Drummarnock Wind Farm

Volume 2:

EIA Text

July 2024

Drummarnock Wind Farm Limited

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1
The Planning Act	The Town and Country Planning (Scotland) Act 1997 (as amended)

List of Abbreviations

Abbreviation	Description
agl	Above ground level
ANC	Association of Noise Consultants
ECU	Energy Consents Unit
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
GWDTE	Groundwater Dependent Terrestrial Ecosytems
IOA	Institute of Acoustics
NGR	National Grid Reference
NTS	Non-Technical Summary
PAC	Pre-Application Consultation
PACR	Pre-Application Consultation Report
SAC	Special Area of Conservation
SC	Stirling Council
SSSI	Site of Special Scientific Interest

1 Introduction

Drummarnock Wind Farm Limited ('the Applicant') is seeking planning permission under the Town and Country Planning (Scotland) Act 1997 (as amended) ('the Planning Act') to construct and operate a wind farm and associated infrastructure known as Drummarnock Wind Farm (the 'Proposed Development').

The Proposed Development is located approximately 10km south-west of Stirling, in the Fintry, Gargunnock and Touch Hills (the 'Proposed Development Site' or 'Site'). The Proposed Development Site is centred on National Grid Reference (NGR) NS 74314 87247 and is illustrated in Figure 1-1. The Proposed Development Site is located entirely within the boundary of Stirling Council (SC) local authority area.

As an EIA Development, this Environmental Impact Assessment (EIA) Report has been produced to support the Planning Application for the Proposed Development and has been prepared in accordance with the Regulation 5 of the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 (the 'EIA Regulations').

In accordance with the EIA Regulations, this EIA Report is based on the Scoping Opinion received from SC on 26 October 2020. Consideration has also been given to the Pre-application consultation response undertaken with SC in May 2020 (Ref: PREAPP-2020-0093).

The Proposed Development would consist of four wind turbines each with a tip height of up to 180m above ground level (agl), plus ancillary infrastructure including:

- One onsite substation which would accommodate 33KV equipment to collect electricity from the site. The substation compound would include a control and metering building;
- New access tracks;
- Construction of turbine foundations, crane hardstandings and storage areas;
- Construction compound;
- Underground cabling;
- Up to four borrow pits; and
- Up to six watercourse crossings.

The Proposed Development will have an indicative electricity export capacity of approximately 30MW. The site layout is presented in Figure 1-2.

The Proposed Development is being developed by Wind2 on behalf of EDPR.

EDPR is a global leader in the renewable sector and the world's fourth-largest renewable energy producer. EDPR is currently present in the UK and internationally in another 27 markets. EDPR has personnel based in Edinburgh and, through its joint venture with ENGIE (Ocean Winds), recently completed construction on the 950MW Moray East Offshore Wind Farm, which has the capability of supplying 40% of Scotland's electricity demand. Further information on EDPR can be found on its corporate website at https://www.edpr.co.en.

Wind 2 is a specialist onshore wind farm developer, founded in 2016. The company has staff based in the Highlands, Perth, Edinburgh, as well as Wales and in various locations throughout England, with significant expertise in renewable energy and a track record of successfully developing onshore wind farms throughout the UK.

Wind2 is working on the development of a number of renewable energy projects and is committed to investing in Stirlingshire. Further information on Wind2 can be found on its corporate website at https://wind2.co.uk.

1.1 Proposed Development Site and Context

1.1.1 Land use and Context

The Proposed Development Site covers a total area of 437.1ha with the land cover within the Site predominantly marshy grassland in the eastern part, with the western part dominated by a mosaic of blanket bog, shrub heath and unimproved acid grassland.

The Proposed Development Site features several watercourses, including the Loch Coulter Burn, the Bannock Burn and the Buckie Burn. The Proposed Development Site is currently used for livestock grazing, including sheep and cattle, and for occasional grouse shooting.

The settlement pattern in the wider area is characterised by scattered residences and farms with the nearest substantial settlement being the city of Stirling located approximately 3km north-east of the Site boundary at its closest point.

The nearest roads are an unclassified single-track road that runs south-west to north-east adjacent to the north-western boundary of the Site and an unclassified road that runs south-west to north-east adjacent to the south-eastern boundary of the Proposed Development Site. The M9 runs approximately north-south 3km north-east of the Proposed Development Site boundary at its closest point.

The closest commercial scale wind farm to the Proposed Development Site is the operational Craigengelt Wind Farm, located immediately adjacent to the south-west border of the Proposed Development Site. Beyond this, the operational Earlsburn and Kingsburn Wind Farms form a broad cluster between 2km and 7km west/north-west of the Site boundary, as illustrated on Figure 1-4.

Shelloch Windfarm Site is located approximately 7km west of the Site boundary. This was granted consent in 2022 but was not constructed at the time of the preparation of this EIA Report.

The proposed Earlsburn Extension Windfarm would be located approximately 4km north-west of the Site. This development is the subject of an application under Section 36 of the Electricity Act 1989 (as amended) submitted to the Scottish Government's Energy Consents Unit (ECU) in December 2022 and is currently being determined (at the time of the preparation of this EIA Report).

1.1.2 Statutory Designations

There are 14 environmental designations within 10km of the Proposed Development Site boundary, which are summarised below:

- Carron Glen SSSI (2km SE from site boundary);
- Denny Muir SSSI (3km S from site boundary);
- Sauchie Craig Wood SSSI (2km N from site boundary);
- Balquhidderock Wood SSSI (6km NE from site boundary);
- Endrick Water SSSI (6km W from site boundary);

- Endrick Water SAC (6km W from site boundary);
- Double Craigs SSSI (8km W from site boundary);
- Corrie Burn SSSI (8km SW from site boundary);
- Dullatur Marsh SSSI (8km S from site boundary);
- River Teith SAC (7km N from site boundary);
- Ochtertyre Moss SSSI (9km N from site boundary);
- Wester Moss SSSI (8km E from site boundary);
- Abbey Craig SSSI (9km NE from site boundary); and
- Firth of Forth SSSI (10km E from site boundary).

These designations are shown on Figure 1-3.

1.1.3 Previous Application

The site has been subject to a previous planning application for a wind farm development of 11 wind turbines at 125m to tip height and associated infrastructure (Planning Application Reference: 09/00170/FUL) which was submitted to Stirling Council in March 2009 and refused in April 2012. The application was not subject to appeal.

The reasons for refusal focussed on visual effects in relation to the nearby Lewis Hill; visual effects on the setting of Stirling Castle; visual effects relating to cumulative wind energy development and effects on the Kings Yett cairn.

The application boundary for the previous planning application covered the area occupied by the Proposed Development Site but also included land further north, with a total of five turbines located on that land.

The Proposed Development is therefore a significantly smaller scheme than the previous application (albeit with larger turbines) located at a greater distance from the assets listed above. Since the previous application there have also been significant changes to the cumulative context, national and local policy and the declaration of a Climate Emergency by the UK Parliament and the Scottish Government. Stirling Council have also formally recognised the climate emergency.

1.2 Purpose of the EIA Report

This EIA Report (EIAR) presents the findings of the EIA process by identifying, describing and assessing the Proposed Development, the current conditions at the Proposed Development Site and the likely significant environmental effects which may result from the construction and operation of the Proposed Development.

Where appropriate, mitigation measures designed to avoid, reduce or offset potentially significant effects are proposed and residual effects (those effects that are expected to remain following implementation of mitigation measures) are presented.

In addition, and in accordance with National Planning Framework (NPF) 4 (Scottish Government 2023), the EIA Report identifies potential benefit and enhancement measures; particularly with respect to biodiversity, but also in relation to improving access, recreation and heritage enhancement where possible.

These measures are included within each technical Chapter where relevant.

As required by the EIA Regulations, the findings and conclusions of the EIA are summarised in a standalone, easily accessible, Non-Technical Summary (NTS). This enables anyone with an interest in the Proposed Development to understand and access information on its potential environmental effects.

1.3 Structure of the EIA Report

The EIA Report is structured as follows:

- Volume 1: Non-Technical Summary;
- Volume 2: EIA Text;
- Volume 3: Technical Appendices;
- Volume 4: Figures.

Volume 2 of the EIA Report is structured around the following chapter headings:

- Chapter 1: Introduction;
- Chapter 2: EIA Approach & Methodology;
- Chapter 3: Description of Development and Design Evolution;
- Chapter 4: Planning and Energy Policy;
- Chapter 5: Landscape and Visual Impact Assessment;
- Chapter 6: Ecology;
- Chapter 7: Ornithology;
- Chapter 8: Hydrology, Geology and Hydrogeology;
- Chapter 9: Transport and Access;
- Chapter 10: Cultural Heritage;
- Chapter 11: Noise;
- Chapter 12: Socio-economics, Tourism and Recreation;
- Chapter 13: Climate Change and Carbon Balance;
- Chapter 14: Other Considerations;
- Chapter 15: Schedule of Mitigation; and
- Chapter 16: Summary of Predicted Residual Effects.

1.4 The EIA Team

The EIA was undertaken by Atmos Consulting with assistance from specialist consultants listed in Table 1-2. All are suitably qualified and competent experts in their field, as is required in accordance with Regulation 5(5) of the EIA Regulations.

Table 1-1: EIA Team

EIA Subject	Company	Statement of Competency
Planning, Ecology & Ornithology, Carbon and Climate Balance, Socio Economics and Other Considerations	Atmos Consulting	Atmos has a proven track record in the onshore wind sector built up over 15 years of experience working in the industry and leading EIA projects. The team are appropriately qualified and assessments are overseen by experts with at least ten years' experience in their field.

EIA Subject	Company	Statement of Competency
Landscape and Visual & Cultural Heritage	Land Use Consultant (LUC)	LUC has a track record of over 50 years in the planning and environmental sector. They are experienced at undertaking robust and defensible landscape and visual and cultural heritage impact assessments, working alongside the development team to embed mitigation into design wherever possible.
Hydrology, Geology and Hydrogeology	Ferry Hydro East Point Geo	Ferry Hydro have advised on over 70 wind farms at the pre-consent, planning and construction stage and focus on the impact, protection and mitigation of the water environment resource (including peat, GWDTE and other drainage matters) with respect to wind farm infrastructure construction and operation. With over twenty years' experience in understanding ground conditions, East Point Geo provide practical application of geology, geophysics, geomorphology, geotechnics and GIS for engineering projects.
Traffic and Transport	Systra	Systra's team has assisted both Transport Scotland in the preparation of guidelines for assessing the impacts of wind farm developments and over 14 years' experience working on EIA transport Chapters for onshore wind in Scotland. The team hold the appropriate qualifications and Charterships.
Noise	Hayes McKenzie	Hayes McKenzie Partnership Ltd has been involved with over 1000 onshore wind projects in the UK and overseas at the planning, post-planning and operational stages of development as well at public inquiry. Hayes McKenzie is a member of the UK Association of Noise Consultants (ANC). All work is carried out in line with recognised industry standards, and best practice of the Institute of Acoustics (IOA) and ANC.

1.5 Additional Documents

Along with the EIA Report, the Planning Application for the Proposed Development is accompanied by a number of supporting documents that should be read in conjunction with this EIA Report.

1.5.1 Planning Statement

The Planning Statement is intended to allow the Applicant to demonstrate the benefits of the Proposed Development and assess it against policy background and policy requirements, including the relevant policy provisions of the statutory Development Plan and any Supplementary Guidance relevant to Onshore Wind.

In contrast to the Planning Policy EIAR Chapter, which summarises the policies relevant to the EIA as a whole, the Planning Statement assesses the Proposed Development against adopted and emerging planning policies and other material considerations.

The Planning Statement presents the arguments in relation to the need for the Proposed Development and concluding with recommendations about the overall acceptability of the proposal in a planning context.

1.5.2 Design and Access Statement

The Design and Access Statement, in accordance with Regulation 13 of the Scottish Planning Series Circular 3/2022: Development Management Procedures (Scottish Government 2022), explains the design principles and concepts that have been applied to the Proposed Development.

It demonstrates the evolution of the design and how the context of the development has influenced the design.

It sets out how the Proposed Development is considered a suitable development for the Proposed Development Site and its setting and aims to demonstrate that the Proposed Development can be adequately accessed by its prospective users.

1.5.3 Pre-Application Consultation Report

The purpose of the Pre-Application Consultation (PAC) exercise is to engage with local communities, so they are better informed about Major and National development proposals and have an opportunity to contribute their views before the planning application is submitted to the Planning Authority.

The PAC seeks to improve the quality of planning applications, mitigate negative effects where possible, address misunderstandings, and air and deal with any community issues that can be tackled.

A Pre-Application Consultation Report (PACR) is submitted alongside this EIA Report as a supporting document to the planning application for the Proposed Development. The PACR demonstrates the scope of consultation undertaken with the community and how feedback has been considered, in accordance with legislation and requirements.

1.6 Copies of the EIA Report

The EIAR will be publicised in accordance with Part 5 of the 2017 Regulations and a notice will be published as follows:

- On the Applicant's project website: www.drummarnockwindfarm.co.uk;
- In the Edinburgh Gazettte; and
- In the Stirling Observer.

In addition to the statutory requirements for publicising the EIAR, the Applicant has advised the following local Community Councils and Community Groups of the EIA Report being available:

- Carron Valley Community Council;
- Cambusbarron Community Council;
- Bannockburn Community Council;
- St Ninians Community Council;
- Fintry Community Council;

- Denny Community Council;
- Gargunnock Community Council;
- Queenzieburn Community Council; and
- Plean Community Council.

A hard copy of the EIAR can be viewed at Stirling Council Offices, 1-5 Port Street, Stirling, FK8 2EJ during their opening hours (Monday - Friday, 9am to 2pm).

A copy of the EIAR volumes will be made available for download from the Applicant's project website at: www.drummarnockwindfarm.co.uk

Paper copies of the NTS are available free of charge from:

- info@wind2.co.uk
- 01352 748300
- Wind2 Limited, 2 Walker Street, Edinburgh, EH3 7LB

Paper copies of the EIAR (including Supporting Documents and Non-Technical Summary) may be purchased by arrangement from the above address for £1,400 per copy, or free per USB stick copy. The price of the paper reflects the cost of producing all of the Landscape and Visual photographs at the recommended size.

1.7 References

Scottish Government (2017). The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 available at; http://www.legislation.gov.uk/ssi/2017/102/contents/made [Accessed: 26/03/24]

Scottish Government (2022) Scottish Planning Series Planning Circular: Development Management Procedures. Available at: https://www.gov.scot/publications/planning-circular-3-2022-development-management-procedures/ [Accessed 26/03/24]

Scottish Government (2023) National Planning Framework 4. Available at: https://www.gov.scot/publications/national-planning-framework-4/ [Accessed 26/03/24]

UK Government (1989) Electricity Act 1989 (as amended). Available at: https://www.legislation.gov.uk/ukpga/1989/29/contents [Accessed 26/03/24]

UK Government (1997) Town and Country Planning (Scotland) Act 1997 (as amended) Online at: https://www.legislation.gov.uk/ukpga/1997/8/contents [Accessed: 26/03/24]

Chapter 2: EIA Approach and Methodology

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
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Environmental Impact Assessment	Environmental Impact Assessment (EIA) is a means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (EIA Regulations)
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1
The Planning Act	The Town and Country Planning (Scotland) Act 1997 (as amended)

List of Abbreviations

Abbreviation	Description
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
IEMA	Institute of Environmental Management and Assessment
NNR	National Nature Reserve
NTS	Non-Technical Summary
SAC	Special Area of Conservation
SC	Stirling Council
SPA	Special Protection Area
SSSI	Sites of Special Scientific Interest

2 EIA Approach and Methodology

2.1 Introduction

This Chapter of the Environment Impact Assessment Report (EIAR) presents the approach taken to the Environmental Impact Assessment (EIA) for the Proposed Development.

The preparation of this EIAR has been undertaken in accordance with the Regulation 5 of the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 (the 'EIA Regulations').

The EIAR has also been informed by relevant best practice guidance on EIA generally, for example the Institute of Environmental Management and Assessment Guidelines for Environmental Impact Assessment (IEMA 2016), and NatureScot and Historic Environment Scotland's Environmental Impact Assessment Handbook Version 5 (2018).

On specific environmental subjects (for example noise, and landscape and visual assessment), technical guidance has been referred to in the appropriate chapters of this EIAR.

2.2 EIA Screening and Scoping

2.2.1 The Requirement for EIA (Screening)

Schedule 1 of the EIA Regulations lists those developments for which an EIA is mandatory, whilst Schedule 2 describes projects for which the need for EIA is judged by a planning authority or the Scottish Ministers on a case-by-case basis.

The Proposed Development is not a Schedule 1 development, but it does fall within paragraph 3 of Schedule 2 of the EIA Regulations, as an installation for the harnessing of wind power for energy production with more than two turbines, and the height of any single turbine exceeding 15 metres.

A Schedule 2 development is determined an EIA development if it is likely to have significant effects on the environment by virtue of factors such as its nature, size or location.

Schedule 3 of the EIA Regulations sets out the criteria that should be considered by a planning authority or Scottish Ministers in undertaking a screening exercise to determine whether a Schedule 2 development is likely to have significant environmental effects and requires an EIA.

The Applicant identified at an early stage that the Proposed Development has the potential to have significant environmental effects.

As such it was not considered necessary to seek an EIA Screening Opinion from the planning authority. The Applicant has voluntarily undertaken an EIA and is submitting the EIAR. The Proposed Development is considered an EIA Development, subject to the provisions of the EIA Regulations.

Whilst it is considered that the Proposed Development has the potential for likely significant environmental effects, it is important to note that this does not mean that this is the conclusion of the EIA. And hence, the EIA sets out to assess the likely significant effects that would occur as a result of the construction and operation of the Proposed Development.

The Applicant considers that EIA has an important role in developing the design of the Proposed Development to minimise adverse environmental effects and maximise positive benefits.

Embedding mitigation into the design and the incorporation of mitigation measures into the construction and/or operation of the Proposed Development has been undertaken and is proposed to avoid, reduce and, if possible, remedy any likely significant adverse effects or enhance positive effects.

2.2.2 The Scope of the EIA Report

Pre-Application Consultation

Pre-Application Advice was sought from SC on 12th May 2020, and a Pre-Application Enquiry Response was issued in July 2020 (PREAPP-2020-0093).

The pre-application response provided information on the planning history of the Proposed Development Site, the relevant local planning policy and guidance applicable to the Proposed Development. It also detailed consultation responses from various stakeholders (summarised in Table 2-1 below).

The advice produced in the pre-application response; alongside technical consultation carried out by technical experts (as detailed in Chapters 5-15) have informed the scope of the EIA.

EIA Scoping

An EIA Scoping Opinion was requested from SC in August 2020 through the submission of an EIA Scoping Report (Ref 40419-03). The EIA Scoping Report contained details of the Proposed Development Site baseline and the Proposed Development design at the time. It also proposed which environmental impacts would be assessed in the EIA, and the assessment methodologies that would be used.

SC consulted with a variety of consultees before providing an EIA Scoping Opinion in October 2020.

In accordance with the EIA Regulations (Regulation 5(3)) this EIAR is based on the Scoping Opinion obtained from the SC in October 2020 and the advice contained within it regarding assessment methodology, topics and consultee comments.

It should be noted that the Proposed Development has changed since the issue of the Scoping Opinion, with the design at that time consisting of six turbines of up to a maximum tip height of 149.9m, as opposed to the current design of four turbines to a maximum of 180m tip height.

However, it is considered that the advice associated with Scoping Opinion remains appropriate to the Proposed Development.

Throughout the design and assessment process, consultation has been undertaken with relevant parties to obtain baseline information and to agree aspects of methodology. More details of the consultation feedback relevant to each discipline are provided in the relevant chapters of this EIA Report.

2.3 Location of Information in the EIA Report

The EIA Regulations require a description of the likely direct and indirect significant effects on the following factors:

- Population and human health;
- Biodiversity;
- Land, soil, water, air and climate; and
- Material assets, cultural heritage and the landscape.

Along with the potential interactions with the factors listed above, the EIA Regulations also require identification, description and assessment of the expected effects deriving from the vulnerability of the development to risks of major accidents and disasters in so far as these risks are relevant to the development.

In accordance with Regulation 5(2) the EIA Report must include:

a) "a description of the development comprising information on the site, design, size and other relevant features of the development;

b) a description of the likely significant effects of the development on the environment;

c) a description of the features of the development and any measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;

d) a description of the reasonable alternatives studied by the developer, which are relevant to the development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment;

e) a non-technical summary of the information referred to in sub-paragraphs (a) to (d);

f) and any other information specified in schedule 4 relevant to the specific characteristics of the development and to the environmental features likely to be affected."

Table 2-1 identifies the location within this EIAR of the information required for inclusion in accordance with Schedule 4 of the EIA Regulations.

Table 2-1: Information Contained within the EIA Report

Required information (EIA Regulations)	Relevant Section of this EIA Report
A description of the development, including in particular: (a)a description of the location of the development; (b)a description of the physical characteristics of the whole development, including, where relevant, requisite demolition works, and the land-use requirements during the construction and operational phases; (c) a description of the main characteristics of the operational phase of the development (in particular any production	A description of the location of the Proposed Development and its characteristic of the construction and operation phases is presented in **Chapter 3**. The predicted materials and natural resources used and the expected residues and emissions of the Proposed Development are reported in **Chapters 5 to 14.**

Required information (EIA Regulations)	Relevant Section of this EIA Report
process), for instance, energy demand and energy used, nature and quantity of the materials and natural resources (including water, land, soil and biodiversity) used; (d)an estimate, by type and quantity, of expected residues and emissions (such as water, air, soil and subsoil pollution, noise, vibration, light, heat, radiation and quantities and types of waste produced during the construction and operation phases.	
2. A description of the reasonable alternatives studied by the developer, which are relevant to the development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment;	**Chapter 3** discusses the reasonable alternatives considered.
3. A description of the relevant aspects of the current state of the environment (the "baseline scenario") and an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of relevant information and scientific knowledge.	The baseline description is included in each of the technical chapters of the EIAR**, Chapters 5 to 14.**
4. A description of the factors specified in regulation 4(3) likely to be significantly affected by the development: population, human health, biodiversity (for example fauna and flora), land (for example land take), soil (for example organic matter, erosion, compaction, sealing), water (for example hydromorphological changes, quantity and quality), air, climate (for example greenhouse gas emissions, impacts relevant to adaptation), material assets, cultural heritage, including architectural and archaeological aspects, and landscape.	**Chapters 5 to 14** discuss the aspects likely to be affected. Effects on population and human health are considered in relation to visual aspects in **Chapter 5**, traffic aspects in **Chapter 9**, noise aspects in **Chapter 11**, socio-economic aspects in **Chapter 12** and shadow flicker, telecommunications and aviation radar aspects in **Chapter 14.** Effects on biodiversity are considered in **Chapters 6 and 7.** Effects on land, soil and water are considered in **Chapter 8**. Effects on Climate are considered in respect of climate change and carbon balance in **Chapter 13.** Effects on material assets and cultural heritage assets are considered in **Chapter 10.** Effects on Landscape are considered in **Chapter 5.**
5. A description of the likely significant effects of the development on the environment	The predicted significant effects of the Proposed Development are presented as residual effects after relevant stated mitigation measures in **Chapters 5-14**.
6. A description of the forecasting methods or evidence, used to identify and assess the significant effects on the environment, including details of difficulties (technical deficiencies or lack of knowledge) encountered compiling the required information and the main uncertainties involved.	**Chapters 5 – 14** set out the specific methodologies and evidence used to assess significant effects and describe assumptions and limitations as relevant.

Required information (EIA Regulations)	Relevant Section of this EIA Report
7. A description of the measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment	Specific mitigation measures are reported in each relevant technical chapter (**Chapters 5-14**) and summarised in **Chapter 15** in a tabular form.
8. A description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of major accidents and/or disasters which are relevant to the project concerned. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.	The Proposed Development Site is not in a location of natural disasters and construction will be undertaken in accordance with good construction practice and relevant health and safety regulations and requirements, The overall approach to construction is presented in **Chapter 3.** **Chapter 8** considers risks associated with flooding and peat landslide hazard.
9. A Non-Technical Summary of the information provided under points 1 to 8 above.	A Non-Technical Summary (NTS) accompanies this EIA Report as **Volume 1**.

2.4 EIA Methodology

The reporting of the assessment of environmental impacts in Chapters 5 to 14 of this EIAR has been undertaken in a consistent, structured format, with reference to relevant technical standards, guidelines and legislation and consultation undertaken.

The EIA Regulations refer to the requirement to report the significance of effects. A two-stage assessment has been undertaken whereby the potential effects have been identified and their significance assessed in relation to the setting.

The assessments have been split into the three development phases as each phase has the potential to give rise to different effects:

- **Construction:** Generally temporary/short-term effects that occur during the construction of the Proposed Development;
- **Operation:** Effects resulting from the use of the Proposed Development Site; and
- **Decommissioning:** Effects arising from the removal of infrastructure and restoration of the Proposed Development Site.

In most of the chapters within this EIAR, the significance of an effect is described as a function of magnitude of effects and receptor sensitivity.

Where best practice guidance exists, for example from a professional institution, some chapters follow slightly different methodologies (for example Landscape and Visual Effects have been established/assessed in accordance with industry guidance specifically for that subject and details are provided within that chapter and appendix).

General guidelines on the assessment methodology used within chapters are presented in the following sections.

2.4.1 Receptor Sensitivity

Receptors are affected depending on their setting, size and importance. Where appropriate, it may be necessary to relate the extent of the effects to the importance of the features, i.e. international, national and local standards and an appreciation of the relationship with relevant planning policy.

Additionally, consideration of the reversibility and duration of the predicted effect is required in order to determine significance.

Table 2-2: Receptor Sensitivity

Sensitivity	Importance	Feature Examples
High	National/ International	Residential (occupied) properties, Scheduled Ancient Monuments, Sites of schedulable quality, A-listed buildings or buildings of equivalent quality, some Conservation Areas, Sites of Special Scientific Interest (SSSI)/National Parks, Special Areas of Conservation (SAC) Ramsar designated sites, Special Protection Area (SPA), National Nature Reserve (NNR), National Marine Reserve, Habitats Directive sites, large or moderate water bodies of good ecological status, salmonid waters, primary/high productivity aquifer, properties at risk of flooding, public and private water supplies for human consumption.
Medium	Regional	B-listed buildings or buildings of equivalent quality, some Conservation Areas, archaeological remains of regional importance, Receptor of medium environmental importance or of local regional value, water bodies of good or moderate ecological status and/or Cyprinid waters, sites containing viable areas of threatened habitats listed in a Regional Biodiversity Action Plan, private water supplies for non-potable supply, moderate productivity or secondary aquifer.
Low	Local	C(s)-listed buildings or buildings of equivalent quality; archaeological remains of local importance, local nature reserve, water body of low environmental importance, low productivity aquifer.
No importance	Lesser/Unknown	Archaeological remains of lesser importance/unknown importance; greenfield; non-productive aquifer.

2.4.2 Magnitude of Effect

The extent of potential effect is based on the scale of the potential effect and will vary from site to site and location to location. Table 2-3 provides examples of the magnitude of the effect as used within the assessment of the Proposed Development.

Table 2-3: Magnitude of Effect

Magnitude of Effect	Definition
Substantial	Total loss of or major alteration to key elements or features of the pre-development conditions, such that the post-development character or composition of the feature will be fundamentally changed.
Medium	Loss of or alteration to key elements or features of the pre-development conditions, such that the post-development character of the feature will be partially changed.
Low	Minor alteration from pre-development conditions.
No change	No or unquantifiable change to pre-development conditions.

2.4.3 Assessment of Significance

In the determination of the significance of effect, the following criteria have been used:

- Extent (local, regional or national) and magnitude of the effect;
- Effect duration (whether short, medium or long-term);
- Effects nature (whether direct or indirect, reversible or irreversible, adverse, neutral or beneficial);
- Whether the effects occur in isolation, are cumulative or interactive;
- Performance against environmental quality standards;
- Sensitivity of the receptor; and
- Compatibility with environmental policies.

Where it has not been possible to quantify effects, qualitative assessments have been carried out, based on available knowledge and professional judgment. Where any uncertainty exists, this has been noted in the relevant technical chapter in the Limitations section.

The significance of potential effects arising from the Proposed Development has been categorised throughout this EIAR using the scale as follows:

- **Negligible** – no discernible deterioration or improvement to the existing environment;
- **Minor** (positive or negative) – where the Proposed Development will cause a small improvement (or deterioration) to the existing environment;
- **Moderate** (positive or negative) – where the Proposed Development will cause a noticeable improvement (or deterioration) to the existing environment; and
- **Major** (positive or negative) – where the Proposed Development will cause a substantial improvement (or deterioration) to the existing environment.

To enable consistent understanding of the EIA findings, standard terms are used wherever possible to classify effects throughout the EIA (major, moderate, minor and negligible), and effects are also described as being adverse, neutral or beneficial.

Where the quality standards for each technical discipline result in deviations in the standard assessment methodology, these are described in the relevant chapters as applicable.

In general, the classification of an effect is based on the magnitude of the effect and sensitivity or importance of the receptor, using the matrix shown at Table 2-4.

Where there are deviations away from this matrix (due to the technical guidance for a specific assessment topic), this is highlighted within the relevant technical chapter and the reason for the variation explained.

Table 2-4: Classification of Effects

Receptor Sensitivity Importance	Magnitude of Effects			
	Substantial	Medium	Low	No Change
High	Major	Major	Moderate	Negligible
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
No importance	Minor	Negligible	Negligible	Negligible

Significant Effects are only considered to be classified as 'Major' or 'Moderate'. Effects classified as 'Minor' or 'Negligible' are considered to be Non-Significant.

2.4.4 Mitigation Measures

Mitigation measures have been considered for each significant adverse effect identified. These measures can include:

- Changes to the Proposed Development design;
- Physical measures applied on site; and
- Measures to control particular aspects of the construction or operation of the Proposed Development.

Wherever possible, mitigation has been developed to ensure that no significant residual (negative) environmental effects are predicted. A summary of mitigation measures proposed is presented in Chapter 15 Schedule of Mitigation.

2.4.5 Cumulative and Combined Effects

In addition to the assessment of direct effects of the Proposed Development, an assessment (where appropriate) is also undertaken of the likely interrelationship and cumulative effects of the development proposal.

The assessment of interrelationship effects is required by the EIA Regulations and refers to the interaction between the different environmental aspects, for example water and ecology.

The EIA Regulations also require that the cumulative effects of the Proposed Development in combination with other existing or approved projects is taken into account.

Under cumulative effects, adjacent wind energy schemes either operational, consented or in planning are considered in conjunction with the Proposed Development in order to assess whether the resulting effect of all developments is of greater significance than that of the individual constituents.

This is of particular importance when considering potential landscape and visual effects. Therefore Chapter 5: Landscape and Visual of this EIAR considers developments (operational, consented and in planning) within a 45km radius of the Proposed Development.

The general criteria for the inclusion of developments in the assessment of cumulative landscape and visual effects are as follows:

- Only wind energy generation developments have been included;
- No schemes at scoping stage beyond 10km have been included;
- No single turbine developments beyond 5km have been included; and
- No turbines of less than 50m blade tip height have been included.

This is explained further in Chapter 5: Landscape and Visual Impact Assessment.

It should be noted that not all developments within these radii will be relevant to each discipline and therefore, will be considered on case-by-case basis in the relevant cumulative impact sections.

2.4.6 Assumptions and Limitations

The EIA process is designed to enable good decision-making based on the best possible information about the environmental implications of a proposed development. However, there will always be some uncertainty inherent in the scale and nature of the predicted environmental effects.

This uncertainty arises because of the level of detailed information available at the time of the assessment, the potential for minor alterations to project designs following completion of the EIAR and/or due to the limitations of the prediction process. Where specific assumptions have been made in relation to the technical environmental assessments, these are reported in the relevant chapters of this EIAR.

The environmental effects identified in this EIAR and the level of mitigation described effectively set the minimum standard which will be achieved by the Proposed Development.

2.5 References

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Scottish Government. (2017b). The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017. [Online] Available at: http://www.legislation.gov.uk/ssi/2017/102/contents/made [Accessed 26/03/2024].

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Chapter 3: Description of Development

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	Environmental Impact Assessment (EIA) is a means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (EIA Regulations)
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1
The Planning Act	The Town and Country Planning (Scotland) Act 1997 (as amended)

List of Abbreviations

Abbreviation	Description
BPA	Borrow Pit Appraisal
CAR	Controlled Activities Regulations
CEMP	Construction Environmental Management Plan
DMP	Drainage Management Plan
ECoW	Ecological/Environmental Clerk of Works
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
GWDTE	Groundwater Dependent Terrestrial Ecosystem
HES	Historic Environment Scotland
NATS	formerly National Air Traffic Services, now NATS Holdings Limited
NPF4	Scotland's Fourth National Planning Framework
SCADA	Supervisory Control and Data Acquisition
SC	Stirling Council
SuDS	Sustainable Drainage Systems

3 Description of Development

3.1 Introduction

This chapter describes the Proposed Development, including the current site conditions, the site selection and design process, and details the finalised design proposed in this application.

3.2 Site Selection and Design Evolution

3.2.1 Site Selection

The Proposed Development Site has been selected as suitable by the Applicant because it met the following criteria:

- There is a commercially viable grid connection;
- There is good wind speed;
- The land is available to the Applicant to allow the construction of a windfarm;
- The Proposed Development location is in proximity to existing operational wind farms and is in an area where wind turbines are already operating at a reasonable distance from the Proposed Development Site;
- The Proposed Development Site is not located within a nationally designated area;
- The Proposed Development will generally appear as a small modest extension to the Craigengelt Wind Farm, as laid out in Stirling Council's (SC) Wind Energy Developments Supplementary Guidance (SC 2019);
- The Proposed Development has the capacity to maintain suitable distance from the nearest residential properties and settlements; and
- The Proposed Development Site benefits from a good existing road network that has been previously used for the transportation of wind turbine components.

Site selection was informed by the spatial framework within Stirling Council's (SC) Wind Energy Developments Supplementary Guidance (SC 2019), with the Proposed Development Site lying within Group 3 of the Spatial Framework, Areas with Potential for Wind Farm Development.

3.2.2 Site Design

In accordance Regulation 5(d) of the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 (the 'EIA Regulations'), reasonable alternatives (in terms of project design, technology, location, size and scale and characteristics) of the Proposed Development were considered.

As part of the development process the Applicant has reviewed alternative infrastructure siting (turbines, sections of new access track and access).

The key constraints assessed during the design, pre-application and Scoping process include:

- Landscape character and visual amenity;
- Ground conditions, topography and peat;

- Proximity to noise sensitive receptors;
- Presence of watercourses, private water supplies and related infrastructure;
- Presence of sensitive ecology receptors;
- Presence of sensitive cultural heritage features;
- Presence of telecommunication and aviation/radar constraints; and
- Proximity to suitable grid connection.

These constraints are discussed more in their relevant chapter.

Figure 3-1 (a-d) shows the final Proposed Development site layout.

Table 3-1 presents the key design iterations that have taken place including pre-application and scoping layout, interim designs, design chill and design freeze. The Design Evolution Layouts are shown on Figure 3-2 (a-b).

Table 3-1: Turbine Layout Design Iterations

Layout	Turbines	Tip Height (m)	Design Changes
1: Pre-app & Scoping	6	149.9m	Initial Feasibility layout based on preliminary environmental and technical consideration including distance from neighbouring schemes, residential properties, cultural heritage assets, telecommunication links, radar (in consultation with NATS), watercourses and topography.
2: Interim Layout	6	149.9m	Layout refined based on further information from survey works - primarily phase 1 peat surveying and ecological habitat surveys. Following consultation with Historic Environment Scotland (HES) the horizontal spread of the six turbines was reduced in order to reduce the horizontal field of view from sensitive receptors (including Stirling Castle) with the overall aim of producing a layout that lies within the horizontal field of view of the operational Craigengelt Wind Farm. Ongoing consultation with NATS to ensure layout was acceptable from a radar perspective.
3: Interim Layout	5	149.9m	Following further consultation, turbine 6 was removed in order to address comments from HES on views from Stirling Castle and to mitigate potential effects on residential amenity on nearby properties (Easter Cringate Cottage and Ryecroft). Ongoing consultation with NATS to ensure layout was acceptable from a radar perspective.
4: Interim Layout	4	180m	Following consultation with telecommunication providers the layout was redesigned (pushing the overall layout north) and turbine numbers reduced from 5 to 4 in order to mitigate against aviation constraints and to maximise site efficiency. The turbine tip height was increased in order to achieve project commercial viability given reduction in turbines. Agreement with NATS on the acceptability of the layout from a radar perspective.
5: Design Chill	4	180m	Following further consultation with telecommunication providers turbine 2 was moved south east in order to mitigate against telecommunication constraints. The movement of turbine 2 also reduced residential amenity impacts on nearby properties and reduced impacts on potential Groundwater Dependent Terrestrial Ecosystems (GWDTE). Ongoing consultation with NATS to ensure layout was acceptable from

Layout	Turbines	Tip Height (m)	Design Changes
			a radar perspective.
6: Design Freeze	4	180m	Following further peat, hydrology and Groundwater Dependent Terrestrial Ecosystem (GWDTE) assessment turbines 1 and 4 were moved outwith deeper peat areas. Various options for the location of turbine 2 were considered with the location chosen balanced against technical and environmental constraints whilst aiming to keep the overall layout within the horizontal field of view from of the operational Craigengelt Wind Farm from Stirling Castle. Confirmation from NATS that design freeze layout is acceptable from a radar perspective.

Final layout Turbine location grid references are provided in Table 3-2.

Table 3-2: Turbine Location Co-ordinates and Base Elevations

Turbine ID	Easting	Northing	NGR	Base Elevation AOD (m)
1	272767	687404	NS 72767 87404	341
2	273702	687071	NS 73702 87071	288
3	272913	687021	NS 72913 87021	320
4	273610	687517	NS 73610 87517	282

3.3 Development Description

3.3.1 Development Outline

The Proposed Development **consists of 4 turbines up to a maximum 180m** tip height with an indicative electricity export capacity of approximately 30MW and associated infrastructure.

The associated infrastructure includes:

- New access tracks;
- Construction of turbine foundations, crane hardstandings and storage areas;
- Underground cabling;
- One onsite substation which would accommodate 33KV equipment to collect electricity from the site. The substation compound would include a control and metering building;
- Construction compound;
- Up to four borrow pits; and
- Up to six watercourse crossings.

The Proposed Development includes the provision for 6.59km of new access tracks, which includes two onsite access options (Option A and Option B). However, only one of these onsite access options will be constructed, and therefore of the 6.59km of proposed new tracks, a maximum of up to 5.8km would be constructed, dependent upon the access option utilised. To ensure a robust and conservative assessment, the EIA has assessed the full 6.59km to support the full appraisal of both access options.

The Proposed Development has been designed with an operational life of up to 40 years, at the end of which it will be decommissioned unless further planning permission is granted.

The Proposed Development components are summarised in Table 3-3. "Permanent Infrastructure" in the context of this EIAR means infrastructure that will be in place for the operational life of the Proposed Development.

Following expiry of planning permission, the decommissioned above ground infrastructure will be removed and reinstated in an environmentally sensitive way agreed with statutory consultees.

Once the turbines have been installed, the access tracks and hardstand areas around the turbines will remain in place as permanent infrastructure.

Table 3-3: Proposed Development Components

Proposed Development Components- Maximum Parameters	
Turbines	
Four wind turbines up to 180m to tip height. The maximum rated output is approximately 30MW.	
Permanent Infrastructure (Area, m^2)	
New Access track	25,636m^2
Turbine Foundation (4 No.)	2,356m^2
Crane Hardstanding (4 No.)	3,520m^2
Auxiliary Crane Hardstanding (4 No.)	2,240m^2
Borrow Pits (4 No.)	32,700m^2
Substation	1,050m^2
Temporary Infrastructure (Area, m^2)	
Turbine Installation Areas – blade storage (4 No.)	4,980m^2
Turbine Installation Areas – nacelle storage (4 No.)	656m^2
Turbine Installation Areas – tower storage (4 No.)	2,448m^2
Turbine Installation Areas – boom assembly (4 No.)	2,826m^2
Construction Compound Areas (1 No.)	7,200m^2
Total permanent land take	**104,035m^2**
Total temporary land take	**18,110m^2**

The following sections expand on the various elements of the Proposed Development.

3.3.2 Wind Turbines

Electricity will be generated through the operation of four three-bladed horizontal axis wind turbines, with a maximum 180m tip height. Indicative turbine dimensions are shown on Figure 3-3.

The final choice of turbine will be subject to a selection process which considers technical and commercial aspects of the turbine and will be based on the turbine models which are commercially available at the time of construction.

The wind turbine generator will be mounted on a tapered tubular steel tower and will consist of a nacelle containing the generator and associated equipment. A hub and rotor assembly will be attached to the tower, including three glass/carbon fibre-reinforced polyester blades.

Turbines are typically of a variable speed type so that the turbine rotor speed varies according with the energy available in the wind. Wind turbines typically generate power in wind speeds between 4 and 25 meters per second (m/s).

The turbine stops for high wind speeds. With the exact average windspeed dependent on the turbine model selected.

Turbines are computer controlled and contain wind sensors to determine when there is sufficient wind speed for operation. The turbines are pitch regulated to ensure the blades are pitched in the optimum angle during production and standby situations. The rotor blades of all turbines will rotate in the same direction.

When operating, the rotational speed of the wind turbine blades is transferred and increased to drive the generator. This produces a three-phase power output typically of 690 Volts (V) which is transferred from the generator to the turbine transformer.

If necessary, the location of each turbine will be micro-sited to achieve more favourable ground conditions. This is discussed further below.

3.3.3 Turbine Foundation

Actual turbine foundation design and dimensions will be specific to the site conditions as established during the detailed geotechnical site investigation undertaken before commencing installation and once the final turbine type has been chosen and manufacturer's specification has been finalised.

It is expected that the foundation for the turbine will comprise a standard concrete gravity foundation constructed on poured concrete with steel reinforcement depending detailed geotechnical assessment.

Each foundation will require approximately 3,168³ of steel reinforced concrete. The foundation will have a diameter of up to 27.4m. Depth of the excavation would depend on the need to reach suitable ground, but would be, on average, approximately 3m deep.

The ground excavation methods will vary depending on the local ground conditions and the nature of the surface vegetation. The general processes will be as follows:

- Topsoil/turf will be stripped and stored in order to be reused in restoration of the turbine construction area;
- Subsoil (if present) will be stripped and stored, keeping this material separate from the topsoil/turf;
- Excavation of turbine foundations will then take place followed by the installation of the steel reinforcement bars and casting of concrete; and
- After the foundation has been poured the area will be backfilled as soon as practicable with spoil, pending turbine installation.

Indicative turbine foundation dimensions are shown on Figure 3-4.

3.3.4 Crane Hardstandings

The wind turbines will be erected using a set of heavy lifting cranes. A set consists of the main lifting crane and the tail crane.

Operation of the cranes requires a hardstanding located beside the turbine base with an area of approximately 880m^2. An auxiliary crane hardstanding with an area of approximately 560m^2 will also be constructed.

Two cranes will lift turbine tower sections and blades from the delivery vehicles either onto temporary working areas for storage or directly into their assembly position. The larger crane will be used to lift the tower sections, turbine nacelle and the hub and blade assembly into their final positions. The tail crane will help to align and position the components whilst being installed.

Hardstand working areas are proposed for the construction of the Proposed Development. These will be used for ancillary equipment, vehicles and cranes during the erection of the wind turbines.

Indicative turbine installation area dimensions (including boom assembly and hardstand working areas) are shown on Figure 3-5.

3.3.5 Temporary Construction Compound

One temporary construction compound is proposed during the construction phase of the Proposed Development. The approximate dimensions of the temporary construction compound will be 100m x 80m (7,500m^2).

An indicative layout for the temporary construction compound including dimensions is shown in Figure 3-6.

The compound will house staff offices and welfare facilities as well as car parking area for staff and visitors. The compound will also include an area for materials storage. Once the construction of the Proposed Development has been completed the temporary construction compound will be restored using retained topsoil or turf.

3.3.6 Site Access

Turbine components are expected to be delivered to Port of Grangemouth. The components will be transported by road via a series of abnormal loads movements to the Proposed Development Site access point.

The route for delivery of turbine components to the Proposed Development Site is likely to be from Junction 9 of the M9. The proposed route would take the A872 northbound onto the Pirnhall Road, before passing south over the M9 on the New Line Road, and travelling along approximately 6km of minor roads to reach one of the two points of entry presented in the EIAR for the Proposed Development Site.

Site access is discussed further in Chapter 9 Transport and Access.

3.3.7 Access Track

The Proposed Development includes the provision for 6.59km of new access tracks, which includes two onsite access options (Option A and Option B – see Figure 3-1). However, only one of these onsite access options will be constructed, and therefore of the 6.59km of proposed new tracks, a maximum of up to 5.8km would be constructed, dependent upon the access option utilised. To ensure a robust and conservative assessment, the EIA has assessed the full 6.59km to support the full appraisal of both access options.

New Access Track

Up to 5.8km of new access track (dependent upon the access option utilised) will be constructed to the specification required by the wind turbine supplier, typically with a running width of 5m in straight sections, increasing at bends, passing places and junctions. The tracks will be designed to have sufficient radii for turning of the construction vehicles, abnormal loads and plant. The access tracks have been designed to avoid sensitive features.

The access tracks will be constructed using 'cut and fill track' design. Topsoil is stripped to expose a suitable rock or sub-soil horizon on which to build the track. Subject to final design by a qualified contractor, it is likely the track will then be built up on a geotextile layer by laying and compacting crushed rock to a depth dependent on ground conditions and topography.

Generally, the surface of the track will be flush with or raised slightly above the surrounding ground level.

Where the presence of peat has been identified to be greater than 0.5m in depth, floating tracks are proposed to be used (where gradients allow and where lengths and cut and fill requirements do not preclude their construction). A layer of crushed stone (0.5m – 1m, dependant on ground conditions) will be laid on geotextile/geogrid reinforcement to form the track, which results in the site track being raised above the peat surface.

An indicative track construction design is shown in Figure 3-7.

Soils removed from the excavated area will be stored separately in piles, no greater than 3m in height, directly adjacent to, or near the tracks on ground appropriate for storage of materials i.e., relatively dry and flat ground, a minimum of 50m away from any watercourses. Wherever possible, reinstatement of ground disturbed to facilitate construction of the track will be carried out as track construction progresses.

Prior to the commencement of site construction, detailed engineering specification for the access track design will be submitted to the planning authority as part of a Planning Conditions Compliance Statement, which will include Construction Method Statements for all aspects of construction.

Access Track Drainage

The drainage design will comply with General Binding Rules (GBR's) 10, 11 and 21 for the track drainage, under the Water Environment (Controlled Activities) (Scotland) Regulations (CAR) 2011 (as amended) (Scottish Government, 2011).

A Drainage Management Plan (DMP), which will detail proposed surface drainage measures to treat and deal with surface runoff from the site, will be designed in accordance with sustainable drainage systems (SuDS) principles. This plan will form part of a Construction Environmental Management Plan (CEMP) an outline of which is included in this EIAR.

Consideration of Alternatives

The preferred on site track routes have been designed to allow access to the turbine locations taking environmental constraints into account.

The proposed on site access routes are intended to minimise impacts on sensitive receptors by avoiding areas of deep peat and GWDTE where possible, minimising the effects on heritage assets, heritage constraints and limiting the number of water crossings required. They avoid using the existing track past the properties at Carfrae to minimise disruption as much as possible.

3.3.8 Watercourse Crossings

The Proposed Development has been designed to minimise construction works in the vicinity of mapped watercourses and to minimise the need for new water crossings in order to reduce the risk of pollution and changes to watercourse morphology.

Dependent on what onsite track option is constructed then up to six new watercourse crossings (visible on OS 1:25,000 mapping) will be required for the proposed new access tracks within the Proposed Development Site, these locations are shown in Figure 3-1 and summarised in Table 3-5.

The watercourse crossings will be designed in accordance with relevant guidance (WAT-SG-25), and designed to accommodate 1 in 200 year events. Figure 3-8 shows a typical indicative bottomless culvert design.

It is worth noting that should access Option A be constructed, WC1 would not be required. Similarly, should access Option B be constructed, WC6 would not be required.

Further information on watercourse crossings can be found in Technical Appendix 8-1.

Table 3-4: Major Watercourse Crossing Summary

Crossing ID	Easting	Northing	Proposed Crossing Type
WC1	275909	687137	New crossing
WC2	275198	687304	New crossing
WC3	275130	687346	New crossing
WC4	274491	687452	New crossing
WC5	274181	687337	New crossing
WC6	275775	687900	New crossing

3.3.9 Borrow Pits

A Preliminary Borrow Pit Appraisal (BPA) (Appendix 3-1) for the Proposed Development has been prepared to identify potential sources of rock within the Proposed Development Site required for the construction of the windfarm. The purpose of the appraisal is to:

- Assess potential areas for extraction of stone and/or suitable material for the construction of road/hardstandings;
- Provide an estimate of the available material from the source locations;
- Identify overlying superficial soils; and
- Identify underlying rock types.

Five possible sites were identified as borrow pits however one was discounted due to engineering constraints. A total estimated volume of aggregate required from the stone extraction areas will be in the order of 31,109m^3. The borrow pits are able to meet the demand for this volume, based on a 70% recovery rate (to allow for overburden and the presence of any unsuitable material) and a maximum of 5m depth.

The traffic assessment Chapter 9 Transport and Access of this EIA Report assumes import of 70% of stone will be imported to site for a robust assessment, although it is anticipated that greater than 30% will be sourced from on-site borrow pits as indicated by the borrow pit assessment.

The final borrow pit arrangement will be refined through further assessment prior to construction.

3.3.10 Electrical Connections

Cabling

The electrical power produced by the individual turbines will be fed to an onsite substation via underground cables or overhead lines. The grid connection will be subject to a separate application.

On site cabling will typically consist of array cables, at 33,000 volts (33KV). The typical installation depth for cables of this voltage is shown in Figure 3-9. It is anticipated these cables will be sited within the footprint of the existing and proposed access track and will be suitably marked on the surface.

Substation and Control Building

One onsite substation would accommodate 33KV equipment to collect electricity from the site. The substation compound would include a control and metering building.

The substation compound will comprise an area of 5m x 30m in total.

Typical elevations for the control and metering building are presented in Figure 3-10.

SCADA System

A Supervisory Control and Data Acquisition (SCADA) system will be installed to gather information from each turbine and to enable each turbine to be controlled from an external location. A fibre optic communications cable will be laid adjacent to the power cables in the same cable trench to link the turbines to the SCADA system. The SCADA system allows remote monitoring of the turbines via a communication link.

3.3.11 Site Signage

The Proposed Development will have suitable signage to provide directions, contacts and health and safety information. There will be signs at the site entrance providing the operator's name, the name of the development and an emergency contact telephone number.

3.3.12 Micro-siting

Micrositing refers to the precise locating of site infrastructure following detailed design. The location of infrastructure would be revised within a specified distance in response to the findings of the more detailed ground investigations that will be carried out as part of the preparations for construction.

Any such repositioning will be limited so as not to involve encroachment into any environmentally sensitive or technically constrained areas. In addition, micrositing provides scope to mitigate potential geo-environmental and geotechnical constraints which may be identified during detailed site investigation works or preparatory ground works.

It is proposed that wind turbines and associated infrastructure including tracks and other hardstandings will have a micrositing allowance of up to a radius of 50m.

Any mitigation measure specified in this EIA Report will be applied during micro-siting of the turbines and associated infrastructure in order that there is no resultant significant additional adverse effect on protected species, habitats or hydrological features.

3.3.13 Construction Programme

Subject to receipt of planning permission and discharge of pre-commencement conditions; construction works are anticipated to commence in 2027 with a total duration estimated at approximately 15 months. The work will proceed in four phases as summarised in Table 3-6.

Table 3-5: Construction Programme

Phase	Summary of Works
Phase 1 (months 1 and 2); Enabling/Access Works;	Construction of new access routes from existing access tracks to the turbine locations.
Phase 2 (month 3 to 12); Development (Main Site)	Establishment of site facilities, turbine foundation and turbine cabling. Delivery of turbine components & installation with cranes.
Phase 3 (month 13 to 14); Commissioning	Testing and commissioning equipment and turbines.
Phase 4 (month 15); Reinstatement and Restoration	Removal of temporary facilities and re-instatement of temporary working areas. Restoration of working areas as set out in the Schedule of Mitigation and CEMP.

The proposed normal hours of operations for construction activity are between 07:00 - 19:00 Monday to Friday, and 07.00 to 13.00 on Saturdays, excluding Sundays and Scottish local and national holidays. During the installation phase, there may be a requirement for extended working hours as some critical elements of installation cannot be stopped once started such as concrete pouring, this will be agreed in advance with Stirling Council.

3.3.14 Construction Methods

An outline CEMP for the Proposed Development has been prepared as part of the EIA Report (Appendix 15-1). The outline CEMP details the principles and procedures for the environmental management of the Proposed Development during construction.

It is intended to be read as an indicative document, noting that the Final CEMP will be developed in collaboration with Stirling Council and will comply with the terms of any planning consent and attendant planning conditions as well as any other relevant agreements and commitments made during the consenting process.

The outline CEMP is considered a live document and methods and processes provided in the document are for guidance only and will be expanded upon and/or amended prior to construction once the Applicant has selected a main Contractor.

3.3.15 Construction Materials

The key materials required for the construction of the track, turbine foundation, hardstanding and cable trenches are as follows:

- Crushed stone;
- Geotextile;
- Cement;
- Sand;
- Concrete quality aggregate;
- Steel reinforcement; and
- Electrical cable.

Materials will be sourced and transported to the site from local suppliers, where possible.

The foundation concrete will be of a grade that accords with the turbine manufacturer's requirements.

3.3.16 Construction Movements

Various vehicle types are required during the construction stage of the Proposed Development. Of these, the majority will be standard road vehicles of similar type to those using local roads on a daily basis. In addition, there will also be dumper trucks, concrete mixer trucks, and lorries. However, the delivery of the main wind turbine components will require vehicles and transport configurations that are longer and/or wider and/or heavier than standard road vehicles.

3.3.17 Health and Safety

High standards of health and safety will be established and maintained throughout the project.

At all times activities will be undertaken in a manner compliant with applicable health and safety legislation and with relevant good practice as defined under applicable statutory approved codes of practice and guidance. This includes:

- The Health and Safety at Work etc. Act 1974, (UK Government, 1974);
- The Construction (Design and Management) Regulations 2015 (as amended) (UK Government, 2015);
- The Work at Height Regulations 2005 (UK Government, 2005); and
- Onshore Wind Health & Safety Guidelines (Renewable UK, 2015).

3.3.18 Environmental Management

The risk of potential environmental impact during the construction phase will be managed by the Site Manager, with specialist advice as required from an Ecological/Environmental Clerk of Works (ECoW). The Site Manager will ensure that construction and activities are carried out in accordance with the CEMP and mitigation measures outlined in the EIA Report.

