0.00	970.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	970.4
		100.00%	0.00	0.00	970.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	970.4
	99.80%	100.00%	0.00	0.00	1.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.9

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Golden plover	
Bird length	L	0.275	m
Wingspan	W	0.715	m
Bird flight speed	v	13.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0.000204	0					0.0000
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	13.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	9

Stage C

No of blades	b	3		Bird length	l	0.275	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.715	m
Rotor radius	R	81.5	m	Bird flight speed	v	13.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.95%
	downwind	2.43%
	weighted mean	4.19%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.3
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.3
98.00%		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.0
99.80%		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0.000992	0.000718	0					0.0001
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	37.0	26.9	0.0	0.0	0.0	0.0	0.0	64

Stage C

No of blades	b	3		Bird length	l	0.61	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.465	m
Rotor radius	R	81.5	m	Bird flight speed	v	12.8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.26%
	downwind	3.58%
	weighted mean	5.42%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	1.70	1.24	0.00	0.00	0.00	0.00	0.00	3

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	1.70	1.24	0.00	0.00	0.00	0.00	0.00	2.9
		100.00%	0.00	0.00	0.00	0.00	0.00	1.70	1.24	0.00	0.00	0.00	0.00	0.00	2.9
		100.00%	0.00	0.00	0.00	0.00	0.00	1.70	1.24	0.00	0.00	0.00	0.00	0.00	2.9
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.000104	0.000277	0.000635	0.000816	0					0.0002
Proportion at rotor risk height	Q_{2R}	92.34%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	3.1	9.7	23.0	29.7	0.0	0.0	0.0	0.0	0.0	66

Stage C

No of blades	b	3		Bird length	l	0.61	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.465	m
Rotor radius	R	81.5	m	Bird flight speed	v	12.8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.26%
	downwind	3.58%
	weighted mean	5.42%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.14	0.45	1.06	1.37	0.00	0.00	0.00	0.00	0.00	3

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	0.00	0.00	0.00	0.14	0.45	1.06	1.37	0.00	0.00	0.00	0.00	0.00	3.0
			100.00%	0.00	0.00	0.00	0.14	0.45	1.06	1.37	0.00	0.00	0.00	0.00	0.00	3.0
			100.00%	0.00	0.00	0.00	0.14	0.45	1.06	1.37	0.00	0.00	0.00	0.00	0.00	3.0
		98.00%	100.00%	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A	birds/km^2				0.000361	0	0.00132	0.012133	0					0.0012
Proportion at rotor risk height	Q_{2R}	95.00%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

No of turbines	T	13	
Rotor radius	R	81.5	m
		Total rotor frontal area m^2	271274
Nocturnal activity factor	f_{night}	0%	
Bird flight speed	v	12.8	m s^{-1}

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
Projected number of rotor transits	0.0	0.0	0.0	11.1	0.0	49.2	454.8	0.0	0.0	0.0	0.0	0.0	515

Stage C

No of blades	b	3		Bird length	l	0.61 m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.465 m
Rotor radius	R	81.5	m	Bird flight speed	v	12.8 m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding
Pitch	λ	15	degrees	% of flights upwind/downwind		50% 50%
Blade profile		see Blade profile sheet				

Single transit risk	upwind	7.26%
	downwind	3.58%
	weighted mean	5.42%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Collision rates before avoidance		0.00	0.00	0.00	0.51	0.00	2.27	20.95	0.00	0.00	0.00	0.00	0.00	year total 24

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.51	0.00	2.27	20.95	0.00	0.00	0.00	0.00	0.00	23.7
		100.00%	0.00	0.00	0.00	0.51	0.00	2.27	20.95	0.00	0.00	0.00	0.00	0.00	23.7
		100.00%	0.00	0.00	0.00	0.51	0.00	2.27	20.95	0.00	0.00	0.00	0.00	0.00	23.7
	98.00%	100.00%	0.00	0.00	0.00	0.01	0.00	0.05	0.42	0.00	0.00	0.00	0.00	0.00	0.5

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0.000256	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	0.0	0.0	6

Stage C

No of blades	b	3		Bird length	l	0.61	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.465	m
Rotor radius	R	81.5	m	Bird flight speed	v	12.8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.26%
	downwind	3.58%
	weighted mean	5.42%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Collision rates before avoidance		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	year total 0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled		Collision rates allowing for avoidance												
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.3
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.3
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.3
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0	0.000475	0	0.0000
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	0.0	9

Stage C

No of blades	b	3		Bird length	l	0.61	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.465	m
Rotor radius	R	81.5	m	Bird flight speed	v	12.8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.26%
	downwind	3.58%
	weighted mean	5.42%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.4
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.4
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.4
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Hen harrier	
Bird length	L	0.48	m
Wingspan	W	1.1	m
Bird flight speed	v	8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0	0.000724					0.0001
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.2	0.0	0.0	0.0	0.0	15

Stage C

No of blades	b	3		Bird length	l	0.48	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.1	m
Rotor radius	R	81.5	m	Bird flight speed	v	8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	8.91%
	downwind	4.25%
	weighted mean	6.58%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.9
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.9
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.9
	99.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Hen harrier	
Bird length	L	0.48	m
Wingspan	W	1.1	m
Bird flight speed	v	8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0.002052	0.00156						0	0	0	0	0.0003
Proportion at rotor risk height	Q_{2R}	11.01%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	8	m s^{-1}														
		Projected number of rotor transits			0.0	2.9	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6

Stage C

No of blades	b	3		Bird length	l	0.48	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.1	m
Rotor radius	R	81.5	m	Bird flight speed	v	8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	8.91%
	downwind	4.25%
	weighted mean	6.58%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.16	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.16	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
		100.00%	0.00	0.16	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
		100.00%	0.00	0.16	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
	99.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Hen harrier	
Bird length	L	0.48	m
Wingspan	W	1.1	m
Bird flight speed	v	8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0.000206	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	0.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Stage C

No of blades	b	3		Bird length	l	0.48	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.1	m
Rotor radius	R	81.5	m	Bird flight speed	v	8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	8.91%
	downwind	4.25%
	weighted mean	6.58%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		99.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.004216	0.000454	0.000934	0.000837	0.002539					0.0007
Proportion at rotor risk height	Q_{2R}	84.19%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	113.5	14.4	30.6	27.6	75.1	0.0	0.0	0.0	0.0	261

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755	m
Rotor radius	R	81.5	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.35%
	downwind	2.65%
	weighted mean	4.50%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	4.34	0.55	1.17	1.06	2.87	0.00	0.00	0.00	0.00	10

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	4.34	0.55	1.17	1.06	2.87	0.00	0.00	0.00	0.00	10.0
	95.00%	100.00%	0.00	0.00	0.00	0.22	0.03	0.06	0.05	0.14	0.00	0.00	0.00	0.00	0.5
		100.00%	0.00	0.00	0.00	4.34	0.55	1.17	1.06	2.87	0.00	0.00	0.00	0.00	10.0
		100.00%	0.00	0.00	0.00	4.34	0.55	1.17	1.06	2.87	0.00	0.00	0.00	0.00	10.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.016005	0.007554	0.0003	0.001941	0.010858					0.0031
Proportion at rotor risk height	Q_{2R}	96.80%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	495.4	275.4	11.3	73.6	369.1	0.0	0.0	0.0	0.0	1225

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755	m
Rotor radius	R	81.5	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.35%
	downwind	2.65%
	weighted mean	4.50%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	18.96	10.54	0.43	2.82	14.12	0.00	0.00	0.00	0.00	47

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	18.96	10.54	0.43	2.82	14.12	0.00	0.00	0.00	0.00	46.9
	95.00%	100.00%	0.00	0.00	0.00	0.95	0.53	0.02	0.14	0.71	0.00	0.00	0.00	0.00	2.3
		100.00%	0.00	0.00	0.00	18.96	10.54	0.43	2.82	14.12	0.00	0.00	0.00	0.00	46.9
		100.00%	0.00	0.00	0.00	18.96	10.54	0.43	2.82	14.12	0.00	0.00	0.00	0.00	46.9

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}				0.000386	0.002111	0.002444	0.008065	0.000715					0.0011
Proportion at rotor risk height	Q_{2R}	94.50%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	11.7	75.1	90.0	298.4	23.7	0.0	0.0	0.0	0.0	499