3.3.19 Waste Management

Waste will be removed off-site for safe disposal at a suitably licensed waste management facility in accordance with current waste management regulations. Wherever possible, excavated stone or soils will be re-used on site, primarily for the restoration of disturbed ground. Details of this will be included within the CEMP.

The main items of construction waste and their sources are:

- Hardcore, stone, gravel from temporary surfaces to facilitate construction waste, and concrete;
- Subsoil from excavations for foundations and roads;
- Timber from temporary supports, shuttering and product deliveries;
- Miscellaneous building materials left over from construction of the control building;
- Sanitary waste from chemical toilets (if used);
- Plastics packaging of material, and
- Lubricating oils, diesel - unused quantities at end of construction period.

Subsoil not required for reinstatement purposes will be collected at the end of the construction phase and disposed of according to best practice and existing waste legislation. Waste oils and diesel will be removed from the Proposed Development Site and disposed of by an approved waste contractor in accordance with provisions of the relevant legislation.

3.3.20 Post Construction Restoration

Reinstatement will be undertaken as soon as practicable after each stage of the project is completed.

Materials and other temporary infrastructure will be removed off-site.

The proposed access tracks will be left in place after completion of the construction phase as they will provide access for maintenance, repairs and the eventual decommissioning phase.

Hardstanding areas at each turbine location will be retained for use in on-going maintenance operations, with the edges as far as possible blended to the adjacent contours with natural vegetation being allowed to re-establish.

3.4 Operation

3.4.1 Operational Lifespan

The Proposed Development will have an operational period of generation of up to 40 years.

3.4.2 Infrastructure Maintenance

On-going track maintenance will be undertaken to ensure that safe access is maintained. The wind turbines will also undergo regular maintenance to ensure safety, cleanliness and efficiency.

3.4.3 Waste Management

Wastes arising as a result of servicing and maintenance (e.g., lubricating oils, cooling oils, packaging from spare parts or equipment, unused paint etc.) will be removed from the Proposed Development Site and reused, recycled or disposed of in accordance with best practice and applicable legislation.

3.5 Decommissioning

Once the Proposed Development ceases operation after the period of generation, the wind farm decommissioned and above ground infrastructure dismantled and removed from the Proposed Development Site.

Unless required in connection with ongoing land management operations, tracks and crane hardstands will be left in situ and allowed to grass over or will be covered with soil and reseeded.

All underground cables will be left in place and de-energised. The crane hardstanding adjacent to a turbine will be removed, if required, and reinstated.

The upper sections of the turbine foundations will be covered with filling material, leaving the foundation completely buried which will permit the continuation of current land use practices.

Peat or topsoil will be replaced and the area reseeded. Tracks and crane hardstands will be left in situ and allowed to grass over or will be covered with soil and reseeded. Cabling will be left in-situ. At least six months prior to the decommissioning of the Proposed Development Site, a Decommissioning Method Statement will be prepared, for agreement with the local authorities and relevant consultees.

It is estimated that this process will take up to 12 months. Unless otherwise agreed, the upper sections of the foundations will be removed to a depth which will permit the continuation of current land use practices.

3.5.1 Waste Management

The decommissioned turbine components will have sufficient salvage value to ensure their proper recycling.

Potentially contaminating material (e.g., lubricating/cooling oils etc.) will be removed and disposed of in accordance with best practice and applicable legislation.

3.5.2 Site Reinstatement

At the expiry of the Proposed Development's lifespan of up to 40 years, it is proposed that the turbines and their transformers will be removed.

The upper sections of the turbine foundations will be removed to a depth which will permit the continuation of current land use practises and backfilled with appropriate material.

Peat or topsoil will be replaced and the area reseeded. Tracks and crane hardstands will be left in situ and allowed to grass over or will be covered with soil and reseeded. Cabling will be left in-situ.

At least six months prior to the decommissioning of the site, a Decommissioning Method Statement will be prepared, for agreement with the local authorities and relevant consultees.

3.6 References

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Chapter 4: Planning and Energy Policy

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1
The Planning Act	The Town and Country Planning (Scotland) Act 1997 (as amended)

List of Abbreviations

Abbreviation	Description
CCC	Climate Change Committee
CCRA	Climate Change Risk Assessment
COP	Conference of the Parties
CO_2	Carbon dioxide
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ESJTP	Energy Strategy and Just Transition Plan
GHG	Greenhouse Gas
LDP	Local Development Plan
NDC	Nationally Determined Contribution
NPF4	National Planning Framework 4
PAN	Planning Advice Note
OnWPS	Onshore Wind Policy Statement
SC	Stirling Council
SES	Scottish Energy Strategy

4 Planning and Energy Policy

4.1 Introduction

This Chapter of the EIA Report identifies the main Development Plan policies and other material considerations applicable to the EIA as a whole. Topic-specific policy is detailed in the relevant topic chapters and not included in this Chapter (Chapters 5-14).

A detailed assessment of the Proposed Development against planning policy is contained within a separate Planning Statement, which is submitted with the planning application and not covered by this Chapter.

4.2 Statutory Development Plan

The Statutory Development Plan consists of the National Planning Policy Framework 4 (NPF4, Scottish Government 2023a) and Stirling Council Local Development Plan (SC LDP, Stirling Council 2018). When determining planning applications Stirling Council (SC) is legally required to make a determination in accordance with the provisions of the Development Plan unless material considerations indicate otherwise.

The approach to the transitional period between the adoption of NPF4 and the adoption of revised local development plans is specified in section 24(3) of the Town and Country Planning Act 1997 (Scottish Government 2023b):

> *"In the event of any incompatibility between a provision of the National Planning Framework and a provision of a local development plan, whichever of them is the later in date is to prevail."*

4.2.1 National Planning Framework 4 (NPF4)

NPF4 was adopted on 13th February 2023 and is the national spatial strategy for Scotland. It sets out the principles for spatial development, defines national developments and regional priorities and sets out national planning policy.

NPF4 sets out significant and increased emphasis on the climate and nature crises as well as the net zero agenda to bring together cross-cutting priorities and achieve sustainable development through three key themes: sustainable places, liveable places and productive places.

Part 1 of NPF4, the National Spatial Strategy for Scotland 2045, will be supported by the planning and delivery of sustainable places; "*where we reduce emissions, restore and better connect biodiversity*"(NPF4 page 4*)*. It sets out that:

> *"Scotland's future places will be net zero, nature-positive places that are designed to reduce emissions and adapt to the impacts of climate change, whilst protecting, recovering and restoring our environment."*(NPF4 page 7)

In terms of renewable energy generation, NPF4 (Annex B – National Developments of Need) acknowledges that:

> *"A large and rapid increase in electricity generation from renewable sources will be essential for Scotland to meet its net zero emissions targets"*: noting that:

> *"Additional electricity generation from renewables and electricity transmission capacity of scale is fundamental to achieving a net zero economy and supports improved network resilience in rural and island areas"*(NPF4 page 103).

National Planning Policy 1 in Part 2 of NPF4: Tackling the climate and nature crises states that:

> *"When considering all development proposals significant weight will be given to the global climate and nature crises"* (NPF4 page 36).

Policy 2: Climate mitigation and adaptation has the policy intent to:

> *"… encourage, promote and facilitate development that minimises emissions and adapts to the current and future impacts of climate change."* (NPF4 page 37)

This indicates that climate change should be a guiding principle for decision making and that substantial policy support is given to any development which contributes towards climate change targets.

Policy 3: Biodiversity has the policy intent to:

> *". . . protect biodiversity, reverse biodiversity loss, deliver positive effects from development and strengthen nature networks"* (NPF4 page 38).

Policy 3(a) states that:

> *"Development proposals will contribute to the enhancement of biodiversity, including where relevant, restoring degraded habitats and building and strengthening nature networks and the connections between them. Proposals should integrate nature-based solutions, where possible."*

Policy 3(b) clarifies that:

> *"Development proposals for national or major development, or for development that requires an Environmental Impact Assessment will only be supported where it can be demonstrated that the proposal will conserve, restore and enhance biodiversity, including nature networks so they are in a demonstrably better state than without intervention."*

Policy 3(d) states that:

> *"Any potential adverse impacts, including cumulative impacts, of development proposals on biodiversity, nature networks and the natural environment will be minimised through careful planning and design."*

The intent of Policy 4: Natural places is to:

> *"…protect, restore and enhance natural assets making best use of nature-based solutions."* (NPF4 page 40).

Policy 4 (a) states that:

> *" Development proposals which by virtue of type, location or scale will have an unacceptable impact on the natural environment, will not be supported"*

The intent of Policy 5: Soils is to:

> *". . . protect carbon-rich soils, restore peatlands and minimise disturbance to soils from development."* (NPF4 page 42)

Policy 5(a) states that:

> *"Development proposals will only be supported if they are designed and constructed:*
>
> *i. In accordance with the mitigation hierarchy by first avoiding and then minimising the amount of disturbance to soils on undeveloped land."*

Policy 5(c) makes it clear that:

> *"Development proposals on peatland, carbon-rich soils and priority peatland habitat will only be supported for:*
>
> *ii. The generation of energy from renewable sources that optimises the contribution of the area to greenhouse gas emissions reductions targets; and*
>
> *v. Restoration of peatland habitats."*

Further clarification as regards requirements for developments that are proposed on peatland, carbon rich soils, or priority peatland habitat is subsequently provided in Policy 5(d), as follows:

> *". . . a detailed site specific assessment will be required to identify:*
>
> *i. The baseline depth, habitat condition quality and stability of carbon rich soils;*
>
> *ii. The likely effects of the development on peatland, including on soil disturbance; and*
>
> *iii. The likely net effects of the development on climate emissions and loss of carbon."*

Policy 7: Historic assets and places has the policy intent to:

> *"...protect and enhance historic environment assets and places, and to enable positive change as a catalyst for the regeneration of places."* (NPF4 page 45)

Policy 7(a) states that:

> *"Development proposals with a potentially significant impact on historic assets or places will be accompanied by an assessment which is based on an understanding of the cultural significance of the historic asset and/or place. The assessment should identify the likely visual or physical impact of any proposals for change, including cumulative effects and provide a sound basis for managing the impacts of change.*
>
> *Proposals should also be informed by national policy and guidance on managing change in the historic environment, and information held within Historic Environment Records."*

Policy 7(h) clarifies that:

> *"Development proposals affecting scheduled monuments will only be supported where:*
>
> *i. direct impacts on the scheduled monument are avoided;*
>
> *ii. significant adverse impacts on the integrity of the setting of a scheduled monument are avoided; or*

> iii. *exceptional circumstances have been demonstrated to justify the impact on a scheduled monument and its setting and impacts on the monument and its setting have been minimised."*

Policy 7(j) states that:

> *"Development proposals affecting nationally important Historic Battlefields will only be supported where they protect and, where appropriate, enhance their cultural significance, key landscape characteristics, physical remains and special qualities."*

The intent of Policy 11: Energy is:

> *"To encourage, promote and facilitate all forms of renewable energy development onshore and offshore. This includes energy generation, storage, new and replacement transmission and distribution infrastructure and emerging low-carbon and zero emissions technologies including hydrogen and carbon capture utilisation and storage (CCUS)."*(NPF4 page 53)

Policy 11(a) states that:

> *"Development proposals for all forms of renewable, low-carbon and zero emissions technologies will be supported. These include: wind farms including repowering, extending, expanding and extending the life of existing wind farms".*

Policy 11 (c) states that:

> *"Development proposals will only be supported where they maximise net economic impact, including local and community socio-economic benefits such as employment, associated business and supply chain opportunities."*

Policy 11(e) states that:

> *"In addition, project design and mitigation will demonstrate how the following impacts are addressed"*; including
>
> *"ii.significant landscape and visual impacts, recognising that such impacts are to be expected for some forms of renewable energy. Where impacts are localised and/ or appropriate design mitigation has been applied, they will generally be considered to be acceptable"*
>
> *"vii. Impacts on historic environment"*

It is clear within NPF4 that the generation of renewable energy is recognised as being of national importance as:

> *"significant weight will be placed on the contribution of the proposal to renewable energy generation targets and on greenhouse gas emissions reduction targets."*

NPF4 recognises that renewable energy generation through onshore wind farm development is a key part of the way in which the emissions reduction statutory outcome and the attainment of the legally binding net zero will be fulfilled. This can be afforded significant weight.

4.2.2 Planning Advice Notes

The Scottish Government has published a number of Planning Advice Notes (PANs, Scottish Government (various dates)) providing advice on good practice on a variety of subjects. Since the adoption of NPF4, references in planning advice to 'spatial framework', 'spatial planning' and 'areas of search', in relation to onshore wind generation have been superseded and are, therefore, not relevant.

The following are considered of relevance to this application as they have informed the EIAR:

- PAN 2/2011: Planning and Archaeology;
- PAN 3/2010: Community Engagement;
- PAN 1/2011: Planning and Noise;
- PAN 51: Planning, Environmental Protection and Regulation;
- PAN 60: Natural Heritage;
- PAN 62: Radio Telecommunications;
- PAN 68: Design Statements;
- Onshore wind turbines: planning advice;
- PAN 73: Rural Diversification;
- PAN 75: Planning for Transport;
- PAN 79: Water and Drainage;
- Flood risk: planning advice;
- Wind farm developments on peat land: planning advice; and
- Planning and waste management advice;

4.3 Local Planning Policy

The adopted Local Development Plan for the Proposed Development comprises:

- SC LDP (Adopted 2018); and
- Relevant supplementary guidance, including the SC Supplementary Guidance on Wind Energy Developments (2019).

4.3.1 Stirling Council Local Development Plan

The SC LDP was adopted in October 2018 setting out how the SC sees the Stirling LDP area developing over the next 10-20 years.

The following policies are considered applicable to the EIA and have been considered during the preparation of this EIAR:

- Primary Policy 1: Placemaking;
- Primary Policy 3: Provision of Infrastructure;
- Primary Policy 4: Greenhouse Gas Reduction;
- Primary Policy 5: Flood Risk Management;
- Primary Policy 7: Historic Environment;
- Primary Policy 8: Conservation and Enhancement Biodiversity;
- Primary Policy 9: Managing Landscape Change;
- Primary Policy 12: Renewable Energy;

- Primary Policy 13: The Water Environment;
- Primary Policy 14: Soil Conservation and Agricultural Land; and
- Primary Policy 15: Tourism and Recreational Development.

4.3.2 Stirling Council Wind Energy Developments Supplementary Guidance (SG) (2019)

The SC Wind Energy Developments Supplementary Guidance (SC 2019a) was produced in February 2019. The Proposed Development sits within the Spatial Framework Map for Onshore Wind Energy produced by SC in August 2016, illustrating that the Proposed Development site is not located within either 'Group 1 Areas where wind farms will not be acceptable' or 'Group 2 Areas of Significant Protection'.

As such falls under Scottish Planning Policy Group 3 Area - with potential for wind farm development, subject to detailed consideration against identified policy criteria.

It is noted, however, that the spatial framework was developed in accordance with SPP which is now superseded and the areas identified within the framework may be incompatible with the principles identified in NPF4.

The Guidance is therefore considered to provide an indication of SC's view on the potential acceptability of wind energy developments in a particular area as opposed to a policy on the spatial approach to wind energy development.

The Proposed Development lies to the immediate north-east of the operational Craigengelt Wind Farm, for which SC provides the following guidance in relation to potential extension: *"Limited expansion of the Craigengelt development, of say 2-3 turbines closely related to the existing layout, may be capable of being absorbed into the area without substantially altering the existing balance between developed and undeveloped areas."*

4.3.3 Other Considerations

Three further SC supplementary guidance documents are considered relevant to this EIA:

- Supplementary Guidance May 2019 Historic Environment Battlefields (SC 2019b);
- Supplementary Guidance November 2019 Biodiversity and Landscape (SC 2019C); and
- Draft Supplementary Guidance November 2019 Landscape Character Assessment (SC 2019d).

Assessment of the Proposed Development against these polices is associated with the relevant technical assessments and included in the relevant Chapters of this EIAR (5 and 6).

4.4 Material Considerations

Onshore Wind Policy Statement

The Onshore Wind Policy Statement (OnWPS) 2022 (Scottish Government, 2022) was published on 21 December 2022 and outlines the Scottish Government's ambitions for the Onshore Wind Sector, highlighting how these can be delivered. The urgency and relevance of the need to meet Net Zero targets is stressed through the statement that: *"We must now go further and faster than before"*.

The OnWPS noted Scotland's installed onshore capacity was 8.7GW as of June 2022, and the aim to maintain a supportive policy and regulatory framework, which will enable an increase in renewable energy deployment and the realisation of the overall ambition of 20 GW of installed onshore wind capacity in the country by 2030. In March 2024 Scotland's onshore wind capacity was 9.6GW, as published by the Scottish Government (2024).

The OnWPS highlights the role '*taller and more efficient turbines*' have to play in meeting this ambition for installed onshore wind capacity, stating: *"Taller turbines have a higher installed capacity which results in the need for fewer turbines per site."* (page 17)

The OnWPS emphasises the Scottish Government's support for: *"all forms of renewable, low-carbon and zero emission technologies"* and clarifies that:

> *"the only areas where wind energy is not supported are National Park and National Scenic Areas. Outside of these areas, the criteria for assessing proposals have been updated, including stronger weight being afforded to the contribution of the development to the climate emergency, as well as community benefits."*

The OnWPS reiterates the Scottish Government's commitment to tackling the climate and nature crises in tandem.

It notes that nature-based solutions, like peatland restoration, can target investment in the right types of natural capital in the right places. In good condition, peatlands provide multiple benefits, including capturing and storing carbon but when degraded peat can become a net emitter of greenhouse gases. Reversing degradation through peatland restoration is therefore central to mitigating and adapting to the linked climate and nature crises.

The OnWPS cites evidence that significant positive effects for biodiversity from wind farm developments can be achieved and provides examples of best practice in biodiversity enhancement on wind energy development. Through this there is an expectation that new onshore wind development will demonstrate commitment to protecting and restoring habitats.

The criteria through which proposals will be evaluated has been updated to focus a stronger emphasis on the role which wind energy developments can play both in the response to the joint climate and nature crises as well as the resulting socioeconomic and community benefits.

Draft Energy Strategy and Just Transition Plan (2023)

The Draft Energy Strategy and Just Transition Plan was published on 10 January 2023 (Scottish Government, 2023c). The Scottish Government's key ambitions for Scotland's energy future are detailed, as well as; "*proposing a vision for a just energy transition*" which provides socioeconomic benefits whilst protecting the environment and providing energy security.

Expanding the energy generation sector is identified as a key ambition with offshore wind, onshore wind, solar and hydrogen listed as just some of the sources which should have the potential to make up the energy mix.

The draft Just Transition Plan emphasises the Scottish Government's focus on; "…*collaboration between people from all parts of Scotland and all walks of life*…" (page 3), ensuring that workers, businesses, communities and consumers have all played a key part in forming the draft through early codesign.

4.5 Climate Change and Energy Policy

4.5.1 Introduction

Climate change has been described as the greatest environmental challenge facing the world today, with the Scottish Government's declaration of the global climate emergency in April 2019 and continued publicity around increasing devastating global climate events linked to climate change to date.

The burning of fossil fuels to produce electricity is a major contributor to climate change through the release of atmospheric carbon dioxide (CO_2) and other harmful gases known collectively as greenhouse gases. As part of the response to climate change, the UK Government has entered into binding international agreements and the Scottish Government has made national commitments to reducing greenhouse gas emissions.

Furthermore, there is a clear national focus, following the COVID-19 crisis, to ensure a 'green recovery' for Scotland.

The generation of electricity from renewable energy sources is one of the principal ways in which the Scottish Government targets to reduce greenhouse gas emissions are to be met within the current policy framework.

The following sections set out key UK and Scottish policies and commitments that are central to the requirement for the Proposed Development.

4.5.2 The Climate Emergency

The UK Parliament, Scottish Parliament and the Scottish Government have declared a Climate Emergency. While there is no formal obligation to act associated with this status it does emphasise a public and political desire to increase the effort to combat climate change and may result in climate change targets being brought forward.

In October 2019 SC recognised the Climate and Nature Emergency, and in 2021 the SC Climate and Nature Emergency Plan 2021-2045 (SC 2021) was published. The Plan explains SC's vision for a fossil fuel-free and climate-ready Stirling and sets out a target for the SC area to achieve 'net zero' carbon by 2045.

4.5.3 International Climate Change Agreements

COP26 – The Glasgow Climate Pact

On 31 October 2021, the COP26 climate summit took place in Glasgow. World leaders and delegates from almost 200 countries were in attendance, alongside tens of thousands of negotiators, government representatives, businesses and members of the public for 13 days of discussions and negotiations.

On the final day of the conference (13 November 2021) the world leaders agreed to the Glasgow Climate Pact (UNFCCC, 2021), a global agreement with the aim of accelerating action on climate change to 2030 and limiting the rise of global temperature to 1.5 degrees, in line with the Paris Agreement (UNFCCC, 2015).

The Glasgow Climate Pact calls on countries to revisit and strengthen their 2030 targets by the end of 2022 to align them with the Paris Agreement's temperature goals. Counties also agreed to return in 2022 with a new UN climate programme on mitigation ambition and that they finalised the Paris "Rulebook".

Notably the Pact states that:

> *"The Glasgow Climate Pact only keeps 1.5C in sight if countries take concerted and immediate action to deliver on their commitments. This means phasing down coal power, halting and reversing deforestation, speeding up the switch to electric vehicles and reducing methane emissions."*

COP27 – The Sharm el-Sheikh Implementation Plan

The COP27 climate summit took place in Sharm el-Sheikh, Egypt from 6th to 18th November 2022. The aim of COP27 was to reiterate the global commitment to tackling the challenges of climate change, particularly in the face of the current energy crisis, as highlighted in the Presidency Vision (UNFCCC, 2022a) target to;

> *"Avoid backsliding on commitments and pledges despite the multiple challenges and crises in particular the energy crisis. We all must show leadership, where pledges and commitments are confirmed…"*

During the summit the parties agreed to the "Sharm el-Sheikh Implementation Plan" which emphasises the *"common but differentiated responsibilities and respective capabilities"* of the nations (UNFCCC, 2022b). Article 3 of Decision-/CP.27 of UNFCCC (2022b) refers to the solution which low-emission, renewable energy presents to climate change and to the energy crisis. The urgent need to rapidly produce sustainable reductions in greenhouse gas emissions and importance of "*enhancing a clean energy mix*" are stressed in Article 3.8 and 3.10 respectively.

Countries agreed to return in 2023 to attend COP28 in the United Arab Emirates to review and strengthen these goals.

4.5.4 UK Climate Change Programme

Sixth Carbon Budget 2020

Following on from the Climate Change Committee's (CCC) Net Zero - The UK's Contribution to Stopping Global Warming 2019, the CCC (2019; 2020) published its recommendations for the UK's Sixth Carbon Budget which will run from 2033 to 2037 with the aim of achieving a fully decarbonised UK economy.

The principal recommendation from the CCC is that the UK sets a Sixth Carbon Budget to require a reduction in UK greenhouse gas emissions of 78% by 2035 relative to 1990, or a 63% reduction from 2019.

The sixth budget, imposed by the Carbon Budget Order 2021 on 24 June, covers the years 2033-2037 (UK Government, 2021a). The UK Government set the budget at 965 million tonnes of carbon dioxide equivalent. This is in line with the CCC's recommendation (CCC, 2021).

Net Zero Strategy: Build Back Greener

In October 2021, the UK Government's (2021b) Net Zero Strategy was presented to the UK Parliament In accordance with Section 14 of the Climate Change Act 2008 (UK Government, 2008). It acknowledges the devastating impact that the increase of global temperatures has already had on the UK through flooding and disruption to major services.

In line with the Paris Agreement (UNFCCC, 2015), reference is made to potentially catastrophic events that will unfold should global warming increase above 1.5 degrees. It is recognised that in order to meet the Paris Agreement, urgent global action is needed hence why the UK called for ending coal fired power generation, retiring petrol and diesel engines from all cars, and halting deforestation at COP26.

The strategy sets out clear policies and proposals for keeping the UK on track for forthcoming carbon budgets, ambitious Nationally Determined Contribution (NDC), and the UK Government's vision for a decarbonised economy in 2050.

The strategy has a number of commitments for reducing emissions across the economy in relation to power generation. For instance, the target that the UK government will take action so that by 2035, all electricity will come from low carbon sources, bringing forward the government's commitment to a fully decarbonised power system by 15 years.

In 2019, net UK GHG emissions from the power sector totalled 58 tonnes of CO_2 and accounted for 11% of total net UK GHG emissions. This is a reduction of 72% between 1990 and 2019. In 1990, the power sector accounted for 23% of UK GHG emissions. This has largely been achieved through renewables and natural gas generation displacing coal.

The UK Government's vision is that low carbon forms of energy generation will be the paradigm shift away from the use of unabated oil and gas. Low carbon energy is expected to account for a 50% or higher share of final energy consumption. This shift to low carbon energy is expected to account for up to 76% reduction in emissions by 2030; up to 85% by 2035 and 98% by 2050, when compared with 2019 emissions.

In delivering this strategy of decarbonising the power sector, significant public and private investment is needed and will see new employment opportunities across the UK. The UK Government estimate that policies and proposals to reduce emissions in the sector could support up to 59,000 jobs by 2024 and up to 120,000 jobs by 2030.

UK Climate Change Risk Assessment 2022

The third UK Government (2022) Climate Change Risk Assessment report (CCRA3, Betts, R.A. and Brown, K. (2021)) was presented to Parliament on 17 January 2022 and outlines the UK Government and devolved administrations' position on the key climate change risks and opportunities that the UK faces.

The Technical Report for the CCRA3 identified 61 UK-wide climate risks and opportunities across multiple sectors such as energy; agriculture; people; transport and biodiversity if there is a 2- and 4-degree global warming scenario (Betts and Brown, 2021).

Of the 61 climate risks and opportunities 34 risks are assessed as 'more action needed' at a UK-wide level. This means that new, stronger, or different government action is required in the next five years over and above those already planned.

Some of the risks include:

- Risk to soils from changing climatic conditions, including seasonal aridity and wetness;
- Risks and opportunities for natural carbon stores, carbon sequestration and GHG emissions from changing climatic conditions, including temperature change and water scarcity;
- Risks to and opportunities for agricultural productivity from extreme events and changing climatic conditions (including temperature change, water scarcity, wildfire, flooding, coastal erosion, wind and saline intrusion);
- Risks to infrastructure services from river, surface water and groundwater flooding;
- Risks to public water supplies from reduced water availability;
- Risks to health and wellbeing from high temperatures;
- Risks to people, communities and buildings from river and surface flooding; and
- Risks to UK food availability, safety, and quality from climate change overseas.

4.5.5 Scotland Climate Change Programme

Climate Change (Emission Reduction Targets) (Scotland) Act 2019

The Climate Change (Emission Reduction Targets) (Scotland) Act 2019 (Scottish Government 2019), emphasises the need to deliver renewable energy targets and focuses on giving considerable weighting to the determination of renewable energy proposals.

These include wind farm applications in areas where the principle of development has already been established.

The Act strengthens Scotland's climate change targets for the reduction of emission levels from an 80% reduction by 2050 to 100% by 2045. Renewable energy projects, such as the Proposed Development, play a key role in supporting the decarbonisation of the energy sector.

Scotland's Climate Assembly: Recommendations for Action (2021)

The Assembly on climate change was established by the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 and comprises a group of over 100 people selected to be representative of Scotland's adult population. The Assembly published their Recommendations for Action in June 2021.

The Recommendations for Action outlined several goals and recommendations across a variety of sectors aimed at addressing the climate emergency in an effective and fair way. The report identified eradicating fossil fuels as a priority through the maximisation of energy generation via renewables.

The Scottish Government (2021a) issued their Response to Scotland's Climate Assembly in December 2021. The Scottish Government set out their intention to publish an Energy Strategy Just Transition Plan (ESJTP), a consultative draft of which was published on 10 January 2023 (Scottish Government, 2023b).

Towards a Robust, Resilient Wellbeing Economy for Scotland, a report of the Advisory Group on Economic Recovery (June 2020)

Established by the Scottish Government in April 2020, the advisory group focusses on the economic recovery following the Covid pandemic. It recognises that the pandemic provides the opportunity to reevaluate Scotland's economic ambition.

In particular, there is a renewed emphasis on the need to accelerate transition to a low carbon economy and support renewable technology with the aspiration of tackling climate change and developing a resilient economy.

Update to the Climate Change Plan 2018-2032: Securing a Green Recovery on a Path to Net Zero

The Scottish Government (2020b) published its updated Climate Change Plan in December 2020. This update to the 2018-2032 Climate Change Plan, along with the Scottish Government (2021b) Energy Strategy: Position Statement (2021) provides the strategic framework for the transition to a low carbon Scotland.

The Update sets ambitious new targets to end Scotland's contribution to climate change by 2045 and sets out the commitment to reduce emissions by 75% by 2030 (compared with 1990) and to net zero by 2045. It states that COVID-19 does not change Scotland's ambitions and indeed, gives Scotland the opportunity to lead the way in meeting climate change targets.

The March 2024 Climate Change Committee (CCC, 2024) Progress in reducing emissions in Scotland 2023 Report to Parliament stated that;

"Most delivery indicators are off track, many significantly so… and overall policy progress has been insufficient over the past year"

and;

"Given the pace at which supply chains and investment would need to develop, this rate of reduction is not credible. However, the Scottish Government should build on its high ambition and implement policies that enable the 75% emissions reduction target to be achieved at the earliest date possible."

In acknowledgement of this report, on 18 April 2024, the Scottish Government (2024) announced that whilst the climate change target to reduce emissions by 75% by 2030 would be removed, the overarching commitment to reach Net Zero by 2045 would remain, stating the intention to;

"…introduce expedited legislation to address matters that the CCC raised and to ensure that our legislative framework better reflects the reality of long-term climate policy making".

The Scottish Government have stated that the adjustment of the 75% target and introduction of this expedited legislation will allow Scotland to;

"retain our legal commitment to 2045, alongside annual reporting on progress, while introducing a target approach that is based on five-yearly carbon budgets."

4.6 Scottish Energy Strategy (2017)

The Scottish Energy Strategy (SES): The Future of Energy in Scotland was published in December 2017 and set out the Scottish Government (2017b) vision for the future energy system in Scotland. It articulates six energy priorities for a whole-system approach that considers both the use and the supply of energy for heat, power and transport.

Sitting alongside the Climate Change Plan, SES is intended to strengthen the development of local energy, protect and empower consumers, and support Scotland's climate change ambitions while tackling poor energy provision.

Built around a series of six energy priorities, the SES will guide the decisions that the Scottish Government, working with partner organisations, needs to make over the coming decades.

Specifically in relation to renewable energy generation, this includes the commitment to;

> "*continue to champion and explore the potential of Scotland's huge renewable energy resource, and its ability to meet our local and national heat, transport and electricity needs – helping to achieve our ambitious emissions reduction targets*".

The SES sets two new targets for the Scottish energy system by 2030:

- The equivalent of 50% of the energy for Scotland's heat, transport and electricity consumption to be supplied from renewable sources; and
- An increase by 30% in the productivity of energy use across the Scottish economy.

For the longer term the SES states that;

> "*Scotland's long term climate change targets will require the near complete decarbonisation of our energy system by 2050, with renewable energy meeting a significant share of our needs*"

It is important to note that this commitment has been brought forward to 2045 following the Climate Change (Emission Reduction Targets) (Scotland) Act 2019 and noted in the Scottish Government (2021b) Energy Position Statement.

In setting out this target, the Scottish Government analysis that sits behind it is described as indicating that renewable electricity has already outperformed targets, stating that;

> "the *interim 2015 target of 50% – could rise to over 140% of Scottish electricity consumption, ensuring its contribution to the wider renewable energy target for 2030*."; and

> "*This assumes a considerably higher market penetration of renewable electricity than today – requiring in the region of 17 GW of installed capacity in 2030 (compared to 9.5 GW in June 2017) – with greater interconnection with parts of continental Europe providing an expanded market for our electricity*".

In championing the potential of Scotland's huge renewable energy resource, the SES recognises that renewable and low carbon energy will provide the foundation of the envisaged future energy system and considers onshore wind to be amongst the lowest cost forms of renewable power generation.

The SES is clear that onshore wind should continue to play a vital role in decarbonising Scotland's energy systems and confirms the importance of supporting onshore wind development, including the extension and replacement of existing sites with larger turbines, in the right places.

Identifying and providing a route to market for onshore wind energy is recognised in the SES as key to achieving the objectives and vision of the strategy and refers to further detail provided in the Scottish Government Onshore Wind Policy Statement 2017 (Scottish Government, 2017a) which was published alongside the SES.

4.6.1 Scotland's Energy Strategy Position Statement (2021)

Published in March 2021, the Scottish Government (2021b) Position Statement provides an overview of key priorities for the short to medium-term in ensuring a green economic recovery and emphasises that Scotland has the most ambitious legislative framework for emissions reduction in the world and a particularly challenging interim target for 2030, underpinned by a legal commitment to deliver a just transition. It recognises that Scotland is making progress towards its target and in 2019, Scotland's renewable electricity generation was able to meet the equivalent of 90% of its gross electricity consumption.

The need for the continued development of the renewable energy sector in Scotland is emphasised within the Position Statement (Scottish Government, 2021b), where is noted that:

> *"The continued growth of Scotland's renewable energy industry is fundamental to enabling us to achieve our ambition of creating sustainable jobs as we transition to net zero."*

This point is further illustrated by recent statistics from Scottish Renewables (2023) and the Scottish Energy Statistics Hub (2023c) which show that:

> *"renewable electricity generation is now equivalent to approximately 97% of Scotland's gross electricity consumption."*

The Statement was published to set out a clear overview of policies in relation to energy ahead of COP26 in November 2021. It reinforces Scotland's commitment to *"supporting the increase of onshore wind in the right places to help meet the target of Net Zero"*, whilst ensuring a *"green, fair and resilient recovery"* for the Scottish economy. It is clear in its position that *"The potential remains for much more renewable capacity and development across Scotland"*.

Furthermore, the recent publication of the June 2023 Climate Change Committee (CCC) report to the UK Parliament (CCC 2023), emphasises the need for the expansion of onshore wind energy, noting that its deployment is "slightly off-track," despite its status as one of the most cost-effective forms of electricity generation.

4.6.2 Draft Energy Strategy and Just Transition Plan (2023)

The Draft Energy Strategy and Just Transition Plan was published on 10 January 2023 (Scottish Government, 2023b). The Scottish Government's key ambitions for Scotland's energy future are detailed, as well as *"proposing a vision for a just energy transition"* which provides socioeconomic benefits whilst protecting the environment and providing energy security.

Expanding the energy generation sector is identified as a key ambition with offshore wind, onshore wind, solar and hydrogen listed as just some of the sources which should have the potential to make up the energy mix.

This is a consultative draft, with responses invited until 9 May 2023, after which they will be used in combination with continuing engagement to further develop the Strategy and Plan. The final version is expected to be published in late 2023.

4.6.3 Progress Towards Energy Targets

The Scottish Government's Energy Statistics for Scotland Q1 2023 (Scottish Government, 2023c) published in June 2023 shows a decrease in renewable electricity generation of 9% from the same period in 2022 and an increase in renewable electricity capacity of 2.2% from 13.9GW in December 2022 to 14.2GW in March 2023.

The Scottish Government previously had a target that by 2020 the equivalent of 100% of Scotland's electricity demand would be generated from renewable sources. Although the target year has passed and the target itself missed, the Scottish Government are continuing to monitor progress against the target of 100% of electricity from renewable sources.

The latest Scottish Energy Statistics (Scottish Government 2023d) indicated that in the twelve months leading up to March 2023, 83.6% of gross electricity consumption was from renewable sources, down from 85.8% in the same period ending March 2022.

This decrease of 2.2% compared to 2022 has been attributed by the Scottish Government to milder weather in 2022 and illustrates that Scotland is not on track to meet its renewable energy targets.

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Chapter 5: Landscape and Visual Impact Assessment

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Technical Appendices

Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site or 'Site'	The land enclosed by the red line shown on Figure 1-1
The Planning Act	The Town and Country Planning (Scotland) Act 1997 (as amended)

List of Abbreviations

Abbreviation	Description
AOD	Above Ordnance Datum
Cumulative LVIA	Cumulative Landscape and Visual Impact Assessment
EDC	East Dunbartonshire Council
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ECU	Energy Consents Unit
FC	Falkirk Council
GDL	Gardens and Designed Landscape
GLVIA	Guidelines for Landscape and Visual Impact Assessment
LCA	Landscape Character Assessment
LCT	Landscape Character Type
LLA	Local Landscape Areas
LVIA	Landscape and Visual Impact Assessment
NCN	National Cycle Network
NLC	North Lanarkshire Council
NSA	National Scenic Area
OS	Ordnance Survey
SC	Stirling Council
SNH	Scottish Natural Heritage (now NatureScot)
WLA	Wild Land Area
ZTV	Zone of Theoretical Visibility

5 Landscape and Visual Impact Assessment

5.1 Introduction

This Chapter of the EIA Report considers the potential effects of the Proposed Development on the landscape and visual resources of the Proposed Development Site (the Site) and the surrounding study area, during construction and operation.

The Site is located in a broadly similar position to the refused Muirpark Wind Farm (11 turbines at 125m to tip height, refused in April 2012, planning reference 09/00170/FUL). The Design and Access Statement of the EIAR provides further information on the reasons for refusal for Muirpark Wind Farm..

Landscape character and resources are considered to be of importance in their own right and are valued regardless of whether they are seen by people. Effects on views and visual amenity as perceived by people are clearly distinguished from, although closely linked to, effects on landscape character and resources. Landscape and visual impact assessment (LVIA) are therefore separate, although linked, processes.

The assessment methodology for the LVIA has been developed in accordance with the Guidelines for Landscape and Visual Impact Assessment (3rd Edition, 2013) (GLVIA3), and is detailed in Appendix 5-1: LVIA and Visualisation Methodology.

This Chapter deals with landscape and visual effects separately, including an assessment of cumulative landscape and visual effects in each relevant section. The baseline for the primary LVIA, against which the effects of the Proposed Development are assessed, includes wind farms which are operational and under construction only.

The cumulative landscape and visual impact assessment (Cumulative LVIA) includes consideration of the Proposed Development against one or more theoretical future baselines, which include all wind farms within the study area that are operational, under construction, consented and at application stage.

A large number of wind farm developments at different stages of development (representing different levels of certainty) are located within the study area. The potential future baseline has been split into two possible scenarios for considering cumulative effects:

1. Scenario 1 – assessment against a baseline including that used for the primary LVIA (wind farms that are operational and under construction) plus those which are **consented** (the presence of which have a higher level of certainty, given they have planning consent); and
2. Scenario 2 – assessment against the primary LVIA and Scenario 1 baseline, plus the inclusion within the baseline of projects at **application stage** and wind farms at **appeal** (the presence of which have a lower level of certainty, given they are as yet undetermined).

The LVIA was undertaken by chartered Landscape Architects (Chartered Members of the Landscape Institute (CMLI)) at LUC with extensive experience in the assessment of landscape and visual effects of wind energy developments.

This chapter should be read in conjunction with the following chapters:

- Chapter 3: Description of Development;

- Chapter 6: Ecology;
- Chapter 10: Cultural Heritage; and
- Chapter 12: Socio-Economics, Tourism and Recreation.

1.1 Scope of the Assessment

1.1.1 Effects Assessed in Full

The following effects have been assessed in full, as identified through the EIA Scoping/consultation process:

- Direct effects on the physical landscape of the Site during construction and operation;
- Direct and indirect effects on landscape character within 20km during construction and operation;
- Indirect effects within 20km which could be of relevance to the reasons for designation as well as the overall integrity of designated landscapes, as required by National Planning Framework 4, with reference to key characteristics/special qualities;
- Direct effects on visual receptors at representative viewpoints within 45km during construction and operation;
- Direct effects on visual receptors at settlements (within 15km) and routes (within 10km for transport routes and 15km for important recreational routes) during construction and operation;
- Cumulative landscape and visual effects (including combined, successive and sequential visual effects) during operation across the 45km study area (but focusing on effects within 20km where significant cumulative interactions are more likely to occur); and
- Effects on residential visual amenity for properties within 2km of the Proposed Development. Further information is provided in Appendix 5-2.

1.1.2 Effects Scoped Out

On the basis of the desk based and field survey work undertaken, the professional judgement of the landscape team, experience from other relevant projects, policy guidance or standards, and feedback received from consultees, the following topic areas have been 'scoped out' of detailed assessment, as proposed in the Scoping Report:

- Effects on receptors beyond 45km from the proposed turbines, where it is judged that significant landscape and visual effects are unlikely to occur;
- Effects on receptors at settlements beyond 15km and along transport routes beyond 10km from the proposed turbines (15km for important recreational routes) where it is judged that significant visual effects are unlikely to occur;
- Effects on landscape character beyond a 20km radius from the proposed turbines, where it is judged that potential significant effects on landscape character are unlikely to occur;
- Effects on designated landscapes beyond a 20km radius from the proposed turbines, from where it is judged that potential significant effects on key

characteristics and/or special qualities, or recognised views from these areas, are judged unlikely to occur;

- Effects on landscape and visual receptors that have minimal or no theoretical visibility (as predicted by the zone of theoretical visibility (ZTV), minimal or no actual visibility or where, in the case of landscape receptors, the key characteristics indicate that significant effects are unlikely;
- Cumulative effects in relation to turbines under 50m to blade tip height, single turbines beyond 5km from the proposed turbines and wind farms at design/scoping stage (except where otherwise stated);
- Effects on landscape character beyond the Site during the construction phase, visual effects during the construction phase, and cumulative landscape and visual effects during the construction phase. These effects are transient in nature and unlikely to exceed operational phase effects, when the proposed turbines are in place; and
- An assessment of effects during the decommissioning phase, as these are likely to be similar to construction phase effects.

5.2 Methodology and Approach

5.2.1 Legislation, Guidance and Relevant Planning Policy

The following guidance, legislation and information sources were considered in carrying out this assessment. Key planning policy, relevant to LVIA is also listed with further detailed policy references provided in Chapter 4.

Legislation and Assessment Guidance

- Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017; Landscape Institute and the Institute of Environmental Management and Assessment (2013) Guidelines for Landscape and Visual Impact Assessment, 3rd Edition (GLVIA3);
- Landscape Institute (2019) Technical Guidance Note 06/19, Visual Representation of Development Proposals;
- Landscape Institute (2019) Technical Guidance Note 2/19, Residential Visual Amenity Assessment (RVAA);
- SNH (2018) A Handbook on Environmental Impact Assessment, Appendix 2: Landscape and Visual Impact Assessment, Version 5;
- SNH (2017) Visual Representation of Wind Farms, Version 2.2; and
- NatureScot (2021) Assessing the Cumulative Impact of Onshore Wind Energy Developments.

Design and Locational Guidance

- SNH (2019) Good Practice During Windfarm Construction, 4th Edition;
- SNH (2017) Siting and Designing Wind Farms in the Landscape, Version 3a;
- SNH (2015) Constructed Tracks in the Scottish Uplands, 2nd Edition;
- SNH (2015) Spatial Planning for Onshore Wind Turbines – Natural Heritage Considerations;

- SNH (updated 2009) Policy Statement No 02/02: Strategic Locational Guidance for Onshore Windfarms in Respect of the National Heritage;
- Scottish Government (2017) Scottish Energy Strategy: The Future of Energy in Scotland;
- Scottish Government (2023) Draft Energy Strategy and Just Transition Plan; and
- Scottish Government (2022) Onshore Wind Policy Statement.

Relevant Planning Policy

The Statutory Development Plan consists of the National Planning Policy Framework 4 (NPF4, Scottish Government 2023a) and Stirling Council Local Development Plan (SC LDP, Stirling Council 2018) and Supplementary Guidance (SC Supplementary Guidance – Wind Energy Developments). Relevant landscape policies include:

- NPF4 Policy 4 – Natural Places;
- NPF4 Policy 11 – Energy;
- SCLDP Policy 9 - Managing Landscape Change; and
- SCLDP Policy 12 – Renewable Energy.

5.2.2 Consultation

In undertaking the assessment, consideration was given to the scoping responses and other consultation as undertaken as detailed in Table 5-1.

In addition to Scoping, consultation was carried out regarding the selection of viewpoints (including night time assessment viewpoints) and cumulative developments for inclusion in the Cumulative LVIA. Consultees included Stirling Council (SC) and NatureScot.

Table 5-1: Consultation Responses

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken/Outcome
Stirling Council 23/10/20	Scoping Opinion	No specific landscape and visual issues raised.	N/A
NatureScot 23/10/20	Scoping Opinion	Do not consider effects will approach or surpass levels that raise natural heritage issues of national interest. The applicant should refer to general scoping and pre-application guidance for onshore wind farms.	N/A
Loch Lomond and Trossachs National Park 23/10/20	Scoping Opinion	No response.	N/A
Other authorities 23/10/20	Scoping Opinion	Not consulted.	N/A
Stirling Council 30/11/22	Post Scoping Viewpoint	Furter viewpoint requested from Doune	Additional day time view included from

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken/Outcome
	Consultation (and Night Time Assessment Viewpoints)	Castle and the Crow Road. Additional night time views requested from these locations and Tomtain.	Crow Road. Due to limited visibility of hubs this is not proposed as a night time view. Visibility from Doune Castle also limited - not included as an LVIA assessment viewpoint given the limited visibility (a visualisation from this location is included to demonstrate the limited nature of visibility, see Viewpoint 17). Tomtain included as a night time viewpoint, see Appendix 5-3.
NatureScot 24/02/23	Post Scoping Viewpoint Consultation (and Night Time Assessment Viewpoints)	Assessment should include a turbine lighting assessment. Requested a night time view from Ben Ledi.	Turbine lighting assessment included. Refer to Appendix 5-3. Following further consultation (email response dated 24/02/23), it was agreed that a night time assessment viewpoint from Ben Ledi is not required (there will not be a significant impact on this view due to viewing distance and intervening lights).
Stirling Council 04/09/23	Post Scoping Cumulative Consultation	No further comment	N/A
NatureScot (No response)	Post Scoping Cumulative Consultation	No response	N/A

5.2.3 Assessment Methodology

This assessment is carried out in accordance with the principles contained within the Landscape Institute Guidelines for Landscape and Visual Impact Assessment (GLVIA3), and is described in detail in Appendix 5-1.

The key steps in the methodology for assessing both landscape and visual effects are as follows:

- The landscape of the study area was analysed, and landscape receptors identified;

- The area from which the Proposed Development may be theoretically visible was established through creation of a ZTV covering a distance of up to 45km from the proposed turbines, refer to Figure 5-1-1a and b for blade tip ZTV;
- The visual baseline was recorded in terms of the places where people will be affected by views of the Proposed Development, and the nature of views and visual amenity, seen by different groups of people;
- Viewpoints were selected (including representative viewpoints, specific viewpoints and illustrative viewpoints), in consultation with NatureScot and Stirling Council (SC);
- Likely effects on landscape and visual resources were identified; and
- The significance of landscape and visual effects were judged with reference to the sensitivity of the resource/receptor (its susceptibility and value) and magnitude of effect (taking cognisance of the scale of effect, geographical extent and duration/reversibility).

Study Area

The study area for the assessment is defined as 45km radius from the outermost turbines of the Proposed Development, as recommended in NatureScot guidance for turbines over 150m to blade tip (SNH, 2017). The study area is shown on Figure 5-1-1.

To consider cumulative effects of the Proposed Development in relation to other schemes in the wider area, wind farms within 45km of the Proposed Development are included for the purposes of modelling and assessment, as agreed with NatureScot and SC. A review of patterns of wind farm development across the study area is also provided following guidance from NatureScot (SNH, 2012) (see Figure 5-1-5a).

A ZTV map was generated, illustrating areas from where the Proposed Development may be visible in the study area. The ZTV is based on bare earth topography and therefore does not take account of potential screening by vegetation or buildings.

The ZTV is used as a tool for understanding where significant visual effects may occur. Receptors which are outside the ZTV will not have visibility of the Proposed Development and are not considered further in this LVIA. The ZTV to blade tip height (up to 180m) is shown in Figure 5-1-1a, and the ZTV to hub height (up to 98.5m) is shown in Figure 5-1-2a. Large A1 format tip and hub height ZTVs were also prepared (refer to Figure 5-1-1b and 5-1-2b).

Desk Based Research and Data Sources

The following data sources informed the assessment:

Designated Areas

- Stirling Council (2019) Supplementary Guidance: Biodiversity and Landscape;
- North Lanarkshire Council (2018) Local Development Plan Background Report: Local Landscape Character;
- Falkirk Council (2021) Supplementary Guidance: Landscape Character Assessment and Landscape Designations; and
- East Dunbartonshire Council Local Development Plan 2 (2022).

Landscape Character and Landscape Capacity

- SNH (2019) National Landscape Character Assessment;
- Stirling Council (2019) Supplementary Guidance: Wind Energy Developments;

- North Lanarkshire Council (2018) Local Development Plan Background Report: Landscape Capacity Study for Wind Turbine Development; and
- Falkirk Council (2015) Supplementary Guidance: Spatial Framework and Guidance for Wind Energy Development.

Mapping

- Ordnance Survey (OS) Maps;
- Landranger 1:50,000 Scale;
- Explorer 1:25,000 Scale;
- Online map search engines; and
- British Geological Society, 1979. Geological Map, Solid, North.

Modelling

- OS Terrain 50 height data;
- Raster Data at 1:50,000 (to show surface details such as roads, forest and settlement detail equivalent to the 1:50,000 scale Landranger maps); and
- Raster Data at 1:250,000 (to provide a more general location map).

Cumulative Assessment

- Data from other wind farm applications; and
- NLC, SC, EDC, FC and the ECU planning portals.

Field Survey

The following field surveys were carried out to inform the assessment:

- Visits to the Site;
- Visits to viewpoints and designated landscapes; and
- Extensive travel around the study area to consider potential effects on landscape character and on experiences of views seen from specific viewpoints, settlements and routes.

Field survey work was carried out during several visits under differing weather conditions between March 2021 and August 2023 and records were made in the form of field notes and photographs.

5.2.4 Assessing Significance

The significance of the potential effects of the Proposed Development was determined by professional consideration of the sensitivity of the receptor and the magnitude of the potential effect.

Sensitivity

Judgements regarding the sensitivity of landscape or visual receptors require consideration of both the susceptibility of the landscape or visual receptor to the type of development proposed and the value attached to the landscape or visual resource. Judgements are recorded as **high, medium or low**. Detailed information about the approach to assessment of sensitivity is provided in Appendix 5-1.

Magnitude

Judgements regarding the magnitude of landscape or visual change are recorded as **high, medium, low or barely perceptible** and combine an assessment of the scale and geographical extent of the landscape or visual effect, its duration and reversibility. Detailed information about the approach to assessment of magnitude is provided in Appendix 5-1.

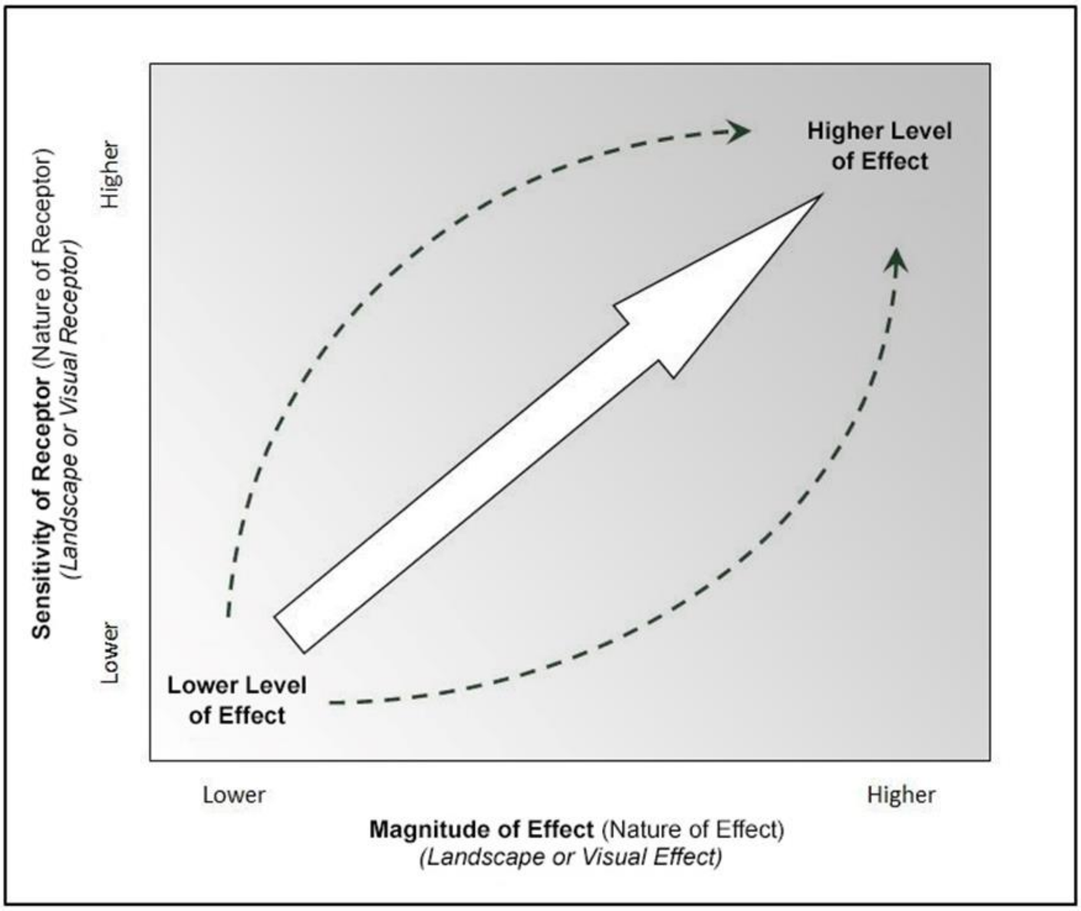
Significance

The predicted significance of the effect was determined through a standard method of assessment based on professional judgement, considering both sensitivity and magnitude of change as detailed in Plate 1 below. **Major and moderate** effects are considered significant in the context of the EIA Regulations.

Judgements are made on a case-by-case basis. Appendix 5-1 provides full details of the criteria considered in judging the identified aspects of sensitivity (susceptibility and value) and magnitude of change (scale, geographical extent, duration and reversibility), and the grades used to describe each.

In terms of the direction of effects (positive or adverse) there is a wide spectrum of opinion with regard to wind energy development. Taking a precautionary stance, effects are assumed to be adverse, unless stated otherwise.

Plate 1 Judging Levels of Effect



5.2.5 Assessment Assumptions / Limitations

No relevant information gaps were identified during the preparation of baseline information or in undertaking the assessment, and it is considered that there is sufficient information to enable an informed decision to be taken in relation to the identification and assessment of likely significant environmental impacts on landscape, views and visual amenity.

In certain visualisations the turbines within the operational Craigengelt Wind Farm (the adjacent operational scheme) have been re-modelled with the rotor blades facing the viewer, to represent the worst case scenario views when the Proposed Development is seen alongside this scheme.

5.3 Landscape Baseline

5.3.1 Introduction

This section presents an overview of the landscape baseline covering current landscape character (including constituent landscape elements), landscape condition and any designations attached to the landscape.

5.3.2 The Site and Context

The Site context is described in Chapter 1: Introduction and detailed information of the Proposed Development is provided in Chapter 3: Description of Development and shown on Figure 3-1.

The Site is located approximately 6km from the edge of Stirling, as shown on Figure 1-1. The Site is contained within the boundaries of Stirling Council.

Located within the Fintry, Gargunnock and Touch Hills to the southwest of Stirling, this is an area of rounded lowland hills, situated between the Campsie Fells and Kilsyth Hills to the south and the Carse of Forth to the northeast.

The landform of the Site comprises a gently sloping ridge which rises from east to west to a localised high point of 357m Above Ordnance Datum (AOD) near the western extent of the Site. A number of water courses emerge within the Site and drain into Buckle Burn, a tributary of the River Carron, and to Loch Coulter Reservoir to the east.

The land cover of the Site is predominantly moorland, and this largely extends across the surrounding hills. Blocks of coniferous forestry and operational wind turbines are also located upon the hills surrounding the Site, and influence the character of the surrounding landscape.

The nearest more substantive settlement to the Site is Stirling, approximately 6km to the east northeast of the nearest proposed wind turbine. Cambusbarron is situated directly to the west of Stirling, to the west of the M9, approximately 6km to the northeast of the nearest proposed wind turbine.

There are a number of individual properties and small clusters of properties located within closer proximity, largely located along minor roads to the northwest, northeast and south of the Site. Carron Bridge is a hamlet which lies around 3.5km to the south. Core Paths within 5km of the Site are mapped on Figure 5-1-1.

5.3.3 The Study Area

The Study Area, shown on Figure 5-1-1a, extends to a 45km radius from the outermost turbines of the Proposed Development in all directions, and includes land within Stirling, Argyll & Bute, Perth & Kinross, Clackmannanshire; Falkirk, North Lanarkshire, East Dunbartonshire, West Dunbartonshire, Glasgow City, East Renfrewshire, Renfrewshire, South Lanarkshire, West Lothian, City of Edinburgh and Fife.

The Study Area reaches from Comrie and the surrounding hills in the north to the Forth Bridges in the east, to areas of farmland beyond Glasgow to the south, to the inner Firth of Clyde and southern extents of Loch Lomond in the west.

The landscape character of the Study Area is very varied and includes open areas of rolling plateau farmland, upland hills and mountains, lowland river valleys and urban centres. The Firth of Forth is located in the east of the Study Area, and the Firth of Clyde is located in the west.

Within the more immediate Study Area, open moorland and areas of coniferous forestry form the characteristic landcover. Coniferous forestry is particularly evident beyond the Carron Valley Reservoir to the south, although scattered blocks of coniferous forestry are also evident closer to the Site on the surrounding low-lying hills to the north and east.

There are nine residential properties within 2km of the proposed turbines. Settlement near the Site is largely focussed to the east and south, and within 10km includes the small hamlet of Carron Bridge, as well as Gargunnock, Cambusbarron, Stirling, Denny and Kilsyth. Within the Study Area more broadly, settlement is also focused to the south and east.

Glasgow is located wholly within the Study Area to the southwest, while to the east and southeast towns include Livingston, Falkirk and Dunfermline. Major transport routes within the Study Area include the M8, M9 and M80 which link Glasgow, Edinburgh and Stirling, as well as the A9 and a number of main line railway lines.

There are a number of Scottish Great Trails within the Study Area, including the John Muir Way and Forth and Clyde Canal, approximately 10km to the south. Approximately 20km to the west, the West Highland Way passes through Milngavie and Drymen.

The Rob Roy Way passes approximately 25km to the north, running through Aberfoyle and near Ben Ledi. To the east, the Fife Coastal Path skirts along the northern edge of the Firth of Forth, passing within 20km of the Site. To the south, the Clyde Walkway passes within 25km, cutting through Glasgow.

Other recreational routes within the Study Area include National Cycle Network (NCN) routes. NCN routes 76/765 are in closest proximity to the Site, passing approximately 10km to the northeast near Stirling.

The closest commercial scale wind farm to the Site is the operational Craigengelt Wind Farm, situated to the immediate southwest (eight turbines at 125m to tip height). There are also a number of large scale wind farms across the Study Area, as shown on Figure 5-1-5a.

Within the more immediate context, these include the operational Kingsburn (9 turbines at 115m to tip height) and Earlsburn (15 turbines at 110m to tip height) Wind Farms, located approximately 5km to the northwest. Refer to Table 5-2 for further detail of wind farms in the Study Area.

5.3.4 Other Wind Farm Development

Existing Wind Farm Development

There are a number of operational wind farms and wind farms under construction in the study area which form part of the primary LVIA baseline, as listed in Table 5-2 and shown in Figure 5-1-5a.

Identification of Developments to be included in the Cumulative LVIA

The assessment of cumulative effects focuses on developments that are likely to give rise to significant cumulative effects, and concentrates on the relationship between the Proposed Development with other operational, consented and proposed developments (i.e. developments with a valid application or awaiting determination following appeal/public inquiry) in a theoretical future baseline.

Wind energy developments located within the 45km radius study area, which may potentially give rise to significant cumulative effects, and therefore included in the Cumulative LVIA, have been selected as follows:

- Single wind turbines ≥50 m blade tip height within a 5km radius of the proposed outermost wind turbines; and

- Wind farms (e.g. clusters of 2 or more wind turbines) with wind turbines of ≥50 m blade tip height within a 45km radius of the proposed outermost wind turbines.

Consented wind farms and wind farms currently in the planning system are considered as part of the assessment of potential future cumulative effects and included in the Cumulative LVIA. Scoping stage schemes, within 10km of the Proposed Development are considered, but noting that there are currently none.

Cumulative cut off (the list of wind farms included within the cumulative assessment) was agreed in August 2023 with statutory consultees. However, given the passage of time this has been updated to 30th April 2024. These developments are listed in Table 5-3 below and shown on Figure 5-1-5a.

Table 5-2: Operational and Under Construction Wind Farms Considered in The Primary LVIA Baseline

Distance (km)[1]	Name	Status	Blade Tip Height (m)	Number of Turbines
Operational				
1	Craigengelt	Operational	125	8
3	Craignannet	Operational	99	1
5	Earlsburn	Operational	110	15
7	Kingsburn (Earlsburn North)	Operational	115	9
10	Tod Hill	Operational	125	4
12	Rosehill Farm	Operational	99.5	3
18	Greendykeside	Operational	100	2
19	Gardrum 1 & 2	Operational	86.45	2
19	Greengairs East	Operational	149.9	8
22	Burnfoot Hill	Operational	100	13
22	Rhodders	Operational	102	6
23	Braes O Doune	Operational	100	36
23	Burnfoot East	Operational	135	3
23	Burnfoot Hill North (was previously called Extension II)	Operational	102	2
23	Burnhead	Operational	126.5	13
23	Drumduff	Operational	120	3
27	Standhill Farm	Operational	84	2
27	Torrance Farm	Operational	125	3
27	Torrance Farm (Wind Park) Extension	Operational	125	2
30	West Benhar	Operational	149.9	7
31	Greenknowes	Operational	93	18
35	Blantyre Muir	Operational	115	3
35	Blantyre Muir Extension	Operational	115	3
35	Black Law Extension Phase 2	Operational	126.5	11

[1] This is an approximate distance taken between the approximate centre point of each wind farm

Distance (km)[1]	Name	Status	Blade Tip Height (m)	Number of Turbines
36	Black Law Extension	Operational	126.5	23
36	Tormywheel	Operational	111	15
37	Black Law	Operational	115.1	54
37	Longhill Burn	Operational	200	8
35	Watsonhead Farm	Operational	149.9	2
38	Pates Hill	Operational	107	7
39	Pearie Law	Operational	125	6
40	Lochhead Farm	Operational	100	3
41	Harburnhead	Operational	126	22
41	Over Enoch and Ardoch	Operational	110	5
42	Middleton	Operational	100	6
43	Muirhall	Operational	125	6
43	Whitelee	Operational	110	140
44	Mossmorran	Operational	100	2
44	Muirhall Wind Farm Extension	Operational	147	2
44	Myres Hill	Operational	87	2
44	Neilston	Operational	110	4
44	Priestside Farm	Operational	67	2
45	Little Raith	Operational	126.5	9
45	Muirhall South	Operational	147	3
46	Inverclyde	Operational (note: some turbines within 45km study area)	110	8
46	West Browncastle	Operational (note: some turbines within 45km study area)	129.9	12
47	Whitelee Phase I	Operational (note: some turbines within 45km study area)	140	36
47	Whitelee Phase II	Operational (note: some turbines within 45km study area)	140	39
Under Construction				
27	Strathallan (previously called Greenscares)	Under construction	93	9

Table 5-3: Consented and Proposed Wind Farms considered in the Cumulative LVIA

Distance (km)[2]	Name	Status	Blade Tip Height (m)	Number of turbines
Consented (included in Scenario 1 and 2 cumulative baseline)				
7	Shelloch	Consented	180	5
18	Greengairs	Consented	125	9
20	Easter Drumclair Extension (now called Easter Drumclair Wood)	Consented	149.5	2
24	Forrestfield	Consented	125	4
24	Drumduff Extension	Consented	149.9	3
29	Brownhill Farm	Consented	150	2
29	Hartwood	Consented	126.5	7
36	Rigmuir Landfill	Consented	149.9	3
36	Tormywheel Extension	Consented	149.9	2
38	Heathland (Variation)	Consented	180	14
39	Kittymuir Farm	Consented	77	2
39	Pearie Law Extension	Consented	180	4
42	Camilty Resubmission	Consented	149.9	6
Application Submitted (included in Scenario 2 cumulative baseline)				
5	Earlsburn Extension	Application Submitted	180	11
24	The Heights	Application Submitted	180	3
25	Dewshill	Application Submitted	200	2
27	Torrance Farm Extension II	Application Submitted	200	4
31	Vale of Leven	Application Submitted	250	10
35	Gladsmuir Hills	Application Submitted	220	6
39	High Knoweglass Farm	Application Submitted	150	2
39	Woolfords Farm	Application Submitted	180	3

It should be noted that the baseline situation for the cumulative assessment is constantly evolving, and there may be changes to the status or list of wind energy developments considered between carrying out the assessment and the determination of the application.

Unless there are substantial changes to proposals that will materially alter the pattern of cumulative development (such as the addition of a large wind farm located within a 10km radius of the Proposed Development), it is considered that the cumulative assessment undertaken within this LVIA will remain largely relevant and able to inform the consenting process.

Although all these wind farms are considered in the cumulative assessment, the assessment focuses on the relationship of the Proposed Development with the closest wind farms or groups of wind farms, as identified on Figure 5-1-5b.

[2] This is an approximate distance taken between the approximate centre point of each wind farm

Given the varied status, and therefore uncertainty, associated with un-built wind farms across the study area, the Cumulative LVIA is structured so as to report on two potential development scenarios:

- Scenario 1: Higher level of certainty: the addition of the Proposed Development to an assumed baseline with operational, under construction and **consented** wind farms; and
- Scenario 2: Lower level of certainty: the addition of the Proposed Development to an assumed baseline with operational, under construction, consented and **undetermined valid applications** (including those at appeal).

The Cumulative LVIA provides assessments of the Proposed Development against alternative future theoretical baselines. Where effects differ to those as identified in the primary assessment, these are discussed.

'Total' or 'in combination' cumulative effects (i.e. assessment which considers the effects if all current, past and future proposals are deemed present, including the Proposed Development) are also discussed.

Combined ZTVs (Figures 5-1-6a to e) for other wind farms were prepared to show where ZTVs overlap and where cumulative views may occur. This includes combined views – two wind farms seen at the same time in a similar direction, and successive views – two wind farms seen from the same location but in different directions.

General Observations – Current Wind Energy Baseline

General observations on the location, pattern and scale of existing wind energy development (**operational and under construction**) across the study area are summarised below:

- The closest commercial scale wind farm development to the Site, Craigengelt (eight turbines, 125m to tip height) is a standalone scheme less than 1km to the southwest of the nearest turbine.
- Two operational wind farms, Kingsburn (9 turbines, 115m to tip height) and Earlsburn (15 turbines, 110m to tip height) are located approximately 5km to the northwest of the Site.
- There is a cluster of operational wind farm development approximately 23km to the northeast of the Site in the Ochil Hills, including Burnfoot Hill (11 turbines, 102m to tip height), Burnfoot Hill East (2 turbines, 135m tip height), Burnfoot Extension (was called Burnfoot North) (2 turbines, 102m tip height), and Rhodders (6 turbines, 102m tip height).
- The operational Braes of Doune wind farm (36 turbines, 100m tip height) is located approximately 24km to the north of the Site.
- There are two smaller operational schemes in the Carse of Stirling, within 15km to the east of the Site (Rosehill Farm and Tod Hill).
- There are a number of operational schemes in farmland and moorland in the central belt between Livingstone and Airdrie, including Greendykeside, Burnhead and Drumduff.
- There is a large cluster of turbines beyond 40km to the southwest of the study area, around Whitelee Wind Farm.
- There is a large cluster of turbines to the southeast of the study area, beyond 30km around Black Law Wind Farm.

- Strathallan (was called Greenscares) (9 turbines, 92.5m to tip) is approximately 27.5km northeast of the Site and is currently under construction.

As illustrated on Figure 5-1-5b, within the immediate surroundings the Proposed Development will generally be seen in combination with the operational Craigengelt Wind Farm, and is often likely to be perceived as an extension of this development, extending the influence of wind turbines to the northeast of this operational scheme. This is explored further in the following assessment.

General Observations – Consented Developments

General observations on the location, pattern and scale of existing wind energy development (operational and **consented**) across the study area are summarised below:

- The consented Shelloch Wind Farm (5 turbines, 180m to tip height) is approximately 7km to the west of the Site.
- Forrestfield (4 turbines, 125m to tip) and other consented schemes including Greengairs, Drumduff Extension and Easter Drumclair Extension will increase the influence of wind farms in farmland and moorland in the central belt between Livingstone and Airdrie within approximately 25km southeast of the Site.
- Consented schemes increase the influence of wind turbines around the Black Law Wind Farm cluster, beyond 30km to the southeast of the study area.

As illustrated on Figure 5-1-5b, within the immediate surroundings the Proposed Development will be seen in combination with the operational Craigengelt Wind Farm, and is often likely to be perceived as an extension of this development, moving northeast into the landscape.

The Proposed Development will be seen as separate to the existing wind farm cluster located to the northwest (Earlsburn and Kingsburn) and the consented Shelloch Wind Farm, located 7km west of the Site, which will further extend the influence of wind farm development into the Gargunnock and Touch Hills.

General Observations – Proposed Developments at Application and Appeal

General observations on the location, pattern and scale of existing wind energy development (operational, consented and **proposed**) across the study area are summarised below:

- Earlsburn Extension (15 turbines, 180m to tip) is located approximately 3.5km to the northwest.
- Proposed schemes including The Heights, Dewshill and Torrance Extension will increase the influence of wind farms in farmland and moorland in the central belt between Livingstone and Airdrie within approximately 30km southeast of the Site.
- Proposed schemes increase the influence of wind turbines around the Black Law Wind Farm cluster, beyond 30km to the southeast of the study area.

As illustrated in Figure 5-1-5b, the Proposed Development will continue to be seen in combination with the existing Craigengelt Wind Farm scheme, and is often likely to be perceived as an extension of this development, moving northeast into the landscape.

Under a theoretical baseline which includes proposed wind farms, the Proposed Development will continue to be seen as separate to the existing wind farm cluster located to the northwest (including the operational Earlsburn and Kingsburn and the consented Shelloch Wind Farm).

When seen in combination with the proposed Earlsburn Extension, the Proposed Development is likely to substantially increase the influence of wind farm development into the Gargunnock and Touch Hills.

5.3.5 Landscape Character Types

This section provides a description of landscape character (including constituent landscape elements), drawing on published studies, supplemented with project specific research and fieldwork where relevant.

In 2019 NatureScot, via their website, made available an updated national Landscape Character Assessment (LCA) for Scotland[i]. The Site is classified as Lowland Hills Landscape Character Type (LCT) within this LCA.

The wider study area includes many different LCTs from lowland and urban areas to high plateaux and hills. These are described in further detail in the NatureScot Scottish Landscape Character Types Map and Descriptions. The LCTs within the Study Area are illustrated on Figure 5-1-3a and with the ZTV of Figure 5-1-3b.

Consideration of the key characteristics; influence of existing operational wind farms; and potential relationship with the Proposed Development (including the extent of the ZTV coverage and actual visibility) is used as a means of identifying which LCTs require further assessment, and which LCTs can be scoped out because they are unlikely to experience significant effects arising from the Proposed Development.

Due to the nature and theoretical visibility of the Proposed Development (a four turbine wind farm located adjacent to the operational Craigengelt), effects on landscape character in LCT beyond 20km are not judged to be significant.

For LCT within 20km of the Proposed Development and for those with limited actual visibility; and/ or LCT where the existing landscape characteristics or relationship with existing wind farms is such that effects are unlikely to be significant, these are not considered further within the assessment. Details are provided in Table 5.4, with LCTs to be included shown in bold.

Table 5-4: Landscape Character Types

Landscape Character Type	Theoretical visibility of Proposed Development (ZTV coverage) and other considerations to determine if LCT should be carried forward for detailed assessment
149. Lowland Hills – Central	**The Site is located in this LCT and there is widespread theoretical visibility within 20km – considered further.**
150. Lowland Hill Fringes – Central	**Widespread theoretical visibility across parts within 20km – considered further.**
151. Lowland Plateaux – Central	No visibility from the unit to the northwest, just within 10km. More widespread visibility from the unit to the southeast. This unit is beyond 10km distance and when visible the Proposed Development will be seen in the context of outward views which have been altered by wind farm development. Other human influences over the landscape are also readily

Landscape Character Type	Theoretical visibility of Proposed Development (ZTV coverage) and other considerations to determine if LCT should be carried forward for detailed assessment
	apparent. In this context effects on landscape character are unlikely to be significant – not considered further.
152. Lowland River Valleys – Central	**Widespread theoretical visibility across parts within 20km – considered further.**
153. Carselands	**Widespread theoretical visibility across parts within 20km, to the east – considered further.**
154. Lowland Valley Fringes	**Widespread theoretical visibility across parts within 20km, to the east – considered further.**
200. Rolling Farmland – Glasgow & Clyde Valley	Very limited theoretical visibility within 20km – not considered further.
201. Plateau Farmland – Glasgow & Clyde Valley	Some theoretical visibility across parts within 20km; actual visibility reduced by built form in the LCT. When visible the Proposed Development will be seen in the context of outward views which have been altered by wind farm development. Other human influences over the landscape are also readily apparent. In this context effects on landscape character are unlikely to be significant – not considered further.
203. Urban Fringe Farmland	Very limited theoretical visibility within 20km – not considered further.
205. Broad Valley Lowland - Glasgow & Clyde Valley	Very limited theoretical visibility within 20km – not considered further.
211. Drumlin Foothills	Very limited theoretical visibility within 20km – not considered further.
213. Plateau Moorlands - Glasgow & Clyde Valley	Theoretical visibility across parts beyond 10km; actual visibility limited by coniferous forest cover within the LCT. This unit is beyond 10km distance and when visible the Proposed Development will be seen in the context of outward views which have been altered by wind farm development (and other human influences). In this context effects on landscape character are unlikely to be significant – not considered further.
216. Rugged Moorland Hills	**Widespread theoretical visibility within 5km across the northern extents of the LCT – considered further.**
257. Plateau Moor and Forest – Loch Lomond and the Trossachs	Very limited theoretical visibility within 20km – not considered further.
259. Rolling Farmland and Estates – Loch Lomond and the Trossachs	Very limited theoretical visibility within 20km – not considered further.
262. Lowland Peatland and Loch Basin	Very limited theoretical visibility within 20km – not considered further.

5.3.6 Designated Landscapes

The Site is situated within the locally designated Southern Hills Local Landscape Area (LLA). There are also a number of landscape designations across the 45km study area, including local level designations. These are shown on Figure 5-1-4a and b.

Consideration of the special qualities / reasons for designation; influence of existing operational wind farms; and potential relationship with the Proposed Development (including the extent of the ZTV coverage and actual visibility) are used as means of identifying which designated landscapes require further assessment.

National landscape designations within the study area comprise the Trossachs National Scenic Area (NSA), Loch Lomond NSA and River Earn (Comrie to St Fillans) NSA; and Loch Lomond and the Trossachs National Park.

These national landscape designations are all located more than 20km from the Proposed Development, and visibility is generally limited to higher site-facing hill flanks. Where the Proposed Development is visible, it will be seen in the context of wide-ranging, panoramic views which have been altered by wind farm development including the operational Craigengelt, near the Site. As such, these national level landscape designations are not considered further.

Table 5-5 sets out which local level designated landscapes require further consideration. Due to the nature of the Proposed Development (a four turbine wind farm located adjacent to the operational Craigengelt) and when visible, effects on landscape designations beyond 20km is not judged to be significant.

For those within 20km of the Proposed Development, and those with limited actual visibility; or where the context in which the Proposed Development is seen is unlikely to compromise the reasons for designation, these are not considered further within the assessment.

Table 5-5: Designated Landscapes

Designated Landscape	Theoretical visibility of Development (ZTV coverage) and other considerations to determine if Landscape Designation carried forward for detailed assessment
Southern Hills LLA	**The Site is located within this LLA and there is widespread theoretical visibility within 20km – considered further.**
Denny Hills SLA	Located in the adjacent Falkirk Council area, the ZTV indicates visibility from the northwestern facing hill flanks across this LLA, between 3 and 6km distance approximately. Forest cover along the northwestern edge of the area will somewhat reduce visibility. When visible, the Proposed Development will be seen in large scale medium distance views looking out of the LLA. It will be seen in the context of views which have already been altered by operational wind farm development in the Gargunnock and Touch Hills (including the closer proximity Craigengelt). The role the hills play in providing a setting to settlements to the southeast, will not be altered by wind farm development at the Site. As such, the Proposed Development is

Designated Landscape	Theoretical visibility of Development (ZTV coverage) and other considerations to determine if Landscape Designation carried forward for detailed assessment
	unlikely to significantly alter the integrity of the LLA – not considered further.
Kilsyth Hills SLA	Located in the adjacent Falkirk Council area, the ZTV indicates visibility from the northwestern facing hill flanks across this LLA, between 3 and 6km distance approximately. Forest cover along the northwestern edge of the area will notably reduce visibility. When visible, the Proposed Development will be seen in large scale medium distance views looking out of the LLA. It will be seen in the context of views which have already been altered by operational wind farm development in the Gargunnock and Touch Hills (including the closer proximity Craigengelt). The role the hills play in providing a setting to settlements to the southeast, will not be altered by wind farm development at the Site. As such, the Proposed Development is unlikely to significantly alter the integrity of the LLA – not considered further.
Campsie Fells LLA	Somewhat limited theoretical visibility across parts within 15km; actual visibility limited by coniferous forest cover within the LLA – not considered further.
Western Ochils and The Ochills LLA	Theoretical visibility from southern facing hill flanks, within 20km. When visible, will be seen in the context of longer distance views (beyond 10km) and in the context of other wind farms (including Craigengelt and Earlsburn). The role the hills play in providing a setting to settlements to the south, will not be altered by wind farm development at the Site. As such, the Proposed Development is unlikely to significantly alter the integrity of the LLA – not considered further.
Keir LLA	Widespread theoretical visibility within 15km. Actual visibility will be reduced by mixed woodland cover, including policy woodlands associated with Keir House. When visible, will be seen in the context of longer distance views (beyond 10km) and in the context of other wind farms (including Craigengelt and Earlsburn). The role the hills play in providing a setting to settlements to the northeast, will not be altered by wind farm development at the Site. As such, the Proposed Development is unlikely to significantly alter the integrity of the LLA – not considered further.
Glazert Valley LLA	Very limited theoretical visibility – not considered further.
Bar Hill LLA	Very limited theoretical visibility – not considered further.
Bardowie, Baldernock and Torrance LLA	Very limited theoretical visibility – not

Designated Landscape	Theoretical visibility of Development (ZTV coverage) and other considerations to determine if Landscape Designation carried forward for detailed assessment
	considered further.
The Forest LLA	Widespread theoretical visibility, beyond 15km. Actual visibility will be reduced by characteristic forest cover across the LLA. From more limited areas with open views, will be seen in the context of longer distance views (beyond 15km) and in the context of other wind farms (including Craigengelt and Earlsburn). As such, the Proposed Development is unlikely to significantly alter the integrity of the LLA – not considered further.
Slamannan Plateau/ Avon Valley LLA	More limited pattern of visibility focused to southern valley side. Woodland cover will further reduce actual visibility. When visible, will be seen in the context of longer distance views (beyond 15km) and in the context of other wind farms (including Craigengelt). As such, the Proposed Development is unlikely to significantly alter the integrity of the LLA – not considered further.
Rednock LLA	Very limited theoretical visibility – not considered further.

5.3.7 Wild Land Areas

Wild Land Areas (WLAs) are not designated but are identified and mapped, with accompanying WLA descriptions published by NatureScot in January 2017. There is one area of Wild Land located within the 45km study area, as shown on Figure 5-1-4a, Ben More – Ben Ledi (07) WLA (an LVIA Viewpoint is also included from here, see Viewpoint 15). Theoretical visibility from this WLA, as illustrated by Figure 5-1-4a, is limited, with localised areas of high elevation experiencing theoretical visibility at a distance of beyond 25km. Limited and long distance views of further wind farm development outside the WLA are unlikely to compromise its key attributes.

Furthermore, under NPF4 Policy 4 (g), Buffer zones around wild land will not be applied, and effects of development outwith wild land areas will not be a significant consideration. As such, it is not considered further within this assessment.

5.3.8 Gardens and Designed Landscapes, Regional Parks and Country Parks

There are no Gardens and Designed Landscapes (GDL) within the Site. There are a number of GDL across the 45km Study Area as shown on Figure 5-1-4a. The closest GDL is Touch, a designated landscape renowned for its artistic layout, plant collection and architectural features, located within 5km to the north.

However, there is very limited theoretical visibility to the Site, and it is not anticipated that views towards the Proposed Development are likely to detract from the GDL's special qualities.

Effects on the settings of GDL are considered further in Chapter 10: Archaeology and Cultural Heritage of this EIA Report.

5.4 Visual Baseline

5.4.1 Introduction

This section identifies the extent of potential visibility of the Proposed Development, and identifies visual receptors that are assessed as part of the LVIA. This section also introduces the viewpoints that are used to assess effects on receptors, including reasons for their selection.

5.4.2 Analysis of Visibility of the Proposed Development

Figure 5-1-1 and Figure 5-1-2 show the theoretical visibility of the Proposed Development to maximum wind turbine blade tip height (180m) and hub height (98.5m) respectively. The ZTV indicates that, across the study area, theoretical visibility of the Proposed Development is significantly more widespread around the Site and to the east of the Study Area.

Within 5km, the ZTV indicates that theoretical visibility of the Proposed Development is widespread in all directions, particularly across the low rolling hills to the east, and across the elevated areas of the Gargunnock and Touch Hills to the north. There is widespread visibility of the Proposed Development from the minor road that crosses to the north at the base of Earl's Hill and to the south near Carron Bridge.

Between 5km and 10km from the turbines, there is theoretical visibility of all four turbines across the northern facing moorland slopes of the Kilsyth Hills and east facing slopes within the Fintry Hills, and widespread theoretical visibility from the lower ground to the northeast within the Forth Valley and the Carse of Stirling. There is some theoretical visibility from the NCN Route 76 near Stirling, although built development and vegetation is likely to reduce actual visibility.

Between 10km and 20km, the ZTV indicates theoretical visibility from higher ground in the Campsie Fells to the west within approximately 15km. Beyond this, theoretical visibility to the west is very limited. To the east, theoretical visibility is widespread across lower ground surrounding the Firth of Forth and across the Carse of Stirling, stretching as far as Dunfermline, and the south facing hills flanks of the Ochil Hills.

Beyond 25km, the ZTV indicates theoretical visibility from the hills to the north of Doune, on south-facing slopes. To the south, theoretical visibility is more intermittent, focussed towards the site-facing rising ground and lower lying hills between Glasgow and Edinburgh.

Beyond 30km to the south, theoretical visibility is limited, concentrated across rising ground south of Glasgow, near Hamilton. To the west within 30km, there is limited and scattered theoretical visibility from areas of higher ground, particularly from Ben Ledi and Ben Venue and Ben Vorlich, on Site-facing slopes.

Beyond 30km, there is scattered theoretical visibility across west facing slopes north of the River Forth and the Forth of Firth, to the east of the Study Area.

5.4.3 Key Visual Receptors

Potential visual receptors include:

- Residents, including views from isolated properties and settlements;
- Those engaged in recreational activities (e.g. hill walkers and cyclists);
- Road users (including tourists); and
- People at their place of work, including agricultural workers.

5.4.4 Selection of Viewpoints for Assessment

This section presents the viewpoints that are used to represent and assess the visual effects of the Proposed Development. The viewpoint list is a representative selection of locations agreed with the statutory consultees that have responded; it is not an exhaustive list of locations from which the Proposed Development will be visible.

16 assessment viewpoints (and a representative viewpoint from Doune Castle) were selected across the 45km study area through desk study, field work and discussions with statutory consultees.

These viewpoints are all publicly accessible as advocated by GLVIA3 and include:

- Locations selected to represent the experience of different types of receptor;
- Locations at different distances to provide a representative range of viewing angles and distances (i.e. short, medium and long distance views);
- Locations which illustrate key cumulative interactions with other existing, consented and/or proposed wind farms (either in combination or succession);
- Locations which represent a range of viewing experiences (i.e. static views and points along sequential routes);
- Specific viewpoints selected because they represent promoted views or viewpoints within the landscape; and
- Illustrative viewpoints chosen specifically to demonstrate a particular visual effect or specific issue (which could include restricted visibility in particular locations).

The viewpoints were selected to represent a range of receptors, viewing directions, distances and elevations. The viewpoints are listed in Table 5-6 and shown on Figure 5-1-1.

Table 5-6: Viewpoint Locations

No.	Location	Reason for Selection	Grid Reference (NGR)		Approx. Distance[3]
1	North Third Reservoir	This viewpoint represents views experienced by road users on the minor road network to the east of Site, as they pass North Third Reservoir.	275155	688977	2.1km
2	Lewis Hill	This viewpoint	276065	688820	2.8km

[3] Distance between viewpoint and nearest turbine of the Proposed Development.

No.	Location	Reason for Selection	Grid Reference (NGR)		Approx. Distance[3]
		represents views experienced by recreational receptors visiting the hill summit to the northeast of the Site.			
3	Carron Bridge at Northshields	This viewpoint represents views experienced by road users on the minor road network to the south of the Site.	276599	684212	4.1km
4	Tomtain	This viewpoint represents views experienced by recreational receptors visiting this hill summit within the Kilsyth Hills, to the south of the Site,	272120	681416	5.7km
5	M9 / A811 overpass	This viewpoint represents views experienced by road users travelling along the M9 and the A811 to the northeast of the Site.	277577	693539	7.2km
6	Meikle Bin	This viewpoint represents views experienced by recreational receptors visiting the hill summit to the southwest of the Site.	266721	682183	7.9km
7	Bannockburn Memorial	This viewpoint represents views experienced by recreational receptors visiting the memorial to the northeast of the Site.	279483	690689	6.7km
8	Stirling Castle	This viewpoint represents views experienced by recreational receptors visiting Stirling Castle, to the northeast of the Site.	279009	693969	8.4km
9	M80 at Denny Myothill Road overpass	This viewpoint represents views experienced by road users travelling along the M80 to the southeast of the Site.	280402	681150	8.9km
10	Wallace Monument	This viewpoint represents views experienced by recreational receptors visiting the Wallace	280903	695676	10.9km

No.	Location	Reason for Selection	Grid Reference (NGR)		Approx. Distance[3]
		Monument, to the northeast of the Site.			
11	Falkirk Wheel	This viewpoint represents views experienced by recreational receptors visiting the Falkirk Wheel, to the southeast of the Site.	285260	679986	13.6km
12	Dumyat	This viewpoint represents views experienced by recreational receptors visiting the hill summit, to the northeast of the Site.	283567	697672	14.2km
13	Clackmannan Tower	This viewpoint represents views experienced by recreational receptors visiting Clackmannan Tower, to the northeast of the Site.	290649	691945	17.6km
14	Ben Cleuch	This viewpoint represents views experienced by recreational receptors visiting the hill summit, to the northeast of the Site.	290270	700636	21.2km
15	Ben Ledi	This viewpoint represents views experienced by recreational receptors visiting the hill summit, to the northwest of the Site. This viewpoint was requested by NatureScot.	256236	709774	27.8km
16	Crow Road	Represents views experienced by road users travelling north, over the Crow Road. This viewpoint was requested by Striling Council.	264362	683329	9.3km
17	Doune Castle	Viewpoint requested by Stirling Council. Due to the limited nature of visibility, this has not been included as an assessment viewpoint. A visualisation is provided but there is no assessment text in the LVIA chapter.	272834	700997	13.5km

5.4.5 Settlements

Settlements are those defined as such within the Stirling Local Development Plan (2018) and the relevant local plans for surrounding council areas. The settlement pattern across the study area is highly varied, with a range of settlements of different sizes and differing levels of population density.

Glasgow falls within the study area to the southwest, and forms the largest urban centre. Much of the southern part of the study area comprises settled, urban land within the highly developed corridor between Glasgow and Edinburgh. The nearest city to the Site is Stirling, approximately 7km to the northeast. There are also a number of towns throughout the Study Area, including Falkirk and Dunfermline.

Within the vicinity of the Site, settlement comprises individual properties and scattered property groups, and is generally focussed along the B818 to the south, as well as minor roads to the north and east. Within 15km, settlement is generally focussed to the east and south, while to the north and west settlement is generally sparse.

The settlements of Stirling, Denny, Cumbernauld and Kirkintilloch form some of the largest settlements in this area.

In order to focus on potentially significant effects, settlements from which there is no theoretical visibility are not considered further in this assessment.

Furthermore, settlements with limited theoretical visibility; longer distance views i.e. beyond 15km from the Proposed Development; or where views of the surrounding landscape (including the Site) are not important to setting, and where it is unlikely that significant effects could occur, are not considered further in the assessment. Settlements beyond 15km have not been included in the following table.

Table 5-7: Settlements within 15km

Settlement	Theoretical Visibility of Proposed Development (ZTV Coverage)
Within 10km	
Cambusbarron	Located approximately 6km to the northeast of the Site on the northeastern lower flank of Gillies Hill. The ZTV indicates that theoretical visibility is very limited across this settlement. Where longer distance views outside the settlement are available, these tend to be oriented to the northeast (with the Proposed Development to the west) looking towards the Ochil Hills – not considered further.
Denny (and Stoneywood)	**Theoretical visibility within 10km – considered further.**
Gargunnock	No theoretical visibility – not considered further.
Kilsyth	No theoretical visibility – not considered further.
Plean	Located east of the Site, the ZTV indicates very limited theoretical visibility from the settlement within 10km – not considered further.
Stirling	**Widespread theoretical visibility within 10km – considered further.**
Within 15km	
Arnprior	No theoretical visibility – not considered further.

Settlement	Theoretical Visibility of Proposed Development (ZTV Coverage)
Blairlogie	Located northeast of the Site beyond Stirling, the ZTV indicates some theoretical visibility from the settlement within 15km. Actual visibility is likely to be reduced by intervening built development and vegetation. When visible, the Proposed Development will be seen in the context of longer distance views (beyond 13km) and in the context of other wind farms (including Craigengelt and Earlsburn). As such the Proposed Development is unlikely to significantly alter the setting to the settlement – not considered further.
Bridge of Allan (Carse of Stirling)	**Widespread theoretical visibility within 15km – considered further.**
Cowie (Carse of Stirling)	**Widespread theoretical visibility within 15km – considered further.**
Cumbernauld	Located south of the Site, the ZTV indicates no theoretical visibility within 10km and intermittent theoretical visibility within 15km. Built form across the settlement will largely screen outward views, which will be glimpsed in nature when available. When visible, the Proposed Development will be seen in the context of longer distance views (beyond 10km) and in the context of views where human influences (including wind farms and other infrastructure) over the landscape are readily apparent. As such the Proposed Development is unlikely to significantly alter the setting to the settlement – not considered further.
Deanston	Located north of the Site, the ZTV indicates some theoretical visibility from the settlement within 15km. Actual visibility is likely to be reduced by mixed woodland cover. When visible, the Proposed Development will be seen in the context of longer distance views (beyond 14km) and in the context of other wind farms (including Craigengelt and Earlsburn). As such the Proposed Development is unlikely to significantly alter the setting to the settlement – not considered further.
Doune	Located north of the Site, the ZTV indicates widespread visibility. Actual visibility is likely to be screened by built form in the settlement, which will largely screen views to the south. Vegetation along the River Teith Valley, and on the intervening higher ground to the south of the river will also play a screening role. Due to this, and viewing distance (greater than 10km), effects on the settlement are not considered to be significant.
Fallin (Carse of Stirling)	**Widespread theoretical visibility within 15km – considered further.**
Fintry	Located west of the Site, the ZTV indicates very

Settlement	Theoretical Visibility of Proposed Development (ZTV Coverage)
	limited theoretical visibility from the settlement within 15km – not considered further.
Kippen	No theoretical visibility – not considered further.
Kirkintilloch	No theoretical visibility – not considered further.
Lennoxtown	No theoretical visibility – not considered further.
Milton of Campsie	No theoretical visibility – not considered further.
Thornhill	No theoretical visibility – not considered further.
Throsk (Carse of Stirling)	**Widespread theoretical visibility within 15km – considered further.**
Dunblane	The ZTV indicates widespread visibility. However, views from within the settlement, to the southeast typically screened by local built form and woodland in and around the settlement. Any long distance views to Site typically glimpsed in nature, and have been influenced by existing wind farms in the Gargunnock and Touch Hills. Not considered further.
Bonnybridge/ Falkirk/ Stenhousemuir/ Larbert	Located southeast of the Site, larger cluster of settlements. The ZTV indicates widespread theoretical visibility from the area between 10km and 15km. The area is very urban in nature so outward views somewhat limited. When visible, the Proposed Development will be seen in the context of longer distance views (beyond 10km) and in the context of wind farms (including Craigengelt) and other human influences across the surrounding landscape. As such the Proposed Development is unlikely to significantly alter the setting to the settlement cluster – not considered further.
Settlements in western edge of Clackmannanshire	Includes the settlements of Menstrie and Tullibody. More open views likely from western settlement edges. When visible, the Proposed Development will be seen in the context of longer distance views (beyond 13km) and in the context of other wind farms (including Craigengelt and Earlsburn). As such the Proposed Development is unlikely to significantly alter the setting to the settlements – not considered further.

5.4.6 Routes

Visibility from a route is not uniform along its entire length. This is because views of the surrounding landscape change as one moves along the route depending on the surrounding topography, buildings, structures, tree cover and vegetation along the route.

Theoretical visibility of the Proposed Development from routes across the study area is illustrated by Figure 5-1-1 and Figure 5-1-4. The routes include a hierarchy of roads, railways and recreational routes (promoted long distance footpaths, core paths and cycle routes). Road and rail routes tend to use low lying areas or valleys and passes, but walking routes are more variable and can pass over hills and along ridges.

Based on an analysis of theoretical visibility and potential views Table 5-8 provides information on which routes have been carried forward for detailed assessment. Due to their lower receptor susceptibility, roads and railways beyond 10km from the Site have been scoped out from this table.

Due to the higher susceptibility of receptors using promoted long distance footpaths and cycle routes, these have been included up to 15km from the Site. Due to the more localised nature of their use, short-distance footpaths beyond 5km from the Site have been scoped out (and noting that there are there are no Core Paths within the Site).

Where there is limited theoretical visibility, or where actual visibility from a route is likely to be limited due to localised screening, these routes are not considered further in this LVIA, as the likelihood for significant sequential effects is limited.

Table 5-8: Routes

Route	Theoretical Visibility of Proposed Development (ZTV Coverage)
Major Roads	
M9	**Widespread theoretical visibility within 10km – considered further.**
M80	Passes east of the Site, south from Stirling. The ZTV indicates sections of theoretical visibility within 10km, between Stirling and Denny. Actual visibility is likely to be reduced by roadside planting, areas of cutting and built development immediately west of the roadway. When visible, the Proposed Development will be seen in the context of longer distance, oblique and fleeting views (beyond 7km), and in the context of operational wind farm developments (including Craigengelt) and other human influences over the landscape. Sequential effects will be very localised (large sections of the route, beyond 10km are outside of the ZTV). Not considered further.
A84	Passes north of the Site, west of Stirling. The ZTV indicates theoretical visibility from a short section of the southern extents of the route, just within 10km. In this context, sequential effects will be very localised, and unlikely to be significant overall – not considered further.
A811	Passes north of the Site, east-west between Stirling and Kippen. The ZTV indicates no theoretical visibility directly north or northwest of the Site, and limited theoretical visibility within 10km near Cambusbarron from a short section of the route. Actual visibility is likely to be reduced by forestry and roadside vegetation. outward views – not considered further.
A803	Very limited theoretical visibility within 10km – not considered further.
A872	**Widespread theoretical visibility within 10km from northern parts of the route – considered further.**
A9	Passes east and northeast of the Site, through and then north of Stirling. The ZTV indicates areas with theoretical visibility along the route within 10km. Actual visibility very limited by built form within Stirling and Bridge of Allan. In this context, sequential effects will be very localised, and unlikely to be significant overall – not considered further. Effects from the M9, which passes through a more open landscape to the west of Striling (and west of the A9) within 10km of the Site, are considered separately.
A905	Passes east of the Site, east of Stirling. The ZTV indicates theoretical visibility within 10km. Actual visibility is likely to be very limited by built form within

Route	Theoretical Visibility of Proposed Development (ZTV Coverage)
	Stirling. In this context, sequential effects will be very localised, and unlikely to be significant overall – not considered further.
A907	Passes northeast of the Site, east of Stirling. Short section of the route within 10km, and from which built form on the eastern edge of Stirling will limit potential for outward views. Not considered further.
A91	Passes to east of Stirling, within 10km. ZTV indicates visibility, however built form alongside the route (on eastern edge of Stirling) will largely limit the potential for longer distance views to the west, towards the Site.
A883	Built form within Denny, within 10km, will largely screen outward views – not considered further.
Railways	
Glasgow – Stirling – Perth	Passes to the east of the Site, north-south within the Inner Forth area. The ZTV indicates there to be theoretical visibility within 10km, although actual visibility is likely to be limited by built development within Stirling. When visible, on the approach to and from Striling, the Proposed Development will be seen in the context of longer distance views (beyond 10km), and in the context of operational wind farm development in the hills to the west (including Craigengelt) and human influences over the landscape in the Carse of Stirling. As such, the Proposed Development is not likely to significantly alter the setting to the route – not considered further.
Recreational Routes	
NCN Route 76 / 765	Passes to the east of the Site, north-south through Stirling within the Inner Forth area. The ZTV indicates there to be widespread theoretical visibility, although actual visibility is likely to be limited by intervening vegetation and built development within the densely settled Forth Valley. When visible, the Proposed Development will be seen in the context of longer distance views (generally beyond 10km), and in the context of operational wind farm developments in the hills to the west (including Craigengelt). As such, the Proposed Development is not likely to significantly alter the setting to this cycle route– not considered further.
John Muir Way	Passes to the south of the Site. West of Falkirk, the ZTV indicates intermittent theoretical visibility, although actual visibility is likely to be limited by vegetation and built development. When visible, the Proposed Development will be seen in the context of longer distance views (beyond 12km) and in the context of other wind farm developments in the hills to the northwest (including Craigengelt). As such, the Proposed Development is not likely to significantly alter the landscape setting and recreational experience of the route overall– not considered further.
Forth & Clyde Canal	Passes to the south of the Site. West of Falkirk, the ZTV indicates intermittent theoretical visibility, although actual visibility is likely to be limited by vegetation and built development alongside the canal. When visible, the Proposed Development will be seen in the context of longer distance views (beyond 10km) and in the context of other wind farm developments and human influences over the landscape. As such, the Proposed Development is not likely to significantly alter the setting or recreational experience of the route – not considered further.
Core Paths within 5km of Site	**Scattered theoretical visibility from Core Paths to the south and northeast of the Site within 5km – considered further.**

5.5 The 'Do Nothing' Scenario

In the absence of the Proposed Development, it is likely that the Site would continue under the same land use associated with upland farming, grouse shooting and adjacent coniferous forestry.

Land to the immediate southwest of the Site also accommodates a wind farm (Craigengelt) and this land use will continue over the operational phase of this wind farm. The wider surrounding landscape and visual amenity is likely to be further influenced by a number of 'forces for change'.

Forces for change are those factors affecting the evolution of the landscape and which may, consequently, affect the perception of the study area in the near or distant future. Although prediction of these is necessarily speculative, those of particular relevance are discussed briefly below.

Due to the effects of climate change, summer and winter temperatures are likely to be higher than the current baseline (greater for summer), with winter rainfall increasing and summer rainfall decreasing.

The Landscape Institute's Landscape for 2030 (Landscape Institute, 2021) acknowledges that increases in average temperature and more severe weather events will have an effect on the landscape. However, whilst changes in rainfall and rising temperatures are anticipated, it is not considered that this will appreciably change the baseline landscape conditions.

Wind farm development is a clear force for change and is likely to continue within the study area. Figure 5-1-5 shows wind farms which are operational or under construction within the study area, as well as consented developments and proposals for further wind farms.

Given the wind resource in this area, there is likely to be ongoing interest in wind farm development in this part of Stirling and surrounding local authority areas, particularly in the upland areas.

Commercial forestry across the study area, especially on the slopes surrounding upland areas, is likely to remain an important land use. Housing and light industrial development, particularly on the edges of settlements, is also likely to continue.

5.6 Wind Farm Design Considerations

Potential landscape and visual effects associated with the Proposed Development were a consideration in the design evolution, to be balanced against onsite environmental and technical constraints and maximising wind yield. The scheme's relationship with the operational Craigengelt Wind Farm was an important consideration in the design evolution of the scheme also.

Landscape and visual objectives also included the consideration of effects on residential visual amenity from nearby properties and the composition of the layout in key views including from Stirling, Bannockburn and the Wallace Monument.

Further detail on the design evolution of the Proposed Development is described in Chapter 3: Description of Development and the Design and Access Statement accompanying the application for Planning Permission.

5.7 Micrositing Allowance

Micrositing of turbines (up to 50m as proposed in Chapter 3 Description of Development) is considered unlikely to result in changes to predicted landscape or visual effects, and therefore will not materially affect the findings of this assessment.

5.8 Assessment of Effects and Mitigation

The assessment of effects is based on the project description as presented in Chapter 3: Description of Development and follows the methodology detailed in Appendix 5-1. Unless otherwise stated, potential effects identified are considered to be negative.

5.9 Construction Effects

5.9.1 Predicted Construction Landscape Effects

The changes arising from the construction of the Proposed Development include:

- The introduction of construction activity and vehicular/personnel movements around the Site and on local roads;
- The potential need for lighting during construction if work extends into hours of darkness;
- The disturbance of areas of land and surface vegetation at the locations of borrow pits, turbine bases, the proposed substation and along the access track routes;
- The use of construction compounds; and
- The introduction of tall vertical structures (turbines and a met mast) and the use of cranes.

The effect of the construction of the Proposed Development on the Site is set out in Table 5-9. Wider construction stage effects on landscape character and designated landscapes will be short term and transient in nature. These effects are assumed to be no greater than those effects identified in the operational landscape assessment.

Table 5-9: Effects of Construction on the Site

Receptor	The Site
Baseline and Sensitivity	The Site, land use and context is described in Chapter 1: Introduction of this EIA Report. The Site is entirely contained within the 149 Lowland Hills – Central LCT. Situated on a localised plateau within a series of gently defined and low-rounded hills, landcover across the Site comprises moorland, with extensive areas of muirburn. Multiple small watercourses flow east through the Site, joining with Buckie Burn, a tributary of the River Carron and Bannock Burn further east. Drystone walls create a boundary between the areas of muirburn and rough grassland surrounding the Site. A minor road forms a boundary to the northwest. Blocks of coniferous forestry lie in proximity to the north, northeast and south. The Site forms part of the wider upland context in westerly views from the settled Forth Valley, including the large settlement of Stirling. The influence of human activity across the landscape is apparent from the Site due to the proximity of the operational Craignengelt and Earlsburn Wind Farm developments and associated access tracks, communications towers at Earls Hill to the north, minor roads,

Receptor	The Site
	commercial forestry operations, and the wooden electrical poles and extensive areas of muirburn within and across the Site. The Proposed Development is within a designated local landscape, the Southern Hills LLA, which is noted for its diversity of landscape and contrast between open views from hill summits and enclosed views within the valleys. However, the influence of human activity within and in proximity to the Site is apparent, with the operational wind farm developments of Craigengelt, Earlsburn, and Kingsburn altering the perception of grandeur and scale among the hill nearby. **Judgements:** • **Susceptibility: Medium;** • **Value: Medium;** • **Sensitivity: Medium.**
Changes	Construction activity will result in direct landscape effects on the Site. Changes primarily relate to excavations and track construction; the presence of tall cranes and partially built towers whilst turbines are being erected; and construction activity including the movement of construction vehicles and plant. Whilst the existing access track associated with Craigengelt Wind Farm will be utilised as far as possible, construction activity will result in large scale changes to the Site. This will include activity such as the removal/ clearance of features and disturbance to landcover (mainly moorland); introduction of new features (turbines and associated infrastructure); additional movement and activity through construction vehicles and plant; as well as a perceived change from an area of moorland on the edge of an existing wind farm to a construction site. The geographic extent of these changes will be at the Site level (small). The construction works are expected to last approximately 15 months, so will be temporary and short term. The level of reversibility will be varied, from fully reversible changes associated with ground disturbances (albeit that vegetation will take some time to recover) to longer lasting effects associated with infrastructure that forms part of the operational scheme. **Judgements:** • **Scale: Large;** • **Geographical Extent: Small;** • **Duration: Short Term;** • **Reversibility: Fully Reversible to Irreversible;** • **Magnitude of Change: High**
Effect and Significance	Overall, the effects of construction on the Site are judged to be **Significant (Major)**. These effects will be temporary and very localised, largely contained within the geographical extent of the Site where construction of turbines and new sections of track associated with the Proposed Development will result in wider disturbance.

5.9.2 Predicted Construction Visual Effects

In terms of visual effects during the construction phase, beyond those experienced at the Site level where low level construction activity will be apparent in certain views, these will largely relate to views of tall cranes and turbine construction experienced from the wider study area. These effects will be transient and will change throughout the construction period as wind turbines are gradually constructed in sections.

As such, visual effects during the construction phase are unlikely to exceed the level of effect associated with operational visual effects (when all four proposed turbines will be in place).

5.9.3 Proposed Mitigation

Measures such as arrangements for vegetation and soil removal, storage and replacement and the restoration of disturbed areas after construction are detailed in the Outline Construction Environmental Management Plan (CEMP) contained in Appendix 15-1, which includes reference to Construction Method Statements.

All mitigation for landscape and visual effects is mainly embedded within the final design for the Proposed Development.

5.9.4 Residual Construction Effects

Full re-establishment of ground level vegetation will take approximately three to five years, depending on the vegetation and soils, and levels of effect will decline over this period.

There will be no significant landscape or visual effects associated with ground disturbance after restoration works have been completed, and vegetation has regenerated.

5.10 Predicted Operational Landscape Effects

5.10.1 Predicted Operational Landscape Effects

Although all operational and under construction wind farms (Figure 5-1-5) are considered in the baseline for the assessment, interactions with wind farms/ larger emerging wind farm groups in the more immediate landscape context are of most relevance. These include, within 5km, the operational Craigengelt to the southwest; Earlsburn to the west; and Kingsburn to the northwest.

These wind farm clusters extend under the theoretical future cumulative baseline, with further consented (Shelloch) and proposed (Earslburn Extension) schemes as shown on Figure 5-1-5b, and as discussed further in the following assessments below.

All operational effects are judged to be long term and reversible, unless specified otherwise.

5.10.2 Predicted Cumulative Effects during Operation

Existing wind farms and those under construction have been assessed as part of the LVIA baseline (shown in Table 5-2). The following cumulative assessments sets out the assessment of effects arising from the Proposed Development in a potential future landscape in which consented and proposed wind farms are also assumed to be present. The potential future baseline is split into two possible scenarios:

- Scenario 1 – operational, under construction **and consented wind farms** (for which there is a higher level of certainty); and
- Scenario 2 – Scenario 1 **plus application stage and wind farms at appeal** (for which there is a lower level of certainty).

These cumulative wind farm developments are listed in Table 5-2 and shown on Figures 5-1-5a and b.

Certain consented developments are now subject to revised applications, typically to increase the size of turbine used within the proposed wind farm.

Where this is the case, the larger application scheme is considered within the Cumulative LVIA, as identified in Table 5-11. This is an emerging pattern in wind energy development where consented schemes with smaller turbines may not now be financially viable. To avoid an overly complex cumulative assessment, the Cumulative LVIA assumes that the consented scheme is unlikely to be built and focuses on the maximum-case scenario and larger scale application stage scheme.

Although all wind farms as shown on Figure 5-1-5a are considered in the cumulative assessment, the assessment focuses primarily on the relationship of the Proposed Development with the closest wind farms or groups of wind farms, where significant cumulative interactions are more likely to occur.

5.10.3 Effects on Landscape Character of the Site

Table 5-10: Landscape Character of the Site

Receptor	The Site
Description and Sensitivity	The Site is described in detail in Table 5.9 above. Overall sensitivity is considered to be **medium**.
Changes	There will be large scale changes to the Site relating to the physical loss of features (typically moorland cover) and introduction of new features (turbines and associated infrastructure), as well as a perceived change from a moorland site on the edge of a wind farm, to a larger active energy generating site. **Judgements:** • **Scale: Large;** • **Geographical Extent: Small;** • **Magnitude of Change: Medium**
Effect and Significance	Overall, the effects of the wind farm on the Site will be **Significant (Moderate)**.
Cumulative Effects	**Cumulative effects, at the Site level, are not judged to be significant.** The Proposed Development will extend the influence of turbines in relation to the operational Craigengelt Wind Farm, which is considered in the landscape baseline.

5.10.4 Effects on Landscape Character Types

The following tables provide a detailed assessment of effects on LCTs which have been carried forward for further assessment.