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755	m
Rotor radius	R	81.5	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.35%
	downwind	2.65%
	weighted mean	4.50%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.45	2.88	3.44	11.42	0.91	0.00	0.00	0.00	0.00	19

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.45	2.88	3.44	11.42	0.91	0.00	0.00	0.00	0.00	19.1
	95.00%	100.00%	0.00	0.00	0.00	0.02	0.14	0.17	0.57	0.05	0.00	0.00	0.00	0.00	1.0
		100.00%	0.00	0.00	0.00	0.45	2.88	3.44	11.42	0.91	0.00	0.00	0.00	0.00	19.1
		100.00%	0.00	0.00	0.00	0.45	2.88	3.44	11.42	0.91	0.00	0.00	0.00	0.00	19.1

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.000545	0.0000796	0.001273						0.003049	0.00000937	0.000226	0	0.0004
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			9.8	1.6	33.7	0.0	0.0	0.0	0.0	0.0	84.5	0.2	4.2	0.0	134

Stage C

No of blades	b	3		Bird length	l	0.34	m	
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755	m	
Rotor radius	R	81.5	m	Bird flight speed	v	12.7	m s^{-1}	
Max blade width	C	4.15	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	6.35%
	downwind	2.65%
	weighted mean	4.50%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
Collision rates before avoidance													
	0.37	0.06	1.29	0.00	0.00	0.00	0.00	0.00	3.23	0.01	0.16	0.00	5

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.37	0.06	1.29	0.00	0.00	0.00	0.00	0.00	3.23	0.01	0.16	0.00	5.1
	95.00%	100.00%	0.02	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.01	0.00	0.3
		100.00%	0.37	0.06	1.29	0.00	0.00	0.00	0.00	0.00	3.23	0.01	0.16	0.00	5.1
		100.00%	0.37	0.06	1.29	0.00	0.00	0.00	0.00	0.00	3.23	0.01	0.16	0.00	5.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}	0.007817	0.001048	0.002396						0.00000817	0.000515	0	0	0.0010
Proportion at rotor risk height	Q_{2R}	82.30%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

No of turbines	T	13														
Rotor radius	R	81.5	m													
		Total rotor frontal area m^2	271274													
Nocturnal activity factor	f_{night}	0%														
Bird flight speed	v	12.7	m s^{-1}	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		121.3	17.8	54.9	0.0	0.0	0.0	0.0	0.0	0.2	10.6	0.0	0.0	205

Stage C

No of blades	b	3		Bird length	l	0.34 m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755 m
Rotor radius	R	81.5	m	Bird flight speed	v	12.7 m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping
Pitch	λ	15	degrees	% of flights upwind/downwind		50% 50%
Blade profile		see Blade profile sheet				

Single transit risk	upwind	6.35%
	downwind	2.65%
	weighted mean	4.50%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		4.64	0.68	2.10	0.00	0.00	0.00	0.00	0.00	0.01	0.41	0.00	0.00	8

Stage E

Allow for large array correction?		No														
Width of windfarm	w	2	km													
			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	4.64	0.68	2.10	0.00	0.00	0.00	0.00	0.00	0.01	0.41	0.00	0.00	7.8
		95.00%	100.00%	0.23	0.03	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.4
			100.00%	4.64	0.68	2.10	0.00	0.00	0.00	0.00	0.00	0.01	0.41	0.00	0.00	7.8
			100.00%	4.64	0.68	2.10	0.00	0.00	0.00	0.00	0.00	0.01	0.41	0.00	0.00	7.8

COLLISION RISK MODEL

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Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}	0	0.000816	0.000592						0.000158	0	0.000406	0.000369	0.0002
Proportion at rotor risk height	Q_{2R}	93.94%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	15.9	15.5	0.0	0.0	0.0	0.0	0.0	4.3	0.0	7.5	6.1	49

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.755	m
Rotor radius	R	81.5	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.35%
	downwind	2.65%
	weighted mean	4.50%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.61	0.59	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.29	0.23	2

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.61	0.59	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.29	0.23	1.9
	95.00%	100.00%	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.1
		100.00%	0.00	0.61	0.59	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.29	0.23	1.9
		100.00%	0.00	0.61	0.59	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.29	0.23	1.9

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Black-legged kittiwake	
Bird length	L	0.39	m
Wingspan	W	1.075	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.000176	0	0	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6

Stage C

No of blades	b	3		Bird length	l	0.39	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.075	m
Rotor radius	R	81.5	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.55%
	downwind	2.92%
	weighted mean	4.74%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
		100.00%	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.003394	0.003138	0.003258	0.000627	0.000367					0.0009
Proportion at rotor risk height	Q_{2R}	89.63%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	100.3	109.3	117.4	22.7	11.9	0.0	0.0	0.0	0.0	362

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m
Rotor radius	R	81.5	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.14%
	downwind	3.51%
	weighted mean	5.32%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	4.54	4.94	5.31	1.03	0.54	0.00	0.00	0.00	0.00	16

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	4.54	4.94	5.31	1.03	0.54	0.00	0.00	0.00	0.00	16.4
		100.00%	0.00	0.00	0.00	4.54	4.94	5.31	1.03	0.54	0.00	0.00	0.00	0.00	16.4
		100.00%	0.00	0.00	0.00	4.54	4.94	5.31	1.03	0.54	0.00	0.00	0.00	0.00	16.4
	98.00%	100.00%	0.00	0.00	0.00	0.09	0.10	0.11	0.02	0.01	0.00	0.00	0.00	0.00	0.3

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0.000495	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	87.46%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0	0.0	17

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m
Rotor radius	R	81.5	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.14%
	downwind	3.51%
	weighted mean	5.32%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled				Collision rates allowing for avoidance												
			100.00%	0.00	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.8
			100.00%	0.00	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.8
			100.00%	0.00	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.8
		98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.001091	0.006151	0.000243	0	0					0.0006
Proportion at rotor risk height	Q_{2R}	90.12%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	32.4	215.4	8.8	0.0	0.0	0.0	0.0	0.0	0.0	257

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m
Rotor radius	R	81.5	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.14%
	downwind	3.51%
	weighted mean	5.32%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	1.47	9.74	0.40	0.00	0.00	0.00	0.00	0.00	0.00	12

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	1.47	9.74	0.40	0.00	0.00	0.00	0.00	0.00	0.00	11.6
		100.00%	0.00	0.00	0.00	1.47	9.74	0.40	0.00	0.00	0.00	0.00	0.00	0.00	11.6
		100.00%	0.00	0.00	0.00	1.47	9.74	0.40	0.00	0.00	0.00	0.00	0.00	0.00	11.6
	98.00%	100.00%	0.00	0.00	0.00	0.03	0.19	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.2

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.005092	0	0						0	0	0	0	0.0004
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			94.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94

Stage C

No of blades	b	3		Bird length	l	0.6	m	
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m	
Rotor radius	R	81.5	m	Bird flight speed	v	13.1	m s^{-1}	
Max blade width	C	4.15	m	Flight type		gliding		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	7.14%
	downwind	3.51%
	weighted mean	5.32%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		4.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	4.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.3
		100.00%	4.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.3
		100.00%	4.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.3
	98.00%	100.00%	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0.000892	0.000216	0	0	0.0001
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.5	5.3	0.0	0.0	31

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.45	m
Rotor radius	R	81.5	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.14%
	downwind	3.51%
	weighted mean	5.32%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.15	0.24	0.00	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.15	0.24	0.00	0.00	1.4
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.15	0.24	0.00	0.00	1.4
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.15	0.24	0.00	0.00	1.4
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Mallard	
Bird length	L	0.58	m
Wingspan	W	0.9	m
Bird flight speed	v	22	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.000358	0	0	0	0.0000874					0.0000
Proportion at rotor risk height	Q_{2R}	48.56%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

No of turbines	T	13														
Rotor radius	R	81.5	m													
		Total rotor frontal area m^2	271274													
Nocturnal activity factor	f_{night}	25%														
Bird flight speed	v	22	m s^{-1}	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		0.0	0.0	0.0	11.3	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	14

Stage C

No of blades	b	3		Bird length	l	0.58	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.9	m
Rotor radius	R	81.5	m	Bird flight speed	v	22	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.56%
	downwind	3.24%
	weighted mean	4.40%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.5
		100.00%	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.5
		100.00%	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.5
	98.00%	100.00%	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Mallard	
Bird length	L	0.58	m
Wingspan	W	0.9	m
Bird flight speed	v	22	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.000421	0.000249	0	0	0.000273					0.0001
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	22	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	26.1	17.4	0.0	0.0	18.2	0.0	0.0	0.0	0.0	62

Stage C

No of blades	b	3		Bird length	l	0.58	m	
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.9	m	
Rotor radius	R	81.5	m	Bird flight speed	v	22	m s^{-1}	
Max blade width	C	4.15	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk		
upwind		5.56%
downwind		3.24%
weighted mean		4.40%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.98	0.65	0.00	0.00	0.68	0.00	0.00	0.00	0.00	2

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.98	0.65	0.00	0.00	0.68	0.00	0.00	0.00	0.00	2.3
		100.00%	0.00	0.00	0.00	0.98	0.65	0.00	0.00	0.68	0.00	0.00	0.00	0.00	2.3
		100.00%	0.00	0.00	0.00	0.98	0.65	0.00	0.00	0.68	0.00	0.00	0.00	0.00	2.3
	98.00%	100.00%	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Merlin	
Bird length	L	0.275	m
Wingspan	W	0.56	m
Bird flight speed	v	13.47	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.000088	0	0	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	0.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.47	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Stage C

No of blades	b	3		Bird length	l	0.275	m	
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.56	m	
Rotor radius	R	81.5	m	Bird flight speed	v	13.47	m s^{-1}	
Max blade width	C	4.15	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	5.92%
	downwind	2.36%
	weighted mean	4.14%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Merlin	
Bird length	L	0.275	m
Wingspan	W	0.56	m
Bird flight speed	v	13.47	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0.000296	0						0	0	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.47	m s^{-1}														
		Projected number of rotor transits			0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6

Stage C

No of blades	b	3		Bird length	l	0.275	m	
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.56	m	
Rotor radius	R	81.5	m	Bird flight speed	v	13.47	m s^{-1}	
Max blade width	C	4.15	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	5.92%
	downwind	2.36%
	weighted mean	4.14%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
		100.00%	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
		100.00%	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		nd white-fronted goose	
Bird length	L	0.71	m
Wingspan	W	1.47	m
Bird flight speed	v	16.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0.038593	0	0	0.0032
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1528.9	0.0	0.0	1529

Stage C

No of blades	b	3		Bird length	l	0.71	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.47	m
Rotor radius	R	81.5	m	Bird flight speed	v	16.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
upwind		6.89%
downwind		3.78%
weighted mean		5.33%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	69.29	0.00	0.00	69

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	69.29	0.00	0.00	69.3
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	69.29	0.00	0.00	69.3
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	69.29	0.00	0.00	69.3
	99.80%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Peregrine falcon	
Bird length	L	0.42	m
Wingspan	W	1.025	m
Bird flight speed	v	12.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.000303	0	0						0.000559	0.000172	0.000371	0	0.0001
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.1	m s^{-1}														
		Projected number of rotor transits			5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	3.9	6.6	0.0	30

Stage C

No of blades	b	3		Bird length	l	0.42	m	
Rotation speed	Ω	8.8	rpm	Wingspan	w	1.025	m	
Rotor radius	R	81.5	m	Bird flight speed	v	12.1	m s^{-1}	
Max blade width	C	4.15	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	6.86%
	downwind	3.05%
	weighted mean	4.95%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.16	0.28	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.16	0.28	0.00	1.3
		100.00%	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.16	0.28	0.00	1.3
		100.00%	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.16	0.28	0.00	1.3
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0.000206	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	10.6	0.0	0.0	0.0	0.0	0.0	0.0	11

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.455	m
Rotor radius	R	81.5	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.42%
	downwind	2.29%
	weighted mean	3.86%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.3
	100.00%	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.3
	100.00%	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.3
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}	0	0.000279	0						0	0.0000145	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	85.50%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			0.0	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	9

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.455	m
Rotor radius	R	81.5	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
	upwind	5.42%
	downwind	2.29%
	weighted mean	3.86%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.3
	100.00%	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.3
	100.00%	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.3
98.00%	100.00%	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}	0.000962	0.000192	0						0	0.006583	0.000676	0	0.0007
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			32.6	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	259.2	23.0	0.0	321

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.455	m
Rotor radius	R	81.5	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.42%
	downwind	2.29%
	weighted mean	3.86%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		1.07	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.49	0.75	0.00	11

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	1.07	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.49	0.75	0.00	10.5
		100.00%	1.07	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.49	0.75	0.00	10.5
		100.00%	1.07	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.49	0.75	0.00	10.5
	98.00%	100.00%	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.02	0.00	0.2

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}	0	0	0						0	0.000697	0.000411	0	0.0001
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.4	14.0	0.0	41

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.455	m
Rotor radius	R	81.5	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.42%
	downwind	2.29%
	weighted mean	3.86%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.46	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.46	0.00	1.4
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.46	0.00	1.4
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.46	0.00	1.4
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Eurasian teal	
Bird length	L	0.39	m
Wingspan	W	0.55	m
Bird flight speed	v	19.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0.0000673	0					0.0000
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	19.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	4

Stage C

No of blades	b	3		Bird length	l	0.39	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.55	m
Rotor radius	R	81.5	m	Bird flight speed	v	19.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.29%
	downwind	2.71%
	weighted mean	4.00%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.1
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.1
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.1
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Eurasian teal	
Bird length	L	0.39	m
Wingspan	W	0.55	m
Bird flight speed	v	19.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A	birds/km^2				0	0	0	0.002068	0					0.0002
Proportion at rotor risk height	Q_{2R}	95.00%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	19.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	132.6	0.0	0.0	0.0	0.0	0.0	133

Stage C

No of blades	b	3		Bird length	l	0.39	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.55	m
Rotor radius	R	81.5	m	Bird flight speed	v	19.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.29%
	downwind	2.71%
	weighted mean	4.00%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	4.51	0.00	0.00	0.00	0.00	0.00	5

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	4.51	0.00	0.00	0.00	0.00	0.00	4.5
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	4.51	0.00	0.00	0.00	0.00	0.00	4.5
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	4.51	0.00	0.00	0.00	0.00	0.00	4.5
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Eurasian teal	
Bird length	L	0.39	m
Wingspan	W	0.55	m
Bird flight speed	v	19.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0.000043						0	0	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	0.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	19.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Stage C

No of blades	b	3		Bird length	l	0.39	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.55	m
Rotor radius	R	81.5	m	Bird flight speed	v	19.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.29%
	downwind	2.71%
	weighted mean	4.00%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Eurasian woodcock	
Bird length	L	0.28	m
Wingspan	W	0.6	m
Bird flight speed	v	3.33	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		3	
Nocturnal activity factor	f_{night}	50%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.000126	0	0						0	0	0	0.0000205	0.0000
Proportion at rotor risk height	Q_{2R}	57.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	50%															
Bird flight speed	v	3.33	m s^{-1}														
		Projected number of rotor transits			0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1

Stage C

No of blades	b	3		Bird length	l	0.28	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	0.6	m
Rotor radius	R	81.5	m	Bird flight speed	v	3.33	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	14.38%
	downwind	8.75%
	weighted mean	11.57%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
		100.00%	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
		100.00%	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Whooper swan	
Bird length	L	1.525	m
Wingspan	W	2.304	m
Bird flight speed	v	17.3	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0	0	0.002518	0.0002
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

No of turbines	T	13														
Rotor radius	R	81.5	m													
		Total rotor frontal area m^2	271274													
Nocturnal activity factor	f_{night}	25%														
Bird flight speed	v	17.3	m s^{-1}	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
		Projected number of rotor transits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.1	89

Stage C

No of blades	b	3		Bird length	l	1.525	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	2.304	m
Rotor radius	R	81.5	m	Bird flight speed	v	17.3	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	8.78%
	downwind	5.86%
	weighted mean	7.32%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.54	6

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.54	5.5
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.54	5.5
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.54	5.5
99.50%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Whooper swan	
Bird length	L	1.525	m
Wingspan	W	2.304	m
Bird flight speed	v	17.3	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N163	
Hub height		98.5	m
Rotor radius	R	81.5	m
No of blades	b	3	
Rotation speed	Ω	8.8	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		17-180	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.037466	0	0						0	0	0	0	0.0031
Proportion at rotor risk height	Q_{2R}	95.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	81.5	m														
		Total rotor frontal area m^2		271274													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	17.3	m s^{-1}														
		Projected number of rotor transits			1371.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1372