Table 5-11: Operational Effects Lowland Hills (149) LCT – Central

Receptor	149. Lowland Hills – Central
Description and Sensitivity	There are four units of this LCT within 20km. This includes the unit in which the Proposed Development is located (the Gargunnock and Touch Hills), two units in the Campsie Fells to the south and a further

Receptor	149. Lowland Hills – Central
	unit in the Ochils, to the northeast. The NatureScot description[4] identifies the following key characteristics: • *"Prominent, open, large scale character, of predominantly smooth, gently rounded upper slopes and hill summits.* • *Simplicity and unity of landform.* • *Hills covered in rolling expanses of peatland, rough grass and heather moorland.* • *Occasional, widely scattered blocks of coniferous forest.* • *Almost entirely uninhabited landscapes, with any dwellings widely dispersed, often located to the edge of single-track roads which zigzag across lower ground.* • *Recreational use is mainly restricted to the fringes of the hills and higher tops, which provide greater visual interest.* • *Important close visual interrelationships between the hills and escarpments, and neighbouring lowland and carseland areas.* • *Open character, absence of current settlement and limited penetration by roads or hill tracks create a refuge of remoteness in close proximity to densely settled areas.* • *Hills often act as a buffer between more intensively used and populated areas. They create a strong contrast to these areas, and provide a sometimes dramatic backdrop."* Wind Farm development within this LCT, including Craigengelt and Earlsburn in the Gargunnock and Touch Hills unit, has altered the character of the landscape. The Stirling Council Wind Farm Landscape Capacity Study (2019) states there is low capacity for turbines greater than 110m to tip within the Lowland Hills: Fintry, Gargunnock and Touch Hills LCT. However, it is noted in the study that while further extension of wind turbines is likely to "further erode the landscape characteristics" of the Gargunnock and Touch Hills, it is possible that a modest expansion in proximity to the existing Craigengelt wind farm development may potentially be absorbed into the surroundings without altering the balance between areas of developed and undeveloped landscape. The open, large scale and sparsely settled nature of this landscape indicates a lower sensitivity to the type of development proposed. The remote nature and close visual relationship with neighbouring lowlands indicates a higher susceptibility. On balance susceptibility is judged to be medium. In terms of value, the unit the Proposed Development is located within the Southern Hills LLA, although it is not in proximity to any other designated landscapes or in proximity to promoted paths, indicating medium-high landscape value. The overall sensitivity is judged to be medium-high.
Changes	The Proposed Development is located in the Gargunnock and Touch Hills unit of this LCT. There will be direct effects on the landscape fabric of the Site, including changes to the landcover and terrain. In terms of wider effects on landscape character, the ZTV (refer to Figure 5-1-3b) indicates widespread visibility across the Gargunnock

[4] [LCT 149 - Lowland Hills - Central - Final pdf.pdf (nature.scot)]

Receptor	149. Lowland Hills – Central
	and Touch Hills unit of this LCT. There is an area of visual screening around the Backside Burn Valley, to the west of the Site and from an area to the north as the landform falls in elevation. Due to the open nature of this landscape actual visibility will closely reflect theoretical, outside some of the larger areas of coniferous forest. The Proposed Development is located in a landscape which has been altered by wind farm development and will introduce four further turbines, to the northeast of an eight turbine operational wind farm (Craigengelt Wind Farm). The Proposed Development will marginally extend and intensify the effects of wind turbines, to the northeast of this wind farm. The difference in scale between turbines in the operational wind farm and the proposed will also be notable (though not necessarily contribute to the scale of landscape change). This is judged to result in a medium-large scale of landscape change experienced from a very localised area (small geographical extent) of the unit, around the Site and to the northeast of Craigengelt Wind Farm. The role this landscape plays in providing an upland setting to lowland landscapes, and changes to this role as a result of the Proposed Development, is discussed further in the following relevant landscape assessments from lower lying LCT including in the Carse of Stirling. In terms of wider effects on landscape character from the other units of this LCT, theoretical visibility from the Campsie Fells and Ochils unit is limited to Site facing hill flanks. When visible, the Proposed Development will be seen in the context of medium to longer distance larger scale upland outward views, which have been altered by wind farm development in the Touch and Gargunnock Hills. The Proposed Development will typically read as an extension to Craigengelt Wind Farm. In this context, a landscape scale of change no greater than small is predicted. These effects will be localised from Site facing hill flanks in the Campsie Fells and Ochil units (small geographical extent).
Effect and Significance	**When combining judgements on sensitivity and magnitude, a Significant (Moderate) effect is predicted from a very localised area around the Site and to the northeast of Craigengelt Wind Farm (extending to the eastern boundary of the host LCT and approximately 4km to the north, in the Touch Hills).** **In terms of wider effects, these are not judged to be higher than Not Significant (Minor).**
Cumulative Effects	Under scenario 1 Shelloch (consented) will introduce a further wind farm into the host LCT, to the west of the operational Kingsburn and Earlsburn Wind Farms. Under scenario 2 Earlsburn Extension will extend the influence of wind turbines, to the northeast of the operational Earlsburn. These changes to the cumulative baseline will be focused to the north of the minor road which links Stirling to the Carron Valley Reservoir which passes from the southwest to the northeast through the host LCT. Under both scenarios, the Proposed Development will continue to marginally extend the influence of wind turbines to the northeast of the operational Craigengelt (and to the east of the host LCT). Gaps between the larger Craigengelt Wind Farm group and new and larger emerging wind farm groups, which are focused to the north and west of the host LCT, will remain legible. **In this alternative context, landscape effects will reflect those as identified in the primary assessment. A Significant (Moderate) effect is predicted from a very localised area around the Site and to the**

Receptor	149. Lowland Hills – Central
	northeast of Craigengelt Wind Farm. In terms of wider effects, these are not judged to be Significant (no greater than Minor).

Table 5-12: Operational Effects on Lowland Hill Fringes (150) LCT – Central

Receptor	150. Lowland Hill Fringes – Central
Description and Sensitivity	There are five units of this LCT within 20km. Two units to the east of the Gargunnock and Touch Hills and two units either side of the A9, to the north. Visibility from the unit to the west of the Kilsyth Hills is very limited, so effects on this unit have not been considered further. The NatureScot description[5] identifies the following key characteristics: • *"Undulating, rolling topography rising to larger scale hill landforms.* • *Gradation of topography creates transitional landscape linking the open hills of more pronounced relief and the neighbouring settled valley landscapes.* • *Diverse landcover of arable and open improved and unimproved pasture land, interlocks with woodland and forestry, with some estate landscapes with frequent beech hedgerows and shelterbelts.* • *High proportion of woodland cover including large coniferous blocks, mixed shelterbelts and broadleaf tree clumps.* • *Scattered residential development and small settlements on slopes, with recent expansion in some areas.* • *Minor roads.* • *Concentration of small water bodies, reservoirs and small watercourses.* • *Strong interrelationship between stepped escarpment and lower foot slopes in Gargunnock/Fintry and East Touch and Gargunnock Fringe.* • *Estate and designed landscapes give distinctive character to East Touch and Gargunnock Fringe area.* • *Hill fringes offer important panoramic views to neighbouring hills, valleys and straths, as well as large settlements such as Glasgow and Falkirk.* • *A sense of remoteness and isolation in some areas despite proximity to settlement and relatively limited geographic extent."* Tod Hill Wind Farm is located in the unit to the east of the Gargunnock and Touch Hills, and influences character. The Braes of Doune Wind Farm has altered the LCT unit to the west of the A9. The transitional nature of the landscape, scattered residential development and high proportion of woodland cover indicate a medium-high susceptibility, to the type of development proposed. In terms of value, the LCT is partially located within the Southern Hills LLA, and has a visual relationship with both the Keir LLA and Western Ochils LLA to the northwest, indicating a medium-high value. **The overall sensitivity is judged to be medium-high.**
Changes	The Proposed Development is located outside of this LCT, so any effects would be indirect and relate to wider effects on the more perceptual qualities of the landscape.

[5] LCT 150 - Lowland Hill Fringes - Central - Final pdf.pdf (nature.scot)

Receptor	150. Lowland Hill Fringes – Central
	The outer eastern ridge of the Gargunnock and Touch Hills provides an area of visual screening from parts of the western half of the unit, in closer proximity to the Site. Visibility is more widespread from the eastern half of the unit. Built form and woodland cover (including woodland associated with Plean Country Park) will reduce actual visibility, from this area. Visibility from the unit to the southeast (west of Denny) is more limited and fragmented. When visible, the Proposed Development will be seen on horizons to the west. Some of these views have already been altered by wind farm development in the Gargunnock and Touch Hills. Views of wind farms within the Gargunnock and Touch Hills tend to open up further east within the unit. Views from these units, over the lower lying valleys and straths and towards the settlements of Glasgow and Falkirk will not be altered. As the Proposed Development is located outside of this LCT the role this landscape plays in providing a transition between the open hills (to the west) and settled valleys (to the east) will not be altered. In this context, the scale of landscape change and geographical extent of this change will be small. From the two units further north, either side of the A9, visibility is more widespread. However, the Braes of Doune Wind Farm has notably altered the landscape in the unit to the west of the A9, and in closer proximity views from the unit to the east of the A9. When visible, the Proposed Development will be seen in the context of medium distance (greater than 10km) larger scale outward views which have been altered by wind farm development. The Proposed Development will typically read as an extension to Craigengelt Wind Farm. In this context, a landscape scale of change no greater than small is predicted. The geographical extent is judged to be medium-large.
Effect and Significance	**When combining judgements on sensitivity and magnitude a Not Significant (Minor) effect is predicted.**
Cumulative Effects	Under scenario 1 Shelloch (consented) will introduce a further wind farm into the Gargunnock and Touch Hills (outside of the LCT), to the southwest of the operational Kingsburn Wind Farm. Under scenario 2 Earlsburn Extension will extend the influence of wind turbines in the Gargunnock and Touch Hills (outside the LCT), to the northeast of the operational Earlsburn. Under both scenarios, the Proposed Development will continue to marginally extend the influence of wind turbines to the northeast of the operational Craigengelt, to the east of the Gargunnock and Touch Hills (and outside the LCT). The level of visibility towards the Proposed Development (and existing, consented and proposed wind farms in the Gargunnock and Touch Hills) from across the Lowland Hill Fringes LCT will vary, depending on viewing location. When visible, the Proposed Development will generally be seen in the context of the operational Craigengelt Wind Farm and, from certain locations, also in the context of larger wind farm groups to the north and west of the Gargunnock and Touch Hills. **In this alternative context, landscape effects will reflect those as identified in the primary assessment, Not Significant (Minor).**

Table 5-13: Operational Effects on Lowland River Valleys (152) LCT – Central

Receptor	152. Lowland River Valleys – Central
Description and Sensitivity	There are five units of this LCT within 20km, around the River Carron to the south; a small unit to the north of Stenhousemuir with a further unit further east around the River Avon; the Allan Water to the northeast;

	and the River Teith to the north. The NatureScot description identifies the following key characteristics: • *"Well-defined river corridors, most with flat valley floor enclosed by often commanding hills.* • *Strong topographic and visual identity, with varying scale and character.* • *Glacial terrain and deposits located on valley margins, often subject to mineral extraction.* • *Relatively high proportion of tree cover, with roadside and hedgerow trees and semi-natural woodland.* • *Dense areas of coniferous forest cover the slopes surrounding the reservoir in the Upper Carron Valley.* • *Road corridors often running parallel to river corridor form key linear features.* • *Settlement often closely linked to the river corridor and parallel road corridors.* • *Intensive settlement and urban development on margins of valleys south and north of Firth of Forth.* • *Predominance of traditionally managed estate, policy and designed landscapes.* • *Nature conservation importance of river and associated habitats.* • *Frequently enclosed and focussed views along the river valley.* • *Visibility of remnant derelict land, motorway and road corridors, power lines, wind farms and industrial sites from the urban fringe of Falkirk/Denny."* There are no wind farms located in these LCT units. The valley landform and well settled nature indicate a higher sensitivity to the type of development proposed. Lower lying parts of the LCT, to the east of the Study Area, are highly developed indicating a lower susceptibility. In terms of value, parts of this LCT are within locally designated landscapes (including the Southern Hills LLA), indicating a higher value in parts. **The overall sensitivity is judged to be medium-high.**
Changes	The Proposed Development is located outside of this LCT, so any effects would be indirect and relate to wider effects on the more perceptual qualities of the landscape. From the unit to the south, around the River Carron, visibility is more widespread to the east of the unit. From much of the valley floor, as the River Carron flows east between the Touch and Gargunnock and Kilsyth Hills, visibility is limited. In its eastern extents the unit is more developed with roads and larger settlements, including Denny. This will limit the nature of actual visibility. Visibility across the smaller unit to the north of Stenhousemuir and the unit to the east around the River Avon is also widespread within 20km. Woodland and settlement in, and on the edge of the unit, will somewhat limit actual visibility. When visible the Proposed Development will be seen to the west on enclosing horizons which have been altered by wind farms. This is a feature which is recognised in the key characteristics of the LCT in the areas around Falkirk and Denny. Due to the somewhat limited nature of actual visibility and in this context, the landscape scale of change will be small. The geographical extent is judged to be medium. From the two units to the north, around the Allan Water and River Teith, visibility is more widespread from the southern extents of both and the northern flanks of the hillside in the River Teith unit. Settlement

	(Dunblane and Doune) and woodland cover, particularly in the River Teith Unit, will limit actual visibility. When visible, the Proposed Development will be seen in longer distance views to the southwest (beyond 10km) on horizons which have been altered by wind farm development in the Gargunnock and Touch Hills. In this context the landscape scale of change will be small. The geographical extent is judged to be medium.
Effect and Significance	**When combining judgements on sensitivity and magnitude a Not Significant (Minor) effect is predicted.**
Cumulative Effects	Under scenario 1 Shelloch (consented) will introduce a further wind farm into the Gargunnock and Touch Hills, to the southwest of the operational Kingsburn Wind Farm (outside the LCT). Under scenario 2 Earlsburn Extension will extend the influence of wind turbines in the Gargunnock and Touch Hills, to the northeast of the operational Earlsburn (outside the LCT). Under both scenarios, the Proposed Development will continue to marginally extend the influence of wind turbines to the northeast of the operational Craigengelt, to the east of the Gargunnock and Touch Hills. The level of visibility towards the Proposed Development (and existing, consented and proposed wind farms in the Gargunnock and Touch Hills) from across the Lowland River Valleys LCT will vary, depending on viewing location and localised interactions between the terrain and vegetation. When visible, the Proposed Development will generally be seen in the context of the operational Craigengelt Wind Farm and, from certain locations, also in the context of larger wind farm groups to the north and west of the Gargunnock and Touch Hills. **In this alternative context, landscape effects will reflect those as identified in the primary assessment, Not Significant (Minor).**

Table 5-14: Operational Effects on Carselands (153) LCT

Receptor	153. Carselands
Description and Sensitivity	There are four units of this LCT within 20km. One to the north of the Site and a further three focused around the River Forth to the northeast of the Site. The NatureScot description identifies the following key characteristics: • *"Flat, open, large scale Carselands of predominantly open agricultural landcover forming the floor and former floodplains of the River Forth, River Devon and Black Devon.* • *Important as landscape setting of Stirling, Stirling Castle, and the Ochil Hills.* • *Absence of settlement across the Carselands, restricted to villages on the peripheral slopes and scattered farmsteads along the valley floors.* • *Periodic extensive flooding continues to influence land use.* • *Trunk roads run in parallel to the northern and southern perimeters of the Carselands.* • *Distinct character of group of Hillfoot villages, and their relationship with streams issuing from Ochil Hills within Lower Devon area, as well as major overhead power lines and their pylons.* • *Recent expansion of settlement boundaries at edge of carse making new development very visible.* • *Industrial and agricultural buildings, and bonded warehouse on open carseland prominent in views within Lower Devon area* • *Largest remaining intact raised bog in Britain at Flanders Moss, with*

Receptor	153. Carselands
	international importance for nature conservation. • *Importance of Carse of Forth open farmland for flocks of wintering geese.* • *Open views across carse accentuated by consequent dramatic contrast with the adjacent escarpments of the Ochils and Fintry, Gargunnock and Gargunnock and Touch Hills."* Rosehill Farm Wind Farm is located in the Carselands to the southeast of Stirling, and locally influences character. This is a flat, open lower lying area, which provides a landscape setting for Stirling, Stirling Castle and the Ochil Hills. This indicates a higher susceptibility to the type of development proposed. However, the Carselands units to the east have been notably altered by development including settlement, industry and electricity infrastructure, indicative of a lower susceptibility. In terms of value, this LCT largely lies outside designated landscapes, but the areas does provide a setting and contrast with certain upland designated landscape to the north and west, which increases value. **The overall sensitivity is judged to be medium-high.**
Changes	The Proposed Development is located outside of this LCT, so any effects would be indirect and relate to wider effects on the more perceptual qualities of the landscape. The ZTV indicates widespread visibility from the eastern extents of the unit to the north of the Site (and to the west of Stirling) and more widespread theoretical visibility from the units to the northeast (east of Stirling). Actual visibility will be somewhat reduced by areas of woodland cover and settlement, but given the open and flat nature of this landscape there will be numerous viewing opportunities looking west and southwest, towards the Gargunnock and Touch Hills. Development at the Site will not alter the role the Carselands play in providing a setting to Stirling, Stirling Castle and the Ochil Hills. When visible, the Proposed Development will be seen in the context of horizons which have been altered by wind farm development, due to Craigengelt and Earlsburn Wind Farms. Parts of the Carselands, to the southeast of Stirling, have also been locally altered by wind farm development within the LCT. The Proposed Development will introduce further wind turbines seen in this context. This will slightly alter the contrast between the form of the enclosing hills to the west and the Carselands, However, the landscape scale of change, in this context, is not judged to be greater than small. The geographical extent is judged to be medium.
Effect and Significance	**When combining judgements on sensitivity and magnitude a Not Significant (Minor) effect is predicted.**
Cumulative Effects	Under scenario 1 Shelloch (consented) will introduce a further wind farm into the Gargunnock and Touch Hills, to the southwest of the operational Kingsburn Wind Farm (outside the LCT). Under scenario 2 Earlsburn Extension will extend the influence of wind turbines in the Gargunnock and Touch Hills, to the northeast of the operational Earlsburn (outside the LCT). Under both scenarios, the Proposed Development will continue to marginally extend the influence of wind turbines to the northeast of the operational Craigengelt, to the east of the Gargunnock and Touch Hills. The level of visibility towards the Proposed Development (and existing, consented and proposed wind farms in the Gargunnock and Touch Hills) from across the Carselands LCT will vary,

Receptor	153. Carselands
	depending on viewing location and localised screening through buillt form and vegetation in this flatter LCT. When visible, the Proposed Development will generally be seen in the context of the operational Craigengelt Wind Farm and, from certain locations, also in the context of larger wind farm groups to the north and west of the Gargunnock and Touch Hills. **In this alternative context, landscape effects will reflect those as identified in the primary assessment, Not Significant (Minor).**

Table 5-15: Operational Effects on Lowland Valley Fringes (154) LCT

Receptor	154. Lowland Valley Fringes
Description and Sensitivity	There are three units of this LCT within 20km. Visibility is very limited from the two units to the northwest of the Site. The following assessment focuses on the unit to the northeast of the Site, to the north of Stirling and incorporating parts of the Bridge of Allan. The NatureScot description identifies the following key characteristics: • *"Low, undulating and gently rolling landform separating the Lowland River Valleys - Central.* • *Transitional landscape between the low lying Carselands and the more open hill fringes.* • *Often dissected by distinctive narrow river valleys.* • *Varied landcover of enclosed arable farmland, rough grassland and lush pasture.* • *Unified pattern of small settlements and scattered farmsteads.* • *Field boundary patterns well-defined by trees, shelterbelts, hedgerows and small woodlands.* • *Swathes of broadleaf woodland and coniferous forest cover integrate with the undulating landform.* • *Crossed and encircled by a network of communication routes, often running perpendicular to the gently sloping landform.* • *Transitional nature of the landscape provides varying views across the wide, open Carselands and river valleys, and to the lowland hills which often form a dramatic backdrop."* This is a transitional landscape with varied terrain and areas of woodland and settlement indicating a medium-high susceptibility to the type of development proposed. In terms of value the LCT is not within any designated landscape, but is in proximity to the locally designated landscapes of the Western Ochils LLA and the Keir LLA, which increases value. **The overall sensitivity is judged to be medium-high.**
Changes	The Proposed Development is located outside of this LCT, so any effects would be indirect and relate to wider effects on the more perceptual qualities of the landscape. The ZTV indicates quite widespread visibility across this unit, focused to the southern facing slopes. Actual visibility will be somewhat reduced by areas of mixed woodland including policy woodland around Keir House. Built form and woodland around the Bridge of Allan will also limit actual visibility. When visible, the Proposed Development will be seen in longer distance views to the southwest (beyond 10km) on horizons which have been altered by wind farm development (including through Craigengelt and Earlsburn Wind Farms). Whist this will somewhat alter the role the Gargunnock and

Receptor	154. Lowland Valley Fringes
	Touch Hills play in providing a backdrop due to the viewing distance; presence of existing wind farms; and somewhat limited nature of actual visibility, the landscape scale of change will be small. The geographical extent is judged to be small, due to the more limited nature of actual visibility.
Effect and Significance	**When combining judgements on sensitivity and magnitude a Not Significant (Minor) effect is predicted.**
Cumulative Effects	Under scenario 1 Shelloch (consented) will introduce a further wind farm into the Gargunnock and Touch Hills, to the southwest of the operational Kingsburn Wind Farm (outside this LCT). Under scenario 2 Earlsburn Extension will extend the influence of wind turbines in the Gargunnock and Touch Hills, to the northeast of the operational Earlsburn (outside this LCT). Under both scenarios, the Proposed Development will continue to marginally extend the influence of wind turbines to the northeast of the operational Craigengelt, to the east of the Gargunnock and Touch Hills. The level of visibility towards the Proposed Development (and existing, consented and proposed wind farms in the Gargunnock and Touch Hills) from across the Lowland Valley Fringes will vary, depending on viewing location and noting the more limited nature of actual visibility from the unit to the north of Stirling. When visible, the Proposed Development will generally be seen in the context of the operational Craigengelt Wind Farm and, from certain locations, also in the context of larger wind farm groups to the north and west of the Gargunnock and Touch Hills. **In this alternative context, landscape effects will reflect those as identified in the primary assessment, Not Significant (Minor).**

Table 5-16: Operational Effects on Rugged Moorland Hills (216) LCT

Receptor	216. Rugged Moorland Hills
Description and Sensitivity	There is one unit of this LCT within 20km, approximately 4km to the south of the Site near Carron Bridge. Theoretical visibility is widespread across the northern extents of the LCT. The NatureScot description identifies the following key characteristics: • *"Large scale simple landscape;* • *Distinctive upland character created by the combination of elevation, exposure, rugged landform, including a fault line and cliffs, moorland vegetation and the predominant lack of modern development, emphasised by the proximity to low-lying valleys an coastal areas;* • *Undeveloped skylines and striking views towards Glasgow;* • *Extensive man-made reservoirs and smaller natural lochs;* • *Important backdrop to neighbouring settled landscapes, creating a unique sense of place;* • *Sparse settlement and predominant lack of modern development;* • *Presence of archaeological sites on hilltops and sides, and on lower ground;* • *Sense of apparent naturalness, wild character and remoteness which contrasts strongly with the farmed and developed lowland areas; and* • *Diversity of landscape experience."* The larger scale and simple nature of this landscape indicates a

Receptor	216. Rugged Moorland Hills
	lower sensitivity, to the type of development proposed. The lack of modern development and undeveloped skylines indicate a higher susceptibility. On balance susceptibility is judged to be medium. In terms of value, the LCT is mostly located within LLA, indicating a medium-high value. **The overall sensitivity is judged to be medium-high.**
Changes	The Proposed Development is located outside of this LCT, so any effects would be indirect and relate to wider effects on the more perceptual qualities of the landscape. The ZTV indicates widespread theoretical visibility across the northern extent of the unit, focused across northern facing slopes. Actual visibility will be somewhat reduced by extensive areas of forestry across the northern slopes of the unit. When visible, the Proposed Development will be seen in medium distance views (between approximately 4km and 14km) in upland areas to the north which have been altered by wind farm development (through Craigengelt, Kingsburn, and Earlsburn Wind Farms). The Proposed Development will generally be seen behind the operational Craigengelt Wind Farm, in outwards views from this LCT. Whist this will somewhat alter the role the Gargunnock and Touch Hills play in providing a backdrop due to the viewing distance; the presence of existing wind farms; and somewhat limited nature of actual visibility, the landscape scale of change will be small. The role this unit plays in providing an undeveloped upland setting to settlement to the south (including Kilsyth) will also not be altered by wind farm development at the Site. The geographical extent is judged to be small, given the limited nature of actual visibility in the context of this large unit.
Effect and Significance	**When combining judgements on sensitivity and magnitude a Not Significant (Minor) effect is predicted.**
Cumulative	Under scenario 1 Shelloch (consented) will introduce a further wind farm into the Gargunnock and Touch Hills, to the southwest of the operational Kingsburn Wind Farm (outside this LCT). Under scenario 2 Earlsburn Extension will extend the influence of wind turbines in the Gargunnock and Touch Hills, to the northeast of the operational Earlsburn (outside this LCT). Under both scenarios, the Proposed Development will continue to marginally extend the influence of wind turbines to the northeast of the operational Craigengelt, to the east of the Gargunnock and Touch Hills. The level of visibility towards the Proposed Development (and existing, consented and proposed wind farms in the Gargunnock and Touch Hills) from across the Rugged Moorland Hills LCT will vary, depending on viewing location (and noting the role that areas of coniferous forest play in reducing actual visibility from this unit). When visible, the Proposed Development will generally be seen in the context of the operational Craigengelt Wind Farm and, from certain locations, also in the context of larger wind farm groups to the north and west of the Gargunnock and Touch Hills. **In this alternative context, landscape effects will reflect those as identified in the primary assessment, Not Significant (Minor).**

5.10.5 Effects on Designated Landscapes

The Site is within the Southern Hills LLA. There are additional landscape designations within the 45km study area, as listed in Table 5-5 and shown on Figure 5-1-5. This section describes the implications of the Proposed Development for the Southern Hills LLA in the

SC area, which is the only designated landscape taken forward for detailed assessment, as outlined in Table 5-5.

Table 5-17: Operational Effects on Southern Hills LLA

Receptor	Southern Hills LLA
Description and Sensitivity	The Proposed Development is located in this LLA, to the immediate northeast of the operational Craigengelt Wind Farm. The Stirling LLA citations are set out in an Appendix to the 2019 Draft Supplementary Guidance, Landscape Character Assessment. The special qualities of relevance include: Diversity of landscape experience • *Contrast between large scale, simple open hill land and smaller scale, diverse, farmed, wooded and settled hill fringes – with areas such as Kippen Muir and the Carron Valley being transitional between the two.* • *Contrast between expansive views from hill summits and edges with enclosure and introspection within the valleys and parts of the hill fringes.* • *Large-scale forestry management and wind energy developments have created localised areas of marked change in landscape character and experience.* Striking views • *Panoramic outward views from the hill edges and summits and Kippen Muir.* • *Locally important and dramatic views descending into the Endrick Valley from Kippen Muir and the Campsie Fells; to and from Lewis Hill/Sauchie Craigs and passing close to the Earlsburn and Craigengelt Wind Farms.* • *Views towards the LLA are equally important - from surrounding lowland and settlements, key viewpoints in and around Stirling and the edges of the national park. The skylines and outer faces of the hills help to define Strath Blane, the Carse of Stirling and contribute to the setting of Stirling itself.* Hills • *Seemingly towering hills defining and confining adjacent lowland and conveying a strong sense of a physical barrier.* • *Precipitous west and north facing slopes appear much higher and larger than they really are because of lack of scale indicators. Distinctive and dramatic rock outcrops and corrie landforms appear unassailable.* • *Perceived scale of the hills has diminished somewhat in the east, where large turbines at Craigengelt belie the seeming height of the hill mass.* • *A sense of remoteness and isolation.* • *The core, largely uninhabited, simple, large-scale landscapes still convey a sense of remoteness - despite proximity of the whole hill mass to major settlements and the presence of wind turbines. "*
Changes	There will be direct effects on the landscape fabric of the LLA, including changes to the landcover and subtle changes to the terrain. In terms of wider effects on the perceptual qualities of the LLA, the ZTV (refer to Figure 5-1-3b) indicates widespread visibility across the Gargunnock and Touch Hills, within approximately 5km. There is an

Receptor	Southern Hills LLA
	area of visual screening around the Backside Burn Valley, to the west of the Site and further west the pattern of visibility becomes more intermittent, focused to higher Site-facing slopes. Visibility is also limited beyond 5km to the north of the LLA, as the landform falls in elevation. Due to the open nature of this landscape actual visibility will closely reflect theoretical, outside the larger areas of coniferous forest cover. The Proposed Development is located in a landscape which has been altered by wind farm development, which has locally altered perceptual qualities such as remoteness (as recognised in the special qualities of the LLA). The Proposed Development will introduce four further turbines, to the northeast of an eight turbine operational wind farm (Craigengelt Wind Farm). The Proposed Development will marginally extend and intensify the effects of wind turbines, to the east of this wind farm. The difference in scale between turbines in the operational wind farm and the proposed will also be notable (though not necessarily contribute to the scale of landscape change). This is judged to result in a large scale of landscape change experienced from a very localised area of this large LLA, to the northeast of Craigengelt Wind Farm and within approximately 5km. Locating turbines in an area where the influence of operational turbines is already felt will help to lessen effects on other perceptual qualities of the LLA such as 'isolation', the 'physical barrier' the hills provide and the sense of scale of the hills. In terms of wider effects, the role this landscape plays in providing a setting to lowland landscapes (the Carse of Stirling and the settlement itself) will also be altered. However, given that the Proposed Development will generally be seen in the context of skylines which have been altered by wind turbines, the scale of change on this quality (in views towards the LLA and when visible) will be lessened. **In summary, there will be some direct and very localised effects on the landscape fabric of the LLA and on landscape character. These effects are recognised in the landscape assessment for the host LCT (Lowland Hill – Central). However, as the Proposed Development is located in an area which has been altered by wind turbines (as recognised in the qualities of the designation), and will generally be seen as an extension to an operational wind farm in views towards the LLA, this is not judged to significantly alter the overall integrity of the Southern Hills LLA. Furthermore, the experience of the LLA from large areas of the LLA, to the west of the operational Craignengelt Wind Farm, will not be altered.**
Cumulative Effects	Under scenario 1 Shelloch (consented) will introduce a further wind farm into central parts of the Southern Hills LLA, to the southwest of the operational Kingsburn Wind Farm. Under scenario 2 Earlsburn Extension will extend the influence of wind turbines, to the northeast of the operational Earlsburn, and also within the Southern Hills LLA. Under both scenarios, the Proposed Development will continue to marginally extend the influence of wind turbines to the northeast of the operational Craigengelt (and to the east of the Southern Hills) in an area where qualities such as remoteness have already been affected. Furthermore, gaps between the larger Craigengelt Wind Farm group and new and larger emerging wind farm groups, which are focused to the north and west of the Southern Hills LLA, will remain legible.

Receptor	Southern Hills LLA
	In views towards the Southern Hills LLA, and under both scenarios, the Proposed Development will continue to marginally extend the influence of wind turbines to the northeast of the operational Craigengelt, to the east of the LLA. The level of visibility towards the Proposed Development (and existing, consented and proposed wind farms in the Gargunnock and Touch Hills) from across the lower lying landscape to the north and east of the Southern Hills LLA will vary, depending on viewing location. When visible, the Proposed Development will generally be seen in the context of the operational Craigengelt Wind Farm and, from certain locations, also in the context of larger wind farm groups to the north (and more centrally within) the Southern Hills LLA. **In this alternative context, effects will reflect those as identified in the primary assessment. There will be some direct and very localised effects on the landscape fabric of the LLA and on landscape character. However, as the Proposed Development is located in an area which has been altered by wind turbines; gaps between wind farm groups across the LLA will remain legible; and as the Proposed Development will generally be seen as an extension to an operational wind farm in views from and towards the LLA, this is not judged to significantly alter the overall integrity of the Southern Hills LLA.**

5.10.6 In Combination Landscape Effects

With regard to combined cumulative effects, GLVIA3 states that this should include *"all past, present and future proposals together with the new project"*. The following assessment of combined effects therefore considers the effect of all built and unbuilt wind farms, including the Proposed Development.

In terms of combined effects on landscape character, and when looking at the broad pattern of wind farm development, there are areas across the study area where the combined effects of all operational, consented and proposed wind farms will notably influence landscape character.

This includes areas of the Plateau Moorlands, to the south of Glasgow, and areas of Plateau Moorland and Plateau Farmland, between Glasgow and Livingston.

In combination with operational, consented and proposed wind farms the Proposed Development will intensify the effects of wind turbines on the Lowland Hills (Central) LCT (and the overlying Southern Hills LLA which covers a larger area), in the Gargunnock and Touch Hills.

The Proposed Development will marginally extend the influence of wind turbines to the northeast of the operational Craigengelt. Shelloch (consented) will introduce a further wind farm to the southwest of the operational Kingsburn Wind Farm. Earlsburn Extension (proposed) will extend the influence of wind turbines, to the northeast of the operational Earlsburn.

Due to the increase in the presence of wind farms across the Southern Hills, the potential for significant 'in combination' cumulative effects is recognised.

However, the contribution the Proposed Development makes to this picture, in the Gargunnock and Touch Hills, is not judged to tip the balance of 'in combination' effects, through to significant.

In terms of landscape effects, the Proposed Development will generally read as a small extension to an existing scheme, located in an area where qualities such as remoteness have already been affected by wind farms.

Furthermore, gaps between the larger Craigengelt Wind Farm group and larger emerging wind farm groups, which are focused to the north and west of the Gargunnock and Touch Hills will not reduce as a result of the Proposed Development.

5.11 Predicted Operational Visual Effects

The assessment of operational visual effects considers the appearance of the Site, and how it will change existing views. Visual effects are assessed by examining effects on views from settlements, or when travelling through the area (sequential views), and also considering views from static locations (representative viewpoints).

The assessment considers the 'maximum case scenario' in terms of visibility, but it is important to note that visibility may be reduced by screening afforded by buildings and woodland, particularly from built-up and lowland areas and also weather conditions.

Views from roads and in rural areas are often limited by woodland and hedgerows. The degree of filtering of views may vary seasonally where trees are deciduous. The likely extent of screening is noted for each assessed effect.

All visual effects are long-term effects and reversible, unless specified otherwise.

5.11.1 Effects on Viewpoints

The potential operational (long-term) effects on views and visual amenity from specific representative viewpoints, as outlined in Table 5-6, are detailed below. All effects are judged to be adverse, unless stated otherwise.

The viewpoint locations are shown on Figure 5-1-1. Visualisation Figures (Figure 5-2-1 to Figure 5-2-16) accompany each viewpoint by means of a photograph of the existing view, a wireframe illustrating the wind farm and associated photomontage.

Table 5-18: Viewpoint 1 – North Third Reservoir

Viewpoint 1				
Grid Reference	275155	688977	Figure Number	5-2-1
LCT	Lowland Hills - Central		Landscape designation	Southern Hills LLA
Direction of view	Southwest		Distance to nearest turbine	2.2km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located on a minor road, west of North Third Reservoir. The viewpoint represents views experienced by road users travelling south, as they pass the reservoir. Existing views towards the Site are to the southwest. Views towards the Site are comprised of rising landform, primarily rough grassland and pasture fields bound by post and wire fencing and drystone walls, with occasional blocks of coniferous forestry, and wooden overhead poles and electrical lines forming vertical elements in the landscape. Turbines in Craigengelt Wind Farm are visible above the horizon to the southwest. The under construction Strathallan (was called Greenscares) will introduce distant (successive) views of a further			

Viewpoint 1	
	wind farm, in views to the north (and partially screened by intervening vegetation from this location). Tall communication towers at Earl's Hill are visible on the skyline further west. Road users including cyclists on this local road are considered to be of medium susceptibility to changes in the view. In terms of value the viewpoint is located within the locally designated Southern Hills LLA, but does not represent a recognised or promoted view, and is therefore considered to be of medium value. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be medium.**
Changes	Four proposed turbine hubs and four turbine blades will be visible above the skyline to the southwest, with turbine towers partially screened by the rising landform, and seen at a distance of approximately 2.2km. The turbines will be seen in combination with the operational Craigengelt turbines, visible above the horizon. The Proposed Development will appear closer and will extend the influence of wind farm development further north and south in views. The proposed turbines will appear larger in scale (being larger in size and closer to the viewer) than the operational Craigengelt turbines, and will form notable features in south westerly views. Given the existing presence of wind farm development, the introduction of the Proposed Development will result in a medium-large scale of change in the view. The Proposed Development will be widely visible from this local road, to the east of the Site, and the geographical extent is considered to be medium.
Effect	**The overall magnitude of visual change is considered to be medium-high and taking account of the medium sensitivity will result in a Significant (Major) visual effect.**
Cumulative Effects	Under scenario 1, there are no notable changes to the cumulative baseline from this viewpoint. Under scenario 2, Earlsburn Extension (proposed) will introduce turbines onto the horizon in successive views to the north-west. No consented or proposed wind farms will be visible from this viewpoint in views to the south-west. **Effects will reflect those as identified in the primary assessment.**

Table 5-17: Viewpoint 2 – Lewis Hill

Viewpoint 2				
Grid Reference	276065	688820	Figure Number	5-2-2
LCT	Lowland Hills - Central		Landscape designation	Southern Hills LLA
Direction of view	Southwest		Distance to nearest turbine	2.1km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located on an elevated ridgeline, from a Core Path east of North Third Reservoir. The viewpoint represents views experienced by local recreational receptors walking along the path. Existing views towards the Site are to the southwest, looking over North Third Reservoir. Beyond a large block of coniferous forestry, muirburn and pasture fields extend into the far distance over rising, undulating ground, characteristic of the area. Minor roads and watercourses snake through the lower valley,			

Viewpoint 2	
	and are typically bound by strips of riparian woodland and fencing. Dispersed farmsteads can be seen dotted across the lower valley. Craigengelt Wind Farm is clearly visible on the horizon, with all eight turbines forming notable vertical features. Distant views to the west comprise the steeply rising ground of Earl's Hill, which hosts multiple communication towers. A small number of turbines in Earlsburn Wind Farm can be seen over the horizon in this direction. Views to the south are curtailed by Cairnoch Hill, and the sweeping Kilsyth Hills beyond. Recreational receptors, whose attention is focused on their surroundings, are considered to be of medium-high susceptibility to changes in the view. In terms of value, the viewpoint has some scenic rural qualities, with woodland, the reservoir, and distant views across to the Kilsyth Hills in the south and the Campsie Fells in the southwest, and the Gargunnock and Touch Hills to the northwest. It is located within the Southern Hills LLA, but is not a promoted or recognised viewpoint, and therefore the value of the view is considered to be medium-high. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be medium-high.**
Changes	All four turbine hubs and four turbine blades will be fully visible against the skyline, seen at a distance of approximately 2.1km in south westerly views. The Proposed Development will be seen in combination with the operational Craigengelt Wind Farm further southwest, and Earlsburn Wind Farm to the northwest. Proposed turbines will appear closer in views, and will extend the influence of wind farm development in views from this location, likely reading as an extension to Craigengelt Wind Farm (but noting appreciable differences in turbine size and slightly extending the horizontal field of view occupied by turbines in relation to this scheme). From this viewpoint there will be some visual stacking of turbines in the Proposed Development in combination with some of the turbines in Craigengelt. The scale of change is judged to be medium-large. The geographical extent is judged to be small, as this represents views from the more open ridgeline. Coniferous forest across Lewis Hill will reduce the availability of wider views.
Effect	**The overall magnitude of visual change is considered to be medium-high and taking account of the medium-high sensitivity will result in a Significant (Major) effect.**
Cumulative Effects	Views of consented wind farms will be longer distance and successive, and largely screened by intervening coniferous forest from this location. Under scenario 2, the proposed Earlsburn Extension will be partially visible from this location, seen to the north of the operational Earlsburn, and will extend the influence of wind turbines to the north of this scheme. In views towards the Site under scenario 2, the Proposed Development will continue to marginally extend the influence of wind turbines to the northeast of the operational Craigengelt in an area where qualities such as remoteness have already been affected by wind farms. The gap between the now larger Craigengelt Wind Farm cluster and the now larger Earlsburn Wind Farm cluster will remain legible. **In this context effects will reflect those as identified in the primary assessment.**

Table 5-20: Viewpoint 3 – Carron Bridge at Northshields

Viewpoint 3				
Grid Reference	276599	684212	Figure Number	5-2-3
LCT	Lowland River Valleys - Central		Landscape designation	N/A
Direction of view	Northwest		Distance to nearest	4.1km

Viewpoint 3			
		turbine	
Number of hubs theoretically visible	4	Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located adjacent to the B818 minor road. The viewpoint represents views experienced by road users on the minor road network to the south of the Site, agricultural workers near West Riverside Farm, and scattered residential receptors near the hamlets of Carron Bridge and west of Fankerton. Existing views towards the Site are to the northwest. The near distance comprises a rural setting, with pastoral fields bound by fencing, a mature in-field tree in the foreground, and meandering riparian corridor cutting through the rolling fields in the mid-distance. To the west, the B818 passes east-west, and is bound by mature roadside vegetation. A farmstead is situated just north of the B818. In the middle distance turbines in the Craigengelt and Earlsburn Wind Farms can be seen on the horizon to the west. To the northwest, Earls Hill can be seen in the distance, with communication towers forming vertical elements in the landscape. To the north, rising ground comprised of further pastoral fields curtails longer distance views. Dispersed farmsteads can be seen in the distance, set against larger blocks of coniferous forestry, which provide partial screening in northerly views from these residences. The influence of human activity is apparent, through fencing/drystone dykes, built settlement, commercial forestry, distribution overhead lines and operational wind turbines. Road users including cyclists on this local road are considered to be of medium susceptibility to changes in the view. In terms of value, the viewpoint has some scenic rural qualities but is not located in any designated landscape, and does not represent a recognised or promoted view, and is therefore considered to be of medium value. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be medium.**		
Changes	Four turbine hubs and four turbine blades will be visible above the skyline, seen at a distance of approximately 4.1km, alongside and in front of the more distant turbines at Craigengelt Wind Farm. Turbines in the Proposed Development will appear larger than that of the operational Craigengelt and Earlsburn Wind Farms. The Proposed Development is likely to read as a separate entity to an existing wind farm, from this viewing angle. It will increase the influence of wind turbines in views on the horizon to the northwest. The size/scale of visual change will therefore be medium-large, and the geographical extent of the change is judged to be small (representing more fleeting views from a short section of the B818).		
Effect	**The overall magnitude of visual change is considered to be medium-high and taking account of the medium sensitivity will result in a Significant (Major) effect.**		
Cumulative Effects	Under scenario 1, views of consented wind farms will be very limited and long distance. Under scenario 2, the proposed Earlsburn Extension will be partially visible from this location, seen to the northwest and beyond Earls Hill. This scheme will extend the influence of wind turbines seen across the horizon in views to the northwest. In views towards the Site under scenario 2, the Proposed Development will continue to extend the influence of wind turbines to the northeast of the operational Craigengelt, and be seen in front of turbines in the application stage Earlsburn Extension. This may read as one larger wind farm. However, and given that the Proposed Development will continue to be responsible for bringing wind turbines closer to the viewpoint, **effects will reflect those as**		

Viewpoint 3	
	identified in the primary assessment.

Table 5-18: Viewpoint 4 – Tomtain

Viewpoint 4				
Grid Reference	272120	681416	Figure Number	5-2-4
LCT	Rugged Moorland Hills		Landscape designation	Kilsyth Hills LLA
Direction of view	North		Distance to nearest turbine	5.7km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located on an elevated section of a Core Path, in the Kilsyth Hills to the south of the Site and north of Kilsyth. The viewpoint represents views experienced by recreational receptors, walking in the Kilsyth Hills along the path network, and for forestry workers. Existing views towards the Site are to the north, extending over areas of rough grassland and forestry and across the Carron Valley. The landform in the foreground slopes down then up again towards the Site, with expansive views over the surrounding landscape. To the west, Carron Valley Reservoir can be seen partially enclosed by blocks of coniferous forestry. In the mid-distance, forestry operations and recent areas of replanting and felling can be seen. All eight of the turbines at Craigengelt are clearly visible on a lower rounded hill in the middle distance. The turbines are backclothed by rising ground in the north. To the northwest, the operational wind farms of Earlsburn and Kingsburn can be clearly seen, with turbine seen above the distant horizon line. The dramatic rising landforms of Ben Ledi, Ben Venue and Ben Vorlich are apparent beyond. In the far distance to the north, turbines at the Braes of Doune scheme can be seen against the rising ground of the Braes. To the northeast, the low-lying Carse of Stirling unfolds, with extensive areas of settlement and arable fields interspersed with woodland. There is some limited visibility of turbine blades in the Ochil Hills. Strathallan (under construction and was previously called Greenscares) will also introduce a further, albeit very distant wind farm, in views to the north. In terms of value, the viewpoint has some scenic rural qualities, and is located in a locally designated landscape, but does not represent a recognised or promoted view. The influence of human activity is apparent in this working landscape, through commercial forestry, distribution overhead lines and operational wind turbines. Recreational receptors, whose attention is focused on their surroundings, are considered to be of medium-high susceptibility to changes in the view. In terms of value, the viewpoint is located in a locally designated landscape, indicating a medium-high value. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be medium-high.**				
Changes	The Proposed Development will introduce four turbine hubs and four turbine blades, seen at a distance of 5.7km, in views north across the Carron Valley. All four turbine blades will be visible just above the distant horizon. The Proposed Development will be seen behind and alongside (to the north-east) of operational turbines at Craigengelt, appearing larger in scale. There will be a notable gap between turbines to the east and west of the layout, with the two turbines to the west likely to read as part of the operational Craigengelt Wind Farm. Seen in combination with the operational Earlsburn and Kingsburn schemes to the west, and the operational Braes of Doune in the distance to				

Viewpoint 4	
	the north (beyond Craignengelt), the Proposed Development will increase the influence of wind farms across the landscape. A medium scale of change is predicted. The geographical extent is judged to be small, as forestry will limit views from wider sections of the Core Path network in this area.
Effect	**The overall magnitude of visual change is considered to be medium and taking account of the medium-high sensitivity will result in a Significant (Moderate) effect.**
Cumulative Effects	Due to the elevated and open nature of the viewpoint, consented and proposed wind farms will increase the influence of wind farms in large scale and panoramic views in multiple directions from this location. Under scenario 1, and in views towards the Site, the consented Shelloch Wind Farm will introduce a further wind farm into the Gargunnock and Touch Hills, to the southwest of the operational Kingsburn Wind Farm. Under scenario 2 Earlsburn Extension will extend the influence of wind turbines in the Gargunnock and Touch Hills, to the northeast of the operational Earlsburn. Under both scenarios, the Proposed Development will continue to extend the influence of wind turbines to the northeast of the operational Craigengelt. From this viewpoint, the Proposed Development will be seen in the context of the operational Craigengelt Wind Farm and also in the context of larger wind farm groups to the north and west of the Gargunnock and Touch Hills. Together, the consented and proposed developments will occupy a wider horizontal extent, thereby increasing the influence of wind farm development in views. The Proposed Development will contribute to this effect. However, gaps between the now larger emerging wind farm groups in the Gargunnock and Touch Hills will remain similar with the introduction of the Proposed Development, which will extend the influence of turbines to the northeast of Craigengelt. **In this context, effects will reflect those as identified in the primary assessment.**

Table 5-22: Viewpoint 5 – M9/A811 Overpass

Viewpoint 5				
Grid Reference	277570	693537	Figure Number	5-2-5
LCT	Carselands		Landscape designation	N/A
Direction of view	Southwest		Distance to nearest turbine	7.2km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located along the M9 and the A811 overpass, and is representative of views experienced by road users travelling south along the M9 to the northeast of the Site. Views from this location towards the southwest comprise low-lying, open pasture fields in the foreground, bound by post and wire fencing and crossed by wooden electrical poles. The settlement of Cambusbarron can be seen directly south in the mid-distance, with houses sitting below the horizon and extending southwest towards the Site. Sequoia Grove Nature Reserve and the sharply rising landform of Gillies Hill is located behind the settlement of Cambusbarron and forms an elevated band of coniferous woodland. To the west of this feature, the topography is more low-lying but begins to gently rise			

Viewpoint 5	
	beyond the settlement and towards the Touch Hills. Further west, extensive areas of woodland are seen on north-facing slopes across the Touch Hills, which transition into rougher moorland landcover across elevated areas of the landform. The turbines of the operational Craigengelt wind farm are perceptible on the horizon, to the southwest. Road users on this fast moving route are considered to be of medium -low susceptibility to changes in the view. In terms of value, the viewpoint has some scenic rural qualities but is not located in any designated landscape, and does not represent a recognised or promoted view, and is therefore considered to be of medium-low value. On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be **medium-low**.
Changes	The Proposed Development will introduce four turbine hubs and four turbine blades, seen at a distance of 7.2km, in views southwest across the Touch Hills. All four hubs and turbine blades will be visible on the skyline. The Proposed Development will be seen in the context of and in front of the operational turbines at Craigengelt. It will extend the horizontal field of view occupied by turbines in relation to this scheme, and bring turbines closer to this viewpoint. The scale of the proposed turbines will appear larger than the existing Craigengelt turbines. However, the Proposed Development is likely to read as an extension to the operational Craigengelt Wind Farm, given their proximity and similar landscape context. The scale of change is judged to be medium, and the geographical extent is considered to be medium, as this is representative of views from a section of the M9 between Stirling and to the west of Bridge of Allen.
Effect	**The overall magnitude of visual change is considered to be medium and taking account of the medium-low sensitivity will result in a Not Significant (Minor) effect.**
Cumulative Effects	The key change to the cumulative baseline will be under scenario 2. Earlsburn Extension will create a notable new feature on the horizon in views to the southwest. The Proposed Development will continue to read as an extension to Craigengelt, with a clear gap between the now larger Craigengelt cluster, and the proposed Earlsburn Extension. **In this context cumulative effects will reflect those as identified in the primary assessment.**

Table 5-23: Viewpoint 6 – Meikle Bin

Viewpoint 6				
Grid Reference	266721	682183	Figure Number	5-2-6
LCT	Lowland River Valleys - Central		Landscape designation	Southern Hills LLA
Direction of view	Northeast		Distance to nearest turbine	7.9km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located at the summit of Meikle Bin (570m AOD). The viewpoint is representative of views experienced by recreational receptors visiting the hill summit to the southwest of the Site. From the elevated summit of Meikle Bin, there are expansive and far-reaching views north, overlooking the Carron Valley Reservoir which runs northwest to east across the viewpoint. Along the edges of Carron Valley Reservoir, blocks of coniferous forest and areas of felling are clearly visible on the valley sides.			