Stage C

No of blades	b	3		Bird length	l	1.525	m
Rotation speed	Ω	8.8	rpm	Wingspan	w	2.304	m
Rotor radius	R	81.5	m	Bird flight speed	v	17.3	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	8.78%
	downwind	5.86%
	weighted mean	7.32%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		85.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	85

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	85.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	85.3
		100.00%	85.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	85.3
		100.00%	85.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	85.3
	99.50%	100.00%	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.4

Appendix C NatureScot Spreadsheets – Nordex N149

Avian Collision Risk Report

Muingmore Wind Farm

RWE Renewables Ireland Ltd

SLR Project No.: 501.065301.00001

9 July 2025

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0.003245	0.00042	0					0.0003
Proportion at rotor risk height	Q_{2R}	73.95%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	11.9	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	80.1	10.4	0.0	0.0	0.0	0.0	0.0	90

Stage C

No of blades	b	3		Bird length	l	0.355	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.05	m
Rotor radius	R	74.5	m	Bird flight speed	v	11.9	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.22%
	downwind	3.12%
	weighted mean	5.17%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	3.52	0.46	0.00	0.00	0.00	0.00	0.00	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	3.52	0.46	0.00	0.00	0.00	0.00	0.00	4.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.00	3.52	0.46	0.00	0.00	0.00	0.00	0.00	4.0
		100.00%	0.00	0.00	0.00	0.00	0.00	3.52	0.46	0.00	0.00	0.00	0.00	0.00	4.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A	birds/km^2				0	0.000187	0.000834	0.002581	0					0.0003
Proportion at rotor risk height	Q_{2R}	85.70%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13														
Rotor radius	R	74.5	m													
		Total rotor frontal area m^2	226676													
Nocturnal activity factor	f_{night}	0%														
Bird flight speed	v	11.9	m s^{-1}													
		Projected number of rotor transits		0.0	0.0	0.0	0.0	5.2	23.9	74.2	0.0	0.0	0.0	0.0	0.0	103

Stage C

No of blades	b	3		Bird length	l	0.355 m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.05 m
Rotor radius	R	74.5	m	Bird flight speed	v	11.9 m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping
Pitch	λ	15	degrees	% of flights upwind/downwind		50% 50%
Blade profile		see Blade profile sheet				

Single transit risk		
	upwind	7.22%
	downwind	3.12%
	weighted mean	5.17%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
Collision rates before avoidance													
	0.00	0.00	0.00	0.00	0.23	1.05	3.26	0.00	0.00	0.00	0.00	0.00	5

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.23	1.05	3.26	0.00	0.00	0.00	0.00	0.00	4.5
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.02	0.07	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.23	1.05	3.26	0.00	0.00	0.00	0.00	0.00	4.5
		100.00%	0.00	0.00	0.00	0.00	0.23	1.05	3.26	0.00	0.00	0.00	0.00	0.00	4.5

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0.000969	0.015548	0.000411	0					0.0014
Proportion at rotor risk height	Q_{2R}	17.49%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	11.9	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	5.5	90.7	2.4	0.0	0.0	0.0	0.0	0.0	99

Stage C

No of blades	b	3		Bird length	l	0.355	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.05	m
Rotor radius	R	74.5	m	Bird flight speed	v	11.9	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.22%
	downwind	3.12%
	weighted mean	5.17%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.24	3.98	0.11	0.00	0.00	0.00	0.00	0.00	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.24	3.98	0.11	0.00	0.00	0.00	0.00	0.00	4.3
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.24	3.98	0.11	0.00	0.00	0.00	0.00	0.00	4.3
		100.00%	0.00	0.00	0.00	0.00	0.24	3.98	0.11	0.00	0.00	0.00	0.00	0.00	4.3

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Black-headed gull	
Bird length	L	0.355	m
Wingspan	W	1.05	m
Bird flight speed	v	11.9	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0	0.0000576	0	0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	11.9	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	1

Stage C

No of blades	b	3		Bird length	l	0.355	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.05	m
Rotor radius	R	74.5	m	Bird flight speed	v	11.9	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.22%
	downwind	3.12%
	weighted mean	5.17%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Great cormorant	
Bird length	L	0.9	m
Wingspan	W	1.45	m
Bird flight speed	v	14.5	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.001374	0	0.000404						0	0.000575	0	0	0.0002
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	14.5	m s^{-1}														
		Projected number of rotor transits			23.2	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0	12.9	0.0	0.0	46

Stage C

No of blades	b	3		Bird length	l	0.9	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.45	m
Rotor radius	R	74.5	m	Bird flight speed	v	14.5	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	8.26%
	downwind	4.69%
	weighted mean	6.47%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		1.28	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	3

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	1.28	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	2.5
		100.00%	1.28	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	2.5
		100.00%	1.28	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	2.5
	98.00%	100.00%	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Common gull	
Bird length	L	0.41	m
Wingspan	W	1.15	m
Bird flight speed	v	13.4	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0.00435	0					0.0004
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.4	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	140.8	0.0	0.0	0.0	0.0	0.0	141

Stage C

No of blades	b	3		Bird length	l	0.41	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.15	m
Rotor radius	R	74.5	m	Bird flight speed	v	13.4	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.05%
	downwind	3.27%
	weighted mean	5.16%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	6.18	0.00	0.00	0.00	0.00	0.00	6

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	6.18	0.00	0.00	0.00	0.00	0.00	6.2
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.1
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	6.18	0.00	0.00	0.00	0.00	0.00	6.2
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	6.18	0.00	0.00	0.00	0.00	0.00	6.2

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Common gull	
Bird length	L	0.41	m
Wingspan	W	1.15	m
Bird flight speed	v	13.4	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0.001116	0					0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.4	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	36.1	0.0	0.0	0.0	0.0	0.0	36

Stage C

No of blades	b	3		Bird length	l	0.41	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.15	m
Rotor radius	R	74.5	m	Bird flight speed	v	13.4	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.05%
	downwind	3.27%
	weighted mean	5.16%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	1.58	0.00	0.00	0.00	0.00	0.00	2

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	1.58	0.00	0.00	0.00	0.00	0.00	1.6
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	1.58	0.00	0.00	0.00	0.00	0.00	1.6
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	1.58	0.00	0.00	0.00	0.00	0.00	1.6

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common tern	
Bird length	L	0.33	m
Wingspan	W	0.875	m
Bird flight speed	v	10.2	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0.00011	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	10.2	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	3

Stage C

No of blades	b	3		Bird length	l	0.33	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.875	m
Rotor radius	R	74.5	m	Bird flight speed	v	10.2	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.59%
	downwind	3.11%
	weighted mean	5.35%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.1
	100.00%	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.1
	100.00%	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.1
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Greylag goose	
Bird length	L	0.83	m
Wingspan	W	1.64	m
Bird flight speed	v	17.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0.379904						0	0	0	0	0.0317
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	17.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	14045.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14046

Stage C

No of blades	b	3		Bird length	l	0.83	m	
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.64	m	
Rotor radius	R	74.5	m	Bird flight speed	v	17.1	m s^{-1}	
Max blade width	C	4.15	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						
		Single transit risk		upwind	7.54%			
				downwind	4.44%			
				weighted mean	5.99%			

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	715.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	715

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	715.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	715.5
		100.00%	0.00	0.00	715.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	715.5
		100.00%	0.00	0.00	715.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	715.5
	99.80%	100.00%	0.00	0.00	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.4

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Golden plover	
Bird length	L	0.275	m
Wingspan	W	0.715	m
Bird flight speed	v	13.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0.000195	0					0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	13.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	7.2	0.0	0.0	0.0	0.0	0.0	7

Stage C

No of blades	b	3		Bird length	l	0.275	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.715	m
Rotor radius	R	74.5	m	Bird flight speed	v	13.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
	upwind	6.38%
	downwind	2.66%
	weighted mean	4.52%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.3
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.3
98.00%		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.0
99.80%		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0.000987	0.00072	0					0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	30.4	22.3	0.0	0.0	0.0	0.0	0.0	53

Stage C

No of blades	b	3		Bird length	l	0.61	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.465	m
Rotor radius	R	74.5	m	Bird flight speed	v	12.8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.75%
	downwind	3.84%
	weighted mean	5.80%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	1.50	1.10	0.00	0.00	0.00	0.00	0.00	3

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	0.00	0.00	0.00	0.00	0.00	1.50	1.10	0.00	0.00	0.00	0.00	0.00	2.6
			100.00%	0.00	0.00	0.00	0.00	0.00	1.50	1.10	0.00	0.00	0.00	0.00	0.00	2.6
			100.00%	0.00	0.00	0.00	0.00	0.00	1.50	1.10	0.00	0.00	0.00	0.00	0.00	2.6
		98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.0000984	0.000267	0.000439	0.000765	0					0.0001
Proportion at rotor risk height	Q_{2R}	83.36%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	2.4	7.7	13.1	23.0	0.0	0.0	0.0	0.0	0.0	46

Stage C

No of blades	b	3		Bird length	l	0.61	m	
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.465	m	
Rotor radius	R	74.5	m	Bird flight speed	v	12.8	m s^{-1}	
Max blade width	C	4.15	m	Flight type		gliding		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						
		Single transit risk	upwind	7.75%				
			downwind	3.84%				
			weighted mean	5.80%				

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.12	0.38	0.65	1.13	0.00	0.00	0.00	0.00	0.00	2

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.12	0.38	0.65	1.13	0.00	0.00	0.00	0.00	0.00	2.3
		100.00%	0.00	0.00	0.00	0.12	0.38	0.65	1.13	0.00	0.00	0.00	0.00	0.00	2.3
		100.00%	0.00	0.00	0.00	0.12	0.38	0.65	1.13	0.00	0.00	0.00	0.00	0.00	2.3
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A	birds/km^2				0.000359	0	0.00133	0.011182	0					0.0011
Proportion at rotor risk height	Q_{2R}	85.71%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

No of turbines	T	13	
Rotor radius	R	74.5	m
		Total rotor frontal area m^2	226676
Nocturnal activity factor	f_{night}	0%	
Bird flight speed	v	12.8	m s^{-1}

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
Projected number of rotor transits	0.0	0.0	0.0	9.1	0.0	40.9	345.7	0.0	0.0	0.0	0.0	0.0	396

Stage C

No of blades	b	3		Bird length	l	0.61 m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.465 m
Rotor radius	R	74.5	m	Bird flight speed	v	12.8 m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding
Pitch	λ	15	degrees	% of flights upwind/downwind		50% 50%
Blade profile		see Blade profile sheet				

Single transit risk	upwind	7.75%
	downwind	3.84%
	weighted mean	5.80%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.45	0.00	2.02	17.04	0.00	0.00	0.00	0.00	0.00	20

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.45	0.00	2.02	17.04	0.00	0.00	0.00	0.00	0.00	19.5
		100.00%	0.00	0.00	0.00	0.45	0.00	2.02	17.04	0.00	0.00	0.00	0.00	0.00	19.5
		100.00%	0.00	0.00	0.00	0.45	0.00	2.02	17.04	0.00	0.00	0.00	0.00	0.00	19.5
	98.00%	100.00%	0.00	0.00	0.00	0.01	0.00	0.04	0.34	0.00	0.00	0.00	0.00	0.00	0.4

COLLISION RISK MODEL

Required input data is in **orange** boxes
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Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0.000246	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	0.0	5

Stage C

No of blades	b	3		Bird length	l	0.61	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.465	m
Rotor radius	R	74.5	m	Bird flight speed	v	12.8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.75%
	downwind	3.84%
	weighted mean	5.80%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled				Collision rates allowing for avoidance												
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.2
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.2
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.2
		98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Herring gull	
Bird length	L	0.61	m
Wingspan	W	1.465	m
Bird flight speed	v	12.8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0	0.000478	0	0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4	0.0	7

Stage C

No of blades	b	3		Bird length	l	0.61	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.465	m
Rotor radius	R	74.5	m	Bird flight speed	v	12.8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.75%
	downwind	3.84%
	weighted mean	5.80%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.4
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.4
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.4
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Hen harrier	
Bird length	L	0.48	m
Wingspan	W	1.1	m
Bird flight speed	v	8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0	0.000694					0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0	12

Stage C

No of blades	b	3		Bird length	l	0.48	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.1	m
Rotor radius	R	74.5	m	Bird flight speed	v	8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	9.47%
	downwind	4.46%
	weighted mean	6.96%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled				Collision rates allowing for avoidance												
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.7
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.7
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.7
		99.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Hen harrier	
Bird length	L	0.48	m
Wingspan	W	1.1	m
Bird flight speed	v	8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0.002071	0.001539						0	0	0	0	0.0003
Proportion at rotor risk height	Q_{2R}	9.94%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	8	m s^{-1}														
		Projected number of rotor transits			0.0	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5

Stage C

No of blades	b	3		Bird length	l	0.48	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.1	m
Rotor radius	R	74.5	m	Bird flight speed	v	8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	9.47%
	downwind	4.46%
	weighted mean	6.96%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled				Collision rates allowing for avoidance												
			100.00%	0.00	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
			100.00%	0.00	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
			100.00%	0.00	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
		99.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Hen harrier	
Bird length	L	0.48	m
Wingspan	W	1.1	m
Bird flight speed	v	8	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0.000207	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	0.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	8	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Stage C

No of blades	b	3		Bird length	l	0.48	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.1	m
Rotor radius	R	74.5	m	Bird flight speed	v	8	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	9.47%
	downwind	4.46%
	weighted mean	6.96%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		99.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.003709	0.000375	0.000884	0.000832	0.002456					0.0007
Proportion at rotor risk height	Q_{2R}	75.96%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	82.3	9.8	23.9	22.6	59.9	0.0	0.0	0.0	0.0	199

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.755	m
Rotor radius	R	74.5	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.80%
	downwind	2.87%
	weighted mean	4.84%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
Collision rates before avoidance													
	0.00	0.00	0.00	3.39	0.40	0.98	0.93	2.46	0.00	0.00	0.00	0.00	8

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	3.39	0.40	0.98	0.93	2.46	0.00	0.00	0.00	0.00	8.2
	95.00%	100.00%	0.00	0.00	0.00	0.17	0.02	0.05	0.05	0.12	0.00	0.00	0.00	0.00	0.4
		100.00%	0.00	0.00	0.00	3.39	0.40	0.98	0.93	2.46	0.00	0.00	0.00	0.00	8.2
		100.00%	0.00	0.00	0.00	3.39	0.40	0.98	0.93	2.46	0.00	0.00	0.00	0.00	8.2

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.01554	0.007562	0.000259	0.001721	0.010932					0.0030
Proportion at rotor risk height	Q_{2R}	90.85%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	412.6	236.5	8.4	56.0	318.8	0.0	0.0	0.0	0.0	1032

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.755	m
Rotor radius	R	74.5	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.80%
	downwind	2.87%
	weighted mean	4.84%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	16.97	9.73	0.34	2.30	13.11	0.00	0.00	0.00	0.00	42

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	16.97	9.73	0.34	2.30	13.11	0.00	0.00	0.00	0.00	42.5
	95.00%	100.00%	0.00	0.00	0.00	0.85	0.49	0.02	0.12	0.66	0.00	0.00	0.00	0.00	2.1
		100.00%	0.00	0.00	0.00	16.97	9.73	0.34	2.30	13.11	0.00	0.00	0.00	0.00	42.5
		100.00%	0.00	0.00	0.00	16.97	9.73	0.34	2.30	13.11	0.00	0.00	0.00	0.00	42.5

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}				0.000377	0.002124	0.002444	0.007924	0.00068					0.0011
Proportion at rotor risk height	Q_{2R}	85.30%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	9.4	62.4	74.2	241.9	18.6	0.0	0.0	0.0	0.0	407

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.755	m
Rotor radius	R	74.5	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.80%
	downwind	2.87%
	weighted mean	4.84%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.39	2.57	3.05	9.95	0.77	0.00	0.00	0.00	0.00	17