Viewpoint 6	
	The topography rises over Cairnoch Hill (413m AOD), to the north in the middle distance. The operational Craigengelt Wind Farm is seen to the east of Cairnoch Hill, and the two operational schemes Earlsburn and Kingsburn are seen on the undulating uplands of the Gargunnock and Touch Hills, to the northwest of Cairnoch. In the distance to the northeast, the low-lying expanses of the Carse of Stirling can be seen, with densely settled areas of development further east. In the far distance to the north, the Braes of Doune Wind Farm is apparent. There is also some limited visibility of wind farms in the Ochil Hills, to the northeast. Recreational receptors, whose attention is focused on their surroundings, are considered to be of medium-high susceptibility to changes in the view. In terms of value, the viewpoint is located in a locally designated landscape, indicating a medium-high value. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be medium-high.**
Changes	The Proposed Development will introduce four turbine hubs and four turbine blades, seen at a distance of 7.9km, in views north across the Carron Valley. All four hubs and turbine blades will be visible below the skyline, backclothed by the Ochil Hills north of the Carse of Stirling. The Proposed Development will be seen behind the operational turbines at Craigengelt, and whilst appearing larger in scale than the operational scheme, is likely to read as an extension to it. The proposed turbines will appear contained within the horizontal extents of the existing Craigengelt scheme, and will not notably extend the presence of turbines further into the landscape. Furthermore, the gap between Craigengelt Wind Farm, and the operational schemes of Kingsburn and Earlsburn to the west will be maintained, minimising the perception of additional wind farm development within the Gargunnock and Touch Hills. The scale of change is considered to be small, and the geographical extent is considered to be small (as this represents more localised views from a minor summit, which is surrounding by coniferous forest on the lower slopes).
Effect	**The overall magnitude of visual change is considered to be low and taking account of the medium-high sensitivity will result in a Not Significant (Minor) effect.**
Cumulative Effects	Under both scenarios consented and proposed schemes will increase the influence of wind farms in large scale and panoramic views from this summit. Under both scenarios the Proposed Development will continue to read as an extension contained within the horizontal field of view occupied by turbines in the operational Craigengelt Wind Farm. **As such, effects will reflect those as identified in the primary assessment.**

Table 5-24: Viewpoint 7 – Bannockburn Memorial

Viewpoint 7				
Grid Reference	279483	690689	Figure Number	5-2-7
LCT	Lowland Hill Fringes - Central		Landscape designation	N/A
Direction of view	Southwest		Distance to nearest turbine	6.7km
Number of hubs theoretically visible	0		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located at Bannockburn Memorial, northeast of the Site. The viewpoint is representative of views experienced by recreational receptors visiting the memorial. Beyond the grass lawns of the battlefield memorial, pasture and arable fields			

Viewpoint 7	
	comprise the foreground of the view looking southwest. Gently undulating fields are bound by mature hedgerow trees and dense hedgerows, with clumps of broadleaved woodland in the middle distance. Along the rising landforms of the Gargunnock and Touch Hills in the distance, coniferous forests cover much of the north-facing slopes, with scattered settlements across the hill fringes. Views of operational wind farms, to the southwest, are limited in nature (some very limited visibility of the blades of Craigengelt Wind Farm). Recreational receptors, whose attention is focused on their surroundings, are considered to be of medium-high susceptibility to changes in the view. In terms of value, the viewpoint has strong scenic rural qualities, with woodlands, pastoral fields and mature hedgerows, and distant views to the Gargunnock and Touch Hills to the southwest. However, it is not within a designated landscape or a promoted or recognised viewpoint, and therefore the value of the view is considered to be medium. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be medium-high**.
Changes	The Proposed Development will introduce four turbine blades into the view, seen at a distance of 6.7km. The landform and coniferous forest on the horizon will largely screen views of the Proposed development. Upper blades will just be apparent, as these rotate and 'tip over' the horizon. The turbine blades will be visible but will not form noticeable elements in the view, and the scale of visual change will therefore be small. The geographical extent is also small, as this represents views from Bannockburn Memorial.
Effect	**The overall magnitude of visual change is considered to be low and taking account of the medium-high sensitivity will result in a Not Significant (Minor) effect.**
Cumulative Effects	The key change to the cumulative baseline will be under scenario 2. Views of other consented and proposed wind farms will be very limited. Earlsburn Extension will create a new feature on the horizon in views to the southwest. Intervening vegetation will partially screen views of this scheme. The level of visibility will change with the seasons and as people move around the Bannockburn Memorial site. In this context, visibility of the Proposed Development will continue to be limited, and the Proposed Development will read as a distinct wind farm to Earlsburn Extension. **In this context cumulative effects will reflect those as identified in the primary assessment.**

Table 5-25: Viewpoint 8 – Stirling Castle

Viewpoint 8				
Grid Reference	279009	693969	Figure Number	5-2-8
LCT	Urban		Landscape designation	N/A
Direction of view	Southwest		Distance to nearest turbine	8,4km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located at Stirling Castle, situated on an elevated crag within the Carse of Stirling, to the northeast of the Site. The viewpoint is representative of views experienced by recreational receptors visiting Stirling Castle. From the elevated position of Stirling Castle, the view to the southwest comprises expansive long-reaching views over the low-lying floodplains west			

Viewpoint 8	
	of the castle. In the foreground, the King's Knot can be seen, set within manicured grounds. South of this feature, the A811 connects to Dumbarton Road. In the centre of the field of view to the southwest, numerous mature trees and woodland clumps are scattered across the middle distance, within the landscaped King's Park. To the southeast, the densely settled suburbs of Stirling are visible, relatively contained by bands of woodland. To the west, relatively flat and farmed floodplains of the Carse of Stirling are scattered with occasional farmsteads, and hedgerows. The floodplains stretch towards the Gargunnock and Touch Hills, which form rising landforms in the southwest. The elevated landforms are mostly covered with forestry, transitioning to moorland at their upper reaches. The operational Craigengelt Wind Farm is visible on the horizon, to the southwest. Braes of Doune Wind farm is also visible in longer distance views to the north. The view forms a relatively rural scene, despite the areas of denser settlement, arable fields, forestry and more manicured landscapes. Recreational receptors at this nationally important historic site, and whose attention is focused on their surroundings, are considered to be of high susceptibility to changes in the view. In terms of value, the viewpoint is not within a designated landscape, but is considered a key public view and therefore the value is considered to be medium-high. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be high.**
Changes	The Proposed Development will introduce four turbine hubs and four turbine blades, seen at a distance of 8.4km, in views southwest across the Carse of Stirling. All four hubs and turbine blades will be visible on the horizon to the southwest, relatively evenly spaced and largely contained within the horizontal field of view occupied by Craigengelt Wind Farm (turbine 2 will marginally extend the horizontal field of view occupied by turbines, to the east of Craigengelt Wind Farm). The difference in turbine scale between the operational and proposed schemes will be notable, though not incompatible. The Proposed Development is likely to read as an extension, and will not notably further alter undeveloped parts of enclosing horizons to the southwest. Taking a very precautionary approach to the assessment, the scale of change is considered to be medium-small, and the geographical extent is considered to be small, as similar views will be gained from within the immediate surroundings of the elevated vantage point at Castle Rock.
Effect	**The overall magnitude of visual change is considered to be medium-low and taking account of the high sensitivity will result in a Significant (Moderate) effect. This is mainly due to the elevated sensitivity of the viewpoint, from Stirling Castle. Similar views, from less sensitive parts of Stirling, will fall below the threshold of significance.**
Cumulative Effects	The key change to the cumulative baseline will be under scenario 2. Views of other consented and proposed schemes will be very long distance and successive. Earlsburn Extension will create a notable new feature on the horizon in views to the southwest (seen in front of some very limited visibility of turbine blades in the operational Earlsburn Wind Farm). The Proposed Development will continue to read as an extension to the operational Craigengelt Wind Farm, and as a distinct wind farm to Earlsburn Extension. **In this context cumulative effects will reflect those as identified in the primary assessment.**

Table 5-26: Viewpoint 9: M80 at Denny Myothill Road overpass

Viewpoint 9				
Grid Reference	280402	681150	Figure Number	5-2-9
LCT	Lowland Hill Fringes - Central		Landscape designation	N/A
Direction of view	Northwest		Distance to nearest turbine	8.9km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located on Myothill Road. The viewpoint is representative of views experienced by road users travelling along this route, and over the M80, to the southeast of the Site. Views from the M80 are limited by roadside cutting and vegetation through this section. Views to the northwest comprise pasture fields, bound by post and wire fencing, with drystone walls. Transmission towers and lines cross in the foreground along the roadway. In the mid distance, bands of mature broadleaved woodland can be seen, marking the transition to more elevated moorland further north. Behind a band of mixed shelterbelts Little Denny Reservoir can be seen. Settlement is scattered across the hill fringes, and consists mainly of traditional farmsteads and ancillary buildings. Undulating upland expanses form the horizon, including Myott Hill with its communication towers with the wooded Cairnoch Hill seen behind, and the wooded Lewis Hill further north. Existing wind farms in the Gargunnock and Touch Hills can be seen on the horizon beyond Myott Hill, partially screened by landform. In the distance beyond Craigengelt Wind Fam, Earls Hill with its communication towers can be seen. Road users are considered to be of medium susceptibility to changes in the view. In terms of value, the viewpoint has some scenic qualities but is not located in any designated landscape, and does not represent a recognised or promoted view, and is therefore considered to be of medium-low value. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be medium-low.**			
Changes	The Proposed Development will introduce four turbine hubs and four turbine blades, seen at a distance of 8.9km, in views northwest. All four hubs and turbine blades will be visible on the skyline, with towers partially back clothed by open moorland on the slopes to the northwest. The Proposed Development will be seen in front of and to the northeast of operational turbines at Craigengelt (and Earlsburn and Kingsburn Wind Farms, further behind). This will extend the horizontal field of view occupied by turbines in relation to these schemes, and bring turbines slightly closer to this viewpoint. The turbines will appear larger in scale than the existing Craigengelt, and is likely to be perceived as a separate scheme in front from this viewing angle, thus increasing the influence of wind farms across the landscape in views from this location. The Proposed Development will be seen in the context of views which have been altered by operational wind farms, as well as transmission lines, communication towers, commercial forestry, and areas of development. It is unlikely that the Proposed Development will significantly alter the setting that the surrounding landscape provides. Due to this, and the viewing distance, the scale of change is judged to be small, and the geographical extent is judged to be medium-small, as this represents views from a relatively short section of the road network to the northwest of Denny.			
Effect	**The overall magnitude of visual change is considered to be low and taking account of the medium-low sensitivity will result in a Not Significant (Minor)**			

Viewpoint 9	
	effect.
Cumulative Effects	The key change to the cumulative baseline will be under scenario 2, in views towards the Site. Earlsburn Extension will increase the influence of wind farms in the Gargunnock and Touch Hills, in views to the northwest. The Proposed Development will be seen in front of, and contained within the horizontal field of view, of this now larger wind farm group. **In this context cumulative effects will reflect those as identified in the primary assessment.**

Table 5-27: Viewpoint 10: Wallace Monument

Viewpoint 10				
Grid Reference	280903	695676	Figure Number	5-2-10
LCT	Lowland Valley Fringes		Landscape designation	Western Ochils LLA
Direction of view	Southwest		Distance to nearest turbine	10.9km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located at the National Wallace Monument, and is located on an elevated and wooded knoll north of Stirling. The viewpoint is representative of views experienced by recreational receptors visiting the Wallace Monument, to the northeast of the Site. Looking southwest, the densely settled Stirling suburb of Cornton to the west and the low-lying floodplain to the south are bisected by the meandering River Forth. In the centre of the field of view, situated on an elevated crag, Stirling Castle is clearly visible in the middle distance. The city of Stirling sprawls out to the east and north of this landmark feature. In the distance, the rising landforms of the Gargunnock and Touch Hills form a southern boundary to the Carse of Stirling, and curtail longer distance views in this direction. The existing wind farms of Craigengelt, Earlsburn and Kingsburn can be seen across the horizon of the Gargunnock and Touch Hills, including all eight towers and hubs of Craigengelt, directly southwest. Earl's Hill is seen to the west of Craigengelt, and forms an area of higher elevation within the hills. Moorland and scattered commercial forestry cover the northeastern facing slopes of the hills, and provide a backdrop to Stirling and the castle. Recreational receptors, whose attention is focused on their surroundings, are considered to be of medium-high susceptibility to changes in the view. In terms of value, it is within the locally designated Western Ochils LLA, and is recognised as a key public viewpoint, and therefore the value of the view is considered to be high. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be high.**			
Changes	The Proposed Development will introduce four turbine hubs and four turbine blades, seen at a distance of 10.9km, in views southwest across Stirling and towards the Gargunnock and Touch Hills. All four hubs and turbine blades will be visible on the skyline, evenly spaced. The Proposed Development will be seen in front of operational turbines at Craigengelt, and will be largely contained within the horizontal field of view occupied by turbines in relation to this scheme (Turbine 2 will slightly extend the horizontal field of view occupied by turbines, in relation to Craigengelt Wind Farm). The Proposed Development will bring turbines slightly closer to this viewpoint, and the difference in scale between the operational and proposed turbines will be notable, though not			

Viewpoint 10	
	incompatible. However, and partially due to the increased viewing distance, the Proposed Development is likely to read as an extension to Craigengelt Wind Farm. The scale of change and geographical extents (from the elevated area around the base of the Wallace Monument) is judged to be small.
Effect	**The overall magnitude of visual change is considered to be low and taking account of the high sensitivity will result in a Not Significant (Minor) effect.**
Cumulative Effects	The key change to the cumulative baseline will be under scenario 2. Wider and successive views of consented and proposed wind farms will be very long distance, limited by vegetation from the base of the monument. Earlsburn Extension will intensify the influence of wind farms on the horizon in views to the southwest, and seen in the context of more limited views of the operational Earlsburn and Kingburn Wind Farms. The Proposed Development will continue to read as an extension to the operational Craigengelt Wind Farm, and as a distinct wind farm to Earlsburn Extension. **In this context cumulative effects will reflect those as identified in the primary assessment.**

Table 5-28: Viewpoint 11: Falkirk Wheel

Viewpoint 11				
Grid Reference	285260	679986	Figure Number	5-2-11
LCT	Lowland River Valleys - Central		Landscape designation	N/A
Direction of view	Northwest		Distance to nearest turbine	13.6km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located at Falkirk Wheel, south of Larbet. The viewpoint is representative of views experienced by recreational receptors visiting the Falkirk Wheel, to the southeast of the Site. The foreground of the view comprises the narrow watercourse where the Forth and Clyde Canal connect with the Union Canal at the wheel. A large steel structure supports the rotating boat lift. Post and wire fencing bound the watercourse to the northwest, beyond which lie areas of scrub and mixed woodland. In the mid-distance, the landcover pattern is varied with mixed woodland in the river corridor and slopes of Carron Glen. Valley sides are characterised by pasture and arable crops, divided by post-and-wire fences and hedgerow. The settlements of Bonnybridge and Denny can be seen within the river valley, slightly extending up the wooded and farmed slopes. Numerous transmission towers and lines cut through the landscape and through blocks of forestry, forming notable vertical features. To the north, the operational turbines at Tod Hill Farm can be seen, visible over areas of woodland at Baxter Wood. In the distance to then northwest, the rising landforms of the Gargunnock and Touch Hills can be seen, mostly covered with extensive areas of moorland, and scattered with commercial forestry blocks. Turbines in the Craigengelt, Kingsburn and Earlsburn Wind Farms can be seen on the horizon, above the hills. Recreational receptors, whose attention is focused on their surroundings, are considered to be of medium-high susceptibility to changes in the view. In terms of value, the viewpoint is not located within a designated landscape and is not a promoted or recognised viewpoint, and therefore the value of the			

Viewpoint 11	
	view is considered to be lower. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be medium.**
Changes	The Proposed Development will introduce four turbine hubs and four turbine blades, seen at a distance of 13.6km, in views north across Carron Glen and towards the Gargunnock and Touch Hills. All four hubs and turbine blades will be visible on the horizon, with towers partially back clothed by open moorland on the slopes to the north. The Proposed Development will be seen in front of and to the east of operational turbines at Craigengelt, Kingsburn and Earlsburn. This will extend the horizontal field of view occupied by turbines in relation to these schemes, and bring turbines slightly closer to this viewpoint. The turbines will appear larger than the turbines behind, and will slightly increase the influence of wind farm development in views from this location. However, the Proposed Development will be seen in the context of long distant views, and views which have been altered by operational wind farms, numerous transmission lines, and areas of settlement, and it is judged that the Proposed Development will not significantly alter the setting. The scale of change is considered to be small, and the geographic extent is judged to be small (this represents quite localised views from an open and high section of the canal network).
Effect	**The overall magnitude of visual change is considered to be low and taking account of the medium sensitivity will result in a Not Significant (Minor) effect.**
Cumulative Effects	Under scenario 1, there will be some limited additional visibility of wind farms in the Gargunnock and Touch Hills, through the consented Shelloch. The key change to the cumulative baseline will be under scenario 2. Earlsburn Extension will increase the influence of wind farms in the Gargunnock and Touch Hills, in views to the northwest. The Proposed Development will be seen in front of, and contained within the horizontal field of view, of this now larger wind farm group. **In this context cumulative effects will reflect those as identified in the primary assessment.**

Table 5-29: Viewpoint 12: Dumyat

Viewpoint 12				
Grid Reference	283567	697672	Figure Number	5-2-12
LCT	Lowland Hills - Central		Landscape designation	Western Ochils LLA
Direction of view	Southwest		Distance to nearest turbine	14.2km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located at a minor summit at the western edges of the Ochils, to the northeast of the Site. The Ochils form a compact hill plateau north of the Carse of Stirling, capped by smooth, rounded tops which are dissected by the incised valleys of minor watercourses. The viewpoint is representative of views experienced by recreational receptors visiting the summit. From the elevated vantage point, the view comprises expansive and panoramic views across the Carse of Stirling towards the Gargunnock and Touch Hills. In the foreground of the view lies the craggy edge of the summit mainly comprising moorland and rough grassland, which sharply drops into the low-lying carse below. The gently undulating floodplains of the carse in the middle distance are primarily arable, with small pockets of woodland and mature hedgerow belts throughout. Farmsteads and larger blocks of			

Viewpoint 12	
	settlement are scattered across the field of view. To the west, the settlement of the Bridge of Allan is apparent. To the southwest, Stirling and the suburb of Cornton sprawl out, situated below the wooded rising knoll upon which the prominent Wallace Monument can be seen. Beyond this, Stirling Castle is visible. To the south, the settlements of Denny and Falkirk can be seen in the distance. To the southwest, the Gargunnock and Touch Hills rise, forming an elevated hill range which occupies the centre field of view. The hills are covered with expanses of moorland and rough grassland, broken by blocks of commercial forestry. Above the hills, the operational Craigengelt Wind Farm can be seen, backclothed by the Fintry Hills. Further west, the two operational schemes of Kingsburn and Earlsburn are visible above the escarpment. To the south, the operational Tod Hill Farm is visible beyond Denny. There are occasional views to the Highland Bens in the far distance to the northwest. Recreational receptors, whose attention is focused on their surroundings, are considered to be of medium-high susceptibility to changes in the view. In terms of value, it is within the locally designated Western Ochils LLA, and is recognised as a key public viewpoint, and therefore the value of the view is considered to be medium-high. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be medium-high**.
Changes	The Proposed Development will introduce four turbine hubs and four turbine blades, seen at a distance of 14.2km, in views south across the Carse of Stirling. All four hubs and turbine blades will be visible on the horizon, which is formed by the Gargunnock and Touch Hills. The proposed turbines will be mostly back clothed by open moorland on the north-facing slopes of the Fintry Hills. The Proposed Development will be seen in front of and largely contained within the horizontal extents of operational turbines at Craigengelt. This will bring turbines slightly closer to this viewpoint. From this viewing distance, the proposed turbines will only appear marginally larger than the operational Craigengelt. Seen in the context of existing wind farm development within the Gargunnock and Touch Hills, in long range and large scale views, it is unlikely that the Proposed Development will significantly alter the setting. The scale of change is considered to be small, and the geographic extent is judged to be medium.
Effect	**The overall magnitude of visual change is considered to be low and taking account of the medium-high sensitivity will result in a Not Significant (Minor) effect.**
Cumulative Effects	Due to the elevated and open nature of this viewpoint, consented and proposed schemes will be visible in multiple viewing directions. In views towards the Gargunnock and Touch Hills, under scenario 1, there will be some limited additional visibility of wind farms through the consented Shelloch. Under scenario 2, Earlsburn Extension will intensify the influence of wind farms on the horizon in views to the southwest, and seen in the context of the operational Earlsburn and Kingburn Wind Farms. The Proposed Development will continue to read as an extension to the operational Craigengelt Wind Farm, and as a distinct wind farm to the now larger Earlsburn cluster. **In this context cumulative effects will reflect those as identified in the primary assessment.**

Table 5-30: Viewpoint 13: Clackmannan Tower

Viewpoint 13				
Grid Reference	290649	691945	Figure Number	5-2-13
LCT	Carselands		Landscape designation	N/A
Direction of view	Southwest		Distance to nearest turbine	17.6km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located at Clackmannan Tower, to the northeast of the Site. The viewpoint is representative of views experienced by recreational receptors visiting the Clackmannan Tower (access to the tower is seasonal). From this slightly elevated vantagepoint, the view comprises the broad, open floodplains of the Carselands, the low rolling farmland and distant horizon formed by the Gargunnock and Touch Hills to the west. The meandering River Forth can be seen in the floodplains below, passing to the west of the viewpoint. Large rectilinear fields of mostly arable fields of barley, oats and grazing land cover the low lying floodplains in the foreground, divided by post-and-wire fences or broken hedgerows. To the northwest the densely settled town of Alloa can be seen, partially screened by blocks of trees, which are dispersed along the edge of the river floodplain. Numerous transmission towers are in the Forth Valley, forming notable vertical elements in views. The operational Craigengelt Wind Farm is visible on the horizon to the west, over the Gargunnock and Touch Hills. To the southwest, the operational Tod Hill Wind Farm is visible. Beyond Craigengelt, the operational Earlsburn and Kingsburn Wind Farms are also just perceptible over rising landform. Recreational receptors, whose attention is focused on their surroundings, are considered to be of medium-high susceptibility to changes in the view. In terms of value, the viewpoint has some scenic and rural qualities, however is not a designated landscape, and is not recognised as a key public viewpoint, and therefore the value of the view is considered to be medium. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be medium.**			
Changes	The Proposed Development will introduce four turbine hubs and four turbine blades, seen at a long-range distance of 17.6km, in views southwest on uplands beyond the carselands. All four hubs and turbine blades will be visible on the skyline. The Proposed Development will be seen in front of and to the northeast of operational turbines at Craigengelt. This will extend the horizontal field of view occupied by turbines in relation to this scheme, and bring turbines slightly closer to this viewpoint. The proposed turbines will appear slightly larger than the operational turbines at Craigengelt, but are unlikely to form new notable features on the horizon given the expansive horizons and existing vertical elements in the middle distance and far distance. Seen in the context of existing wind farm development (and likely reading as an extension to Craigengelt Wind Farm) within the Gargunnock and Touch Hills, it is unlikely that the Proposed Development will significantly alter the setting. The scale of change is considered to be small, and the geographic extent is judged to be medium.			
Effect	**The overall magnitude of visual change is considered to be low and taking account of the medium sensitivity will result in a Not Significant (Minor) effect.**			
Cumulative Effects	Under scenario 1, there will be some limited additional visibility of wind farms in the Gargunnock and Touch Hills, through the consented Shelloch. Under scenario 2, Earlsburn Extension will intensify the influence of wind farms			

Viewpoint 13	
	on the horizon in views to the southwest, and seen in the context of the operational Earlsburn and Kingsburn Wind Farms. Further distant views of consented and proposed schemes to the far south will not really notably alter the baseline situation. The Proposed Development will continue to read as an extension to the operational Craigengelt Wind Farm, and as a slightly distinct wind farm to the now larger Earlsburn cluster. **In this context cumulative effects will reflect those as identified in the primary assessment.**

Table 5-31: Viewpoint 14: Ben Cleuch

Viewpoint 14				
Grid Reference	290270	700636	Figure Number	5-2-14
LCT	Lowland Hills - Central		Landscape designation	Western Ochils LLA
Direction of view	Southwest		Distance to nearest turbine	21.2km
Number of hubs theoretically visible	4		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located at the highest summit within the Ochils, to the northeast of the Site. The viewpoint is representative of views experienced by recreational receptors visiting the summit (which is generally accessed from the south via Tillicoultry). From this elevated vantagepoint, the foreground of the view is comprised of the smooth rounded tops, seen between prominent glens, of the Ochil Hills at the peak of and around Ben Cleuch. The Carse of Stirling unfolds in the mid-distance, with large areas of dense settlement lying either side of the meandering River Forth, including the sprawling settlement of Stirling, west of the river. Across the floodplains lie the Gargunnock and Touch Hills, across which stretches of rough grassland, coniferous forestry, and heather moorland characterise the landform. The operational Craigengelt, Kingsburn, and Earlsburn Wind Farms are seen in the context of the Gargunnock and Touch Hills, and are mostly back clothed by the rising forms of the Fintry Hills/ Campsie Fells beyond. To the northwest, the Highland Bens can be seen on the distant horizon. There are wider successive views of operational wind farms form this summit, including close proximity views of the Rhodders/ Burnfoot cluster to the north. Recreational receptors, whose attention is focused on their surroundings, are considered to be of high susceptibility to changes in the view at the summit area of well frequented hills. In terms of value, it is within the locally designated Western Ochils LLA, indicating a higher value. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be high.**			
Changes	The Proposed Development will introduce four turbine hubs and four turbine blades, seen at a long range distance of 21.2km, in views southwest across the Carse of Stirling. All four hubs and turbine blades will be visible, seen within the Gargunnock and Touch Hills and backclothed by the Fintry Hills beyond. The Proposed Development will be seen in front of and within the horizontal extents of operational turbines at Craigengelt. This will bring turbines slightly closer to this viewpoint. Seen in the context of existing wind farm development within the Gargunnock and Touch Hills and with extensive backclothing, it is unlikely that the Proposed Development will significantly			

Viewpoint 14	
	alter the setting and is likely to read as an extension to Craigengelt. The scale of change is considered to be small, and the geographic extent is judged to be medium (this represents upland views from a number of summits and higher ground in the western Ochil Hills).
Effect	**The overall magnitude of visual change is considered to be low and taking account of the high sensitivity will result in a Not Significant (Minor) effect.**
Cumulative Effects	Due to the elevated and panoramic nature of views from this location, there will be views of consented and proposed wind farms in multiple viewing directions and distances. In views to the southwest, towards the Site, the key changes under scenario 1 will relate to the consented Shelloch, which will introduce some limited additional visibility of wind farms in the Gargunnock and Touch Hills beyond the Earlsburn cluster. Under scenario 2, Earlsburn Extension will intensify the influence of wind farms on the horizon in views to the southwest, and seen in the context of the operational Earlsburn and Kingburn Wind Farms. The Proposed Development will continue to read as an extension to the operational Craigengelt Wind Farm, and as a slightly distinct wind farm to the now larger Earlsburn cluster. **In this context cumulative effects will reflect those as identified in the primary assessment.**

Table 5-32: Viewpoint 15: Ben Ledi

Viewpoint 15				
Grid Reference	256236	709774	Figure Number	5-2-15
LCT	Highland Summits		Landscape designation	Cairngorms National Park and Ben Ledi WLA
Direction of view	Southeast		Distance to nearest turbine	27.8km
Number of hubs theoretically visible	2		Number of turbines with blades theoretically visible	4
Description and Sensitivity	This viewpoint is located at the Munro summit of Ben Ledi (879m AOD), to the northwest of the Site. The viewpoint is representative of views experienced by recreational receptors visiting the summit. From this elevated vantage, the view comprises the pronounced craggier outcrops of the Highland summit. The summit is generally covered with sparse grassland and heather, before sloping down into more forested areas below. Conifer forests can be seen on the lower narrow valley slopes, which cut between landforms. Glen Finglas Reservoir and Loch Venachar are two of the nearest waterbodies in the viewpoint, extending west and southwest and fringed by woodland. In the middle distance, the settlement of Callander is seen tucked against the rising foothills to the east. The low-lying Carse of Stirling spreads out beyond this, extending to the Gargunnock and Touch Hills to the southeast. The Fintry Hills and Campsie Fells form an elevated band extending south and southwest across the horizon in the field of view. The Ochils are visible on the horizon to the east. There are numerous operational wind farms in the view. Craigengelt, Kingsburn, Earlsburn are just visible above the Gargunnock and Touch Hills to the southeast, and the operational Rhodders/ Bum Foot Hill cluster are visible north of The Ochils, to the east. Recreational receptors, whose attention is focused on their surroundings, are considered to be of high susceptibility to changes in the view from this well			

Viewpoint 15	
	frequented Munro summit. In terms of value, the viewpoint is within the National Park, indicating a higher value. **On balance, taking account of the judgements of susceptibility and value, the overall sensitivity of receptors at this viewpoint is judged to be high.**
Changes	The Proposed Development will introduce four turbine hubs and blades, seen at a long-range distance of 27.8km, in views southeast across the Carse of Stirling. The Proposed development will be backclothed by distant rising slopes further southeast. The Proposed Development will be partially screened by Earls Hill, and will be seen in the context of existing wind farm development within the Gargunnock and Touch Hills. It is unlikely that the Proposed Development will significantly alter the setting in the large scale and panoramic view. The scale of change is considered to be small, and the geographic extent is judged to be medium.
Effect	**The overall magnitude of visual change is considered to be low and taking account of the high sensitivity will result in a Not Significant (Minor) effect.**
Cumulative Effects	Due to the elevated and panoramic nature of views from this location, there will be views of numerous consented and proposed wind farms particularly in long distance views to the east and south (and outside the National Park). The Proposed Development will be seen in this context, and not notably add to the cumulative picture. Under scenario 2 it will be seen behind the proposed Earlsburn Extension. **In this context cumulative effects will reflect those as identified in the primary assessment.**

Table 5-33: Viewpoint 16 – Crow Road

Viewpoint 16				
Grid Reference	264362	683329	Figure Number	5-2-16
LCT	Lowland River Valleys - Central		Landscape designation	Southern Hills LLA
Direction of view	Northeast		Distance to nearest turbine	9.3km
Number of hubs theoretically visible	2		Number of turbines with blades theoretically visible	0
Description and Sensitivity	This viewpoint is located on the Crow Road, as it crosses the Campsie Fells. The viewpoint represents views experienced by road users travelling north, towards Fintry. Existing views towards the Site are to the northeast. The near distance comprises a rural setting, with rough pasture and areas of coniferous forest. In the middle distance the landform rises up towards the Gargunnock and Touch Hills. Turbines in the Earlsburn and Kingsburn Wind Farms can be seen on the horizon. There is also some limited visibility of turbine blades in Craigengelt, seen on horizons further east. The influence of human activity is further apparent through fencing, occasional upland settlement, commercial forestry and distribution overhead lines. Road users (including cyclists) on this local road are considered to be of medium susceptibility to changes in the view. In terms of value, the viewpoint is located in a locally designated LLA, indicating a higher value. **On balance, taking account of the judgements of susceptibility and value, the**			

Viewpoint 16	
	overall sensitivity of receptors at this viewpoint is judged to be medium-high.
Changes	The upper sections of two turbine blades will be visible above the skyline, seen at a distance of approximately 9.3km, alongside turbine blades in Craigengelt Wind Farm. The Proposed Development is likely to read as a slight extension to these scheme, and noting the limited nature of visibility of both, due to screening by intervening landform. The scale of visual change will therefore be small, and the geographical extent of the change is judged to be small (representing more fleeting views from a short section of the Crow Road).
Effect	**The overall magnitude of visual change is considered to be low and taking account of the medium-high sensitivity will result in a Not Significant (Minor) effect.**
Cumulative Effects	In views to the northeast and under scenario 1, the consented Shelloch will introduce further turbines onto the horizon. Under scenario 2, the proposed Earlsburn Extension will be visible from this location, seen behind Kingsburn and Earlsburn Wind Farms, and increasing the influence of turbines on the horizon. The Proposed Development will continue to marginally extend the influence of wind turbines to the northeast of the operational Craigengelt and read as one slightly larger wind farm (and noting the limited nature of visibility of both) **In this context cumulative effects will reflect those as identified in the primary assessment.**

5.11.2 Effects on Settlements

Theoretical visibility of the wind farm from settlements across the study area is illustrated by Figure 5-1-1. Visual effects from settlements which have been taken forward for detailed assessment, as outlined in Table 5-7, are discussed below. A number of settlements are also represented by viewpoints.

Table 5-34: Effects on Stirling

Stirling			
Representative viewpoint	VP7: Bannockburn Memorial VP8: Stirling Castle	Approximate distance to nearest turbine	6km
Description and Sensitivity	Residential receptors, in the settlement of Stirling, are considered to be of high susceptibility. In terms of value, the settlement is not within a designated landscape. However, the hills which surround the Carse of Stirling, including the Gargunnock and Touch Hills to the west (The Southern Hills LLA) and The Ochils to the north, are designated at a local level. This is, in part, due to the role they play in providing a setting to the Carse of Stirling, in which this settlement sits. As such, this increases value. **The overall sensitivity is judged to be high.**		
Changes	The ZTV (refer to Figure 5-1-1) indicates fairly widespread visibility across the settlement. There are some notable areas of visual screening to the east of the castle (Gowanhill) and along the valley of Town Burn. In reality, built form and vegetation in the settlement will often screen views outside, and to the west. There will be locations, as highlighted by Viewpoints 7 and 8, where longer distance views to the west are available. From Viewpoint 8 (Stirling Castle) 8, a medium-small scale of change is		

Stirling	
	predicted. The Proposed Development is visible on the horizons of the Gargunnock and Touch Hills. It will be seen in the context of horizons which have been altered by wind farm development to the west, and is largely contained within the horizontal field of view occupied by Craigengelt Wind Farm (Turbine 2 will slightly increase the horizontal field of view occupied by turbine, in relation to Craigengelt Wind Farm). Given the highly sensitive nature of the viewpoint from Stirling Castle, and taking a precautionary approach to the assessment, significant visual effects are predicted. However, this represents one of the most open views from the settlement (which is, in part, the reason why the site was chosen for the castle). The sensitivity of the viewpoint is also inflated due to its popularity as a key national historic visitor attraction. From Viewpoint 7 the landform, and forest cover on the horizon, play a notable screening role. A small scale of change is predicted. This viewpoint is representative of more open and lower lying views from the more southwestern extents of the settlement, where the rising landform to the west (Gillies Hill and eastern flank of Lewis Hill) come closer to the settlement edge. As such, significant visual effects are recognised from very localised parts of the settlement. However, and on balance, the scale of change from the settlement as a whole will be small. In reality, built form, the landform and vegetation in the settlement will often combine to limit longer distance views to the hills to the west. From limited area with visibility, the Proposed development will typically be seen in the context of horizons which have been altered by wind farms.
Effect	**Significant visual effects are acknowledged from very localised parts of the settlement, but not on the settlement as a whole. Built form, the landform and vegetation often combined to limit outward views from large parts of the settlement. The wider setting has been altered by wind farm development and when visible the Proposed Development is generally seen in the context of horizons which have been altered by wind farms.** **On balance, the overall magnitude of visual change is considered to be low and taking account of the high sensitivity will result in a Not Significant (Minor) effect.**
Cumulative Effects	In very localised and limited views, from more elevated and open parts of the settlement with views to the west, the key change to the cumulative baseline will be under scenario 2. Earlsburn Extension will create a notable new feature on the horizon in views to the west (seen in front of some very limited visibility of turbine blades in the operational Earlsburn Wind Farm). In very localised and limited views, from more elevated and open parts of the settlement with views to the west, the Proposed Development will continue to read as an extension to the operational Craigengelt Wind Farm, and as a distinct wind farm to Earlsburn Extension (and when both visible). **In this context cumulative effects will reflect those as identified in the primary assessment.**

Table 5-35: Effects on Denny

Denny			
Representative viewpoint	VP9: M80 at Denny Myothill Road	Approximate distance to nearest turbine	7km

Denny			
	Underpass		
Description and Sensitivity	Residential receptors, in the settlement of Denny, are considered to be of high susceptibility. In terms of value, the settlement is not within a designated landscape. However, this hills to the west (including the Denny Hills) are designated at a local level, which increases value. **The overall sensitivity is judged to be high.**		
Changes	The ZTV (refer to Figure 5-1-1) indicates widespread visibility across the southern extents of the settlement. To the north of the settlement, the rising landform to the west of the M80 provides an area of visual screening. In reality, built form and vegetation in the settlement will often screen views outside, and to the northwest. There will be places within the settlement where glimpses between vegetation and built form, to the northwest will be available. For example, there are glimpses to the hills to the west, from Stirling Street as it loops west. These views will typically be quite fleeting. More open views may also be obtainable from parts of the western settlement edge, as represented by Viewpoint 9 (and from which a small scale of change is predicted). When visible, the Proposed Development will be seen in the context of longer distance horizons which have been altered by wind farm development to the west. Due to the viewing distance (typically over 8km distant); typically fleeting and glimpsed nature of views; and in this context, the scale of change will be no greater than small.		
Effect	**The overall magnitude of visual change is considered to be low and taking account of the high sensitivity will result in a Not Significant (Minor) effect.**		
Cumulative Effects	The key change to the cumulative baseline will be under scenario 2. Earlsburn Extension will increase the influence of wind farms in the Gargunnock and Touch Hills, in views to the northwest. The nature of these views will be very localised and limited from the settlement itself, due to screening from built form and vegetation in the settlement, and the rising landform to the northwest. When visible, the Proposed Development will be seen in front of, and contained within the horizontal field of view, of this now larger wind farm group. **In this context cumulative effects will reflect those as identified in the primary assessment.**		

Table 5-36: Effects on wider settlements in the Carse of Stirling

Bridge of Allan, Cowie, Fallin and Throsk			
Representative viewpoint	VP10: Wallace Monument VP13: Clackmannan Tower	Approximate distance to nearest turbine	Generally beyond 10km, to the north and east of Striling
Description and Sensitivity	Residential receptors, in the settlements of Bridge of Allan, Cowie, Fallin and Throsk, are considered to be of high susceptibility. In terms of value, the settlements are not within a designated landscape. However, this hills which surround the Carse of Stirling, including the Gargunnock and Touch Hills to the west (The Southern Hills LLA) and The Ochils to the north, are designated at a local level. This is, in part, due to the role they play in providing a setting to the Carse of Stirling. As such,		

Bridge of Allan, Cowie, Fallin and Throsk	
	this increases value. **The overall sensitivity is judged to be high.**
Changes	These are all settlements in the wider Carse of Stirling. The ZTV indicates widespread theoretical visibility from all. In reality, built form and vegetation in (and surrounding parts) of the settlement will limit outward views. When visible, including from outwards views from the western/ southwestern settlement edges with open views towards the Gargunnock and Touch Hills, the Proposed Development will generally be seen in the context of horizons which have been altered by wind farms. This includes the adjacent Craigengelt, to the immediate southwest of the Proposed Development. Viewpoints 10 and 13 are both representative of views from the wider Carse of Stirling. Both of these views are from more elevated positions, which offer more open vantage points over settlement within the Carse of Stirling. As such, these are very much worst case views from the wider Carse of Striling. A scale of change of small is predicted from both. In this context, and due to viewing distance (greater than 10km), effects on these settlements (as a whole) are unlikely to be significant.
Effect and Significance	**The overall magnitude of visual change is considered to be low and taking account of the high sensitivity will result in a Not Significant (Minor) effect.**
Cumulative Effects	From the majority of the settlements of Bridge of Allan, Cowie, Fallin and Throsk, built form and vegetation in (and surrounding parts) of the settlement will limit outward views. From certain more open views, from settlements in the wider Carse of Stirling, and under scenario 1, there will be some limited additional visibility of wind farms in the Gargunnock and Touch Hills, through the consented Shelloch. Under scenario 2, Earlsburn Extension will intensify the influence of wind farms on the horizon in views to the southwest, and seen in the context of the operational Earlsburn and Kingburn Wind Farms. Further distant views of consented and proposed schemes to the far south will not really notably alter the baseline situation, particularly from lower lying settlements in the Carse of Stirling. Under both scenarios, and when visible, the Proposed Development will typically continue to read as an extension to the operational Craigengelt Wind Farm, and as a slightly distinct wind farm to the now larger Earlsburn cluster (when visible). **In this context cumulative effects will reflect those as identified in the primary assessment.**

5.11.3 Effects on Routes

Visibility from a route is not uniform along its entire length. This is because views of the surrounding landscape change due to the landform, buildings, and vegetation cover as the viewer moves along the route. Sequential effects from the key routes which have been taken forward for detailed assessment, as outlined in Table 5-8, are set out below.

Table 5-19: Effects on Routes: M9

M9 (A9)			
Representative	VP 5	Approximate distance	6km at closest point

M9 (A9)			
viewpoint		to nearest turbine	
Description and Sensitivity	The M9 connects between Edinburgh and Stirling, before turning into the A9 to the north of Dunblane. The route passes within approximately 6km of the nearest turbine. Frequent roadside vegetation alongside the route and sections of cutting often contain views. As the route passes through/ near settlements, built form also provides a level of screening. Road users on this fast moving route are considered to be of medium susceptibility to changes in the views. In terms of value, the route passes along the eastern edge of the locally designated Southern Hills LLA, and Keir LLA, but generally routes outside of designated landscapes. **The overall sensitivity is judged to be medium-low.**		
Changes	The ZTV indicates widespread theoretical visibility between Dunblane and Grangemouth, and passing within approximately 6km of the Proposed Development at the nearest point. There will be extensive filtering of views through roadside vegetation and built development, and actual visibility is likely to be more limited. When visible, the Proposed Development will generally be seen in the context of horizons to the west which have been altered by wind farms. This includes the adjacent Craigengelt, to the immediate southwest of the Proposed Development. On the approach/ departure from Falkirk there will also be closer proximity views of Tod Hill and Rosehill Farm Wind Farms. Viewpoint 5 represents views from the closest sections of the route to the Proposed Development, when travelling south and passing Stirling. From here a medium scale of change is predicted. When travelling north, and passing Stirling, Viewpoint 7 highlights how the landform of the eastern extents of the Gargunnock and Touch Hills plays a more notable screening role in views west, towards the Proposed Development. Due to the viewing distance (beyond 6km) and oblique nature of closer proximity views; typically fleeting and glimpsed nature of views more generally; and in the context of being seen on horizons which have been altered by wind farm development, the scale of change will be no greater than medium. From large sections of the route, actual visibility will be limited and the scale of change will reduce. The ZTV indicates widespread theoretical visibility within 20km. However, and as noted previously, this will be reduced in reality by roadside vegetation, sections of cutting and built form. Therefore, the geographical extent is judged to be medium-small.		
Effect and Significance	**The overall magnitude of change is judged to be medium-low and taking account of the medium-low sensitivity results in Not Significant (Minor) sequential effects.**		
Cumulative Effects	From the more open and closer proximity section of the route, as it passes to the west of Striling, the key change to the cumulative baseline will be under scenario 2. Earlsburn Extension will create a notable new feature on the horizon in views to the southwest. The Proposed Development will continue to read as an extension to Craigengelt, generally seen with a clear gap between the now larger Craigengelt cluster, and the proposed Earlsburn Extension. From wider sections of the route, visibility of wind farms in the Gargunnock and Touch Hills to the west will differ. However, the scale of change is likely to reduce given the increased viewing distance and more limited nature of outward views from the M9. **In this context cumulative effects will reflect those as identified in the primary assessment.**		

Table 5-20: Effects on Routes: A872 (and northern extents of M80)

A872 (and northern extents of M80)			
Representative viewpoint	VP7	Approximate distance to nearest turbine	7km
Description and Sensitivity	The A872 connects between Stirling and Bonnybridge. To the north of Denny it follows a similar route to the M80. However, the A872 routes on slightly higher ground, and views from the A road tend to be more open in nature, with the motorway passing through sections of cutting, and with roadside vegetation tending to limit views west, on the approach to its junction with the M9, just south of Stirling. The route passes within approximately 7km of the nearest turbine. Road users are considered to be of medium susceptibility to changes in the views. In terms of value, the route passes along the eastern edge of the locally designated Southern Hills LLA, but generally routes outside designated landscapes. **The overall sensitivity is judged to be medium.**		
Changes	The ZTV indicates widespread theoretical visibility between Stirling and to the north of Denny, passing approximately 7km to the east of the Proposed Development at the nearest point. As the route passes through Stirling, to the north, and Denny, further south, built form will screen views to the west. There will also be some filtering of views through roadside vegetation as the route passes through countryside (noting larger area of woodland around Auchenbowie), and actual visibility from the route is likely to be more limited. When visible, the Proposed Development will generally be seen in oblique views and in the context of horizons which have been altered by wind farms. Viewpoint 7 is somewhat representative of views from sections of the route just south and through Stirling, and highlights the role that the rising landform to the west plays in providing screening. A small scale of change is predicted from here. Due to the viewing distance (7km at its closest point) and typically more fleeting nature of closer proximity oblique views, the scale of change will be no greater than small. The geographical extent is judged to be medium-small, as the section of the route with more widespread visibility is contained between Stirling and Denny.		
Effect and Significance	**The overall magnitude of change is judged to be low and taking account of the medium sensitivity results in Not Significant (Minor) sequential effects.**		
Cumulative Effects	In views west, from more open sections of the route between Striling and Denny, the key change to the cumulative baseline will be under scenario 2. Earlsburn Extension will create a new feature on the horizon in views to the west. The level of visibility will change as road users move along the route. Visibility of the Proposed Development will continue to be generally limited by the rising landform to the west, and the Proposed Development will read as a distinct wind farm to Earlsburn Extension. **In this context cumulative effects will reflect those as identified in the primary assessment.**		

Table 5-39: Effects on Routes: Core Paths within 5km

Core Paths within 5km			
Representative viewpoint	VP1 VP2	Approximate distance to nearest turbine	Within 2km
Description and Sensitivity	A number of Core Paths pass within 5km to the northeast and south of the Site (refer to Figure 5-1-4a and b). To the northeast, an interconnected network of Core Paths extend from the western fringe of Stirling, encircling North Third Reservoir. To the south, Core Paths within 5km are contained within the Carron Valley, extending up rising landforms of the Kilsyth Hills to the south. The majority of these Core Paths route through areas of coniferous forest, which will typically limit outward view, so have not been considered further. Recreational receptors, whose attention is focused on their surroundings, are of medium-high susceptibility to changes in the view. Most of the Core Paths are within the locally designated Southern Hills LLA, which increases value. **The overall sensitivity is judged to be medium-high.**		
Changes	The ZTV indicates widespread theoretical visibility within 4km to the northeast across areas of Core Paths. Up to 4 turbine blades and 4 hubs will be seen from points with open views to Site, along these routes. Views will be intermittently filtered/ screened by areas of forestry on the flanks of Lewis Hill. When visible, the Proposed Development will generally be seen in the context of large-scale upland moorland. Additionally, the Proposed Development will be seen in the context of landscapes which have been altered by wind farms. This includes the adjacent Craigengelt, as well as the operational Earlsburn and Kingsburn further west (from more elevated parts of the Core Path network as represented by Viewpoint 2). Due to the close-range distance (within 4km) the scale of change will be medium-large. Due to the typically slow-moving recreational receptors travelling along these routes, the proposed turbines will be visible for longer periods of time, but noting that areas of coniferous forest cover will limit actual visibility.		
Effect and Significance	**From Core Paths top the northeast, within 5km, the magnitude of visual change will be medium-high, and taking account of the medium-high sensitivity of the receptor, will result in Significant (Major) sequential effects.**		
Cumulative Effects	In the worst case more elevated and open views from the Core Path network to the northeast, as represented by Viewpoint 2, views of consented wind farms will be long distance and successive, seen in distant views to the south-east. Under scenario 2, the proposed Earlsburn Extension will be visible from this location, seen to the north of the operational Earlsburn, and will extend the influence of wind turbines to the north of this scheme. There will also be views of further consented wind farms seen in long distance and successive views to the south-east. In views towards the Site under scenario 2, the Proposed Development will continue to marginally extend the influence of wind turbines to the northeast of the operational Craigengelt. The gap between the now larger Craigengelt Wind Farm cluster and the now larger Earlsburn Wind Farm cluster will remain legible. **In this context effects will reflect those as identified in the primary assessment.**		

5.11.4 In Combination Visual Effects

With regard to combined cumulative effects, GLVIA3 states that this should include: *"all past, present and future proposals together with the new project"*. The following assessment of combined effects therefore considers the effect of all built and unbuilt wind farms, including the Proposed Development.

In terms of combined effects on visual amenity, and when looking at the broad pattern of wind farm development, there are areas across the study area where the combined effects of all operational, consented and proposed wind farms will notably increase the influence of wind farms in views.

In combination with operational, consented and proposed wind farms the Proposed Development will intensify the effects of wind turbines in elevated views within the Gargunnock and Touch Hills and from lowland and upland views towards these hills.

Shelloch (consented) will introduce a further wind farm to the southwest of the operational Kingsburn Wind Farm, when visible. Earlsburn Extension (proposed) will extend the influence of wind turbines, to the northeast of the operational Earlsburn, when visible.

The Proposed Development will marginally extend the influence of wind turbines to the northeast of the operational Craigengelt. Due to the increase in wind farms in views from and to the Southern Hills, the potential for significant in combination effects is recognised from certain locations.

In terms of visual effects, and when visible, the Proposed Development will generally read as a small extension to an existing scheme. The difference in turbine scale between turbines in Craigengelt Wind Farm and the Proposed Development will be notable, but not incompatible.

From many views, gaps between these now larger groups of wind farms in the Southern Hills will remain legible. As such, the contribution the Proposed Development makes to this picture, in the Gargunnock and Touch Hills, is not judged to tip the balance of 'in combination' effects, through to significant.

5.12 Residual Effects and Conclusions

Measures to reduce effects upon the landscape resource and upon views and visual amenity were predominantly achieved through the design of the Proposed Development, as described in Chapter 3: Description of Development and the Design and Access Statement.

Appendix 6.5 Outline Habitat Management Plan, outlines measures for habitat enhancement across the Site. This includes measures such as reducing peatland degradation; heathland enhancement; wet grassland creation and habitat enhancement for bats. These measures will contribute to the long term mitigation of operational landscape effects across the Site. However, these measures, once established, will not alter the level of operational effects, as described above and summarised in Table 5-21 below.

As all mitigation for landscape and visual effects is mainly embedded within the final design for the Proposed Development, all effects identified in this Chapter are residual effects.

5.13 Summary and Statement of Significance

Table 5-21 below, summarises the predicted landscape and visual effects.

Table 5-21: Summary of Significant Effects

Receptor	Primary LVIA Assessment Findings	Cumulative Assessment Findings
Construction Effects on Landscape Receptors		
The Site	**Significant (Major)**	Not applicable
Operational Effects on Landscape Receptors		
The Site	**Significant (Moderate)**	Not significant
Lowland Hills (149) LCT – Central	**Significant (Moderate) effect is predicted from a very localised area around the Site and to the northeast of Craigengelt Wind Farm (extending to the eastern boundary of the host LCT and approximately 4km to the north, in the Touch Hills).** **In terms of wider effects, these are not judged to be higher than Not Significant (Minor).**	Will reflect findings of primary assessment
Lowland Hill Fringes (150) LCT - Central	Not significant (Minor)	Will reflect findings of primary assessment
Lowland River Valleys (152) LCT – Central	Not significant (Minor)	Will reflect findings of primary assessment
Carselands (153) LCT	Not significant (Minor)	Will reflect findings of primary assessment
Lowland Valley Fringes (154) LCT	Not significant (Minor)	Will reflect findings of primary assessment
Rugged Moorland Hills (216) LCT	Not significant (Minor)	Will reflect findings of primary assessment
Southern Hills Local Landscape Area	**There will be some direct and very localised effects on the landscape fabric of the LLA and on landscape character. These effects are recognised in the landscape assessment for the host LCT (Lowland Hill – Central). However, as the Proposed Development is located in an area which has been altered by wind turbines (as recognised in the qualities of the designation), and will generally be seen as an extension to an operational wind farm in views towards the LLA, this is not judged to significantly alter the overall integrity of the Southern Hills LLA. Furthermore, the experience of the LLA from large areas of the LLA, to the west of the operational Craigengelt Wind**	Will reflect findings of primary assessment

Receptor	Primary LVIA Assessment Findings	Cumulative Assessment Findings
	Farm, will not be altered.	
Operational effects on Visual Receptors (Viewpoints)		
Viewpoint 1 - North Third Reservoir	**Significant (Major)**	Will reflect findings of primary assessment
Viewpoint 2 - Lewis Hill	**Significant (Major)**	Will reflect findings of primary assessment
Viewpoint 3 - Carron Bridge at Northshields	**Significant (Major)**	Will reflect findings of primary assessment
Viewpoint 4 - Tomtain	**Significant (Moderate)**	Will reflect findings of primary assessment
Viewpoint 5 - M9 / A811 overpass	Not Significant (Minor)	Will reflect findings of primary assessment
Viewpoint 6 - Meikle Bin	Not Significant (Minor)	Will reflect findings of primary assessment
Viewpoint 7 - Bannockburn Memorial	Not Significant (Minor)	Will reflect findings of primary assessment
Viewpoint 8 - Stirling Castle	**Significant (Moderate).** This is mainly due to the elevated sensitivity of the viewpoint, from Stirling Castle. Effects on similar views, from less sensitive parts of Stirling, are likely to fall just below the threshold of significance.	Will reflect findings of primary assessment
Viewpoint 9 - M80 at Denny Myothill Road overpass	Not Significant (Minor)	Will reflect findings of primary assessment
Viewpoint 10 - Wallace Monument	Not Significant (Minor)	Will reflect findings of primary assessment
Viewpoint 11 - Falkirk Wheel	Not Significant (Minor)	Will reflect findings of primary assessment
Viewpoint 12 - Dumyat	Not Significant (Minor)	Will reflect findings of primary assessment
Viewpoint 13 - Clackmannan Tower	Not Significant (Minor)	Will reflect findings of primary assessment
Viewpoint 14 - Ben Cleuch	Not Significant (Minor)	Will reflect findings of primary assessment
Viewpoint 15 - Ben Ledi	Not Significant (Minor)	Will reflect findings of primary assessment
View 16 – Crow Road	Not Significant (Minor)	Will reflect findings of primary assessment
Operational effects on Visual Receptors (Settlements and Routes)		
Stirling	Not Significant (Minor)	Will reflect findings of primary assessment
Denny	Not Significant (Minor)	Will reflect findings of primary assessment
Bridge of Allan, Cowie, Fallin and Throsk	Not Significant (Minor)	Will reflect findings of primary assessment
M9	Not Significant (Minor)	Will reflect findings of primary assessment

Receptor	Primary LVIA Assessment Findings	Cumulative Assessment Findings
A872 (and northern extents of M80)	Not Significant (Minor)	Will reflect findings of primary assessment
Core Paths within 5km	**From Core Paths top the northeast, within 5km, Significant (Major) sequential effects**	Will reflect findings of primary assessment

Significant Landscape Effects

Significant effects are predicted on the landscape resource of the Site during construction (Major) and operation (Moderate).

During operation, significant effects on landscape character (Moderate) are predicted for the Lowland Hills (149) LCT – Central. This is the LCT in which the Proposed Development is located (the host LCT).

Significant effects are predicted from a very localised area around the Site and to the northeast of Craigengelt Wind Farm (extending to the eastern boundary of the host LCT and approximately 4km to the north, in the Touch Hills). In terms of wider effects on the host LCT, these are not judged to be higher than Not Significant (Minor).

Significant effects on landscape character at the Site level are usually unavoidable for wind farm developments. A small number (four) of further turbines to the northeast of the operational Craigengelt Wind Farm will slightly intensify the landscape effects of turbines over the host LCT.

However, and through Craigengelt Wind Farm, turbines have altered the character of the host LCT, and in landscape terms the Proposed Development will generally read as a small extension to this scheme. As such, landscape effects will not be as great as effects associated with the introduction of a new wind farm in an area not subject to development of this type.

No significant effects on other LCTs are predicted. Furthermore, the Proposed Development will not alter the integrity of any landscape designations by affecting the qualities for which they have been designated.

Wind Farms have altered areas of the Southern Hills LLA and the Proposed Development is located in an area which has been altered by wind farms and will not notably narrow the gap between existing wind farm clusters in this locally designated landscape.

Significant Visual Effects

Significant (Moderate and above) effects on views are predicted at five of the 16 representative viewpoints; refer to Table 5-40. The majority of significant visual effects are contained within 6km, and represent closer proximity and more open views (Viewpoints 1 to 4).

Viewpoint 8 – Stirling Castle is 8.4km distant and represents a very high sensitivity view, from a nationally important historic visitor attraction. Less sensitive views from Stirling will fall below the threshold of significance.

In general terms the Proposed Development is seen in the context of the operational Craigengelt Wind Farm. In many views the Proposed Development is largely contained within the horizontal field of view occupied by turbines in this operational scheme.

The difference in scale between the operational Craigengelt turbines (8 turbines at 125m to tip) and the proposed turbines (4 turbines at 180m to tip) is notable in certain views. However, this difference in turbine scale does not stop the two schemes generally reading as one wind farm. It is not uncommon for wind farm extension to utilise advances in turbine technology, and use more efficient and larger turbines, seen next to smaller older turbines.

Significant (Major) effects are also predicted from open sections of the Core Path network, within 4km to the northeast of the Proposed Development. No significant effects from any settlements (overall) are predicted.

Cumulative Landscape and Visual Assessment Summary

There are many operational wind farms across the landscape of the study area (refer to Figure 5-1-5). The number of wind farms will increase should all consented and application stage wind farms be built.

The emerging pattern of wind farms typically sees larger developments located on upland areas. In lowland settled areas, the pattern of wind farm development is more dispersed and smaller scale, associated with industrial areas; rural areas between Edinburgh and Glasgow; or smaller turbines typically associated with farms.

The key cumulative interactions between the Proposed Development and other wind farms is typically with the closest groups of wind farms. These include the operational Craigengelt, to the immediate southwest of the Site; and the operational Earlsburn and Kingsburn, which extends with the consented Shelloch and application stage Earlsburn Extension in a theoretical future cumulative baseline.

Wind farm groups in the Ochil Hills and rural areas between Edinburgh and Glasgow will also extend, in a theoretical future cumulative baseline.

Overall, the Proposed Development will create a slightly larger cluster of turbines in the Gargunnock and Touch Hills, marginally intensifying the influence of turbines to the northeast of the operational Craigengelt Wind Farm. In this alternative context, landscape and visual cumulative effects will generally reflect effects as identified in the primary assessment.

5.14 References

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Chapter 6: Ecology

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1
Study Area	For designated sites up to 10km, for non-statutory designated sites up to 3km, for all other receptors – within the Proposed Development Site

List of Abbreviations

Abbreviation	Description
BAP	Biodiversity Action Plan
CAR	Controlled Activities Regulations
CEMP	Construction Environment Management Plan
CIEEM	Chartered Institute of Ecology and Environmental Management
CSGN	Central Scotland Green Network
EcIA	Ecological Impact Assessment
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EnvCoW	Environmental Clerk of Works
FCS	Forestry Commission Scotland
GWDTE	Ground Water Dependant Terrestrial Ecosystem
HAP	Habitat Action Plan
HMP	Habitat Management Plan
IEF	Important Ecological Feature
IHN	Integrated Habitat Network
JNCC	Joint Nature Conservation Committee
LDP	Local Development Plan
LERC	Local Environmental Record Centre
LNCS	Local Nature Conservation Site
NPF4	National Planning Framework 4
NNR	National Nature Reserve
NS	NatureScot
NVC	National Vegetation Classification
PEAG	Peat Expert Advisory Group
PPP	Pollution Prevention Plan

Abbreviation	Description
PRF	Potential Roost Feature
SAC	Special Area of Conservation
SAP	Species Action Plan
SBL	Scottish Biodiversity List
SC	Stirling Council
SG	Scottish Government
SEPA	Scottish Environment Protection Agency
SSPCA	Scottish Society of the Prevention of Cruelty to Animals
SSSI	Site of Special Scientific Interest
TN	Target Note
TWIC	The Wildlife Information Centre
ZoI	Zone of Influence

6 Ecology

6.1 Introduction

This Chapter describes and evaluates the current nature conservation interest for the Proposed Development Site and Study Area. The Chapter evaluates both habitats and non-avian animal species and assesses the potential impacts of the Proposed Development Site on habitats and species above a certain value.