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.39	2.57	3.05	9.95	0.77	0.00	0.00	0.00	0.00	16.7
	95.00%	100.00%	0.00	0.00	0.00	0.02	0.13	0.15	0.50	0.04	0.00	0.00	0.00	0.00	0.8
		100.00%	0.00	0.00	0.00	0.39	2.57	3.05	9.95	0.77	0.00	0.00	0.00	0.00	16.7
		100.00%	0.00	0.00	0.00	0.39	2.57	3.05	9.95	0.77	0.00	0.00	0.00	0.00	16.7

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.000549	0.0000805	0.001184						0.003083	0.00000755	0.000194	0	0.0004
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			8.1	1.3	25.8	0.0	0.0	0.0	0.0	0.0	70.4	0.1	3.0	0.0	109

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.755	m
Rotor radius	R	74.5	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.80%
	downwind	2.87%
	weighted mean	4.84%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

Collision rates before avoidance													year total
0.33	0.05	1.06	0.00	0.00	0.00	0.00	0.00	2.90	0.01	0.12	0.00		4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.33	0.05	1.06	0.00	0.00	0.00	0.00	0.00	2.90	0.01	0.12	0.00	4.5
	95.00%	100.00%	0.02	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.01	0.00	0.2
		100.00%	0.33	0.05	1.06	0.00	0.00	0.00	0.00	0.00	2.90	0.01	0.12	0.00	4.5
		100.00%	0.33	0.05	1.06	0.00	0.00	0.00	0.00	0.00	2.90	0.01	0.12	0.00	4.5

COLLISION RISK MODEL

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Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}	0.007871	0.001061	0.002235						0.00000525	0.00038	0	0	0.0010
Proportion at rotor risk height	Q_{2R}	74.25%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			100.7	14.9	42.3	0.0	0.0	0.0	0.0	0.0	0.1	6.4	0.0	0.0	164

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.755	m
Rotor radius	R	74.5	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
	upwind	6.80%
	downwind	2.87%
	weighted mean	4.84%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		4.14	0.61	1.74	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00	7

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	4.14	0.61	1.74	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00	6.8
	95.00%	100.00%	0.21	0.03	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.3
		100.00%	4.14	0.61	1.74	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00	6.8
		100.00%	4.14	0.61	1.74	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00	6.8

COLLISION RISK MODEL

Required input data is in orange boxes
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Bird data		Value	Units
Species name		Common kestrel	
Bird length	L	0.34	m
Wingspan	W	0.755	m
Bird flight speed	v	12.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0.000804	0.00059						0.000147	0	0.000363	0.000308	0.0002
Proportion at rotor risk height	Q_{2R}	84.76%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.7	m s^{-1}														
		Projected number of rotor transits			0.0	12.9	12.7	0.0	0.0	0.0	0.0	0.0	3.3	0.0	5.5	4.2	39

Stage C

No of blades	b	3		Bird length	l	0.34	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.755	m
Rotor radius	R	74.5	m	Bird flight speed	v	12.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.80%
	downwind	2.87%
	weighted mean	4.84%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.53	0.52	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.23	0.17	2

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.53	0.52	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.23	0.17	1.6
	95.00%	100.00%	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.1
		100.00%	0.00	0.53	0.52	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.23	0.17	1.6
		100.00%	0.00	0.53	0.52	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.23	0.17	1.6

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Black-legged kittiwake	
Bird length	L	0.39	m
Wingspan	W	1.075	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.000177	0	0	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5

Stage C

No of blades	b	3		Bird length	l	0.39	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.075	m
Rotor radius	R	74.5	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
upwind	7.02%	
downwind	3.18%	
weighted mean	5.10%	

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

Collision rates before avoidance												year total
0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
	98.00%	100.00%	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
		100.00%	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.003144	0.00297	0.0032	0.000594	0.000353					0.0009
Proportion at rotor risk height	Q_{2R}	80.87%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	76.7	85.3	95.1	17.7	9.5	0.0	0.0	0.0	0.0	284

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.45	m
Rotor radius	R	74.5	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.63%
	downwind	3.78%
	weighted mean	5.70%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	3.72	4.13	4.61	0.86	0.46	0.00	0.00	0.00	0.00	14

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	3.72	4.13	4.61	0.86	0.46	0.00	0.00	0.00	0.00	13.8
		100.00%	0.00	0.00	0.00	3.72	4.13	4.61	0.86	0.46	0.00	0.00	0.00	0.00	13.8
		100.00%	0.00	0.00	0.00	3.72	4.13	4.61	0.86	0.46	0.00	0.00	0.00	0.00	13.8
	98.00%	100.00%	0.00	0.00	0.00	0.07	0.08	0.09	0.02	0.01	0.00	0.00	0.00	0.00	0.3

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0.00047	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	78.91%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	13.6	0.0	0.0	0.0	0.0	0.0	0.0	14

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.45	m
Rotor radius	R	74.5	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.63%
	downwind	3.78%
	weighted mean	5.70%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.7
		100.00%	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.7
		100.00%	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.7
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.0011	0.005861	0.000219	0	0					0.0006
Proportion at rotor risk height	Q_{2R}	81.60%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	27.1	169.9	6.6	0.0	0.0	0.0	0.0	0.0	0.0	203

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.45	m
Rotor radius	R	74.5	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.63%
	downwind	3.78%
	weighted mean	5.70%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Collision rates before avoidance														year total
		0.00	0.00	0.00	1.31	8.23	0.32	0.00	0.00	0.00	0.00	0.00	0.00	10

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	1.31	8.23	0.32	0.00	0.00	0.00	0.00	0.00	0.00	9.9
		100.00%	0.00	0.00	0.00	1.31	8.23	0.32	0.00	0.00	0.00	0.00	0.00	0.00	9.9
		100.00%	0.00	0.00	0.00	1.31	8.23	0.32	0.00	0.00	0.00	0.00	0.00	0.00	9.9
	98.00%	100.00%	0.00	0.00	0.00	0.03	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.2

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.005103	0	0						0	0	0	0	0.0004
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			77.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	78

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.45	m
Rotor radius	R	74.5	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.63%
	downwind	3.78%
	weighted mean	5.70%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		3.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled				Collision rates allowing for avoidance												
			100.00%	3.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.8
			100.00%	3.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.8
			100.00%	3.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.8
		98.00%	100.00%	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Lesser black-backed gull	
Bird length	L	0.6	m
Wingspan	W	1.45	m
Bird flight speed	v	13.1	m s^{-1}
Flight type, flapping or gliding		gliding	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0.000905	0.000217	0	0	0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.3	4.4	0.0	0.0	26

Stage C

No of blades	b	3		Bird length	l	0.6	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.45	m
Rotor radius	R	74.5	m	Bird flight speed	v	13.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		gliding	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.63%
	downwind	3.78%
	weighted mean	5.70%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.03	0.21	0.00	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.03	0.21	0.00	0.00	1.2
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.03	0.21	0.00	0.00	1.2
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.03	0.21	0.00	0.00	1.2
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Mallard	
Bird length	L	0.58	m
Wingspan	W	0.9	m
Bird flight speed	v	22	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.000293	0	0	0	0.00007					0.0000
Proportion at rotor risk height	Q_{2R}	43.81%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	22	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	7.7	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	10

Stage C

No of blades	b	3		Bird length	l	0.58	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.9	m
Rotor radius	R	74.5	m	Bird flight speed	v	22	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.98%
	downwind	3.56%
	weighted mean	4.77%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
	large array correction		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%		0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.4
	100.00%		0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.4
	100.00%		0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.4
	100.00%	98.00%	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Mallard	
Bird length	L	0.58	m
Wingspan	W	0.9	m
Bird flight speed	v	22	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.000369	0.000239	0	0	0.000274					0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	22	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	18.9	13.8	0.0	0.0	15.1	0.0	0.0	0.0	0.0	48

Stage C

No of blades	b	3		Bird length	l	0.58	m	
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.9	m	
Rotor radius	R	74.5	m	Bird flight speed	v	22	m s^{-1}	
Max blade width	C	4.15	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	5.98%
	downwind	3.56%
	weighted mean	4.77%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.77	0.56	0.00	0.00	0.61	0.00	0.00	0.00	0.00	2