Potential impacts on birds are considered separately in Chapter 7: Ornithology.

This Chapter has been prepared by Atmos Consulting Ltd, led by Stephen McNee who is an Associate member of the Chartered Institute of Ecology and Environmental Management (CIEEM) with 14 years' experience as an ecological consultant.

The Proposed Development Site has been subject to a previous planning application for a wind farm development of 11 wind turbines at 125m to tip height and associated infrastructure (Planning Application Reference: 09/00170/FUL). This was refused in March 2012 and not subject to appeal. The reasons for this refusal were primarily related to visual effects on historic sites relating to cumulative wind energy development.

An Environmental Impact Assessment (EIA) Scoping Opinion request was submitted to Stirling Council (SC) in August 2020. This document detailed ecological surveys carried out to inform that document and further proposed surveys, which were carried out in 2020/2021. An updated round of all required surveys was then undertaken in 2023.

The results of the baseline surveys were used to inform the design of the Proposed Development and form the basis of the detailed assessment presented in this Chapter.

An outline Habitat Management Plan (HMP) has been produced as the mechanism to deliver mitigation in relation to sensitive habitats such as peat and potential Ground Water Dependant Terrestrial Ecosystems (GWDTE) see Technical Appendix 6-5: Outline Habitat Management Plan.

The Proposed Development includes the provision for 6.59km of new access tracks, which includes two onsite access options (Option A and Option B). However, only one of these onsite access options will be constructed, and therefore of the 6.59km of proposed new tracks, a maximum of up to 5.8km would be constructed, dependent upon the access option utilised. To ensure a robust and conservative assessment, the EIA has assessed the full 6.59km to support the full appraisal of both access options.

Both access options are included within habitat calculations which underpin the basis for assessment for habitats. All habitat loss is assumed as permanent.

The Chapter is supported by the following Technical Appendices:

- Technical Appendix 6-1: Extended Phase 1 Habitat Survey;
- Technical Appendix 6-2: National Vegetation Classification Survey;
- Technical Appendix 6-3: Bat Surveys (automated static and emergence);
- Technical Appendix 6-4: Protected Mammal Surveys; and
- Technical Appendix 6-5: Outline Habitat Management Plan.

6.2 Legislation, Planning Policy and Guidance

The baseline surveys and ecological assessment have been carried out with reference to the legislation and guidance outlined below.

6.2.1 Legislation

The non-avian ecology assessment has been undertaken with reference to the following legislation:

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora;
- Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017;
- Wildlife and Countryside Act 1981 (as amended);
- Wildlife and Natural Environment (Scotland) Act 2011;
- Nature Conservation (Scotland) Act 2004; and
- Conservation (Natural Habitats, &c.) Regulations 1994 (as amended).

6.2.2 Planning Policy

National Policy

Relevant planning policy is summarised in Chapter 4: Planning and Energy Policy. This section focuses solely on policy which is relevant to non-avian ecology.

Policy 3 'Biodiversity' and Policy 4 'Natural Places' of the National Planning Framework 4 NPF4 is considered relevant to this assessment. In particular where it states at Policy 3(b):

> *"Development proposals for national or major development, or for development that requires an Environmental Impact Assessment will only be supported where it can be demonstrated that the proposal will conserve, restore, and enhance biodiversity, including nature networks so they are in a demonstrably better state than without intervention. This will include future management. To inform this, best practice assessment methods should be used.* (Scottish Government, 2023)."

Local Planning Policy

The Local Planning Policy considered applicable to the Proposed Development is the proposed Stirling Council Local Development Plan (2018), especially:

- Policy 1.1 Site Planning;
- Policy 12.1 Wind Energy Developments;
- Primary Policy 8 Conservation and Enhancement of Biodiversity; and
- Primary Policy 13 The Water Environment.

Objectives from the Stirling Council Alive with Nature Plan (2021-2045), Supplementary Guidance: Biodiversity and Landscape (SC 2019)and Supplementary Guidance (SC, 2023) were also consulted to understand local priorities, and where appropriate, inform mitigation.

Other Guidance

Other guidance considered relevant to this assessment are outlined below.

The Scottish Biodiversity List (SBL) (NatureScot (NS), updated 2022) is a list of animals, plants, and habitats that the Scottish ministers consider to be of principal importance for biodiversity conservation in Scotland.

Both scientific and social criteria have been used to define the SBL. Scientific criteria include all Priority Species and Priority Habitats included in the now superseded UK Biodiversity Action Plan (BAP) (UK Biodiversity Partnership, 2007 *et seq*.), which occur in Scotland. Social criteria are based on the results of an omnibus survey of the Scottish public carried out in 2006 and includes some common species and habitats. This chapter only considers those listed using scientific criteria.

Additional key guidance documents relating to the assessment of effects of wind farms on non-avian ecological receptors that have been referenced in this assessment include the following:

- Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (CIEEM, 2022);
- Bats and onshore wind turbines: survey, assessment and mitigation (Scottish Natural Heritage (SNH), Natural England, Natural Resources Wales, Renewable UK, Scottish Power Renewables, Ecotricity Ltd., the University of Exeter, and the Bat Conservation Trust (BCT), 2021);
- Land Use Planning System Scottish Environment Protection Agency (SEPA) Guidance Note 31 (SEPA, 2017); and
- Good Practice During Windfarm Construction (Scottish Renewables, SNH, SEPA and Forestry Commission Scotland (FCS), 2010).

6.2.3 Consultation

The assessment process has been informed by the Pre-Application response received from Stirling Council (May 2020 (PREAPP-2020-0093) and the EIA Scoping Opinion (October 2020).

A summary of the key consultation responses relevant to non-avian ecology is described in Table 6-1. The table has been condensed from the original text to focus on specific relevant scope notes/actions and where comments repeated in the Pre-Application response where they were included in the EIA Scoping Opinion have not been repeated.

It should be noted that some responses, such as that from NatureScot included issues related to Ornithology. Where these can be easily divested from Ecology, text has been removed from Table 6-1. See Chapter 7: Ornithology for a full response.

Table 6-1: Consultation

Consultee	Pre-Application Comments (May 2020)	Scoping Comments (October 2020)	Applicant Response/Where addressed within this Report
Stirling Council	Relevant Local Development Plan (LDP) policies are: 1.1 Site Planning, 12.1 Wind Energy Developments. The ecological information that will need to accompany the application will include: • Phase 1 Habitat survey, including information on any GWDTE. • Surveys for protected species.	The Council Biodiversity Officer comments as follows: I would request that the consultants contact The Wildlife Information Centre (TWIC), the local records centre for our area, to ensure that they have access to the most up to date biological information. This should then be reflected in their report. TWIC will also be able to provide information on the locally designated sites that sit within the vicinity of the proposed development.	The LDP policies have been adhered to. On application of mitigation and with regard to Policy 1.1 the Proposed Development will consider and respect site topography and surrounding natural landmarks, and will be sited, as far as practicable, to retain natural features that contribute to biodiversity. GWDTE, deep peat, watercourses features have been avoided insofar as possible (as shown on Figure 8-1, Figure 8-3 and Figures 8-5a and Figure 8-5b.). Bat roost potential features have been avoided through design change. With regard to Policy 12.1, on application of mitigation, the Proposed Development will avoid or minimise adverse environmental impacts, including cumulative impacts. In the case of bats, as cumulative impacts have been identified, post construction monitoring will be undertaken with a view to further measures should these be required (section 6.7.4). Phase 1 Habitat, Protected Species and GWDTE surveys were carried out in accordance with current guidance and best practice. Details of which can be found in section 6.4.2. A data search from TWIC has been included.

Consultee	Pre-Application Comments (May 2020)	Scoping Comments (October 2020)	Applicant Response/Where addressed within this Report
			(Tables 6-5 and 6-6).
NatureScot (formerly Scottish Natural Heritage)	Scottish Natural Heritage (now NatureScot) have a document for general pre-application and scoping advice for onshore windfarms should also be referred too.	Currently only provide specific advice on wind farm planning cases in the highest priority circumstances. Do not consider effects will approach or surpass levels that raise natural heritage issues of national interest. The applicant should therefore refer to general scoping and pre-application guidance for onshore wind farms. The applicant should also consider the need for species licences as part of any development. We agree that no Sites of Special Scientific Interest (SSSIs) or Special Areas of Conservation (SACs) are likely to be impacted by this proposed development due to the distance from the site and the nature of the protected features. We agree it is therefore appropriate to scope these out of further assessment.	General scoping and pre-application guidance for onshore wind farms has been consulted for this EIA Report and potential effects are limited by qualifying feature and distance from the Zone of Influence (ZoI). Statutory designated sites have been scoped out as shown in section 6.4.1.
Scottish Environmental Protection Agency	To avoid delay and potential objection, the information outlined below must be submitted in support of the application: • Map and assessment of all engineering activities in or impacting on the water environment including proposed buffers, details of any flood risk assessment and details of any related Controlled Activities Regulations (CAR) applications. • Map and assessment of impacts upon GWDTEs and buffers. • Map and table detailing forest removal.	Specified that information covering a range of environmental issues must be submitted in support of the application, including the water environment, pollution, GWDTE and forest removal. There may be opportunities to scope out some of the issues depending on the site. Further Consultation (May 2023) SEPA anticipate inclusion of a CEMP covering all the environmental sensitivities, pollution prevention and mitigation measures identified to avoid or minimise environmental effects. GWDTE: Where possible avoid GWDTE and flush areas via	All appropriate surveys and assessments have been undertaken most of which relate to hydrological assessment, and which are covered in Chapter 8: Hydrology, Geology and Hydrogeology. National Vegetation Classification (NVC) survey included categorisation of potential GWDTE which were passed to the hydrogeologist to establish confirmed GWDTE status included in Chapter 6: Ecology and Chapter 8: Hydrology, Geology and Hydrogeology and Figure 8-5b. A CEMP will be provided with the application (see TA 15.1).

Consultee	Pre-Application Comments (May 2020)	Scoping Comments (October 2020)	Applicant Response/Where addressed within this Report
	• Schedule of mitigation including pollution prevention measures.	micro-siting of infrastructure. Relocation of eastern-most borrow pit currently situated in flush habitat. Mitigation measures to maintain the functionality of wetlands and prevent structures from becoming preferential conduits of water should be included within the CEMP where avoidance is not possible. It is recommended that the time between excavating and backfilling of individual sections of cable trench is minimised near GWDTEs. As a rule, we advise backfilling within three days to minimise drying and disturbance. Current guidance and best practice should be adhered to regarding the excavation and reinstatement of turves and arisings. Where the cable trench passes through sensitive GWDTE habitat, construction should include impermeable barriers and/or clay plugs to avoid the trench acting as a preferential conduit of groundwater. Areas of identified sensitivity (GWDTE and flushes) should be marked out / fenced-off to prevent accidental vehicular access. Any areas identified as wetlands should not be used to treat contaminated water.	The eastern borrow pit is predominantly within MG10a although to a lesser extent, remaining within M6 flush. This topic is addressed in Chapter 8: 8. Hydrology, Geology and Hydrogeology. These measures are included in the CEMP (TA 15-1). These measures are included in section 6.6.1 Design Mitigation.
Loch Lomond and the Trossachs National Park	No response was received.	No response was received.	n/a

6.3 Methodology and Approach

6.3.1 Baseline Data Gathering

Desk Study

An ecological desk study was undertaken to identify nature conservation designations and records of protected or otherwise notable species in the local area using data purchased from The Wildlife Information Centre (TWIC), a local environmental records centre (LERC), and freely available online data.

A review of online data was undertaken in March 2023, following a previous review in May 2020, and the review of TWIC data was carried out in October 2023.

Distances are taken from the approximate centre of the Proposed Development Site for the following Important Ecological Features (IEFs):

- Non-statutory designated sites up to 3km;
- Protected species records/records of high conservation significance (Scottish Biodiversity List, Schedule species from the Wildlife and Countryside Act 1981, local Biodiversity Action Plan species for up to from the centre of the Proposed Development); and
- Records of mobile species (bats – 10km).

Only those features that relate to non-avian ecology are considered in this Chapter, with ornithological data being presented in Chapter 7: Ornithology of this EIA Report.

Field Surveys

The results of the detailed ecological surveys undertaken are summarised in this Chapter, with more details provided in Technical Appendices, as shown in Table 6-2. A summary of the field survey used is provided below.

Table 6-2: Ecological Surveys Undertaken for the Assessment

Study	Date Undertaken	Location in EIA Report
Extended Phase 1 Habitat	February 2023 and April/May 2020	Technical Appendix 6-1
NVC Surveys	April 2023, July 2021* and September 2020	Technical Appendix 6-2
Bat Surveys (automated, static)	April -August 2023 and April - August 2020	Technical Appendix 6-3
Bat Surveys (emergence)	August /September 2021 & July/September 2020	Technical Appendix 6-3
Protected Mammal Surveys	February 2023 and April/May 2020	Technical Appendix 6-4

*On a discrete section in the north of the Proposed Development Site added to the design. This was latterly covered in the 2023 survey.

Extended Phase 1 Habitat Survey

As detailed in Technical Appendix 6-1, the Extended phase 1 survey was carried out in February 2023 to update a previous survey undertaken in April/May 2020. The survey on both occasions was within the Proposed Development Site.

The survey involved mapping areas of habitat greater than 0.1ha and listing target notes to describe significant features as per Joint Nature Conservation Committee (JNCC, 2010). These included features with the potential to support protected or otherwise notable species that may require further survey.

The results are shown on Figure 6-3.

National Vegetation Classification Survey

As detailed in Technical Appendix 6-2 the survey was carried out in April 2023 and previously in September 2020. Survey was also undertaken upon a discrete section in the north of the Proposed Development Site latterly added to the design. This area was included in the 2023 survey. The Survey Area was limited to the Proposed Development Site as access was limited to this area. The results are shown on Figure 6-4.

All surveys were carried out in dry weather conditions with good visibility.

The NVC communities were mapped by eye and classified according to Rodwell (1998a, 1998b, 2006). Where possible, floristic samples were recorded to allow the habitat to be categorised later into the appropriate NVC classification. Small areas of interest and general descriptions of features were made using target notes as per Phase 1 survey methodology (JNCC, 2010).

Higher plant nomenclature follows that of Stace (2020), bryophyte nomenclature follows that of the Hill *et al*. (2008) and lichens follow Coppins (2002). Following the NVC survey, potential GWDTE among the recorded NVC communities were classified in terms of their potential high, moderate, or low groundwater dependence, based on SEPA guidance (SEPA, 2017).

Bat Survey (automated static)

As detailed in Technical Appendix 6-3, bat surveys were carried out between April - August 2023 in accordance with current survey guidelines (NatureScot 2021). The surveys comprised three seasonal (spring, summer, and autumn), ground level automated surveys were carried out. A total of four static detectors were deployed at positions chosen to represent likely wind turbine positions.

Surveys were also undertaken between April - August 2020 on the layout at that time which had six turbines. As such, six recording devices were used.

A full description of the methodology for bat call analysis is provided in Technical Appendix 6-3, a summary of the methodology is provided here.

Analysis of full spectrum .WAV files was undertaken firstly by Kaleidoscope (to convert the raw data into .ZCA files) and then Analook W software to enable identification of species.

All files were manually analysed to identify bat species and to separate common pipistrelle *Pipistrellus pipistrellus* and soprano pipistrelle *Pipistrellus pygmaeus*. All sonogram files classified as "noise" by Kaleidoscope during the conversion process were then subject to manual checking of sonograms, and where bat calls were present, manual identification was undertaken.

As the Ecobat bat activity level assessment tool is off-line, and has been for some time, a bespoke assessment methodology was employed. For ease of examination, three arbitrary levels have been created to provide a context in which to discuss the results.

Table 6-3 indicates the levels of activity required to be considered to be 'low', 'medium' or 'high' activity.

These criteria have been developed by Atmos Consulting based on over 17 years working on multiple upland windfarm projects. It should be recognised that in the context of bat activity across wider landscapes these activity brackets are all relatively low as would be expected for a site at this altitude supporting upland habitats.

In these circumstances, the median is likely to be a more useful summary of the typical activity than the mean (Lintott & Mathews, 2018). Whilst the Proposed Development is not in the Scottish Highlands it is on the upland fringe and is therefore considered analogous.

Bat pass rates are often highly variable between nights, with some nights having few or no passes and other nights having high activity. This is particularly pronounced on sites within the Scottish Uplands

Table 6-3: Criteria for Determining Bat Activity Levels

Activity Level	Number of bat passes per hour 1
Low	< 2
Medium	2 – 5
High	> 5

[1] A bat pass is classified as the presence of a species within a single Analook file.

The index of bat activity was taken to be a sonogram file (maximum length of 15 seconds) recorded from the static detectors. Although this is to some degree an arbitrary measure, the activity levels are comparable across detectors and is a frequently used index.

For the purpose of this report, each file containing a call from a species is termed a 'pass'. Data is then converted to passes per hour adjusting for location specific night-time duration (sunset to sunrise) and days of deployment (adjusted to each detectors period of functioning).

During protected species surveys any signs of bat roost potential features within 30m of infrastructure (e.g., holes within trees or structures) were noted.

Bat Survey (emergence)

Based on the presence of moderate value potential roost features (PRFs) identified during the Extended Phase 1 survey (see Technical Appendix 6-1), two emergence activity surveys were undertaken in 2020 to provide robust data on whether or not bats use the structures for roosting in accordance with guidance extant at the time (Collins, 2016).

Roost surveys relate to Target Notes in TA 6-1: Extended Phase 1. The structures requiring survey are shown in Figure 6-5, as follows:

- Two small groups of ash Fraxinus excelsior trees (Target Notes (TNs), 3, 4 and 6); and
- A bridge built on gabion block supports (TN 5).
  - These features are just outside the south of the Proposed Development Site as shown on Figure 6-5 but were within the environs of an existing access track from Craigengelt Wind Farm. It was intended to use this track for the Proposed Development Site. The features were also within 200m of the rotor swept area and therefore included as they were within the ZoI.

A dusk survey was undertaken on 17th of August 2020 and a dawn survey on 30th of September 2020. Two surveyors undertook each survey with one surveyor positioned at the bridge and a group of ash trees (TNs 3-5) and the second surveyor at TN 6. Passing bats were noted in 2020 despite sub-optimal conditions.

The two surveyors inspected a broken tree categorised as a high value PRF during the Extended Phase 1 survey (Figure 6-3, TN 7). This inspection revealed that the cavity did not lead to an area which was not fully visible and as a result, this feature was determined not to be a bat PRF.

The siting of infrastructure in the vicinity of trees subject to the 2020 emergence/re-entry surveys was altered in 2021 resulting in only one tree with PRFs requiring further survey (TN6). Surveys were undertaken on the 15th of July 2021 and 1st of September 2021 by two surveyors using a hand-held Anabat SD2 detectors in suitable weather conditions.

Further design reiterations in 2023 did not result in the siting of infrastructure within the ZoI of an unchecked potential roost feature (i.e. within 200m plus rotor radius of the boundary of the Proposed Development Site as per NatureScot, 2021).

Protected Species Survey

As detailed in Technical Appendix 6-4, surveys for non-volant or non-flying protected species were undertaken during February 2023. Target species were considered to be otter *Lutra lutra*, water vole *Arvicola amphibius*, badger *Meles meles* and red squirrel *Sciurus vulgaris*. Additionally, any signs of bat roost potential features within 30m of infrastructure (e.g., holes within trees or structures) were noted.

The otter survey followed standard methodologies (Purseglove, 1995; Chanin, 2003; Bang and Dahlstrøm, 2006; Muir and Morris, 2013). The water vole survey was conducted with reference to Strachan (2011).

As no suitable tree blocks were present within the Proposed Development Site surveys therefore focused on trees adjacent to it.

In 2020, near the western site boundary, an incidental record of mountain hare *Lepus timidus* was seen during Ornithology surveys.

Limitations

All surveys were limited to the Proposed Development Site due to access being unavailable beyond. Much of this land is geographically separated by roads or by medium to large sized ravines from the habitats within the Proposed Development Site.

As such, ravines are unlikely to be hydrologically connected to any of the habitats within the Proposed Development Site nor is disturbance likely to otter present within the Bannockburn within the ravines – give the screening they provide.

The 2020 NVC surveys were carried towards the end of the survey season. It is therefore possible that early flowering plants may have been missed but any effect is considered negligible on the survey results however and is unlikely to affect the accurate classification of communities. The 2023 survey was in the early season and no changes in communities were recorded.

No issues were noted with data collection during bat automated static surveys, so no limitations were identified. The change of location of T2 during a design reiteration between the second and third 2023 survey periods resulted in two sets of data that relate to the original location and only one set of data that relates to the new location.

This is not considered a limiting factor as it is noted in the guidance that devices should be placed near turbines where possible, but that locations are subject to change (NatureScot, 2021). In addition, the 2020 data supports the 2023 findings giving context to the results of the latter, as many findings are comparable between the datasets.

Early February is a sub-optimal time for carrying out water vole surveys, however, given surveys from 2020 indicated an absence of the species and desk top results returned no records for the area, this is not considered a limitation.

No significant survey limitations were identified from any survey used to inform this EIA Report.

6.3.2 Significance Criteria

The key objective of field and data analysis is to identify those receptors liable to comprise likely significant effects as a result of the Proposed Development as described in the CIEEM guidelines.

The CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland (CIEEM, 2022) (henceforth referred to as the CIEEM guidelines) form the basis of the impact assessment presented in this chapter.

These guidelines set out a process of identifying the value of each ecological receptor and then characterising the impacts that are predicted, before discussing the effects on the integrity or conservation status of the receptor, proposed mitigation and significance of effects of any residual impacts predicted.

The following definitions of the terms 'impact' and 'effect' are used in this chapter:

- Impact – actions resulting in changes to an ecological feature. For example, the construction activities of a development removing a hedgerow.
- Effect – outcome to an ecological feature from an impact. For example, the effects on a dormouse population from loss of a hedgerow.

The initial action for any ecological EIAR is to determine which features should be subject to detailed assessment. The ecological receptors to be the subject of more detailed assessment should be of sufficient value that impacts upon them may result in effects which are significant in terms of either legislation or policy. The receptors should also be vulnerable to significant impacts arising from the Proposed Development.

All designated nature conservation sites, plant and animal species, habitats and integrated plant and animal communities that occur within the ZoI of the Proposed Development are defined as potential ecological features (as described below).

The ZoI for a project is defined here as the area over which ecological features may be affected by biophysical changes as a result of the Proposed Development and associated activities.

The ZoI is likely to extend beyond the Proposed Development Site, for example where there are ecological or hydrological links beyond the site boundary. The ZoI will also vary for different ecological features, depending on their sensitivity to environmental change.

6.3.3 Determining Value

The CIEEM guidelines recommend that the value of ecological features is determined based on a geographic frame of reference. For this project the following geographic frame of reference is used:

- International (nature conservation designation, habitat or populations of species of international importance, e.g., a SAC or significant numbers of a designated population outside the designated site);
- National (nature conservation designation, habitat or populations of species of Scottish importance, e.g., an SSSI or a National Nature Reserve (NNR), a nationally important population / assemblage of a European Protected Species and / or a species listed on Schedule 5 of the Wildlife and Countryside Act 1981);
- Regional (nature conservation designation, habitat or populations of species of SC area importance, e.g., a site / population that meets SSSI designation criteria but has not been designated due to better examples being present in the regional area or a regionally important population / area of an SBL priority species / habitat);
- Local (i.e., within 3km) (a nature conservation site, habitat, or species of importance in the local or district area, e.g., a breeding population / viable area of an SBL or local BAP species / habitat); and
- Less than local (unremarkable habitat / common species of little or no intrinsic nature conservation value).

6.3.4 Valuing Habitats

The value of habitats, according to the CIEEM guidelines, is measured against published selection criteria where available. Reference may therefore be made to both the SBL and Habitat Action Plans (HAPs) contained within the SC Alive with Nature Plan (2021-2045)(Stirling Council, 2023).

As the guidelines note, the presence of a HAP reflects the fact that the habitat concerned is in a sub-optimal state and hence the action plan is required and a HAP does not, therefore, necessarily imply any specific level of importance for the habitat.

It must be noted, in accordance with the guidance, that features may be assigned greater value if there is reasonable chance that they can be restored to a higher value in the future.

6.3.5 Valuing Species

In assigning a level of value to a species, it is necessary to consider its distribution and status, including a consideration of trends based on available historical records. Rarity is an important consideration because of its relationship with threat and vulnerability.

However, because some species are inherently rare, it is necessary to look at rarity in the context of status. A species that is rare and declining should be assigned a higher level of importance than one that is rare with a stable population.

Reference may also be made to SBL and Species Action Plans (SAPs) contained within the SC Alive with Nature Plan (2021-2045) and other indicators of conservation status, as appropriate, although, as above with HAPs, the existence of a SAP does not necessarily imply any specific level of importance.

6.3.6 Predicting and Characterising Impacts and Effects

The CIEEM guidelines suggest that the process of predicting ecological impacts and effects should take account of relevant ecosystem structure and function such as:

- Available resources – e.g., territory, food and water;
- Environmental process – e.g., flooding, erosion, eutrophication, deposition and climate change;
- Ecological processes and relationships – e.g., population dynamics, vegetation dynamics and predator / prey relationships;
- human influences – e.g., animal husbandry, burning, pollution, disturbance from public access; and
- Historical context – e.g., natural range of variation, historical human influences, and geomorphological evolution.

In accordance with the CIEEM guidelines, when describing impacts and effects, reference is made to the following, where appropriate:

- Confidence in predictions – the level of certainty that an impact will occur as predicted, based on professional judgement and where possible evidence from other schemes – this is based on a four-point scale: certain / near certain; probable; unlikely; and extremely unlikely;
- Magnitude – the size of an impact in quantitative terms where possible;
- Extent – the area over which an impact occurs;
- Duration – the time for which an impact is expected to last;
- Reversibility – a permanent impact is one that is irreversible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it. A temporary impact is one from which a spontaneous recovery is possible; and
- Timing and frequency – i.e., whether impacts occur during critical life stages or seasons.

Both direct and indirect impacts are considered:

- Direct ecological impacts are changes that are directly attributable to a defined action, e.g., the physical loss of habitat occupied by a species during the construction process; and
- Indirect ecological impacts are attributable to an action, but which affect ecological resources through effects on an intermediary ecosystem, process, or receptor, e.g., external sourcing of stone for road surfaces may cause growth of plant species not generally found in that area of the application site.

The potential for cumulative effects was also considered. Cumulative effects can arise from individually insignificant but collectively significant actions taking place over a period of time or concentrated in a location. Ecological features may already be exposed to pressure and further impact could cause irreversible decline (CIEEM, 2022).

Developments within 10km of the Proposed Development were identified as this is considered to be the maximum ZoI for ecological receptors. In line with CIEEM guidance, the following development types were included:

- Proposals for which planning consent has been applied for which are awaiting determination in any regulatory process;

- Projects which have been granted planning consent, but which have not yet been started or which are under construction;
- Proposals which have been refused planning permission, but which are subject to appeal, and the appeal is undetermined; and
- To the extent that their details are in the public domain, proposed projects that will be implemented by a public body but for which no consent is needed from a competent authority.

6.3.7 Significant Effects

For the purposes of Ecological Impact Assessment (EcIA), the CIEEM guidelines define a significant effect as; "*…an effect that either supports or undermines biodiversity conservation objectives for important ecological features or for biodiversity in general*".

Significant effects can be either positive or negative and are qualified with reference to an appropriate geographic scale, from international to local, however, it should be noted that the scale of significance of an effect may not be the same as the geographic context in which the feature is considered important.

For example, an effect on a species which appears on a national list of species of principal importance for biodiversity may not have an effect on its national population.

Significance relates to the weight which should be attached to effects when decisions are made. Any significant effects remaining after mitigation (residual effects), together with an assessment of the likelihood of success of the mitigation, are the factors to be considered against legislation, policy, and development control in determining the application.

6.3.8 Mitigation, Compensation and Enhancement

It is important as part of any Environmental Impact Assessment to clearly differentiate between mitigation, compensation and enhancement and these terms are defined here as follows:

- Mitigation is used to refer to measures to avoid, reduce or remedy a specific negative impact in situ. Mitigation is only required for negative impacts assessed as being significant or where required to ensure compliance with legislation;
- Compensation is used to refer to measures proposed in relation to specific negative impacts but where it is not possible to fully mitigate for negative impacts in situ. Compensation is only required for negative impacts assessed as being significant or where required to ensure compliance with legislation; and
- Enhancement is used to refer to measures that will result in positive ecological impacts, but which do not relate to either specific significant negative impacts or where measures are required to ensure legal compliance.

6.3.9 Assessment Areas

The assessment area for designated sites is up to 10km, for non-statutory designated sites up to 3km, and for all other receptors within the Proposed Development Site.

With respect to vegetation and most fauna the assessment focuses on areas extending up to 250m from borrow pits or structures requiring foundations, and 100m out from all infrastructure, i.e., areas which are considered to be potentially impacted upon by the Proposed Development.

Given the mobility of bats the ZoI extends to up to 10km based on the presence of desk top records, but with priority given to the value of the Proposed Development Site itself, based on the 2023 static survey findings.

The faunal surveys cover a wider area, so impacts have been assessed within the zone of impact appropriate for each receptor, which at its maximum accounts for otter up to 200m of infrastructure.

Whilst access was limited to the Proposed Development Site this is not considered a limitation as most of the infrastructure, plus a 250m buffer, is contained within the Proposed Development Site boundary.

Where this is not the case the Bannockburn ravine or roads provide a barrier effect to potential disturbance from the Proposed Development Site upon most ecological receptors which may have resting sites or use the areas for foraging (species) or prevent a hydrological connection (habitats).

6.4 Baseline Conditions

The land cover within the Proposed Development Site is predominantly marshy grassland in the eastern part, with the western part dominated by a mosaic of blanket bog, shrub heath and unimproved acid grassland.

The Proposed Development Site features several watercourses, including the Loch Coulter Burn, the Bannock Burn and the Buckie Burn. The Proposed Development Site is currently used for livestock grazing, including sheep and cattle, and for occasional grouse shooting.

The settlement pattern in the wider area is characterised by scattered residences and farms with the nearest substantial settlement being the city of Stirling located approximately 3km north-east of the Site boundary at its closest point.

6.4.1 Desk Study

Statutory designated sites for non-avian interests within 10km of the Proposed Development Site are shown in Table 6-4 and Figure 6-1. Where sites have a combination of both ecological and ornithological features, ornithological features are not stated here. For designated sites relating to ornithology see Chapter 7: Ornithology of the SSSI.

Twelve sites were identified, 10 SSSI and two SACs; as shown in Table 6-4.

Table 6-4: Statutory Designated Sites

Designated Sites	Designated Feature	Distance from Proposed Development Site
Carron Glen SSSI	Lowland neutral grassland Upland mixed ash woodland Upland oak woodland	2km
Denny Muir SSSI	Basin fen Blanket bog Subalpine acid grassland	4km

Designated Sites	Designated Feature	Distance from Proposed Development Site
Balquhidderock Wood SSSI	Wet woodland	5km
Endrick Water SSSI	Brook lamprey *Lampetra planeri* River lamprey *Lampetra fluviatilis* Scottish dock *Rumex aquaticus*	6km
Endrick Water SAC	Atlantic salmon *Salmo salar* Brook lamprey River lamprey	6km
Double Craigs SSSI	Subalpine calcareous grassland	8km
River Teith SAC	Atlantic salmon Brook lamprey River lamprey Sea lamprey *Petromyzon marinus*	8km
Wester Moss SSSI	Raised bog	8km
Abbey Craig SSSI	Beetle assemblage Upland mixed ash woodland	9km
Dullatur Marsh SSSI	Hydromorphological mire range	9km
Ochtertyre Moss SSSI	Raised Bog Spider *Heliophanus dampfi*	9km
Firth of Forth SSSI (ecological receptors are listed only)	Beetle assemblage Lowland neutral grassland Maritime cliff Mudflats Northern brown argus *Arcicia Artaxerxes* Saline lagoon Saltmarsh Sand dunes Transition grassland Vascular plant assemblage	10km

All designated sites are scoped out of further assessment based on distance from the Proposed Development Site.

Whilst the Endrick Water SAC/SSSI and River Teith SAC are within a theoretical ZoI, typically considered up to 10km for sensitive aquatic features, a study of the following catchment layers from the Scotland Environment Web website have confirmed that these designated sites are within different catchments to the Proposed Development Site. The consulted layers were:

- River and loch waterbody nested catchments;
- Baseline Water Body Inter catchments;
- Baseline Confluences Nested Catchments; and
- Baseline Confluence Inter Catchments.

A review of non-statutory designated sites was undertaken within 3km from data received from the LERC. No sites were identified but twelve potential Local Nature Conservation Sites (pLNCS) were found, as per Table 6-5. No information was provided by TWIC for these.

Distances are from the closest part of the Proposed Development Site to the pLNCS in Table 6-5.

Table 6-5: Potential Local Nature Conservation Sites

pLNCS	Distance from Proposed Development Site
Bannock Burn pLNCS	Intersects north of the Proposed Development Site boundary
North Cliffs pLNCS	Intersects northeast of the Proposed Development Site boundary
North Third Reservoir pLNCS	0.3km north
Loch Coulter Burn pLNCS	0.03km east
Loch Coulter pLNCS	0.1km southeast
Sauchieburn Woods pLNCS	1.9km northeast
Old Sauchiemill pLNCS	2km northeast
North Third woods pLNCS	1.8km north
Touch Moor pLNCS	2km north
Touch Hills pLNCS	2.2km north
Bard wood pLNCS	2.4km east
Carron Valley pLNCS	3km south

Bannock Burn, Loch Coulter Burn and Loch Coulter potential Local Nature Conservation Site (pLNCS)s will be considered in the assessment given their proximity and that at least some of their interest will be related to aquatic receptors (river habitat or aquatic species) for which the potential for pollution will be considered. These sites are considered of Local value.

All other pLNCs are scoped out due to distance and that they don't obviously comprise aquatic interests (it is not possible to be definitive in this respect however, due to the lack of information). North Third Reservoir pLNCS, whilst close, is outwith the catchment of the Proposed Development Site, as deemed by the Scotland Environment Web website layers described above and it is therefore scoped out.

Table 6-6 comprises European protected species and species of conservation interest within 3km of the centre of the Proposed Development Site and up to 10km for bat species from the last ten years. Species of conservation interest are defined as those on the Scottish Biodiversity List. Each species may be associated with multiple records within the data as provided by the Local Environmental Record Centre.

Target species were identified as those that are either afforded specific legislative protection (i.e., of high conservation interest) or represent qualifying interests in designated sites in the immediate wider area.

Valuations are not provided for desk-top protected species records as they are considered as an indicator as to what may be found during surveys, only adding weight to valuations based on receptors found during surveys, if applicable (i.e. where records are likely to be connected to the Proposed Development Site by means of proximity, or habitat connectivity).

Table 6-6: Protected Species Historical Records

Species	Summary or Records and distance from the Proposed Development Site
Eurasian Otter	1 record 2.31km south in 2015
Eurasian Badger	2 records 1.5km north in 2020
Red Squirrel	2 records 1.6km north in 2013
Brown long-eared Bat, *Plecotus auritus*	1 record 8.3 km south-east in 2016
Myotis Bat Species *Myotis*	2 records 2.9km south in 2016
Natterer's Bat *Myotis nattereri*	1 record 7km south-east in 2016 1 record 7.7km south-east in 2016 2 records 2.9km south-east in 2016
Daubenton's Bat, *Myotis daubentonii*	4 records 7km south-east in 2016 1 record 8.3km north-east in 2019 2 records 6.8km south-east in 2016 1 record 7.7km south-east in 2016 1 record 8km south-east in 2016
Common Pipistrelle	3 record 7km south-east in 2016 4 records 8.3km north-east in 2015 6 records 8.3km south-east in 2016 2 records 5.2km south-east in 2014 4 records 7.3km south-east in 2016 4 records 8.1km south-east in 2016 2 records 7.2km south-east in 2016 2 records 6.8km south-east in 2016 2 records 7.7km south-east in 2016 2 records 8km south-east in 2016 1 record 5.5km north-east in 2016 3 records 2.9km south-east in 2016
Pipistrelle *Pipistrellus pipistrellus sensu lato*	4 records 7km south-east in 2016 5 record 8.3km south-east in 2016 3 records 7.3km south-east in 2016 1 record 8.1km south-east in 2016 1 record 6.8km south-east in 2016 1 record 7.7km south-east in 2016 1 record 8km south-east in 2016 1 record 5.5km north-east in 2016 2 records 2.9km south-east in 2016
Soprano Pipistrelle	6 records 7km south-east in 2016 4 records 8.3km north-east in 2015 6 records 8.3km south-east in 2016 2 records 5.2km south-east in 2014 1 record 9.8km west in 2016 4 records 7.3km south-east in 2016 4 records 8.1km south-east in 2016 2 records 7.2km south-east in 2016 2 records 6.8km south-east in 2016 2 records 7.7km south-east in 2016 1 record 8km south-east in 2016 1 record 5.5km north-east in 2016

Species	Summary or Records and distance from the Proposed Development Site
	2 records 2.9km south-east in 2016

Considering the habitats which appear to be present from aerial photos and previous records identified, the capacity for protected species seems to be limited. The absence of any established forestry on or near infrastructure within the Proposed Development Site further limits the potential for their presence.

As a result, otter, water voles and bats are likely to be the protected species requiring consideration. Reptiles are likely to be present. There is a small chance pine marten *Martes martes* could use the woodland to the northeast of the Proposed Development Site, and badger could forage onto it, however an existing road separates the two.

The closest infrastructure associated with the Proposed Development to the woodland (outside the Proposed Development Site) is at a single location for an access route (Figure 6-6). As there is no woodland to cross into, opportunities for colonisation by badgers are limited.

The desk top search identified an impassable waterfall downstream of the Proposed Development Site; as such, effects on migratory fish are scoped out of the assessment.

6.4.2 Field Survey

Extended Phase 1 Survey

The Proposed Development Site is bounded by New Line Road to the east and an unnamed track south of Earl's Hill in the west. The eastern side is dominated by fields forming part of a working farm, which is upon the Proposed Development Site. The ground rises to the west to a peak of 373m from c.206m on the eastern side.

The marshy grassland which dominates in the east appears to be former grazing land which has been out of use for some time and has therefore reverted to this habitat. In the eastern fields and along the north-eastern section of the farm, young conifer plantation has been established (Figure 6-3) however it is recently planted and not yet the dominating habitat.

Poor semi-improved acid grassland and improved grassland is also present, the latter focused near the fam buildings. Soft rush *Juncus effusus*, red fescue *Festuca rubra* and Yorkshire fog *Holcus lanatus* dominate the marshy grassland.

Tufted hair-grass *Deschampsia caespitosa* and crested dogstail *Cynosuros cristatus* occurring occasionally. Artificial drainage channels occur on the lower ground, many of which have a peaty substrate. The west is dominated by a mosaic of blanket bog, dry dwarf shrub heath, unimproved acid grassland and acid flushes.

Wetter habitats are concentrated around the Buckie and Bannock burns which flow within and adjacent the Proposed Development Site (respectively) and in an easterly direction. Wet modified bog, wet dwarf shrub heath and small swamps are also present though to a lesser extent.

Blanket bog is dominated by heather *Calluna vulgaris*, hairs-tail cottongrass *Eriophorum vaginatum* and mosses including *Sphagnum capillifolium*, *S.fallax* and *Polytrichum* and *Rhytidialephus* spp.

Transitions to dwarf heath habitats contain a greater density of purple-moor grass *Molinia caespitosa* and non-sphagnum mosses. On the exposed drier elevations unimproved acid grassland is dominated by mat gras *Nardus stricta*, bent grasses *Agrostis* spp. with occasional heath bedstraw *Galium saxatile*.

Acid flushes are herb poor and dominated by soft rush, *S.caplllifolium*, *S.fallax* with occasional *S.papillosum* and *Polytrichum* spp. Additionally, there is a small patch of bracken *Pteridium aquilinum* scrub in the southern border of Proposed Development Site.

Valuations for habitats are provided under NVC Survey.

National Vegetation Classification Survey

The NVC survey recorded a total of fifteen communities considered to be of potential conservation interest, or potential GWDTE. Where these communities were floristically distinct, they were assigned into corresponding sub-communities. The communities recorded during the survey were:

- Mires, springs, and flushes: M2, M4, M6, M9, M19, M20, M23, M25 and M35;
- Dry heath communities: H9 and H21; and
- Grasslands and tall herb communities: MG10, U2, U4 and U6.

A map containing all the recorded NVC communities, and their location can be found in Figure 6-4.

Mires, Springs, and Flushes

M2 *Sphagnum cuspidatum/fallax* bog pool community

This is a community that typically forms in small depressions within saturated wet peat. The pools were small and found as a small cluster within species poor M20 mire community. The vegetation in the pools lack diversity and are dominated by *Sphagnum fallax* and *S. cuspidatum* with scattered shoots of *Eriophorum angustifolium*. Due to the small size of the community, vegetation from the surrounding habitat often encroaches the edge of the pools. Frequently recorded species occurring toward the margin of the pool include *Sphagnum medium, S. papillosum, Narthecium ossifragum* and *Erica tetralix*.

Only the M2b *Sphagnum fallax* sub-community was recorded during the survey. It is distinguished from the M2a sub-community by a lack of *Rhynchospora alba* and an abundance of S. fallax (Elkington *et al.*, 2001).

The M2 *Sphagnum cuspidatum/fallax* bog pool community is considered of Local value based on the low species diversity and abundance of *S. fallax*, which is very common, which can also indicate habitat degradation.

M4 *Carex rostrata – Sphagnum fallax* mire

M4 communities are sparsely but widely distributed within the Proposed Development Site. They were restricted to permanently wet depressions or gullies where water moves slowly through the vegetation.

All M4 communities within the Proposed Development Site were species poor and dominated almost exclusively by *Carex rostrata* as the vascular plant component and *Sphagnum fallax* as the dominant component of the bryophyte assemblage. Few other species were recorded within these communities, though common sedge *Carex nigra*, *Philonotis fontana* and *Viola palustris* were noted in some stands.

The M4 *Carex rostrata – Sphagnum fallax* mire is considered of less than Local value given the species-poor nature of the communities.

M6 *Carex echinata – Sphagnum fallax/denticulatum* mire

This community was found in small to medium sized areas where it was located along the margins of small watercourses and depressions in the landscape. This community is a soliginous mire found on peat substrates that are fed primarily by base-deficient water. These mires are situated in valley bottoms, sloping valley sides or channels where water flows slowly over a peaty surface.

There are four sub-communities associated with M6 mires, three of which were recorded within the Survey Area. This community contains a carpet of base-intolerant Sphagnum species such as *S. fallax, S. cuspidatum* and *S. palustre*.

Rushes and sedges are the other dominant species commonly found within this community. M6 can be differentiated from similar NVC communities such as M23 *Juncus effusus/acutiflorus – Galium palustre* mires as these typically lack the abundance of Sphagnum found in M6 communities.

M6c *Juncus effusus* and M6d *Juncus acutiflorus* sub-communities were widely recorded throughout the Proposed Development Site but increased in frequency towards the southern side. The M6c *Juncus effusus* sub-community is rather species poor with the nominate species dominating the vascular assemblage.

The M6c *Juncus effusus* sub-community is dominated by rushes and contains a carpet of common *Sphagnum* species including *S. palustre* and *S. fallax*. Less frequently recorded species include *Ranunculus repens*, *Ranunculus acris* and *Myosotis secunda*.

The M6d *Juncus acutiflorus* community is slightly more varied in its species assemblage and often contained *Viola palustris* and occasional *Carex* species such as *C. echinata* and *C. nigra*. These sedge species are also an important component of M6a *Carex echinata* sub-community and M6b *Carex nigra – Nardus stricta* sub-community although these sub-communities differ from the M6c and M6d sub-communities as Carex species are dominant or co-dominant with rushes.

M6 *Carex echinata – Sphagnum fallax/denticulatum* mire is considered of Local value based on the range of species within and between sub-communities.

M9 *Carex rostrata – Calliergonella cuspidata/giganteum* mire

This is a mire community that is associated with slightly base rich water conditions and are often dominated by *Carex rostrata*. Two sub-communities are described within M9 mires with M9b the only one to be recorded within the survey area.

The M9b sub-community is rather species poor and is dominated by *Carex rostrata* and does not contain the rich assemblage seen in M9a sub-communities. Other than the overwhelmingly dominant *Carex rostrata*, recorded species included *Calliergonella cuspidata, Viola palustris, Carex nigra* and *Carex echinata*.

M9 *Carex rostrata – Calliergonella cuspidata/giganteum* mire is considered of Local value given its relative rarity on the Proposed Development Site but also within the landscape context (i.e., relatively rare given the base water requirements).

M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire

This habitat is dominated by large swathes of *Calluna vulgaris, Eriophorum vaginatum* and sparse but regular shoots of *Eriophorum angustifolium*. Bryophytes are dominated by common pleurocarpous mosses including *Hylocomium splendens, Pleurozium schreberi, Rhytidiadelphus loreus* and *Hypnum jutlandicum*. Sphagnum species are not as well represented in this community as either M17 or M18 *Erica tetralix – Sphagnum papillosum* blanket mires.

S. capillifolium is the most common *Sphagnum* species, though *S. papillosum* and *S. tenellum* were also present in small amounts.

One sub-community was recorded within the Proposed Development Site: M19a *Erica tetralix* sub communities. M19a occupies large areas and contained a rather complex mosaic with dry heath communities in some locations.

Muirburn has had a very strong influence upon the composition of vegetation throughout the recorded areas. Sphagnum cover was rather poorly represented within these areas and have been lost as a result of frequent exposure to fire.

The vegetation also occurs as a patchwork of varying floristic compositions depending on the last time certain patches were burnt. *Molinia caerulea* was frequent in recently burnt patches with *Vaccinium myrtillus* and few other associates, these assemblages were recorded as mosaics with M25a communities, although in time the new growth of *Calluna vulgaris* will likely return the recently burned areas to a composition resembling M19a.

In the wetter stands in the valley bottoms species such as *Narthecium ossifragum, Empetrum nigrum* and *Drosera rotundifolia* became more frequent. In the least degraded sections of the community, *Vaccinium vitis-idea* was recorded but rare.

M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire is considered of Local value given the capacity for restoration/enhancement.

M20 *Eriophorum vaginatum* Blanket and raised mire

This is a community where *Eriophorum vaginatum* is overwhelmingly dominant and contains thick tussocks that allows few other species to compete. The habitat is found in a wide variety of locations throughout the Proposed Development Site, but mainly derived from degraded blanket bog communities.

This is a habitat is characteristic of ombrogenous peatland habitats that have been negatively affected by long term grazing and burning management regimes. These practices render the habitats floristically species poor and are often found adjacent to erosion channels which will have also contributed to water loss from the peatland surface further degrading the habitat.

There are two sub-communities associated with this habitat type, one of which was recorded in the Proposed Development Site. The M20a species poor sub-community lacks diversity and is largely dominated by *Eriophorum vaginatum*. Other species do occur but are only present in small amounts, including *Deschampsia flexuosa, Eriophorum angustifolium* and sparse amounts of *Calluna vulgaris* or *Vaccinium myrtillus*.

M20 *Eriophorum vaginatum* blanket and raised mire is considered of Local value given the capacity for restoration/enhancement. The potential for enhancement considering recent NS guidance (released June 2023) is considered to increase the inherent value of this habitat, and therefore the basis of its inclusion within the assessment.

M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture

There are two sub-communities associated with this habitat type, both of which were recorded within the Proposed Development Site. The M23a *Juncus acutiflorus* sub-community is the more floristically diverse of the two sub-communities.

The community is dominated by *Juncus acutiflorus* but contains a range of forbs including *Viola palustris*, *Carex nigra, Rumex acetosa* and *Cardamine pratensis*. A few small areas to the south were more diverse and contained species such as *Caltha palustris*, *Comarum palustre* and *Lotus pedunculatus*.

The M23b Juncus effusus sub-community is more impoverished and lacks the diversity of species seen in M23a communities. It is dominated by *Juncus effusus* and is often found in drier areas than M23a. Species that are recorded in higher frequency than M23a include *Holcus lanatus and Cirsium palustre*.

Given the differing ecological value between M23a and b communities the valuation is split to apply at Local level to M23a, and less than Local level to M23b.

M25 *Molinia caerulea – Potentilla erecta* mire

This community occurs on moderately wet, shallow peat and is found where there is a transition from the areas of deeper peat (M19 + M20 communities) and the more improved marshy grasslands or heath.

Molinia caerulea is the most dominant species within this community and can form large conspicuous tussocks. Bryophyte diversity is poor and restricted to robust common pleurocarpous mosses such as *Hylocomium splendens*, *Pleurozium schreberi* and *Hypnum jutlandicum*.

The M25a was the one of two sub-communities to be recorded within the survey area. M25a contains a flora that is consistent of a community that is derived from peatland habitats and contained a similar range of species, though they are normally very restricted in their distribution.

Typical peatland associates include *Erica tetralix*, *Calluna vulgaris, Trichophorum germanicum, Sphagnum palustre* and *Potentilla erecta*. The more floristically impoverished stands where *Molinia caerulea* was the overwhelmingly species cannot be assigned to a sub-community.

One area of M25c was recorded where it was found to be herb rich. Species such as *Parnassia palustris, Succisa pratensis, Angelica sylvestris, Lotus pedunculatus, Epilobium palustre, Juncus acutiflorus* and *Mentha aquatica* were all recorded.

M25 *Molinia caerulea – Potentilla erecta* mire is considered of Local value given the capacity for restoration/enhancement. As with M20, the potential for enhancement) is considered to increase the inherent value of this habitat, and therefore the basis of its inclusion within the assessment.

M35 *Ranunculus omiophyllus – Montia fontana* rill

This is a diverse community that is often small in size and found in wet runnels, springs or depressions in the landscape. Species recorded include *Montia fontana, Carex rostrata, Carex nigra, Potamogeton polygonifolius, Chrysosplenium oppositifolium* and *Ranunculus omiophyllus*. Bryophytes were well represented within the community with *Calliergonella cuspidata, Philonotis fontana* and *Warnstorfia exannulata*.

Notably, the Nationally Scarce (Pescott, 2016) *Hamatocaulis vernicosus* was also recorded within this community at grid reference: NS 74668 87396, located 80m from proposed infrastructure.

This is a species that is protected under Schedule 8 of the Wildlife & Countryside Act 1981 (as amended) it is also listed on Annex II of the EC Habitats & Species Directive, and Appendix I of the Bern Convention. No sub-communities are described for this community.

M35 *Ranunculus omiophyllus – Montia fontana* rill is considered of County value given its relative rarity in the context of other habitat on the Proposed Development Site, and the presence of *Hamatocaulis vernicosus*.

Dry heath Communities

H9 *Calluna vulgaris – Deschampsia flexuosa* heath

This is a dry heath community that is derived from other heath and mire communities that have been subjected to long term muirburn management. Muirburn has led to a drier, less diverse peatland than many of the other described peatland communities.

Calluna vulgaris is abundant to dominant throughout most places within the community and varies in composition depending on when the area was last burnt. Recently burnt areas are rather bare and mainly composed of common bryophytes including *Hypnum jutlandicum, Pleurozium schreberi* and *Dicranum scoparium*.

Vaccinium myrtillus dominates the dwarf shrub layer because of recent burning but this dominance is lost as the heather regenerates.

Two sub-communities were recorded within the survey area, the H9a *Hypnum cupressiforme* and the H9d *Galium saxatile* sub-communities. H9a is found where *Calluna vulgaris* is dominant with *Hypnum jutlandicum* on the ground layer. The H9d community is slightly grassier in assemblage but also has forbs including *Potentilla erecta, Galium saxatile* and *Rumex acetosella*.

H9 *Calluna vulgaris – Deschampsia flexuosa* heath is considered of less than Local value given its local ubiquity and impoverishment by muirburn and grazing pressure.

H21 *Calluna vulgaris - Vaccinium myrtillus - Sphagnum capillifolium* heath

This dry heath community has many similarities with blanket bog vegetation, though it occurs on shallow peatland habitats (often <50cm in depth). *Calluna vulgaris* is frequent to abundant but also contains a mixture of *Deschampsia flexuosa* and *Vaccinium myrtillus* throughout the community.

Sphagnum capillifolium is the most frequent Sphagnum species which can form low humps or hummocks, though *Sphagnum subnitens* was also occasionally recorded. Robust pleurocarpous mosses such as *Hylocomium splendens, Pleurozium schreberi, Hypnum jutlandicum* and *Rhytidiadelphus loreus* were frequent to abundant.

No sub-communities were recorded within the Proposed Development Site as there were none which were floristically distinct.

H21 *Calluna vulgaris - Vaccinium myrtillus - Sphagnum capillifolium* heath is considered of Local value as it is wetter than H9, and less defined by dominant species indicated from grazing/burning as is the case with H9.

Grassland Communities

MG10 *Juncus effusus* – *Holcus lanatus* rush pasture

This community is frequently recorded in the eastern half of the survey area. *Juncus effusus* tussocks are the most obvious feature of this community, though *Juncus acutiflorus* was also recorded occasionally.

Between these tussocks is a species poor sward of *Holcus lanatus*, *Agrostis stolonifera* and *Poa trivialis*. Forb species included *Ranunculus repens*, *Ranunculus acris* and *Cardamine pratensis*. It is distinct from other rush dominated communities by the higher frequency of grasses that are frequently grazed which maintains the open, short sward of the grass pasture between the tussocks of rush species.

All MG10 communities were assigned to the MG10a typical sub-community.

MG10 Juncus effusus – Holcus lanatus rush pasture is considered of less than Local value given how common it is on the Proposed Development Site and the general locality.

***U2 Deschampsia flexuosa* grassland**

This grassland was found occurring as a small area to the north of the site. It is a rather heathy grassland that often occurs on thin peaty soils. *Deschampsia flexuosa* was dominant but other species were infrequently recorded including *Agrostis capillaris, Potentilla erecta, Juncus squarrosus* and small amounts of *Vaccinium myrtillus*. This is a habitat of little biodiversity or conservation value.

U2 *Deschampsia flexuosa* grassland is considered of less than Local value as it is a common habitat of low conservation value.

U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland

This grassland was found on many of the summits and occurred as closely grazed which showed evidence of improvement as a result of sheep manure. As such the more improved sub-community, U4b, was found although elsewhere it was only possible to categorise to community level due to a lack of distinction possible from the species observed.

Festuca ovina, in tandem with *Agrostis capillaris* and *Anthoxanthum odoratum* were dominants. In U4b *Holcus lanatus* and *Trifolium repens* had a stronger influence. *Galium saxatile* was rare in both U4 and U4b, most likely due to the exposure of these summits in addition to the grazing pressure.

U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland is considered of less than Local value given its local ubiquity.

U6 *Juncus squarrosus* – *Festuca ovina* grassland

This is a habitat found on mineral deficient soils, often on shallow, moist, peaty substrates. This is another habitat which is formed normally through a combination of intensive grazing and burning practices.

The thick, dark green basal rosettes of *Juncus squarrosus* are the most prominent feature of this habitat type. These are mixed with *Anthoxanthum odoratum, Agrostis canina, Deschampsia flexuosa*, *Galium saxatile* and *Potentilla erecta* shoots growing through bryophytes including *Hylocomium splendens*, *Pleurozium schreberi, Rhytidiadelphus squarrosus* and *Calliergonella cuspidata*.

There was only one area recorded as U6 community within the Survey Area which was variable in its botanical composition. As such it does not conform to any of the four sub-communities associated with this habitat type.

U6 Juncus squarrosus – Festuca ovina *grassland* is considered of less than Local value given its association with disturbance events.

NVC community summary

A number of the recorded communities are considered to have conservation value at a European level (Annex 1) or at a national level (Scottish Biodiversity List). A summary of habitats which have conservation designations assigned to them can be found in Table 6-7.

Table 6-7: Annex 1 and UK BAP Habitats

NVC Code	Annex 1	Scottish Biodiversity List
M2	N/A	Blanket Bog
M4	H7140	Lowland Flush + Upland flush
M6	N/A	Upland flush
M9	H7230	Lowland flush + upland flush
M19	H7130 (Only applicable on peat >50cm deep)	Blanket bog
M20	H7130 stands on blanket bogs (Only applicable on peat >50cm deep)	Blanket bog
M25	H7130 (Only applicable on peat >50cm deep)	Blanket bog
M35	N/A	Lowland flush + upland flush
H9	H4030	Lowland heathland
H21	H4030	Lowland heathland

The communities are only classed as Annex 1 quality if they adhere to certain criteria for each Annex 1 type. All the peatland habitats within the Survey Area are degraded in nature.

There are some very small areas within the communities that occur as near natural in their composition, though these areas are infrequent and very small in size. H7130 Annex 1 codes applying to M19, M20 and M25 communities can only apply where there is a peat depth exceeding 50cm in depth and is capable of regenerating within a 30-year time frame.

However, the scarcity of the important peat building Sphagna such as *S. medium* and *S. papillosum* within these communities will inhibit the opportunity to return these communities to a functioning blanket bog within 30 years. As such, none of the peatland habitats found within the survey area are considered Annex 1 quality.

The flushes were all species poor in their composition and have limited conservation value other than adding diversity to the landscape within the survey area and inherent scarcity value nationally.

Non-NVC Communities

Non NVC habitats were agriculturally improved, or poor acidic grasslands dominated by Yorkshire fog *Holcus lanatus* and/or red fescue *Festuca rubra*, with smooth meadow-grass *Poa pratensis* and as described in Averis *et al*. (2004) as lush, species-poor grasslands.

GWDTE Survey

Table 6-8 lists the NVC communities that have a potential for groundwater dependency. The table categorises each habitat type according to whether they are likely to be moderately or highly groundwater dependent as defined by SEPA (2012). In total, there are three communities listed as moderate and four communities listed as high potential for groundwater dependency.

Table 6-8: Potential GWDTE Communities Recorded within the Proposed Development Site

NVC code	NVC community name	GWDTE potential
MG10	*Holcus lanatus - Juncus effusus rush* pasture	Moderate
M25	*Molinia caerulea – Potentilla erecta* mire	Moderate
U6	*Juncus squarrosus – Festuca ovina* grassland	Moderate
M6	*Carex echinata – Sphagnum fallax* mire	High
M9	*Carex rostrata – Calliergonella cuspidata/gigantea* mire	High
M23	*Juncus effusus/acutiflorus - Galium palustre* rush pasture	High
M35	*Ranunculus omiophyllus – Montia fontana* rill	High

Whilst potential GWDTE were identified, confirmation of their actual GWDTE status is contingent on hydrogeological risk assessment and outwith the exclusive remit of the ecological assessment. As such, Chapter 8: Hydrology, Geology and Hydrogeology shown be consulted in addition to TA 6-2 NVC Survey.

Bat Surveys

Automated Static Detector Surveys

Automated static detector surveys were undertaken in 2020 and again in 2023 based on a revised layout from 2020 and because the earlier surveys had passed their data validity. Surveys were carried out as per guidance (NatureScot, 2021). The detectors were set up to record activity from 30 minutes before sunset to 30 minutes after sunrise for a period of at least 10 nights (Collins, 2016). TA 6-3 contains detailed survey results.

2023

There was a range of activity recorded between the three survey periods in 2023 within the Proposed Development Site. There was minimal activity during the first (Spring) visit where only common pipistrelle was recorded during April. This corresponds with bats not quite emerging from their post winter hibernation.

Activity increased during the second survey period, in June, as 449 passes were recorded, mostly of both pipistrelle species across four of the turbines which were classified as medium levels of activity. *Myotis* spp., noctule and brown-long eared bats were also recorded during the second visit but mostly at low levels of activity.

Bat activity increased further during the third visit to 809 passes, albeit with five detectors deployed compared to the previous four; the recordings consisted mostly of both pipistrelle species.

Medium activity was recorded for common pipistrelles during the second and third visits for all turbines. Soprano pipistrelle was recorded at medium activity around T1 and T4 during the second visit and at all turbines during the third visit. *Myotis* spp. was recorded at T1, T3, and T4 during the second and third survey periods but mostly at low activity levels.

Noctules were recorded at low activity level at T3 in both the second and the third survey visits and irregularly at T1 and T2 (old) in the two latter surveys. Brown long-eared bats was recorded irregularly throughout the survey periods, recorded on only one visit at T1, T2 (old) and T4.

Common and soprano pipistrelle bats are considered of Local value in the context of the Proposed Development Site and taken forward for assessment based on overall medium levels of activity based on the criteria in Table 6-3.

Other bat species are scoped out given the low activity, which is considered a result of the lack of suitable foraging habitat on the Proposed Development Site.

2020 Data as Context for the 2023 Design

The overall activity level on the Proposed Development Site in 2020 was low, but medium activity was recorded around T3 and T4 for unidentified pipistrelle. The most relevant data was collected in 2020 around T6 as it can be used as a proxy for the new T2 location within the 2023 design.

Unidentified pipistrelle was recorded at medium activity, and common pipistrelle and soprano pipistrelle were recorded at low activity around T6. This aligns with records at T2 new in 2023 as unidentified pipistrelle was recorded at low activity, and common pipistrelle and soprano pipistrelle were recorded at medium activity.

More details of the results and analysis of the bat surveys can be found in Technical Appendix 6-3.

Emergence Surveys

Subsequent design changes after the 2021 surveys, meant that the PRFs were no longer within the ZoI in 2023, as per thresholds detailed in guidance (NatureScot, 2021). Therefore, this information is included on the basis to provide contextual data to help inform conclusions within the assessment. No roosts were recorded during the 2020/21 emergence surveys.

Passing bats were noted in 2020 despite the sub-optimal conditions. The first of the 2021 surveys recorded low bat activity with a total of 5 passes comprised of both common and soprano pipistrelle.

The second survey was busier than the first as an individual pipistrelle was foraging around the tree throughout the entire survey, as the sun rose the individual flew eastward. It is considered the trees in the area are a foraging resource as insects would be found in what is otherwise a landscape lacking trees.

It is evident that the tree was not being used as a roost as just before the dawn the bat was observed flying east towards the sun and did not return.

The upland heath habitat and small watercourses within the Proposed Development Site indicate that the bats are likely to be foraging in the area or commuting between more suitable habitat rather than roosting.

Protected Species Surveys (non-volant).

No signs of protected species were seen during surveys although suitable habitat does exist within the Proposed Development Site for otter and water vole.

Considering the habitats present from aerial photos, and previous records identified, the capacity for the Proposed Development Site to support protected species appears to be limited. The absence of substantial woodland within the development boundary further limits the potential for the presence of protected species.

As a result, no non-volant protected species interests will be taken forward for assessment based on the lack of results from surveys. Reptiles are likely to be present although none were seen during surveys.

6.5 Assessment of Effects and Mitigation

6.5.1 Future baseline

If the current land management practices were to continue, it is likely that the range and condition of habitats currently present is likely to deteriorate given grazing and burning pressures as evidenced through the poor condition of many of the bog and heath habitats recorded during surveys. For common and soprano pipistrelle bats, those species taken forth in the assessment, there is unlikely to be change as they fly either over the Proposed Development Site or use the burns to commute, the configuration of which is unlikely to change.

6.5.2 Ecological Features Brought Forward for Assessment

The following applies to all non-avian ecological receptors brought forward to the detailed ecological impact assessment stage. Their value is assessed as being important at a Local level or higher and that they are potentially vulnerable to significant impacts from the Proposed Development.

Ecological features meeting these criteria are considered Important Ecological features (IEFs) and the ecological impact assessment concerns these features only. IEFs include the following described below.

Potential Local Nature Conservation Sites

The basis of pLNCS inclusion in the assessment is based on their proximity to the Proposed Development Site, and likely inclusion of aquatic IEFs within those pLNCS.

The following pLNCS are included in the assessment:

- Bannock Burn pLNCS;
- Loch Coulter Burn pLNCS; and
- Loch Coulter pLNCS.

They are considered of Local value.

Habitats

Table 6-9 shows the areas of habitats recorded within the Proposed Development Site which will be lost to construction and the proportion of these lost to the Proposed

Development. Habitats where there is no loss are not included and habitats where there is loss, but they are assessed as being of Less than Local value are not included.

On a precautionary basis, total loss includes habitats within 10m of that directly lost to account for indirect drying effects from infrastructure which includes earthworks.

Whilst it is noted in NatureScot (2023) that a 30m buffer should be used (as per the Peatland code), this is considered disproportionate given the poor condition of peatlands as there were no near natural features (Figure 6-8) as defined by NatureScot. (It is a requirement of NatureScot (2023) that condition of peatlands are determined and Figure 6-8 contains that results of this categorisation).

Peat comprises Class 4 (area unlikely to be associated with peatland habitats) and Class 5 soils (no peatland habitat recorded) in the western hills and mineral or Class 3 soils (dominant vegetation is not priority peatland habitat) in the east (Scotland's Soils, 2024).

In addition, much of the Proposed Development Site is modified by burning and historic burning and grouse shooting still occurs. As such, an indirect loss buffer of 10m is considered appropriate for priority peatlands which also applies to all habitats, including Groundwater Dependant Terrestrial Ecosystems (GWDTE) and heathlands. Much of the latter are monocultural and lack floristic or conservation interest.

At the time of writing there is uncertainty as to which one of two access tracks will be used. For this reason, both tracks are included within habitat calculations and a worst-case loss is therefore provided in Table 6-9. Ultimately, only one of the access options is constructed and the overall effects of the routes will be reduced.

There may be minor discrepancies between totals due to rounding. Figures are to two decimal places.

Table 6-9: Predicted loss of habitats associated with the Proposed Development and drying effects

Habitat Type NVC	Direct loss to infrastructure (ha)	Indirect loss to drying effects - 10m buffer (ha)	Total loss to infrastructure and drying effects (ha)	Total area in Proposed Development Site (ha)	Percentage of total lost on Site due to infrastructure & drying effects (%)
M6 *Carex echinata – Sphagnum fallax/denticulatum* mire	0.4	0.3	0.7	13.5	5.3
M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire	5.3	4.3	9.6	95.1	4.5
M20 *Eriophorum vaginatum* Blanket and raised mire	0.2	0.2	0.4	9.4	2.5
M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture	0.2	0.4	0.6	43	1
M25 *Molinia caerulea* – Potentilla erecta* mire	0.1**	0.1	0.2	8.9***	3.2

H21 *Calluna vulgaris - Vaccinium myrtillus - Sphagnum capillifolium* heath	1.7	1.9	3.6	42.6	4.5
TOTAL	**7.9**	**7.3**	**15.2**	**212.5**	**-**

*Includes M23/M25 mosaic

**M25a/M23 mosaic only

*** includes M25a/M19, M25a/M23 and M25a/M23b mosaics

Whilst the discovery of the Schedule 8 moss *Hamatocaulis vernicosus* within M35 raises the overall value of that habitat, as the area will not be directly affected (it is 80m from infrastructure) it is considered in the context of M35, and therefore assessed in that section (6.7.1) at county level. Chapter 8: Hydrology, Geology and Hydrogeology should be consulted in relation to potential effects on M35 as a high potential GWDTE.

Habitats associated with peaty substrates are taken forward although the baseline condition varies. This is in part because these areas comprise opportunities for enhancement in line with the principles of the Fourth National Planning Framework (NPF4) which sets out new requirements for development to deliver positive effects and conserve, restore and enhance biodiversity under Policy 3 (Scottish Government, 2023).

M9 Carex rostrata – Calliergonella cuspidata/gigantea mire is not taken forward for assessement for whilst identified in baseline surveys it is outwith the Proposed Development Site +250m and not therefore within the ZoI.

Fauna

The following species are brought forward for assessment: Soprano pipistrelle and common pipistrelle.

For the purposes of the assessment and to avoid repetition, both of the common pipistrelle species are considered hereon as one Local level IEF. Ecological requirements are similar and activity levels were equable.

6.6 Mitigation

In line with current CIEEM guidelines, the impact assessment in this chapter is carried out in the presence of mitigation measures. The following mitigation measures and good practice measures will be applied to the Proposed Development during construction and operation to ensure that any effects on the IEFs, and site ecology in general, are reduced.

6.6.1 Design Mitigation

Embedded mitigation relates primarily to the design evolution of the Proposed Development and agreement on proposed management practices intended from the start of construction.

Detailed information on infrastructure layout and design evolution is shown in Chapter 3: Description of the Development and the Design and Access Statement, however elements specific to terrestrial ecological and environmental protection are summarised here.

The design has evolved iteratively to minimise the impacts on potential GWDTEs and peat habitats through taking account of NVC results and hydrological assessments, in addition to the presence of watercourses.

The Proposed Development has been designed to minimise works in the vicinity of mapped watercourses and to minimise the need for new water crossings to reduce the risk of pollution and changes to watercourse morphology. Up to six watercourse crossings are proposed.

A Pollution Risk assessment will be carried out identifying materials, areas and activities of greatest risk and laying out controls on these. From this a Pollution Prevention Plan (PPP) will be prepared. The PPP will be a sub plan of the CEMP. A PPP will also be in place during operation and decommissioning phases.

The Proposed Development will be constructed in cognisance of the following guidelines:

- 'Control of water pollution from construction sites – Guidance for consultants and contractors' (Masters-Williams et al. 2001)
- 'Control of water pollution from linear construction projects' (Murnane et al. 2006).

The drainage design will comply with General Binding Rules (GBR's) 10, 11 and 21 for the track drainage, under the Water Environment (Controlled Activities) (Scotland) Regulations (CAR) 2011 (as amended) (SEPA, 2023).

Guidance issued by Natural England (2014) and NatureScot (2019) provides a methodology for determining the minimum buffer distance required between a feature of potential value for bats and a wind turbine. A minimum stand-off buffer of 50m will be maintained between the rotor-swept area and the nearest feature, which is considered to be the Bannockburn River ravine - given the lack of tree-lines on the Proposed Development Site or in the vicinity of infrastructure. The calculation for the recommended minimum 50m buffer from blade tips is calculated using the formula:

Buffer distance from edge/feature = $\sqrt{(50m + bl)^2 – (hh – fh)^2}$; and

Where "bl" = blade length, "hh" = the hub height and "fh" = feature height. For the Bannockburn River ravine (assumed 0m in height in relation to a turbine) this corresponds to a minimum buffer of 87.1m between turbine towers and the nearest woodland/edge feature

If micro-siting occurs, pre-construction re-surveys will not be required. However, if the wind farm design changes and potential impacts are identified, further surveys may be required.

6.6.2 Pre-Construction Phase

A pre-construction survey will be undertaken within 4 weeks of the start of construction, covering suitable habitat within 200m from construction areas. This buffer accounts for potential otter as well as all other possible protected species interests, including the potential presence of mountain hare forms. The survey will be undertaken by a suitably qualified ecologist and the results will inform whether the CEMP will include further mitigation, if required.

Should the presence of a protected species be found in an area where disturbance or destruction of breeding structures, cannot be avoided, a protected species licence may be required.

6.6.3 Construction Phase

Full details of construction mitigation measures will be provided in a CEMP to be agreed with Stirling Council, in consultation with relevant stakeholders, post-consent but prior to development commencing. The PPP will detail proposed surface drainage measures to treat and deal with surface runoff from the Site, will be designed in accordance with sustainable drainage systems (SuDS) principals. This plan will form part of the CEMP.

Indicative Measures in the CEMP will also include:

General

- Works to be overseen by an Environmental Clerk of Works (EnvCoW) and their role and responsibilities will be detailed in the CEMP. In outline, this role will include ongoing monitoring of environmental / ecological constraints, review and audit of the appointed contractor's environmental performance, delivery of toolbox talks, and supervision of construction works.
- There will be no direct discharges to any natural watercourses, with all drainage waters being dispersed as overland flows, as directed by the EnvCoW to avoid erosion or siltation of existing watercourses in the process. All discharges from the proposed works areas will be made over vegetation filters at an appropriate distance from natural watercourses.
- It is proposed that wind turbines and associated infrastructure including tracks and other hardstandings will have a micro siting allowance of up to a radius of 50m.
- Site drainage measures, including drainage ditches and silt traps, will be provided to collect and treat increased surface run off.
- Appropriate bunded storage will be in place for storage of fuels/oils, with onsite storage of hydrocarbons to be kept to a minimum.
- Use of wet-cement products within the hydrological buffer will be avoided, insofar as possible. Should their use be proposed, this would be in agreement between the EnvCoW and SEPA prior to their use.
- Wastewater emanating on-site (sewage, wastewater from site office) will be taken off-Site for disposal/treatment at controlled facilities. To this effect, welfare facilities for construction site workers will include self-contained port-a-loos with an integrated waste holding tank. No water will be sourced on the Site, nor will any wastewater be discharged from the Site.
- Infiltration interception drains for upslope 'clean' water collection and dispersion.
- Flow attenuation and filtration check dams to reduce velocities, with consideration given to gradient with drains to determine spacing requirements; and
- Silt fences, straw bales and biodegradable matting will be used to control surface water runoff for deposition areas.
- Deposition areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff.

Habitats

The loss of plant communities is an unavoidable consequence of the Proposed Development. However, incidental habitat loss will be avoided by minimising the footprint of construction activities. This will be achieved by:

- Operating machinery and storing materials within the footprint of permanent construction features wherever practicable; and
- By ensuring that vehicles and their operators do not inadvertently stray onto adjacent habitat areas.

Other indicative measures within the CEMP will be:

- Re-instatement of habitats – best practice techniques for vegetation and habitat re-instatement will be adopted and implemented on areas subject to disturbance, such as the temporary construction compound area, as soon as is practicable.
- Materials and other temporary infrastructure will be removed off-site and all temporary construction areas will be reinstated.
- The surface layer of soil and vegetation will be stripped separately from the lower soil layers, stored separately, and replaced as intact as possible once the construction phase is complete. Turf material will be replaced as far as possible in similar locations to where it was removed.
- Soils removed from the excavated area will be stored separately in piles, no greater than 3m in height, directly adjacent to, or near the tracks on ground appropriate for storage of materials i.e., relatively dry and flat ground, a minimum of 50m away from watercourses (where possible); Wherever possible, reinstatement of ground disturbed to facilitate construction of the track will be carried out as track construction progresses.
- Given that the Bannock Burn pLNCS intersects the Proposed Development Site double silt fences will be installed adjacent to the burn to prevent sediment/silt infiltration ingress. The EnvCoW will be present at their installation.
- No refuelling will be permitted at works locations within the 50m of watercourses (where possible).
- There will be no direct dewatering to watercourses during the construction phase. All outflows from drainage associated with construction will be by diffuse overland drainage at appropriate locations.
- The time between excavating and backfilling of individual sections of cable trench will be minimised near GWDTEs. As a rule, these should be backfilled within three days to minimise drying and disturbance.
- Impermeable barriers and/or clay plugs will be used to avoid the trenches acting as preferential conduits of groundwater.
- Areas of identified sensitivity (GWDTE and flushes) will be marked out / fenced-off to prevent accidental vehicular access.

Fauna

- As there is potential for fauna to access the Proposed Development Site excavations/holes will be covered at the end of each working day, or a wooden plank placed inside to allow faunal species to escape, should they enter the hole. Any temporarily exposed open pipe system would be capped in such a way as to prevent wildlife gaining access.
- No in-channel obstructions (floodlighting, fencing or diversions) will be permitted within watercourses unless specifically authorised in writing by the relevant authority (i.e., SEPA and/or a suitably experienced freshwater Ecologist).

- Measures shall be implemented to reduce the potential for even non-significant construction impacts to bats, e.g., downward-directed artificial lighting will be used to shine light to the working area only and reduce 'light leakage' that may temporarily affect bat flightlines.
- In the event that a protected species is discovered on site all work in that area would stop immediately and the EnvCoW would be contacted. Increased buffer areas may be required in these locations. Details of the local police Wildlife Crime Officers, NS Area Officer, and Scottish Society for the Prevention of Cruelty to Animals (SSPCA) relevant Officer would be held in the site emergency procedure documents.
- No new ground will be cleared without prior inspection by the EnvCoW to ensure reptiles, should they be present, are encouraged to disperse before clearance. Clearance will occur in a manner to ensure dispersal routes for reptiles.
- A Site speed limit of 15mph will be in place at all times to reduce the risk of collision and protected species mortality associated with construction vehicles.

6.6.4 Operational Phase

During the operational phase the following mitigation will be in place.

Habitats

Table 6-10 shows priority peatland loss compared against intended restoration. A principal aim of restoration will be to restore all peatlands identified to M19 and, as a result, the actual benefit is greater than the numbers shown for M20 and M25 are typically degraded forms of bog which, with the right interventions, can be pushed towards M19. M19 is typically wetter, holds deeper peat and a higher diversity of mosses and floral species.

Erosion features including artificial drains and areas for bog improvement have been identified as shown on Figure 6-7 and form the basis of compensation and enhancement calculations within unimpacted priority peatland and peaty soil habitats which remain following infrastructure installation.

Table 6-10: Loss and Restoration of Priority Peatland Communities (in Hectares)

NVC Vegetation Community	Total loss	Restoration
M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire	9.6	15.9
M20 *Eriophorum vaginatum* Blanket and raised mire	0.4	-
M25 *Molinia caerulea – Potentilla erecta* mire, sub-community	0.2	-
TOTAL	**10.2**	**15.9**

It is noted that the priority peatland loss (M19, M20 and M25) accounts for 10.2ha and the compensation/enhancement intended accounts for 15.9ha.

Whilst this 1:1.5 ratio is less than the 1:10 ratio stated in NatureScot, 2023 guidance (plus 10% of loss required for enhancement) attention is drawn to the fact that there are very little opportunities for priority peatland restoration on the Proposed Development Site. It is noted that this guidance is subject to review by the Peatland Expert Advisory Group which advises both NS and Scottish Government and that revised guidance is expected in 2025.

Much of the Proposed Development Site has low quality peat (Class 3-5) and there are few drains within 0.5m of peat or more available for restoration. Drains where the peat profile is shallower, based on habitat defined in the NVC survey, would not be suitable for restoration as their capacity to wet will be limited. The available drains for restoration have been provided by the peat specialist.

Figure 6-7 shows the minimal amount of drains available (shown in blue) and the Peatland Condition Assessment map (Figure 6-8) shows the poor condition of peat given the extent of modified and historically burned areas. It is noted in the 2023 guidance that changing grazing or burning regimes does not count towards restoration targets.

Whilst the threshold within the 2023 guidance has not been met it is considered that the 'significance test in EIA terms' has been. Whilst it is noted in Table 6-1 that NatureScot do not consider effects will approach or surpass levels that raise natural heritage issues of national interest the deficit in relation to latest guidance is noted. As such, the Applicant is therefore keen to enter discussions with NatureScot and SC with a view to financially contributing to off-site peatland restoration or research in the region.

Areas are not provided for creation of new GWDTE in this EIAR due to difficulty in creating these. As such, the emphasis in the HMP is protection and enhancement of existing GWDTE.

The EnvCoW will monitor the condition of sensitive habitats, including areas GWDTE, restored peat and watercourses. Details of the reinstatement and monitoring programme are included in the HMP (TA 6-5). Quadrats should be established in year 1 following the start of restoration with surveys carried out in year 3 and 5. Further surveys would be carried out in years 7, 10, 15 and 40.

The proposed access tracks will be left in place after completion of the construction phase as they will provide access for maintenance, repairs, and the eventual decommissioning phase.

Hardstanding areas at each turbine location will be retained for use in on-going maintenance operations, with the edges as far as possible blended to the adjacent contours with natural vegetation being allowed to re-establish.

Fauna

A site speed limit of 15mph will be always in place to reduce the risk of faunal collisions with construction vehicles.

6.7 Identification and Evaluation of Key Impacts

The three phases of the project lifecycle are considered separately as different effects will occur over the project lifetime.

6.7.1 Construction Effects

During construction it is anticipated that, in the absence of further mitigation to that embedded with the design likely sources of direct and secondary effects may arise from:

- Habitat loss or damage (permanent and temporary) due to construction of wind farm infrastructure.

- Sedimentation or other pollution of watercourses from construction activities and vehicular traffic.
- Secondary effects on sensitive habitats through siltation/pollution/spread of invasive species.
- Inadvertent killing, injuring or disturbance of fauna during construction.
- Disturbance to fauna due to vehicular traffic, operating plant, and the presence of construction workers.

Potential Nature Conservation Sites

Upon implementation of measures to mitigate the likelihood of a pollution event as detailed in 6.6.3, **no significant effect** on the Bannock Burn pLNCS is considered likely. Double silt fencing adjacent the burn, coupled with no works within 50m (where possible) of watercourses, in tandem with the range of measures described in respect of soil storage and pollution attenuation, will ensure the integrity of the pLNCS.

It is unclear from OS mapping whether there is a hydrological connection between the Proposed Development Site and the Loch Coulter Burn and Loch Coulter pLNCSs- located 0.03km and 0.1km away, respectively. Given the strong possibility exists however, these sites will be treated as per Bannock Burn pLNCS in that double-silt fencing will be applied to all burns within the Proposed Development Site. This precautionary measure, coupled with other measures described previously, will ensure **no adverse effects** on these pLNCs.

Habitats

Chapter 3: Description of the Development includes proposed dimensions of all turbines, turbine foundations, crane hard-standings, access tracks, substation, borrow pits, control building and construction compounds. The impacts are categorised as follows:

- Direct habitat loss: this includes habitats present under the footprint of the Proposed Development, including tracks, turbine bases, crane pads, substation, compounds, and drains; and
- Indirect habitat disturbance: where temporary infrastructure is proposed and in relation drying out effects on habitat adjacent to that directly lost.

These potential impacts are addressed for each pLNCS, habitat or species brought forward to assessment.

Table 6-9 indicates the potential temporary and permanent habitat loss associated with the infrastructure and habitats brought forward for assessment. Loss calculations include a 10m buffer of infrastructure land-take to account for indirect, drying effects.

M6 *Carex echinata – Sphagnum fallax/denticulatum* mire

This habitat is of **Local** value and aligns with the SBL habitat, 'Upland Flushes'. There will be loss of 0.7ha; 0.4ha of which will be direct loss. Direct and indirect loss equates to 5.3% of the 13.5ha recorded within the Proposed Development Site, which is considered to be a **minor adverse effect on a Local IEF which is not significant in EIA terms.** This is on the basis that effects on Local receptors cannot be regarded as significant under the EIA Regs.

M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire

This habitat is of **Local** value and aligns with the SBL habitat, 'Blanket Bog'. The degraded nature and lack of important peat building Sphagna such as *S. medium* and *S. papillosum* means it does not meet the threshold for Annex 1 habitat as described in Table 6-7 and associated text.

There will be loss of 9.6ha; 5.3ha of which will be direct loss. Direct and indirect loss equates to 4.5% of the 95.1ha recorded within the Proposed Development Site, which is considered to be a **moderate adverse effect on a Local IEF. Whilst not significant in EIA terms, the amount represents a noted loss at the local level and compensation and enhancement is intended equal to 15.9ha of blanket bog.** The HMP (TA 6-5) describes measures to create new bog matching the M19 NVC type.

M20 *Eriophorum vaginatum* Blanket and raised mire

This habitat is of **Local** value and aligns with the SBL habitat, 'Blanket Bog'. For the same reason as for M19, M20 on the Proposed Development Site does not meet the Annex 1 threshold.

There will be loss of 0.4ha; 0.2ha of which will be direct loss. Direct and indirect loss equates to 2.5% of the 9.4ha recorded within the Proposed Development Site, which is considered to be a **minor adverse effect on a Local IEF which is not significant in EIA terms.**

M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture

This habitat is of **Local** value but in relation to its high GWDTE status as confirmed in Chapter 8: Hydrology, Geology and Hydrogeology.

Given its ubiquity on the Proposed Development Site, and that it does not comprise an Annex 1 or SBL habitat, potential impacts do not relate to biodiversity but rather ground-water flow. Whilst measures to protect GWDTE are therefore included in the HMP (TA 6-5) this habitat is not considered further in the assessment of effects.

M25 *Molinia caerulea – Potentilla erecta* mire

This habitat is of **Local** value and aligns with the SBL habitat, 'Blanket Bog' when on peat 0.5m depth or more. As such, not all M25 within the Proposed Development Site will meet this criterion.

There will be loss of 0.1ha, all of which will be direct loss. This loss equates to 3.2% of the 8.9ha recorded within the Proposed Development Site, which is considered to be a **negligible effect on a Local IEF.**

M35 *Ranunculus omiophyllus – Montia fontana* rill

As also described in Chapter 8: Hydrology, Geology and Hydrogeology the small patch of M35 is upslope and up-gradient of the new track east of watercourse crossing 5.

However, as the M35 is within 100m of proposed infrastructure it is recommended that the micro-siting allowance of 50m is used to move the working corridor outwith the ZoI of the M35 to ensure that the integrity of the M35, and the Nationally Scarce moss, *Hamatocaulis vernicosus* within it, will be maintained. This will ensure a **negligible effect on this County IEF.**

H21 Calluna vulgaris - *Vaccinium myrtillus - Sphagnum capillifolium* heath

This habitat is of **Local** value and aligns with the SBL habitat 'Lowland heathland'.

There will be loss of 3.6ha 1.7ha of which will be direct loss. Direct and indirect loss equates to 4.5% of the 42.6ha recorded within the Proposed Development Site which is considered to be a **minor adverse effect on a Local IEF, which is not significant in EIA terms.**

As this habitat is not showing the denudation from grazing and burning as that of the H9 heath, plus that it forms part of the Integrated Habitat Network (IHN) for Bog and Heath within the Central Scotland Green Network (Scotland Environment Web 2023, CSGN 2023) an area of 6.2ha of poorer heath (typically the H9) will be succeeded to an H21 type.

Further detail on this is expanded upon in the HMP and it is noted that this measure will contribute to enhancing habitats for Short-eared owl *Asio flammeus* (see Ornithology Chapter 7 for further information).

Fauna

No roosts were found within the Proposed Development Site and the lack of foraging resources suggests common and soprano pipistrelle bats are mainly flying over rather than foraging upon the Proposed Development Site.

Overall, the risk from effects from construction are therefore considered low, particularly in the context of adapted lighting as described in section 6.6.3. As a result of these conditions, **no significant effects** are considered likely on these Local level receptors.

6.7.2 Operational Effects

During operation it is anticipated that impacts may arise from:

- Death, injury to bats from collision with wind turbines and displacement of bats from commuting routes by presence of infrastructure;
- Minor pollution events connected to machinery used for maintenance; and
- Inadvertent killing, injuring or disturbance of fauna during from the movement of operational plant.

Potential Nature Conservation Sites

No significant effects are considered likely on all identified pLNCS as a result of operation. Given that activity on the Proposed Development Site will be limited to occasional maintenance the likelihood of a pollution/siltation event is low and considered of negligible significance (should it occur).

Habitats

Habitats are grouped given the lower potential magnitude of effects applicable at the operational stage. Whilst effects from construction on hydrologically sensitive habitats, may persist into operation, there are no new effects generated by the operational phase. Overall, **no significant effects** are considered likely.

Fauna

Given the low quality of foraging and roosting habitats for bats on the Proposed Development Site it is considered unlikely that collision risk will be a substantial issue in relation to these species.

The risk of turbine mortality for common and soprano pipistrelle species is considered medium, but when considered at the population level the risk of significant mortality is low. As such, **no significant effects** are considered likely on these Local level receptors.

Given the potential for roosting bats around the farm in the east of the Proposed Development Site (outside the ZoI of infrastructure) a range of bat boxes are proposed as an enhancement measure to be located on the farm buildings. Further measures are described in the HMP (TA 6-5).

6.7.3 Decommissioning Effects

It is difficult to predict impacts which could arise from decommissioning and the confidence in all predictions is therefore considered to be less certain due to the length of the operational period (40 years) and changes in habitat and species assemblage therein.

It is assumed, however, that impacts are likely to be similar in nature to the construction phase but of lower magnitude, because the infrastructure will be in place to enable access to the Proposed Development.

IEFs are grouped as the lower magnitude of possible effects does not require splitting habitats, and fauna, into separate types or species as set out in the construction phase.

Once the Proposed Development Site ceases operation after the period of generation, all major equipment and structures will be removed or may be replaced with a new set of turbines subject to planning permission being obtained.

Upon decommissioning of the Proposed Development, the wind turbines would be disassembled in reverse order to how they were erected. All above ground turbine components would be separated and removed off-site for recycling.

Tracks and crane hardstands will remain and be grassed over or reseeded. Underground cables will be de-energised and left in place. Turbine foundations will be buried, and the area will be reseeded.

It is estimated that this process will take up to 12 months.

A Decommissioning Plan will be prepared prior to any decommissioning, which will be agreed with SC. The plan will provide details of the methodologies that will be adopted, the environmental controls that will be implemented, the Emergency Response Procedure, methods for reviewing compliance and an indicative programme of decommissioning works.

Potential Nature Conservation Sites

No significant effects are considered likely on pLNCS as a result of decommissioning**.** This is based on the minor nature of the works and the agreed mitigation measures described in section 6.6 (Mitigation) where appropriate. Measures will be adapted through the lifetime of the project by which time well-established systems will be in place.

Habitats

As removal of infrastructure may occur where habitat restoration has occurred, for example cable ducting and turbine removal, should this be the case the work will be overseen by an EnvCoW.

As the principle of restoration assumes higher value habitats over time, and on a precautionary basis, it is assumed they will be Local-County IEFs given the 40-year interval between restoration and decommissioning. As a result of EnvCoW guidance, as detailed in the HMP (Technical Appendix 6-5), a **minor adverse effect, which is not significant in EIA terms, is possible.**

Fauna

No significant effects are considered likely on common or soprano pipistrelle populations, Works will be a significantly scaled down version of those associated with construction occurring at discrete locations and at specific times.

6.7.4 Cumulative Effects

Cumulative effects can occur where impacts from one development, which may not be significant at the population level itself, when combined across many developments could result in a detrimental effect on a wider scale.

This could mean habitat loss, disturbance to species (for example of several wind farms adjacent to each other were to be in construction either simultaneously or consecutively) or impacts across connected receptors, such as watercourses which form part of one river system. Developments described below are shown on Figure 1-4.

Wind Farm Developments

Several wind farm developments occur within 10km, and these are listed in sequential order of proximity to the Proposed Development in Table 6-11 Distances under-estimate proximity as they relate to distance between the centre of the Proposed Development and the centre point of the listed site but not necessarily to infrastructure locations within either development.

Table 6-11: Cumulative Wind Farm Developments within 10km

Site Name	Status	No of Turbines	Tip Height	Approximate Distance from Centre of Proposed Development (km)
Craigengelt	Operational	8	125	1
Craignannet	Operational	1	99	3
Earlsburn	Operational	15	110	5
Earlsburn Extension	In planning	11	180	5
Kingsburn (Earlsburn North)	Operational	9	115	7
Shelloch	Consented	5	180	7
Tod Hill	Operational	4	125	10

Non wind farm Developments

St Ninians Overhead Line (OHL) refurb (Consented) Upon adoption of mitigation, that included micro-siting infrastructure, no significant effect was considered likely for the St Ninians OHL refurbishment works. As a result, no significant cumulative effect is considered likely.

Glenside Farm Battery Energy Storage System (BESS) (In planning) Given the agricultural use of the site, the location of the development, and the opportunity to create landscape features, and provide landscape buffers and habitat improvements, it is not considered that any cumulative effects would be significant in the context of the EIA regulations.

Interactions with the Proposed Development

Based on the IEFs found in relation to the Proposed Development Site and based upon review of ecological reporting in respect of the above developments, where this information is available, the following broad IEF groups are considered.

Bats

As the impact from the Proposed Development Site impact is so low, it will be unlikely to materially change the cumulative effect.

For there to be a cumulative effect over the area, the other sites would have to have much larger impact than they do which is unlikely given the habitats present. Therefore, the absence of the Proposed Development Site will have only a limited effect on the cumulative effect, for any effect would still be driven by the other sites.

Habitats

Craigengelt, Earlsburn, Earlsburn Extension and Kingsburn wind farms all contain provisions for habitat restoration and enhancement via Habitat Management Plans, or, in the case of Earlsburn, a Habitat Action Plan - in order to create moorland habitats to improve the conditions for sensitive avian species.

As encountered at the Proposed Development Site, much of the blanket bog encountered at these projects is in a degraded state following historic grazing and burning. For Kingsburn the aim is to develop the M20 (degraded blanket bog) to a gradient to M19.

The common theme across these projects (with the predicted gains encompassed in these plans), is expected to improve the blanket bog resource overall within the 5-10km radius of the Proposed Development Site as shown on Figure 1-4. In the context of the marginal quality peatland on upland fringe **there is not therefore considered to be a cumulative effect on priority peatlands from the Proposed Development**.

6.8 Residual Effects and Conclusions

Table 6-12: Summary of residual effects of the Proposed Development

Receptor	Evaluation	Assessment carried out	Construction	Operational	Decommissioning
Carron Glen SSSI	National	No	N/A	N/A	N/A
Denny Muir SSSI	National	No	N/A	N/A	N/A
Balquhidderock Wood SSSI	National	No	N/A	N/A	N/A
Endrick Water SSSI	National	No	N/A	N/A	N/A
Endrick Water SAC	International	No	N/A	N/A	N/A
Double Craigs SSSI	National	No	N/A	N/A	N/A
River Teith SAC	International	No	N/A	N/A	N/A

Receptor	Evaluation	Assessment carried out	Construction	Operational	Decommissioning
Wester Moss SSSI	National	No	N/A	N/A	N/A
Abbey Craig SSSI	National	No	N/A	N/A	N/A
Dullatur Marsh SSSI	National	No	N/A	N/A	N/A
Ochtertyre Moss SSSI	National	No	N/A	N/A	N/A
Firth of Forth SSSI (ecological receptors are listed only)	National	No	N/A	N/A	N/A
Bannock Burn pLNCS	Local	Yes	Negligible - No Significant Effect	Negligible – No Significant Effect	Negligible – No Significant Effect
North Cliffs pLNCS	Local	No	N/A	N/A	N/A
North Third Reservoir pLNCS	Local	No	N/A	N/A	N/A
Loch Coulter Burn pLNCS	Local	Yes	Negligible - No Significant Effect	Negligible – No Significant Effect	Negligible – No Significant Effect
Loch Coulter pLNCS	Local	Yes	Negligible - No Significant Effect	Negligible – No Significant Effect	Negligible – No Significant Effect
Sauchieburn Woods pLNCS	Local	No	N/A	N/A	N/A
Old Sauchiemill pLNCS	Local	No	N/A	N/A	N/A
North Third woods pLNCS	Local	No	N/A	N/A	N/A
Touch Moor pLNCS	Local	No	N/A	N/A	N/A
Touch Hills pLNCS	Local	No	N/A	N/A	N/A
Bard wood pLNCS	Local	No	N/A	N/A	N/A
Carron Valley pLNCS	Local	No	N/A	N/A	N/A
M2 Sphagnum cuspidatum/fallax bog pool community	Local	No	N/A	N/A	N/A
M4 Carex rostrata – Sphagnum fallax mire	Less than Local	No	N/A	N/A	N/A

Receptor	Evaluation	Assessment carried out	Construction	Operational	Decommissioning
M6 Carex echinata – Sphagnum fallax/denticulatum mire	Local	Yes	Minor Adverse Effect	Negligible – No Significant Effect	Negligible – No Significant Effect
M9 Carex rostrata – Calliergonella cuspidata/giganteum mire	Local	No	N/A	N/A	N/A
M19 Calluna vulgaris – Eriophorum vaginatum blanket mire	Local	Yes	Moderate Adverse Effect	Negligible – No Significant Effect	Negligible – No Significant Effect
M20 Eriophorum vaginatum Blanket and raised mire	Local	Yes	Minor Adverse Effect	Negligible – No Significant Effect	Negligible – No Significant Effect
M23 Juncus effusus/acutiflorus-Galium palustre rush-pasture	Local	Yes	Negligible - No Significant Effect	Negligible – No Significant Effect	Negligible – No Significant Effect
M25 Molinia caerulea – Potentilla erecta mire	Local	Yes	Negligible - No Significant Effect	Negligible – No Significant Effect	Negligible – No Significant Effect
M35 Ranunculus omiophyllus – Montia fontana rill	County	Yes	Negligible - No Significant Effect	Negligible – No Significant Effect	Negligible – No Significant Effect
H9 Calluna vulgaris – Deschampsia flexuosa heath	Less than Local	No	N/A	N/A	N/A
H21 Calluna vulgaris - Vaccinium myrtillus - Sphagnum capillifolium heath	Local	Yes	Minor Adverse Effect	Negligible – No Significant Effect	Negligible – No Significant Effect
MG10 Juncus effusus – Holcus lanatus rush pasture	Less than Local	No	N/A	N/A	N/A
U2 Deschampsia flexuosa grassland	Less than Local	No	N/A	N/A	N/A
U4 Festuca ovina - Agrostris	Less than Local	No	N/A	N/A	N/A

Receptor	Evaluation	Assessment carried out	Construction	Operational	Decommissioning
capillaris - Galium saxatile grassland					
U6 Juncus squarrosus – Festuca ovina grassland	Less than Local	No	N/A	N/A	N/A
Amphibians	N/A	No	N/A	N/A	N/A
Common reptiles	Less than Local	No	N/A	N/A	N/A
Bats	Local	Yes	Negligible - No Significant Effect	Negligible – No Significant Effect	Negligible – No Significant Effect
Water vole	N/A	No	N/A	N/A	N/A
Otter	N/A	No	N/A	N/A	N/A
Red Squirrel	N/A	No	N/A	N/A	N/A
Badger	N/A	No	N/A	N/A	N/A
Fish	N/A	No	N/A	N/A	N/A

Under the EIA Regulations it is very unlikely that significant effects will occur on Local or lower IEFs, and therefore there are no significant effects in terms of the EIA Regulations from the Proposed Development Site.

6.9 Summary and Statement of Significance

Because of the design mitigation and further mitigation/monitoring in relation to bats and habitats **no residual effects are considered likely to remain.** The Ecological Impact Assessment is therefore concluded with a finding of no significant adverse impacts in terms of the EIA Regulations should the Proposed Development go ahead.

6.10 References

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Chapter 7: Ornithology

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Collision Risk Modelling	The approach developed to estimate the number of bird collisions over a period of time
Collision Risk Zone	The three dimensional area around the wind turbines within which birds are at risk of colliding with the blades
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
Habitat Management Plan	Document which includes the habitat enhancement measures
Potential Collision Height	This encompasses the rotor swept height (i.e., the lowest height above ground up to tip height)
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1
The Planning Act	The Town and Country Planning (Scotland) Act 1997 (as amended)
Study Area	The Study Area used for the surveys undertaken to inform the Ornithological Impact Assessment differs according to receptors as recommended by relevant good practice survey guidance, as defined by NatureScot (NS) (formerly SNH) guidelines (SNH, 2017). These are summarised in the Field Survey Methodology Section and are described in more detail within Technical Appendix 7-1: Ornithology Baseline Surveys For the assessment of impacts on bird species a variety of buffer distances have been applied to each turbine location and around all other infrastructure where appropriate. These buffers are in accordance with current guidance and evidence-based research. Further details are provided in the Assessment of Potential Effects Section.
Wind Farm Polygon	The area encompassing the outer turbine blades buffered by 500m. This is created in GIS, as a convex hull of the turbine locations buffered by the blade length + 500m.

List of Abbreviations

Abbreviation	Description
BoCC	Bird of Conservation Concern
BPP	Bird Protection Plan
BTO	British Trust for Ornithology
CEMP	Construction Environmental Management Plan
CIEEM	Chartered Institute of Ecology and Environmental Management

Abbreviation	Description
CRM	Collision Risk Modelling
CRZ	Collision Risk Zone
CSRSG	Central Scotland Raptor Study Group
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EnvCoW	Environmental Clerk of Works
EU	European Union
HMP	Habitat Management Plan
IOF	Important Ornithological Feature
JNCC	Joint Nature Conservation Committee
LBAP	Local Biodiversity Action Plan
MAGIC	Multi-Agency Geographic Information for the Countryside
NBN	National Biodiversity Network
NHZ	Natural Heritage Zone
NNR	National Nature Reserve
NTS	Non-Technical Summary
PCH	Potential Collision Height
RSPB	Royal Society for the Protection of Birds
SAC	Special Areas of Conservation
SBL	Scottish Biodiversity List
SC	Stirling Council
SNH	Scottish Natural Heritage (now NatureScot)
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TWIC	The Wildlife Information Centre
VP	Vantage Point
WP	Windfarm Polygon
WTG	Wind Turbine Generator

7 Ornithology

7.1 Introduction

This Chapter provides the Ornithological Impact Assessment for the Proposed Development. The specific objectives of the chapter are to:

- Describe the current baseline;
- Describe the assessment methodology and significance criteria used in completing the impact assessment;
- Describe the potential effects, including direct, indirect and cumulative effects;
- Describe the mitigation measures proposed to address the likely significant effects; and
- Assess the residual effects remaining following the implementation of mitigation measures.

This Chapter is supported by the following Technical Appendices:

- Technical Appendix 7-1: Ornithology Baseline Surveys; and
- Technical Appendix 7-2: Collision Risk Modelling.

7.2 Methodology and Approach

7.2.1 Legislation, Planning Policy and Guidance

The ornithological assessment has been undertaken with reference to the following legislation (see also Chapter 4: Planning and Energy Policy):

- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds ('The Birds Directive');
- Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland)(the Habitats Regulations);
- Wildlife and Countryside Act 1981 (as amended in Scotland);
- Nature Conservation (Scotland) Act 2004;
- Wildlife and Natural Environment (Scotland) Act 2011; and
- Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017.

Planning policies relevant to ornithology are listed below. Further information regarding planning policy is provided in Chapter 4: Planning and Energy Policy.

- National Planning Framework 4 (2023) (e.g., biodiversity); and
- Stirling Council: Supplementary Guidance, Wind Energy Developments (2019).

Other documents and guidance reviewed and applied in the ornithological assessment are outlined below (see also References Section at the end of this Chapter):

- Band, Madders and Whitfield (2007). Developing Field and analytical Methods to Assess Avian Collision Risk at Wind Farms;
- Chartered Institute of Ecology and Environmental Management (CIEEM) (2022). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine;

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7.2.2 Consultation

Table 7-1 includes a summary of ornithology-specific points raised by consultees during pre-application, scoping and subsequent consultation process, and where these are addressed in this Chapter and/or elsewhere in the EIA Report.

Table 7-1: Consultation Responses

Consultee	Summary of Consultee Response	Where addressed within this Report
Pre-Application		
Stirling Council Planning Services, Pre Application Enquiry (PREAPP-2020-0093) 12 May 2020	Biodiversity – The ecological information that will need to accompany the application will include Ornithological Surveys.	Ornithology surveys were undertaken in 2020 and 2021 (see section 7.3 of this chapter and Technical Appendix 7-1: Ornithology Baseline Surveys).
Scoping		
NatureScot (17 September 2020)	There are two Special Protection Areas (SPAs) within potential foraging distance for their qualifying species - pink footed geese (Firth of Forth SPA) and Taiga bean geese (Slamannan Plateau SPA). Ornithological information has been reviewed along with NatureScot knowledge of species distribution. Based on this information, in our view there is unlikely to be a significant effect on any qualifying species for these designated sites and agree is appropriate to scope out a second year of non-breeding season VP surveys. Agree that no Sites of Special Scientific Interest (SSSIs) or Special Areas of Conservation (SACs) are likely to	Noted. Effects on Designated Sites have been scoped out. A second season of non-breeding season VP surveys was not undertaken.

Consultee	Summary of Consultee Response	Where addressed within this Report
	be impacted by this Proposed Development due to the distance from the site and the nature of the protected features. We agree it is therefore appropriate to scope these out of further assessment.	
Stirling Council - Sustainable Development Team (02 September 2020))	The ecology and ornithology sections of the report have utilised data obtained from the NBN and MAGIC website. It is requested consultants contact The Wildlife Information Centre (TWIC), the local records centre for our area, to ensure that they have access to the most up to date biological information. This should then be reflected in their report. TWIC will also be able to provide information on the locally designated sites that sit within the vicinity of the Proposed Development.	For ornithology, data consultations were undertaken with RSPB and the Central Scotland Raptor Study Group.
Post-Scoping		
NatureScot – in response to Ornithology Data Review, to establish the requirement for a second year of breeding bird surveys (05 November 2020, by email)	We are happy for you to scope out a second year of surveys. Although this is not in line with the guidance as the data from the previous applications is over 5 years old, we agree that the fact that the new data matches numbers / use expected, based on habitat and trends, provides a sufficiently accurate understanding of the site and a second year is unlikely to add value at this time. The reasoning for deviating from the guidance, as set out in the data report, should be included in the application documents.	After consideration of the NatureScot advice, it was decided to undertake a reduced scope of surveys in Year 2, in order to target short-eared owls and other primary target raptor species (to establish whether the activity recorded in 2020 was typical for the Proposed Development Site). These surveys were undertaken during April 2021 to August 2021.

7.2.3 Assessment Methodology

This Chapter takes an appropriate and topic-specific approach to assessment of the Proposed Development within the parameters identified in Table 3-2 of Chapter 3: Description of the Development.

This Chapter provides a worst-case assessment for ornithology and aims to describe the likely significant effects of the Proposed Development and present enough information for consultees and the decision makers to comment on and determine the application within the parameters of the Proposed Development.

Chapter 2: EIA Approach and Methodology provides further detail on the general approach to assessment. The specific methodology used for this assessment is set out below.

The CIEEM Guidelines for Ecological Impact Assessment in the UK (CIEEM 2022) form the basis of the impact assessment with other relevant guidance, as listed in Section 7.2.1 referred to as appropriate. In accordance with the CIEEM guidelines, only ornithological receptors which are considered to be important, (including those required to be considered by the EIA Regulations and other relevant policies) and potentially affected by the project (i.e., the Important Ornithological Features or IOFs) should be subject to detailed assessment.

It is not necessary to carry out detailed assessment of receptors that are not subject to legal or policy protection and are sufficiently widespread, unthreatened and resilient to project impacts and would remain viable and sustainable.

Information and Data Sources

A desk study was undertaken to collate existing information on bird populations in and around the Proposed Development, and to identify target species for baseline surveys.

This information, combined with baseline survey results, was utilised to put each target bird species recorded within the study area into context in terms of its national, regional and local importance.

Designated Sites

A desk search was carried out via the NatureScot SiteLink website (NatureScot, 2023) to identify statutorily designated sites within 20km of the Proposed Development which are designated for their avian interest (including Special Protection Areas (SPAs) and SSSIs).

Beyond 20km connectivity between SPAs and development proposals is unlikely and given the nature of the Proposed Development significant effects on terrestrial SACs are also unlikely beyond this distance.

The distance of 20km is, however, pertinent to grey geese species only such as greylag goose and pink-footed goose. Further information on the interest features of sites was obtained through the JNCC and NatureScot websites.

Desk Study

Primary sources of contextual data from the desk study were as follows:

- Drummarnock Wind Farm, Review of Ornithology Data (SLR 2020);
- The Birds of Scotland (Forrester *et al*., 2007);
- Scottish Raptor Monitoring Scheme Reports (e.g. Challis *et al*., 2022);
- Review of published estimates of bird populations in Scotland (Wilson *et al.* 2015) and the UK (e.g., from the Avian Population Estimates Panel (APEP, Woodward et al. 2020));
- Data received from RSPB Data Unit and the Central Scotland Raptor Study Group (CSRSG);
- A search for and review of any EIA Report or Environmental Statement chapters, survey reports and post consent monitoring reports from other developments within the relevant Natural Heritage Zone (NHZ 17 – West Central Belt); and
- Review of relevant online resources (e.g., BTO website).

Field Survey

Baseline ornithology surveys were conducted during the periods September 2019 to September 2020 and April to August 2021. Full details are presented in Technical Appendix 7-1: Ornithology Baseline Surveys with a summary provided below.

The scoping response from NatureScot in September 2020 agreed that it was appropriate to scope out a second year of non-breeding season VP surveys (Table 7-1), therefore surveys were not continued.

Following this, a review of the available ornithology data for the site and surrounding area was undertaken to inform a further consultation with NatureScot on the requirement for a second year of breeding season surveys (SLR 2020). This review focussed on contextual data from:

- The previous Muirpark application for an 11-turbine wind farm development (Planning Ref. 09/00170/FUL); and
- The application for the adjacent Craigengelt 8-turbine wind farm development (06/01052/DET), which was consented and is now operational.

SLR (2020) concluded that;

> *"the current non-breeding, breeding and transitory ornithology at Drummarnock is, based on the data considered, both representative and stable given recent trends in population change. Wader densities are within the expected ranges as are the current numbers of black grouse and the presence of the short-eared owl is possibly influenced by the exceptional vole year in 2020 providing good foraging opportunities*."

On the basis of this data review, NatureScot agreed that a second breeding season was not required, However, it was decided that a second season of surveys with reduced scope should be undertaken, primarily to focus on short-eared owl activity.

Target Species

Target species for the ornithology surveys were chosen considering the location of the site and were defined by legal and/ or conservation status and vulnerability to impacts potentially caused by wind turbines, as defined in SNH (2017).

The following species were considered as primary target species:

- All raptors and owls listed on Annex I of the Birds Directive or Schedule 1 of the Wildlife and Countryside Act 1981 (with kestrel included in 2019/2020 but not 2021);
- All wader species;
- All wild goose, swan and duck species, with the exception of Canada goose and mallard; and
- Black grouse.