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.77	0.56	0.00	0.00	0.61	0.00	0.00	0.00	0.00	1.9
		100.00%	0.00	0.00	0.00	0.77	0.56	0.00	0.00	0.61	0.00	0.00	0.00	0.00	1.9
		100.00%	0.00	0.00	0.00	0.77	0.56	0.00	0.00	0.61	0.00	0.00	0.00	0.00	1.9
	98.00%	100.00%	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Mallard	
Bird length	L	0.58	m
Wingspan	W	0.9	m
Bird flight speed	v	22	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A birds/km^2					0.003565	0	0	0	0.000312					0.0003
Proportion at rotor risk height	Q_{2R}	83.81%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

No of turbines	T	13	
Rotor radius	R	74.5	m
		Total rotor frontal area m^2	226676
Nocturnal activity factor	f_{night}	25%	
Bird flight speed	v	22	m s^{-1}

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
Projected number of rotor transits	0.0	0.0	0.0	178.3	0.0	0.0	0.0	16.8	0.0	0.0	0.0	0.0	195

Stage C

No of blades	b	3		Bird length	l	0.58 m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.9 m
Rotor radius	R	74.5	m	Bird flight speed	v	22 m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping
Pitch	λ	15	degrees	% of flights upwind/downwind		50% 50%
Blade profile		see Blade profile sheet				

Single transit risk	upwind	5.98%
	downwind	3.56%
	weighted mean	4.77%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Collision rates before avoidance														year total
		0.00	0.00	0.00	7.23	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00	8

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	7.23	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00	7.9
		100.00%	0.00	0.00	0.00	7.23	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00	7.9
		100.00%	0.00	0.00	0.00	7.23	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00	7.9
	98.00%	100.00%	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.2

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
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Bird data		Value	Units
Species name		Merlin	
Bird length	L	0.275	m
Wingspan	W	0.56	m
Bird flight speed	v	13.47	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0.0000584	0	0	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	0.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.47	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Stage C

No of blades	b	3		Bird length	l	0.275	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.56	m
Rotor radius	R	74.5	m	Bird flight speed	v	13.47	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	6.35%
	downwind	2.57%
	weighted mean	4.46%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Merlin	
Bird length	L	0.275	m
Wingspan	W	0.56	m
Bird flight speed	v	13.47	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0.000299	0						0	0	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	13.47	m s^{-1}														
		Projected number of rotor transits			0.0	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5

Stage C

No of blades	b	3		Bird length	l	0.275	m	
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.56	m	
Rotor radius	R	74.5	m	Bird flight speed	v	13.47	m s^{-1}	
Max blade width	C	4.15	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	6.35%
	downwind	2.57%
	weighted mean	4.46%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
		100.00%	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
		100.00%	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		nd white-fronted goose	
Bird length	L	0.71	m
Wingspan	W	1.47	m
Bird flight speed	v	16.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0.03828	0	0	0.0032
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16.1	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1250.7	0.0	0.0	1251

Stage C

No of blades	b	3		Bird length	l	0.71	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.47	m
Rotor radius	R	74.5	m	Bird flight speed	v	16.1	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	7.38%
	downwind	4.11%
	weighted mean	5.75%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
Collision rates before avoidance													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.10	0.00	0.00	61

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.10	0.00	0.00	61.1
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.10	0.00	0.00	61.1
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.10	0.00	0.00	61.1
	99.80%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Peregrine falcon	
Bird length	L	0.42	m
Wingspan	W	1.025	m
Bird flight speed	v	12.1	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		1	
Nocturnal activity factor	f_{night}	0%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.000289	0	0						0.000483	0.000143	0.000376	0	0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	0%															
Bird flight speed	v	12.1	m s^{-1}														
		Projected number of rotor transits			4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	2.7	5.5	0.0	23

Stage C

No of blades	b	3		Bird length	l	0.42	m	
Rotation speed	Ω	9.2	rpm	Wingspan	w	1.025	m	
Rotor radius	R	74.5	m	Bird flight speed	v	12.1	m s^{-1}	
Max blade width	C	4.15	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	7.34%
	downwind	3.29%
	weighted mean	5.32%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.12	0.25	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
		100.00%	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.12	0.25	0.00	1.0
		100.00%	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.12	0.25	0.00	1.0
		100.00%	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.12	0.25	0.00	1.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

		Value	Units
Bird data			
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

		Value	Units
Windfarm data			
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

		Value	Units
Turbine data			
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}				0	0.000207	0	0	0					0.0000
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.455	m
Rotor radius	R	74.5	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.82%
	downwind	2.53%
	weighted mean	4.18%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
	Collision rates allowing for avoidance												
Avoidance rates modelled													
100.00%	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
100.00%	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
100.00%	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.3
98.00% 100.00%	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}	0	0.000278	0						0	0.0000136	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	77.14%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	7

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.455	m
Rotor radius	R	74.5	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.82%
	downwind	2.53%
	weighted mean	4.18%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.3
		100.00%	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.3
		100.00%	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.3
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^{-2}	0.000945	0.000192	0						0	0.006076	0.000676	0	0.0007
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			26.4	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	197.3	19.0	0.0	248

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.455	m
Rotor radius	R	74.5	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.82%
	downwind	2.53%
	weighted mean	4.18%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.94	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.67	0.00	9

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.94	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.67	0.00	8.8
	100.00%	0.94	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.67	0.00	8.8
	100.00%	0.94	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.67	0.00	8.8
98.00%	100.00%	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.01	0.00	0.2

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Common snipe	
Bird length	L	0.26	m
Wingspan	W	0.455	m
Bird flight speed	v	16	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0.000705	0.0000414	0	0.0001
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	16	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.9	1.2	0.0	24

Stage C

No of blades	b	3		Bird length	l	0.26	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.455	m
Rotor radius	R	74.5	m	Bird flight speed	v	16	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.82%
	downwind	2.53%
	weighted mean	4.18%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.04	0.00	1

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.04	0.00	0.9
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.04	0.00	0.9
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.04	0.00	0.9
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Eurasian teal	
Bird length	L	0.39	m
Wingspan	W	0.55	m
Bird flight speed	v	19.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A	birds/km^2				0	0	0	0.0000678	0					0.0000
Proportion at rotor risk height	Q_{2R}	85.71%													
At latitude 54.1		Daylight hours per month	247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month	496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	19.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	4

Stage C

No of blades	b	3		Bird length	l	0.39 m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.55 m
Rotor radius	R	74.5	m	Bird flight speed	v	19.7 m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping
Pitch	λ	15	degrees	% of flights upwind/downwind		50% 50%
Blade profile		see Blade profile sheet				
		Single transit risk	upwind	5.69%		
			downwind	2.99%		
			weighted mean	4.34%		

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
Avoidance rates modelled	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.1
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.1
	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.1
98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Eurasian teal	
Bird length	L	0.39	m
Wingspan	W	0.55	m
Bird flight speed	v	19.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2				0	0	0	0.002053	0					0.0002
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	19.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	108.6	0.0	0.0	0.0	0.0	0.0	109

Stage C

No of blades	b	3		Bird length	l	0.39	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.55	m
Rotor radius	R	74.5	m	Bird flight speed	v	19.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					
		Single transit risk	upwind	5.69%			
			downwind	2.99%			
			weighted mean	4.34%			

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	4.01	0.00	0.00	0.00	0.00	0.00	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
			Collision rates allowing for avoidance												
Avoidance rates modelled		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	4.01	0.00	0.00	0.00	0.00	0.00	4.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	4.01	0.00	0.00	0.00	0.00	0.00	4.0
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	4.01	0.00	0.00	0.00	0.00	0.00	4.0
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.1

COLLISION RISK MODEL

Required input data is in **orange** boxes
Calculated output is in **blue** boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Eurasian teal	
Bird length	L	0.39	m
Wingspan	W	0.55	m
Bird flight speed	v	19.7	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0.0000265						0	0	0	0	0.0000
Proportion at rotor risk height	Q_{2R}	0.00%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	19.7	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Stage C

No of blades	b	3		Bird length	l	0.39	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.55	m
Rotor radius	R	74.5	m	Bird flight speed	v	19.7	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	5.69%
	downwind	2.99%
	weighted mean	4.34%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

			large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
				Collision rates allowing for avoidance												
Avoidance rates modelled			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
			100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Eurasian woodcock	
Bird length	L	0.28	m
Wingspan	W	0.6	m
Bird flight speed	v	3.33	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		3	
Nocturnal activity factor	f_{night}	50%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.000128	0	0						0	0	0	0.0000161	0.0000
Proportion at rotor risk height	Q_{2R}	51.43%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	50%															
Bird flight speed	v	3.33	m s^{-1}														
		Projected number of rotor transits			0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1

Stage C

No of blades	b	3		Bird length	l	0.28	m	
Rotation speed	Ω	9.2	rpm	Wingspan	w	0.6	m	
Rotor radius	R	74.5	m	Bird flight speed	v	3.33	m s^{-1}	
Max blade width	C	4.15	m	Flight type		flapping		
Pitch	λ	15	degrees	% of flights upwind/downwind		50%		50%
Blade profile		see Blade profile sheet						

Single transit risk	upwind	15.19%
	downwind	9.06%
	weighted mean	12.12%

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
		100.00%	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
		100.00%	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.1
	98.00%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Whooper swan	
Bird length	L	1.525	m
Wingspan	W	2.304	m
Bird flight speed	v	17.3	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0	0	0						0	0	0	0.002086	0.0002
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	17.3	m s^{-1}														
		Projected number of rotor transits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.9	61

Stage C

No of blades	b	3		Bird length	l	1.525	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	2.304	m
Rotor radius	R	74.5	m	Bird flight speed	v	17.3	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk		
upwind	9.37%	
downwind	6.30%	
weighted mean	7.84%	

Stage D

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
		Collision rates before avoidance												year total
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	4

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

		large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
Avoidance rates modelled			Collision rates allowing for avoidance												
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	4.1
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	4.1
		100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.06	4.1
	99.50%	100.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.0

COLLISION RISK MODEL

Required input data is in orange boxes
Calculated output is in blue boxes
green boxes are for information only, to show variables used at each stage

Bird data		Value	Units
Species name		Whooper swan	
Bird length	L	1.525	m
Wingspan	W	2.304	m
Bird flight speed	v	17.3	m s^{-1}
Flight type, flapping or gliding		flapping	
% of flights upwind/downwind		50%	50%
Nocturnal activity ranking 1-5		2	
Nocturnal activity factor	f_{night}	25%	

Windfarm data		Value	Units
Site name		Muingmore	
Latitude		54.143	degrees
No of turbines	T	13	
Width of windfarm	w	2	km

Turbine data		Value	Units
Model		N149	
Hub height		104.5	m
Rotor radius	R	74.5	m
No of blades	b	3	
Rotation speed	Ω	9.2	rpm
Max blade width	C	4.15	m
Blade pitch	λ	15	degrees
Risk height range		30-179	m

normal approach

Set to 'normal approach' to use survey data on bird density
Set to 'birds on migration' to use 'Migrant collision risk' sheet in place of Stage A

Stage A

				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Daytime bird density	D_A		birds/km^2	0.03776	0	0						0	0	0	0	0.0031
Proportion at rotor risk height	Q_{2R}	85.71%														
At latitude 54.1		Daylight hours per month		247.8	271.8	366.1	420.2	495.0	512.0	514.5	461.5	383.2	328.4	258.0	231.3	4489.9
		Nighttime hours per month		496.2	400.2	377.9	299.8	249.0	208.0	229.5	282.5	336.8	415.6	462.0	512.7	4270.1

Stage B

					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
No of turbines	T	13															
Rotor radius	R	74.5	m														
		Total rotor frontal area m^2		226676													
Nocturnal activity factor	f_{night}	25%															
Bird flight speed	v	17.3	m s^{-1}														
		Projected number of rotor transits			1140.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1140

Stage C

No of blades	b	3		Bird length	l	1.525	m
Rotation speed	Ω	9.2	rpm	Wingspan	w	2.304	m
Rotor radius	R	74.5	m	Bird flight speed	v	17.3	m s^{-1}
Max blade width	C	4.15	m	Flight type		flapping	
Pitch	λ	15	degrees	% of flights upwind/downwind		50%	50%
Blade profile		see Blade profile sheet					

Single transit risk	upwind	9.37%
	downwind	6.30%
	weighted mean	7.84%

Stage D

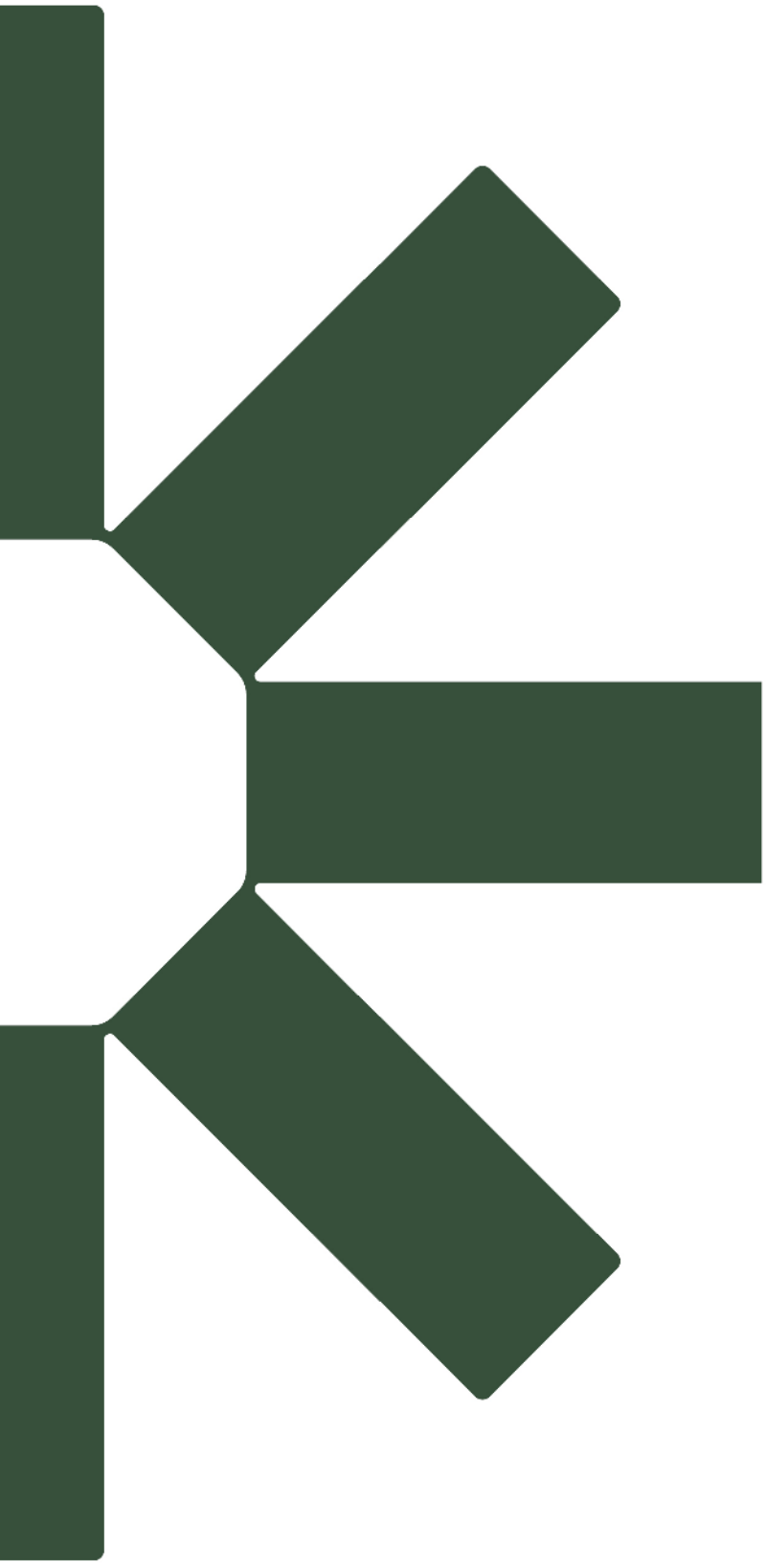
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year avge
Proportion of time operational	Q_{op}	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	year total
Collision rates before avoidance													
	75.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	76

Stage E

Allow for large array correction? No
Width of windfarm w 2 km

Avoidance rates modelled	large array correction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	per year
		Collision rates allowing for avoidance												
	100.00%	75.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	75.9
	100.00%	75.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	75.9
	100.00%	75.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	75.9
99.50%	100.00%	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.4



Making Sustainability Happen