The following species were considered as secondary target species:

- All other waterfowl (e.g. mallard and grey heron);
- All other raptor and owl species (kestrel in 2021);
- Gull species;

- Raven; and
- Any large aggregations of passerines that are red-listed or appear in the SBL.

Baseline Survey Methodologies

The surveys undertaken in 2019/ 2020 (non-breeding season and breeding season) and 2021 (breeding season) were carried out in accordance with current NatureScot guidance on bird survey methods for onshore wind farms (SNH 2017).

Figures showing vantage point locations and viewsheds, plus the species-specific survey buffers, are provided in Technical Appendix 7-1: Ornithology Baseline Surveys.

Flight Activity Surveys

Standard flight activity surveys were conducted from one vantage point (VP) location during September 2019 to March 2020 (42 hours), April to August 2020 (48 hours), September 2020 (6 hours), and May to August 2021 (25 hours).

Breeding Wader Surveys

Surveys for breeding waders were carried out within the Proposed Site boundary and 500m buffer (where accessible) following the standard adapted Brown & Shepherd (1993) method, with four survey visits at least seven days apart between mid-April and mid-July 2020.

Records from each survey visit were collated and then combined into a final visit map, enabling territory analysis to be carried out following the methods in Brown and Shepherd (1993).

Breeding Raptor Surveys

Species-specific surveys were undertaken for all raptors likely to occur, following methods outlined within Hardey *et al*. (2013), within 2km of the site (where accessible), between mid-April and late July 2021.

Black Grouse Lek Surveys

Black grouse *Lyrurus tetrix* surveys were undertaken based on the standard methodology (Etheridge and Baines (1995), Gilbert *et al*. (1998)). Two visits were undertaken, in mid-April and mid-May 2021.

Collision Risk Modelling

The standard Band Collision Risk Modelling (CRM, Band *et. al.* 2007) was used to estimate collision risk based on recorded 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 is a two-stage process. Stage 1 estimates the number of birds that fly through the rotor swept disc. Stage 2 predicts the proportion of these birds that have the potential to be hit by a rotor blade.

Combining both stages produces an estimate of collision mortality in the absence of any avoidance action/behaviour by birds. Avoidance rates are then applied to generate predicted rates of collision mortality. Full details are provided in Technical Appendix 7.2: Collision Risk Modelling.

Assessment Methods

The specific methodology used for this assessment is set out below.

Assumptions, Limitations and Confidence

The validity of ornithological survey data requires that they were obtained using accepted methodologies and that surveys were carried out in suitable conditions.

The field survey methodologies outlined above and described in greater detail in Technical Appendix 7-1: Ornithology Baseline Surveys were all carried out using survey standards recommended by NatureScot and were carried out during suitable times of the year. As noted in Table 7-1, NatureScot agreed that a second year of surveys was not required.

Not all areas within the extensive survey buffers were accessible, or viewable from publicly accessible areas. However, the entire area within the red line boundary, which is much larger than the Proposed Development Site, were accessed for surveys. Therefore, the spatial extent of the surveys is considered sufficient to inform a robust assessment.

The majority of VP surveys for the Proposed Development were undertaken in optimal weather conditions during the breeding and non-breeding seasons, with a number of surveys being re-scheduled due to low cloud where necessary.

Due to the topography within the Proposed Development Site and changes in proposed turbine locations from the original indicative locations used in the survey design, there is a gap in viewshed coverage in the north-east part of the turbine layout, around WTG 4. However, the overall viewshed coverage of the 500m buffer of the turbine layout is calculated at 71.7%. Movements of turbine positions were as a result of embedded mitigation related to landscape and visual, peat and hydrology.

In addition, flights were recorded in this area, which were allocated to the lowest height band (<30m) and these were all used for CRM. Therefore, overall, the data collected are considered to be representative of the Proposed Development as a whole and sufficient to inform a robust assessment.

On the basis of the above, there are considered to be no significant limitations in the data on which the assessment is based.

7.2.4 Significance Criteria

Sensitivity Criteria

Ornithological receptors should be considered within a defined geographical context so for this project the following geographic frame of reference is used:

- International:
  - Species that form part of the cited interest within an internationally protected site or candidate site (for example SPA, or Ramsar site);
  - A species which is either unique or sufficiently unusual (in terms of distribution and/or abundance) to be considered as being a population of the highest

quality example in an international/national context that the site is likely to be designated as an SPA;

- National (i.e., Scotland):
  - Species that form part of the cited interest within a nationally designated site (for example, a SSSI or a National Nature Reserve (NNR);
  - A population of a species which is either unique or sufficiently unusual (in terms of distribution and/or abundance) to be considered as being of nature conservation value at up to a country context. This includes Wildlife and Countryside Act Schedule 1 (as amended in Scotland) species, a red- or amber-listed species (as in Birds of Conservation Concern) and a priority Scottish species;
- Regional (i.e., West Central Belt, Natural Heritage Zone (NHZ 17)):
  - Sites supporting a regularly occurring, regionally significant number of internationally or nationally important species in the context of NHZ 17 West Central Belt;
- Local (i.e., the Site plus circa 10km):
  - Populations of any species of conservation importance in the context of the local area within an approximate radius of 10km from the Site;
- Negligible:
  - Commonplace species with little or no significance, the loss of which would not be seen as detrimental to the ecology of the area.

In assigning a level of value to the population of a species, it is necessary to consider its distribution and status, including a consideration of trends based on available historical records. Reference has therefore been made to published lists and criteria where available.

Examples of relevant lists include:

- Species of European conservation importance (as listed on Annex I of the Birds Directive);
- Species with enhanced legal protection (as listed on Schedule 1 of the Wildlife and Countryside Act (as amended in Scotland); and
- Species considered to be of principal importance for biodiversity in Scotland, as listed on the SBL.

Criteria for evaluation include the SPA and SSSI selection guidelines published by JNCC.

Reference has also been made in particular to published bird population estimates such as Wilson *et al.* (2015) for NHZs within Scotland and Woodward *et al.* (2020) for Great Britain.

Where appropriate, the value of species populations has been determined using the standard '1% criterion' method (e.g. Holt *et al.*, 2012). Using this, the presence of >1% of the international population of a species is considered internationally important; >1% of the national population is considered nationally important; etc.

Assessing Impacts and the Significance of an Effect

Both direct and indirect impacts are considered. Direct impacts are changes that are directly attributable to a defined action, e.g., the physical loss of habitat occupied by a bird species during the construction process.

Indirect ecological impacts are attributable to an action, but which affect ecological resources through effects on an intermediary ecosystem, process or feature, e.g., the creation of roads which cause hydrological changes, which, in the absence of mitigation, could lead to the drying out of wetland habitats used by important bird species.

For the purposes of this ornithology assessment, in accordance with CIEEM guidelines, under the EIA Regulations, a 'significant effect' is 'one that is sufficiently important to require assessment and reporting so that the decision-maker is adequately informed as to the environmental consequences of permitting the project'.

Effects can be considered significant at a wide range of scales from international to local. For example, a significant effect on a regionally important population of a species is likely to be of regional significance. They are also significant if they do not comply with legal and policy protection.

Consideration of conservation status is important for evaluating the effects of impacts on bird species and assessing their significance. Conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area (which for the purposes of the Birds Directive is the EU).

Avoidance, Mitigation, Compensation and Enhancement

A sequential process has been adopted to avoid, mitigate and compensate for ornithological impacts. This is referred to as the 'mitigation hierarchy'.

The differences between avoidance, mitigation, compensation and enhancement are defined here as follows:

- Avoidance is used where an impact such as disturbance or displacement of breeding IOFs e.g., through changes in scheme design;
- Mitigation is used to refer to measures to reduce or remedy a specific negative impact in situ i.e., direct habitat loss which may reduce a breeding or foraging range;
- Compensation describes measures taken to offset residual effects, i.e., where mitigation in situ is not possible; and
- Enhancement is the provision of new benefits for biodiversity that are additional to those provided as part of mitigation or compensation measures, although they can be complementary. Such measures can be set out in species specific biodiversity action plans.

7.3 Baseline Conditions

7.3.1 Designated Sites

Statutory designated sites for ornithology are shown in Figure 7-1-1: Appendix 7-1: Ornithology Baseline Surveys.

A brief description of each site designated in full or in part for its ornithological interest is provided in Table 7-2 Other non-avian sites are covered in Chapter 6: Ecology of this EIA Report.

Designated sites are scoped out of further assessment for the reasons specified in Table 7-1.

Table 7-2: Statutory Sites Designated for Ornithological Features within 20km

Site Name	Designation	Distance and Direction from Proposed Development Site	Qualifying Features/ Reasons for Designation (Ornithological)	Evaluation
Firth of Forth	SPA/ Ramsar	12.8km/ NE	Supports internationally important migratory species including populations of: • Red-throated diver *Gavia stellata* • Slavonian grebe *Podiceps auritus* • Golden plover *Pluvialis apricaria* • Bar-tailed godwit *Limosa lapponica* • Pink-footed goose *Anser brachyrhynchus* • Shelduck *Tadorna tadorna* • Knot *Calidris canutus* • Redshank *Tringa totanus* • Turnstone *Arenaria interpres* • Sandwich tern *Thalasseus sandvicensis* Waterfowl assemblage (in excess of 20,000)	International
Slamannan Plateau	SPA	13.4km/ SE	Supports international important migratory species population of: Taiga bean goose *Anser fabalis fabalis*	International

Flight Activity Surveys

Full details of the flight activity (VP) surveys in 2021/2022 (including Figures showing flight lines) are provided in Technical Appendix 7-1: Ornithology Baseline Surveys.

A seasonal summary of 'at risk' flight activity within the Collision Risk Zone (CRZ) surrounding the Proposed Development is provided in Table 7-3.

Table 7-3: Number of target species flights and individuals observed passing through the Drummarnock Windfarm Polygon (WP) during VP surveys (2019/ 2020 & 2021)

Species name	Period of analysis	Total number of birds recorded in flight	Flights through WP		Flights through WP at Potential Collision Height (PCH)	
			Flights	Individuals	Flights	Individuals
Greylag goose	Sep 2019 – Mar 2020	2	0	0	0	0
	Apr 2020 – Aug 2020	10	5	10	5	10
	May 2021 – Aug 2021	16	8	16	8	16
Hen harrier	Apr 2020 – Aug 2020	1	1	1	1	1
	Sep 2020	1	0	0	0	0
	May 2021 – Aug 2021	1	0	0	0	0
Red kite	Sep 2019 – Mar 2020	4	3	3	3	3
	May 2021 – Aug 2021	6	5	5	5	5
Osprey	Apr 2020 – Aug 2020	1	1	1	1	1
Kestrel	Sep 2019 – Mar 2020	4	4	4	4	4
	Apr 2020 – Aug 2020	20	11	12	11	12
	Sep 2020	10	4	6	4	6
Curlew	Apr 2020 – Aug 2020	14	13	14	13	14
	May 2021 – Aug 2021	2	2	2	2	2
Golden plover	Sep 2020	26	1	23	1	23
Short-eared owl	Apr 2020 – Aug 2020	26	25	26	25	26

Breeding Wader Surveys

Three species of wader: lapwing, snipe and curlew, were observed apparently holding territories within the Study Area (i.e., the 500m buffer of the Proposed Development Site boundary).

These were located within the various buffers of Proposed Development Site boundary, turbine layout and access track as specified in Table 7-4.

Figures showing territory locations are provided in Technical Appendix 7-1: Ornithology Baseline Surveys.

Table 7-4: Summary of Wader Territory Locations, Drummarnock

Species	Total no. of territories within 500m buffer of Proposed Development Site boundary	No. of territories within Proposed Development Site boundary	No. of territories within 500m buffer of Turbine Layout	No. of territories within 500m buffer of Access Track
Lapwing	3	1	1	2
Curlew	3	1	2	0
Snipe	3	1	1	2

Breeding Raptor Surveys

No raptors were confirmed breeding within a 2km buffer of the Proposed Development Site. Territorial behaviour was recorded by short-eared owl, but there was no evidence of successful breeding.

Regular buzzard and kestrel foraging activity occurred over the site and the presence of these species on all the raptor surveys in the 2km buffer indicated territories off site in suitable habitats.

Black Grouse Lek Surveys

A maximum of two male black grouse were observed north of Craigengelt Farm, c.1km from the Proposed Development Site. These birds were in flight and no leks were recorded.

Data Consultations

- Black Grouse: RSPB provided details of black grouse records within 2km of the Proposed Development Site boundary, from the period 2012 to 2017. As these data contained no records within the last five years and no records within 1km of the Proposed Development, they have not been considered further in the assessment. In addition, these data are deemed sensitive environmental information under the terms of the RSPB data supply contract and are not to be released into the public domain.
- Schedule 1 and Annex I Raptors: Central Scotland Raptor Study Group (CSRSG) provided records within a search area around the Proposed Development Site boundary, from the period 2013 to 2023. There were no useful records of breeding raptors within 2km, therefore these have not been considered further in the assessment.

Collision Risk Modelling

Sufficient data for CRM from the Drummarnock dataset 2019-2021 was available for six target species: greylag goose, red kite, kestrel, curlew, golden plover and short-eared owl.

Table 7-5 shows the predicted collisions risk used for the assessment.

Table 7-5: Summary of CRM Output for Drummarnock

Species name	Period of analysis	Modelled collisions per Season	Years per collision
Greylag goose	Breeding season (Apr 2020 – Aug 2020 + May 2021 – Aug 2021)	0.0222	45.01
Red kite	Annual	0.0353	28.29
Kestrel	Annual	0.3317	3.01
Curlew	Breeding season (Apr 2020 – Aug 2020 + May 2021 – Aug 2021)	0.0790	12.66
Golden plover	Non-breeding season (Sep 2019 – Mar 2020; Sep 2020)	0.1125	8.89
Short-eared owl	Breeding season (Apr 2020 – Aug 2020 + May 2021 – Aug 2021)	0.2102	4.76

7.3.2 Evaluation of Ornithological Features

Applying the criteria outlined in the 'Sensitivity of Features' section, Section 7.2.4), an evaluation of the importance of the relevant study areas for each primary target species recorded during the baseline surveys is provided in Table 7-6 (overleaf).

There are four target species with a value of 'local' or and one with a value of 'regional' which are the ones taken forward as IOFs for detailed assessment.

Details on the status of other primary and the secondary target species at the site are provided in Technical Appendix 7-1: Ornithology Baseline Surveys.

Table 7-6: Evaluation of Important Ornithological Feature Populations within the Study Area

Value	IOF	Species Information, Status & Baseline	Justification
Regional	Short-eared owl	• Listed on Annex I of the Birds Directive. • SBL species • UK BoCC Amber List; • The estimated population in the UK was 620 pairs in 2016 (Woodward et al., 2020) with an estimated population in Scotland of 125-1,250 pairs (Forrester et al. 2007), 1,088 pairs in 2013 (Wilson et al. 2015) and 620-2,200 pairs in 2020 (Challis et al. 2023). • The estimated population in NHZ 17, West Central Belt, was 3 pairs in 2013 (Wilson et al. 2015), with 58 pairs in 2013 in the adjacent NHZ 16, Eastern Lowlands (Wilson et al. 2015). • Baseline surveys – Up to three birds recorded during May to July 2020. No confirmed breeding within 2km. 25 flights were recorded within the Proposed Development Site. An annual collision rate of 0.2102 is predicted (one collision every 4-5 years).	The species is listed on Annex I and is of medium conservation concern due to fluctuations in the availability of suitable habitat caused by maturation of commercial conifer plantations. A maximum of one breeding pair represents a maximum of 0.8% of the Scottish Population. Evaluation of the short-eared owl population is dependent of fluctuations in the national and regional populations caused by the availability of prey (i.e., cyclical vole populations). It is considered that Proposed Development Site is most likely to be occupied in years of high vole numbers. However, the population of one pair is considered of regional value for short-eared owl.
Local	Kestrel	• SBL species • UK BoCC Amber List; • The estimated population in the UK was 31,000 pairs in 2016 (Woodward et al., 2020) with an estimated population in Scotland of 7,500-7,800 pairs (Forrester et al. 2007), 3,850 pairs in 2013 (Wilson et al. 2015) and 2,750-5,500 pairs in 2020 (Challis et al. 2023). • The estimated population in NHZ 17, West Central Belt, was 443 pairs in 2013 (Wilson et al. 2015). 33 pairs were recorded in Central Scotland in 2020 (Challis et al. 2023). • Baseline surveys – Frequently recorded during VP surveys, maximum of 3 birds recorded. An annual collision rate of 0.3317 is predicted (one collision every 3 years). No breeding within 2km.	The species is not listed on Annex I or Schedule 1 but is of conservation concern due to habitat changes possibly causing reductions in prey availability. The maximum of three birds represents 0.3% of the NHZ17 population (443 pairs) and up to 4.5% of the Central Scotland population (likely based on an underestimate of 33 pairs). As there are no breeding pairs within 2km, the population is considered of no more than local value for kestrel.

Value	IOF	Species Information, Status & Baseline	Justification
Local	Lapwing	• SBL species • UK BoCC Red List; • The estimated population in the UK was 98,000 pairs in 2016 (Woodward et al., 2020) with an estimated population in Scotland of 71,500 - 105,600 pairs (Forrester et al. 2007). • No estimates are available for the NHZ 17, West Central Belt (Wilson et al. 2015). • Baseline surveys – Three territories recorded, one of which was located within 500m of proposed turbine layout. None was observed within the Proposed Development Site; therefore collision risk is negligible or non-existent.	The species is not listed on Annex I or Schedule 1 but is of high conservation concern due to habitat loss and degradation. The maximum of three pairs represents a negligible proportion of the Scottish population. In the absence of regional population data, three pairs is considered of local value for lapwing.
Local	Common snipe	• UK BoCC Amber List; • The estimated population in the UK was 67,000 pairs in 2016 (Woodward et al., 2020) with an estimated population in Scotland of 30,000 - 40,000 pairs (Forrester et al. 2007) and 34,594 pairs in 1997-2000 (Wilson et al. 2015). • The estimated population in NHZ 17, West Central Belt, was 568 pairs in 1997-2000 (Wilson et al. 2015), with 582 pairs in 1997-2000 in the adjacent NHZ 16, Eastern Lowlands (Wilson et al. 2015). Baseline surveys – Three territories recorded, one of which was located within 500m of proposed turbine layout. None was observed within the Proposed Development Site; therefore, collision risk is negligible or non-existent.	The species is not listed on Annex I or Schedule 1 but is of medium conservation concern due to habitat loss caused by drainage of wet grasslands. The maximum of three pairs represents 0.5% of the NHZ17 population. Three pairs is considered of local value for snipe.
Local	Curlew	• SBL species • UK BoCC Red List; • The estimated population in the UK was 59,000 pairs in 2016 (Woodward et al., 2020) with an estimated population in Scotland of 58,800 pairs (Forrester et al. 2007) and 30,194 pairs in 2005 (Wilson et al. 2015) . • ·The estimated population in NHZ 17, West Central Belt, was 2.303 pairs in 2005 (Wilson et al. 2015), with 3,253 pairs in 2005 in the adjacent NHZ 16, Eastern Lowlands (Wilson et al. 2015). Baseline surveys – Three territories recorded, one of which was located	The species is not listed on Annex I or Schedule 1 but is of high conservation concern due to habitat loss and degradation. The maximum of three pairs represents 0.1% of the NHZ17 population. Three pairs is considered of local value for curlew.

Value	IOF	Species Information, Status & Baseline	Justification
		within 500m of proposed turbine layout. 15 flights were recorded within the Proposed Development Site. An annual collision rate of 0.0790 is predicted (one collision every 12-13 years).	
Negligible	Greylag goose	• Native breeding population restricted to Outer Hebrides, Caithness, Sutherland and Wester Ross. Naturalised breeding population widely distributed throughout rest of mainland Scotland. • Listed on Schedule 1.2 of the WCA (applies to native breeding population only). Allowed to be killed or taken outside of close season. • UK BoCC Amber List; • The estimated breeding population in Great Britain was 47,000 pairs in the period 2013 to 2017 (Woodward et al., 2020). The naturalised population in Scotland is at least 700 pairs (Forrester et al. 2007). • No estimates are available for the NHZ 17, West Central Belt (Wilson et al. 2015). • Baseline surveys – the cumulative total of greylag geese recorded during flight activity surveys was 26 (all of which were during spring (April/ May). All flights involved pairs of birds. • All activity involved birds in flight. Habitats on site are considered potentially suitable for breeding but generally not suitable for feeding or roosting greylag geese. There were no records of feeding or roosting greylag geese within 2km. 26 birds were recorded flying through the wind farm which produced an annual collision estimate of 0.0222 birds per year (one collision every 45 years).	This species is not listed on Annex I of the Birds Directive and is not a qualifying feature of any designated site within potential foraging range of the Proposed Development Site. The Proposed Development Site is outside of the native breeding range in Scotland where it is a Schedule 1 species. Given the pattern of site use (i.e., low numbers only commuting through the air space, with no breeding, feeding or roosting recorded within 2km), the population is assessed as of no more than negligible value for greylag goose.
Negligible	Black grouse	• SBL species • UK BoCC Red List; • The estimated population in the UK was 4850 males in 2016 (Woodward et al., 2020) with an estimated population in Scotland of 3550 - 5750 males (Forrester et al. 2007). • According to the last national census, the estimated population in NHZ 17, West Central Belt, was 78 males in 2005, with 844 males in the adjacent NHZ 15 (Loch Lomond, the Trossachs and Breadalbane) in 2005 (Wilson et al.	The species is not listed on Annex I or Schedule 1 but is of conservation concern due to habitat loss, overgrazing and forestry management practices. There is a historically large black grouse lek at Craigengelt (c. 1.4km to the south of the Proposed Development Site), e.g., 26 males in 2006. However, only 1-2 males were recorded during surveys north of

Value	IOF	Species Information, Status & Baseline	Justification
		2015). • Baseline surveys – up to two males were observed (in flight only) in area suitable for lekking, c. 1km from the nearest proposed turbine location. None was observed within the Proposed Development Site, therefore collision risk is negligible or non-existent. Desk study – data from the Craigengelt assessment dates back to 2006 (26 males). Confidential data from RSPB shows a decline in the numbers lekking in the area, with no records after 2017.	Craigengelt, in 2020, none of which were lekking. Data from RSPB indicate the numbers were in decline by 2017. No black grouse leks were recorded. The records of 1-2 males in flight equates to 1.3 - 2.6% of the regional population (78 males). However, due to the absence of any black grouse records within 750m of the Proposed Development Site infrastructure (i.e., the upper limit of the breeding season buffer zone for lekking males) the population is assessed of negligible value for black grouse.
Negligible	All other species	See Technical Appendix 7-1 for baseline survey results. The following species which are listed as Annex I, Schedule 1 or SBL were recorded so infrequently and in such small numbers that they were scoped out of further assessment: • Red kite o Ten records of single birds recorded in flight during VP surveys which produced an annual collision rate of 0.0353 (one collision every 28 years). No breeding within 2km. • Hen harrier o Single birds recorded in flight (n=3) during VP surveys, and a single bird recorded during breeding raptor survey. Collision risk is negligible due to the low level of flight activity. No breeding with 2km. • Osprey o Single flight of one bird during VP surveys. Collision risk is negligible due to the low level of flight activity. No breeding with 2km. • Golden plover o Recorded on a single date in September 2020, during VP surveys, involving a minimum of 23 birds. A collision rate of 0.1125 is predicted (one collision every 8-9 years). • Barn owl	All other species are either relatively common or widespread and/or were recorded only infrequently/in small numbers and are therefore not considered important.

Value	IOF	Species Information, Status & Baseline	Justification
		◦ Incidental record of one bird. No breeding recorded with 2km.	

Future Baseline

In the absence of the Proposed Development, and assuming the continuation of the current land use in the area (livestock grazing and grouse shooting), no major changes are expected to the character of the landscape. No change in these habitats is anticipated in the short to medium term and consequently the bird community is likely to continue to be present in similar abundances and distributions.

It is more difficult to predict changes that may occur in the long-term, especially in the wake of climate change, which is thought to cause range shifts in some bird species (Huntley *et al.*, 2008). Climate change may alter habitat types by impacting the composition and health of the plant communities present, thereby affecting the habitat suitability for some of the bird species which currently occupy the site.

Baseline surveys carried out for the Proposed Development represent a snapshot of the bird community at the time and cannot be extrapolated to predict future population trends in the event of climate change.

7.4 Assessment of Effects and Mitigation

Both direct and indirect impacts are considered. Direct impacts are changes that are directly attributable to a defined action, e.g., the physical loss of habitat occupied by a bird species during the construction process.

Indirect ecological impacts are attributable to an action, but which affect ecological resources through effects on an intermediary ecosystem, process or feature, e.g., the creation of roads which cause hydrological changes, which, in the absence of mitigation, could lead to the drying out of wetland habitats used by important bird species.

For the purposes of this ornithology assessment, in accordance with CIEEM guidelines, under the EIA Regulations, a 'significant effect' is 'one that is sufficiently important to require assessment and reporting so that the decision-maker is adequately informed as to the environmental consequences of permitting the project'.

Effects can be considered significant at a wide range of scales from international to local. For example, a significant effect on a regionally important population of a species is likely to be of regional significance. They are also significant if they do not comply with legal and policy protection.

Consideration of conservation status is important for evaluating the effects of impacts on bird species and assessing their significance. Conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area (which for the purposes of the Birds Directive is the EU).

7.4.1 Potential Sources of Impact

This assessment concentrates on the effects of construction, operation and decommissioning of the Proposed Development upon important ornithological features. The following potential effects have been assessed:

- Habitat loss or damage (permanent and temporary) due to construction of wind farm infrastructure;

- Inadvertent destruction of nests during construction;
- Disturbance to birds during construction due to vehicular traffic, operating plant and the presence of construction workers;
- Disturbance to birds due to the operation of the wind turbines, vehicular traffic and the presence of people during operation;
- Barrier effect due to the operation of the wind turbines; and
- Mortality of birds caused by collisions with turbine blades and other infrastructure.

Effects have been assessed in detail for the following ornithological features (see Table 7-6 for justification):

- Lapwing;
- Curlew;
- Common snipe;
- Short-eared owl; and
- Kestrel.

This list includes all species which are potentially vulnerable to significant effects from the Proposed Development, which are also:

- Species for which the study area is considered to be important at a local level or above;
- Species listed on Annex I of the birds directive;
- Breeding species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended in Scotland); and/or
- Priority species listed on the Scottish Biodiversity List.

7.4.2 Embedded Mitigation

The assessment of effects is based on the information outlined in Chapter 3: Description of Development. The Proposed Development has undergone a number of design iterations and evolution in response to the constraints identified as part of the baseline studies and field studies.

With respect to ornithology, no constraints have been identified during the design phase that would necessitate any changes to the Proposed Development.

7.4.3 Construction Effects

Potential effects, assuming that the good practice mitigation measures outlined in Section 7.5.1 are implemented, are addressed for each important feature in turn.

Nest Damage or Destruction

Damage or destruction to active nests could contravene the Wildlife and Countryside Act 1981. However, the good practice measures would avoid the likelihood of damage, destruction or disturbance to occupied bird nests during the construction phase. As such, no significant effects are predicted for any species due to nest damage or destruction.

Habitat Loss

Construction of turbine bases, access tracks and other structures would lead to habitat loss (see Chapter 6: Ecology, Table 6-9). Within the total area of the Proposed Development Site (212.5ha), the direct permanent loss of habitats which have potential value to support important ornithological features amounts to 7.9ha, with a further indirect loss due to drying effects of 7.3ha (i.e., 15.2ha in total, 7.1% of the total area). These habitats include priority peatland communities (10.2ha) and dry heath (3.6ha).

Habitat loss is only likely to affect important species breeding within the study area, which are likely to use these habitats for nesting and foraging (i.e., lapwing, common snipe, curlew and short-eared owl).

Lapwing

One lapwing territory was located within 500m of the Proposed Development infrastructure in 2020, plus a second within 500m of the access track only (see Technical Appendix 7-1: Ornithology Baseline Surveys for details). The potential effects of direct habitat loss on lapwing due to the development are not considered to be significant, compared with the distribution of the species' preferred habitat (i.e., mosaics of grassland habitats, particularly rough grassland grazed by livestock (Wilson *et al*. 2001)). These habitats are limited to areas away from the direct footprint of the Potential Development. With a potential foraging range size (e.g., >1000m² (GWCT)) and the amount of alternative habitat available for nesting and foraging, it is considered that there would be **no significant effect** on the conservation status of lapwing in terms of direct habitat loss.

Curlew

Two curlew territories were located within 500m of Proposed Development infrastructure in 2020 (ranging between 150 m and 450 m from proposed infrastructure, see Technical Appendix 7-1: Ornithology Baseline Surveys for details). The potential effects of direct habitat loss on curlew due to the development are not considered to be significant compared to the species' overall territory size (core range of 1km, with maximum range up to 2km (SNH, 2016a)). With the amount of alternative habitat available for nesting and foraging, it is considered that there would be **no significant effect** on the conservation status of curlew in terms of direct habitat loss.

Common snipe

A maximum of one snipe territory was recorded within 500m of the Proposed Development infrastructure in 2020, plus a second within 500m of the access track only (see Technical Appendix 7-1: Ornithology Baseline Surveys for details). Habitat suitable for nesting and foraging snipe (wet bog and grassland) is common within the Site. Due to the wide availability of suitable habitat it is considered that there would be **no significant effect** on the conservation status of snipe in terms of habitat loss.

Short-eared owl

Direct loss of potential short-eared owl nesting and foraging habitat would occur, with the entire area of the Proposed Development being potentially suitable. However, the magnitude of predicted habitat loss is considered negligible within the context of a pair's foraging range (core range of 2km extending out to 5km (SNH, 2016a)). Compared to the overall habitat available locally and in the wider NHZ, the loss would be negligible and there would be **no significant effect** on the conservation status of short-eared owl in terms of direct habitat loss.

Disturbance/ Displacement

During the construction phase of the Proposed Development, the potential effects of associated noise and visual disturbance could lead to the temporary displacement or disruption of breeding and foraging birds.

The level of impact would depend on the timing of potentially disturbing activities, the extent of displacement (both spatially and temporally) and the availability of suitable habitats in the surrounding area for displaced birds to occupy.

Potential effects are likely to be greatest during the breeding season (predominantly between March and August, depending on the species under consideration) and behavioural sensitivity to the effects would vary between species.

Disturbance of birds due to construction activities of this type have not been sufficiently quantified in the literature and the available information is often contradictory. However, it is likely that construction impacts would be greater on species that are intolerant of noise and other sources of disturbance, i.e., those with a medium to high sensitivity to disturbance (defined by Goodship and Furness 2022).

Larger bird species, those higher up the food chain or those that feed in flocks in the open tend to be more vulnerable to disturbance than small birds living in structurally complex or closed habitats such as woodland (Hill *et al.*, 1997).

The potential effects associated with construction activities are only likely to occur for as long as the construction phase continues and are thus generally short-term in nature.

The exception to this would be if a negative effect on the breeding success of a feature were such that the local population becomes extinct and replacement through recruitment or re-colonisation does not occur.

For example, a study by Pearce-Higgins *et al.* (2012) found that snipe and curlew densities declined significantly on wind farms during construction and had not recovered by the first-year post- construction.

Disturbance/displacement effects during construction are only likely to affect species potentially breeding within the relevant parts of the study area (i.e., lapwing, curlew, snipe and short-eared owl).

Construction disturbance can be readily mitigated by avoiding sensitive areas through the implementation of appropriately defined buffer zones and by timing construction activities to avoid periods where sensitive species are present (if and where possible), such as the breeding season.

A range of good practice measures have therefore been proposed to mitigate for potential construction disturbance effects (Section 7.5.1).

Lapwing

Neither Ruddock and Whitfield (2007) nor Goodship and Furness (2022) cover disturbance distances for lapwing. There is a lack of absolute evidence regarding construction disturbance in the scientific literature (although Hötker *et al.* (2006) previously reported minimum disturbance distances for lapwing (108 m+/-110 m) in the breeding season).

As noted above, one lapwing territory was identified within 500m of the Proposed Development infrastructure in 2020, plus a second within 500m of the access track. This is likely to be at or beyond the upper limit of the active disturbance distance for this species. In the worst-case scenario however, there is the potential for nesting lapwing to occur at a closer distance, therefore there is the potential for temporary disturbance caused by construction activities.

In the worst-case scenario of the temporary displacement of one-two pairs of lapwing, this is considered **potentially significant** for the local population. Therefore, any nesting attempts by lapwing would be safeguarded under a BPP (Bird Protection Plan) to ensure disturbance is avoided. A minimum disturbance-free buffer of 300m is considered appropriate for this species.

Curlew

Goodship and Furness (2022) stated that depending on the level of habituation to disturbance, a buffer zone of 200-300m is suggested to protect nesting curlew. Results from the study by Pearce-Higgins *et al*. (2012) suggest that curlew populations may decline by about 40% as a result of disturbance from construction work within a 620 m circular buffer around the turbines. This supports earlier work (Pearce-Higgins *et al*. 2009) which demonstrated a 30% lower density of birds within a 1,000m buffer around turbines than expected from the habitat. Other studies (e.g. Whitfield *et al*., 2010) involving long-term monitoring found no evidence of displacement due to wind farm infrastructure however.

As noted above, two curlew territories were identified within 500m of the Proposed Development infrastructure in 2020, one of which was as close as 320m from the nearest proposed turbine location and 160m from one of the borrow pit locations. This is likely to be within the range of the active disturbance distance for this species. Therefore, there is the potential for temporary disturbance of nesting curlew caused by construction activities.

In the worst-case scenario of the temporary displacement of two pairs of curlew, this is considered **potentially significant** for the local population. Therefore, any nesting attempts by curlew would be safeguarded under a BPP to ensure disturbance is avoided. A minimum disturbance-free buffer of 300m is considered appropriate for this species.

Common snipe

Neither Ruddock and Whitfield (2007) nor Goodship and Furness (2022) cover disturbance distances for snipe. There is a lack of absolute evidence regarding construction disturbance in the scientific literature (although Hötker *et al*. (2006) previously reported minimum disturbance distances for snipe (403 m+/-221 m) in the non-breeding season); however the disturbance distance to which human activity would affect snipe is likely to be low, based on the species' propensity to remain still until flushed at close proximity. Their predominantly crepuscular[1] activity also means that construction work on Site is unlikely to take place at the same time as peaks in snipe courtship or feeding activities.

As noted above, one snipe territory was identified within 500m of the Proposed Development infrastructure in 2020, plus a second within 500m of the access track. This is likely to be at or beyond the upper limit of the active disturbance distance for this species. In the worst-case scenario however, there is the potential for nesting snipe to

[1] Appearing or active in twilight.

occur at a closer distance, therefore there is the potential for temporary disturbance caused by construction activities.

In the worst-case scenario of the temporary displacement of one-two pairs of snipe, this is considered **potentially significant** for the local population. Therefore, any nesting attempts by snipe would be safeguarded under a BPP to ensure disturbance is avoided. A minimum disturbance-free buffer of 300m is considered appropriate for this species.

Short-eared owl

Goodship and Furness (2022) stated short-eared owls have a likely medium/ high sensitivity to disturbance, and recommend a breeding season buffer zone of 300-500m. One potential short-eared owl territory lies within the Proposed Development Site, within this distance.

In the worst-case scenario of the temporary displacement of one pair of short-eared owls, this is considered **potentially significant** for the regional population. Therefore, any nesting attempts by short-eared owl would be safeguarded under a BPP in compliance with legislative requirements to avoid disturbance to the sites of specially protected birds.

7.4.4 Operational Effects

Habitat Loss and Modification

Permanent habitat modification includes the maintenance of the open areas surrounding the wind farm infrastructure and tracks plus the areas undergoing habitat enhancement relating to the HMP (Technical Appendix 6-5). Habitat modification is only likely to affect important species breeding within the study area, which are likely to use these habitats for nesting and foraging (i.e., lapwing, curlew, common snipe and short-eared owl).

Lapwing

No significant habitat loss is considered likely, with only one territory within a 500m buffer of the proposed turbine layout. Habitat enhancement proposals included within the HMP for the creation and management of wet grassland (6.6ha) are considered likely to have positive benefits for lapwing. Habitat enhancement will be undertaken in an area away from the influence of the wind turbines and the land management practices of the surrounding area.

Curlew

No significant habitat loss is considered likely, with two territories within a 500m buffer of the proposed turbine layout. Habitat enhancement proposals included within the HMP for peatland restoration/ enhancement (8.8ha), heathland creation (6.2ha) and the creation and management of wet grassland (6.6ha) are considered likely to have positive benefits for curlew. Habitat enhancement will be undertaken in an area away from the influence of the wind turbines and the land management practices of the surrounding area.

Common Snipe

No significant habitat loss is considered likely, with only one territory within a 500m buffer of the proposed turbine layout. Habitat enhancement proposals included within the HMP for bog restoration (8.8ha) and the creation and management of wet grassland

(6.6ha) are considered likely to have positive benefits for snipe. Habitat enhancement will be undertaken in an area away from the influence of the wind turbines and the land management practices of the surrounding area.

Short-eared owl

Habitat enhancement proposals included within the HMP for heathland creation (6.2ha) are considered likely to have positive benefits for short-eared owl. Habitat enhancement will be undertaken in an area away from the influence of the wind turbines and the land management practices of the surrounding area.

Disturbance/ Displacement

The operation of wind turbines and associated human activities for maintenance purposes also has the potential to cause disturbance and displace birds from the site. Disturbance effects during the operational phase may be less than during the construction phase, as species may become habituated to wind turbines and disturbance due to human activities would be considerably reduced.

Studies have shown that, in general, species are not disturbed beyond 500m to 800m (for the most sensitive species) from wind turbines (e.g. Drewitt and Langston, 2006 and references therein; Hötker *et al.*, 2006; Pearce-Higgins *et al.*, 2009) and, in some cases, birds do not appear to have been disturbed at all (e.g. Devereux *et al.*, 2008; Whitfield *et al.*, 2010; Douglas *et al.*, 2011; Fielding and Haworth, 2013).

There is less consensus of opinion about disturbance effects closer to wind farm infrastructure. Pearce-Higgins *et al.*, (2009) found evidence of lower frequencies of occurrence of some species within the vicinity of wind turbines during the breeding season, with a significant reduction in frequency of occurrence, compared to control sites, in seven of the 12 species studied.

Other studies of curlew (Whitfield *et al.*, 2010), involving long-term monitoring found no evidence of displacement due to wind farm infrastructure.

The evidence suggests that impacts vary between species and sites (see discussion for raptors; Madders & Whitfield, 2006). There is potential for some disruption of feeding and nesting due to increased human activity for maintenance purposes.

However, this would be relatively infrequent, involve low levels of disturbance and would be restricted to areas of the Proposed Development accessible by tracks. Therefore, the overriding source of disturbance and displacement of birds during the operational period is considered to be the operating turbines (Pearce-Higgins *et al.*, 2009).

Disturbance/displacement effects during operation are considered for species in the breeding season, within the relevant parts of the study area, i.e. close to the proposed wind turbines. As such, the assessment concentrates on IOFs that are potentially vulnerable to disturbance/displacement based on current survey data (lapwing, snipe, curlew and short-eared owl).

Whilst kestrel may suffer some disturbance from wind turbines whilst foraging, effects are not likely to be significant given the wide availability of alternative foraging habitat. The use of the study area outside of the breeding season by the IOFs in question is likely to be limited in extent therefore is not likely to be significant. Other species are therefore not considered here.

Lapwing

Steinborn & Reichenbach (2011) concluded that in spite of a multitude of studies concerning the influence of wind turbines on birds (many of them on the lapwing) there are still uncertainties about the assessment of the effects of wind turbines on this species. A seven year BACI-study (before-after-control-impact) investigated the influence of wind turbines on breeding lapwings, and concluded that parameters like agricultural land use, distance from hedges and vegetation structure had more influence on the dispersal of lapwings than the distance to the next turbine. Lapwings breeding within the wind farms studied showed only minor displacement effects up to 100 m. Pearce-Higgins *et al.*, (2012) also failed to find significant displacement effects by wind turbines on lapwing, stating that wader species associated with short vegetation (such as lapwing) appear to be the least detrimentally affected by wind farms.

On the basis of one lapwing territory being located approximately 450m from the turbine layout, based on survey data, it is considered that there is negligible potential for permanent disturbance/ displacement impacts on lapwing. On this basis it is considered that there would be **no significant effect** on the conservation status of lapwing in terms of disturbance/ displacement caused by the operation of the Proposed Development.

Curlew

Whilst there is some uncertainty over the extent of potential disturbance impacts on curlew during wind farm operation (as stated above for temporary construction disturbance/ displacement), a precautionary approach has been adopted here. Using the largest disturbance turbine buffer of 1,000m suggested by Pearce-Higgins *et al.*, 2009) and based on survey data for 2020, there are two territories within this distance.

On the basis of two curlew territories within 1,000m of proposed turbine locations, (based on survey data), up to 1 pair may be permanently displaced by the Proposed Development. This would result in the possible loss of <0.1% of the NHZ population. On this basis it is considered that there would be **no significant effect** on the conservation status of curlew in terms of disturbance/ displacement caused by the operation of the Proposed Development.

Common snipe

Pearce-Higgins *et al.*, (2012) reported evidence of reduced habitat usage by snipe within operational wind farms. Snipe were also shown by Pearce-Higgins *et al.* (2009) to use areas of habitat within 400m of wind turbines less than expected, leading to an expected 48% decline in abundance within 500m of the wind turbines.

On the basis of one snipe territory within 500m of proposed turbine locations, (based on survey data), 0 to 1 pairs may be displaced by the Proposed Development. This would result in the possible loss of <0.2% of the NHZ population. On this basis it is considered that there would be **no significant effect** on the conservation status of snipe in terms of disturbance/ displacement caused by the operation of the Proposed Development.

Short-eared owl

There is no directly relevant literature to draw on for this species in terms of likely disturbance/displacement during wind farm operation. As stated in the assessment of disturbance/ displacement during construction, Goodship and Furness (2022) consider that short-eared owls have a likely medium/ high sensitivity to disturbance, with a recommended breeding season buffer zone of 300-500m. One potential short-eared owl territory lies within the Proposed Development Site, within this distance.

In the worst-case scenario of the displacement of one pair of short-eared owls, this could be considered potentially significant for the regional population (which fluctuates widely between years). However, this is likely to be temporary and reversible, as the wider area within and around the Proposed Development Site has an abundance of potential breeding and foraging habitat for short-eared owl. Due to the wide availability of suitable nesting and foraging habitats areas in the vicinity of the Site, and the nomadic nature of this species, it is considered that there would be **no significant effect** on the conservation status of short-eared owl in terms of disturbance/ displacement caused by the operation of the Proposed Development.

Barrier Effect

Individual turbines, or a wind farm as a whole, may present a barrier to the movement of birds, restricting or displacing birds from much larger areas. The effect this would have on a population is subtle and difficult to predict with any degree of certainty.

If birds regularly have to fly over or around obstacles or are forced into suboptimal habitats, this may result in reduced feeding efficiency and greater energy expenditure. By implication, this will reduce the efficiency with which they accumulate reserves, potentially affecting breeding success or survival.

All Species

Baseline surveys showed that the air space around the Proposed Development is not frequently used by migrating or commuting species, such as geese. In addition, given the relatively small scale of the development in comparison with the areas through which migrating bird species move through, it is unlikely that this four-turbine development will have more than negligible effect on distances flown by migrating birds and therefore on their populations. There are no sites used for roosting or feeding that would have access restricted by any potential barrier effects.

Hence, it is considered that there would be **no significant effect** on the conservation status of any species in terms of barrier effects caused by the Proposed Development.

Collision with Wind Turbines

Collision of a bird with turbine rotors is almost certain to result in the death of the bird. In low density populations (e.g., raptors) this could have a greater negative effect on the local population than in higher density populations (e.g., passerines) because a higher proportion of the local population would be affected in a low-density population.

Larger birds such as raptors also live longer and have much slower reproductive rates than passerines, which can also increase the significance of the impact of collisions on the relevant population.

The frequency and likelihood of a collision occurring depends on a number of factors which include aspects of the size and behaviour of the bird (including their use of a site), the nature of the surrounding environment, and the structure and layout of the wind turbines.

Collision risk is perceived to be higher for birds that spend much of the time in the air, such as foraging raptors and those that have regular flight paths between feeding and breeding/roosting grounds (e.g. geese).

The risk of bird collisions at wind farms is greatest in areas where large concentrations of birds are present (such as on major migration routes), and in poor flying conditions, such as rain, fog, strong winds that affect birds' ability to control flight manoeuvres, or on dark nights when visibility is reduced (Langston and Pullan, 2003; Drewitt and Langston, 2006 and references therein).

Birds may also be more susceptible if the wind farm is located in an area of high prey density. For diurnal foraging raptors, the proximity of structures on which to perch can increase the likelihood of collision with wind turbines (e.g. Percival, 2005 and references therein).

It should be noted that operational disturbance and collision risk effects are mutually exclusive in a spatial sense; i.e. a bird that avoids the wind farm area due to disturbance cannot be at risk of collision with the turbine rotors at the same time. However, they are not mutually exclusive in a temporal sense; i.e. a bird may initially avoid the wind farm but habituate to it, and would then be at risk of collision.

Passerines nesting within a wind farm site would be expected to be regularly flying between wind turbines and could therefore be expected to be most at risk of collision. However, passerines tend to fly below PCH and evidence suggests that passerines collide with wind turbines infrequently.

Moreover, most of the species concerned are of low or negligible conservation value. Collision is therefore mainly considered in relation to species of high sensitivity, e.g., target raptor species and species not particularly manoeuvrable in flight, such as geese and swans.

IOFs with sufficient data (minimum of five flights per season and/or minimum of 10 birds) to undertake CRM are considered at risk of collision with the proposed wind turbines at the site. The species that met this criterion and were subject to CRM are as follows:

- Curlew;
- Short-eared owl; and
- Kestrel.

For all other species, the number of at-risk flights (i.e., within the collision risk zone at potential collision height), was so low that collision risk is considered unlikely or negligible.

Curlew

Fourteen curlew collisions have been reported at European wind farms, none of which were in GB (Dürr 2023). Although there may be other, unpublished reports of collisions of this species, curlew collisions nevertheless appear to be an uncommon event.

The curlew flight activity survey data for Drummarnock is shown on Technical Appendix 7-1, Figure 7-1-7. This flight activity was recorded during two survey seasons (breeding season 2020 and breeding season 2021). Flights were recorded across the Site, with most flight activity in the northern part of the Proposed Development Site in the area of a breeding territory. 11 out of the 15 flights recorded were in June 2020.

Collision risk analysis was carried out on this flight activity data. Based on these data, 15 curlew flights with a cumulative total of 16 birds were recorded at PCH within the CRZ during surveys. Assuming a 98% avoidance rate (as per SNH, 2018c), 0.0790 collisions per year were predicted (i.e., one collision every 12-13 years).

Assuming a worst-case scenario that the mortality would involve breeding adults, the annual predicted collision mortality rate of 0.0790 represents a negligible proportion of both the estimated Scottish and NHZ 17 breeding populations (60,388 and 4,606 adults respectively). Against background annual mortality of 10.1% for adults (BTO BirdFacts) (which amounts to 465.2 birds in NHZ 17), this represents an increase of 0.02% in adult mortality in NHZ 17.

The predicted mortality for curlew caused by the Proposed Development is therefore very low and is **not considered to be significant**.

Short-eared owl

Seven short-eared owl collisions have been reported at European wind farms, none of which were in GB (Dürr 2023). Although collisions of this species are likely to have been under-reported, short-eared owl collisions nevertheless appear to be an uncommon event, due to the fact that most short-eared owl flight activity is close to the ground. The exception to this is during territorial and breeding display flights.

The short-eared owl flight activity survey data for Drummarnock is shown on Technical Appendix 7-1, Figure 7-1-8. This flight activity was recorded during breeding season 2020 only. Flights were concentrated across the centre and west of the Proposed Development Site. 14 out of the 25 flights recorded were on one date (14 May 2020).

Collision risk analysis was carried out on this flight activity data. Based on these data, 25 short-eared owl flights with a cumulative total of 26 birds were recorded at PCH within the CRZ during surveys. Assuming a 98% avoidance rate (as per SNH, 2018c), 0.2102 collisions per year were predicted (i.e., one collision every 4-5 years).

Assuming a worst-case scenario that the mortality would involve breeding adults, the annual predicted collision mortality rate of 0.2102 represents a negligible proportion of the estimated Scottish breeding population (2,176 adults) but 3.5% of the NHZ 17 breeding population given by Wilson *et al.* (2015) (6 adults). Wilson *et al.* (2015) state that "*the dearth of knowledge on short−eared owl and, in particular, on the size of its Scottish population, is reflected in the entry for this species in Forrester et al. (2007), which places the Scottish breeding population at 125−1,250 pairs. This estimate is loosely based on extrapolation from regional estimates and reporting, and part of the variation it encompasses derives from the difference in the number of pairs thought to breed during poor and good vole years. According to changes in occupancy between the two most recent Bird Atlases, the Scottish short−eared owl population appears to have undergone a decrease of around 8% since the estimate of Gibbons et al. (1993). Given both the incompleteness of our understanding about this species' population and ecology, and also the propensity for breeding numbers in many areas to be highly variable, these figures should be treated only as loosely indicative.*"

Short-eared owls are nomadic and move around in response to fluctuations in vole populations, and therefore population data are 'loosely indicative'. Therefore, it is appropriate to also consider adjacent NHZs when assessing potential impacts. These are NHZ 15 (L. Lomond, Trossachs & Breadalbane) – 109 pairs, and NHZ 16 (Eastern Lowlands) – 58 pairs. This gives a combined population for NHZs 15, 16 and 17 of 170 pairs.

Against the background annual mortality of 41.0% (BirdLife International) (which amounts to 69.7 birds in the combined NHZ 15, 16 and 17 population of 170), the additional mortality of 0.2102 represents an increase of 0.3% in mortality in NHZ 15, 16 and 17.

Therefore, in the context of the species' high background mortality, the additional predicted mortality for short-eared owl caused by the Proposed Development is **not considered to be significant**.

Kestrel

Over 800 kestrel collisions have been reported at European wind farms, with two of these in Scotland (Dürr 2023). However, it is likely that there are a significant number of unpublished collisions, including in the UK.

The hovering behavior of kestrel is thought to increase the species' vulnerability to wind turbine collisions (e.g., Barrios and Rodriguez, 2004 in Marques *et al*., 2014). This is reiterated by the fact that NS have retained the default avoidance rate of 95% for this species at the last review of such rates, where most species were elevated to 98% (SNH 2018c). This avoidance rate is an integral element of the collision risk modelling method given in Band (2007).

The kestrel flight activity survey data for Drummarnock is shown on Technical Appendix 7-1, Figure 7-1-6. This flight activity was recorded during September 2019 to September 2020, with the majority during July to September 2020 (25 out of 28 flights). Flights were recorded across the Site, with most flight activity in the western part of the Proposed Development Site involving adult birds (a maximum of three).

Collision risk analysis was carried out on this flight activity data. Based on these data, 19 kestrel flights with a cumulative total of 22 birds were recorded at PCH within the CRZ during surveys (during 01 September 2019 to 30 September 2020). Assuming a 95% avoidance rate, 0.3317 collisions per year were predicted (approximately one collision every 3 years).

Assuming a worst-case scenario that the mortality would involve breeding adults, the annual predicted collision mortality rate of 0.3317 represents less than 0.01% of the Scottish breeding population (7,700 adults) and 0.04% of the NHZ 17 breeding population (assumed to be 886 adults). Against background annual mortality of 31% for adults (BTO BirdFacts) (which amounts to 274.66 birds in NHZ 17), this represents an increase of 0.1% in adult mortality. This is **not considered to be significant**.

7.4.5 Decommissioning Effects

Potential effects associated with decommissioning of the Proposed Development are assumed to be similar to those identified for construction phase (i.e., habitat loss and disturbance/ displacement). Decommissioning effects are therefore not considered separately for each species.

Due to the length of the operational period (40 years) the future composition of the bird community at the site is not known and the confidence in any prediction would be uncertain. In the absence of mitigation, decommissioning could cause short term effects through disturbance.

Positive effects however, might also occur through the removal of turbines and the reinstatement of topsoil.

Good practice measures, similar to those employed during the construction phase, including surveys prior to decommissioning, to inform an up-to-date assessment of potential effects on important bird species, would be implemented during decommissioning. Following the implementation of these measures, no significant effects would be anticipated.

7.4.6 Cumulative Effects

The following section assesses the potential cumulative effects on IOFs from the Proposed Development along with all other operational, consented and submitted plans or projects within an appropriate zone of influence and against the relevant NHZ population estimates, following NatureScot guidance (SNH, 2018b).

In line with this guidance, any wind farm developments of fewer than three turbines (small scale wind energy proposals (SNH, 2016b)) were excluded from the cumulative impact assessment, due to the problems associated with finding appropriate data for developments of this size.

Only IOFs for which a greater than negligible residual impact is predicted are considered in the cumulative impact assessment, as unquantified negligible impacts will not result in a detectable increase in cumulative impacts.

All existing, consented and submitted wind farm developments (of three or more turbines) and other projects identified within NHZ17, were considered as part of the assessment of cumulative impacts. This produced a list of c. 100 wind farms. This list was scrutinised for projects with relevant information on species which are IOFs at Drummarnock (lapwing, curlew, snipe, short-eared owl and kestrel). These projects are listed in Table 7-7.

Table 7-7: Projects Considered for Cumulative Effects Assessment for Drummarnock IOFs, NHZ 17 (West Central Belt)

Project	Status	Distance (km)/ Direction from Proposed Development Site	No. of Turbines	Information Available	Species Assessed
Craigengelt	Operational	1.1km/ S	8	Environmental Statement (2006)	Curlew (not fully assessed)
Earlsburn / Kingsburn	Operational	5.2km/ W	24	Environmental Statement (2008)	Curlew; Short-eared owl
Earlsburn Extension	In planning	6.2km/ W	9	EIA Report (2022)	Curlew; Lapwing; Short-eared owl
Shelloch	Consented	7.7km/ W	5	EIA Report (2020)	Curlew
Tod Hill	Operational	10.4km/ ESE	4	Environmental Statement (2011)	Lapwing
Greengairs	Operational	18.2km/ S	9	Environmental Statement (2007)	Curlew; Lapwing; Short-eared owl
Forrestfield	Consented	24.4km/ SSE	4	EIA Report (2015)	Curlew; Lapwing; Kestrel
Torrance Farm	Operational	27.0km/ SE	3	Environmental Appraisal (2010)	Curlew; Snipe; Kestrel
Black Law Extension Grid Connection	Installed	35.0km/ SSE	-	Environmental Statement (2012)	Curlew; Short-eared owl
Black Law Extension	Operational	34.9km/ SSE	34	Mentioned in Shelloch EIA Report	Curlew
Muirhall South	Operational	45.0km/ SSE	3	EIA Report (2014)	Breeding waders, short-eared owl
West Browncastle	Operational	46.4km/ SSW	12	ES (2010)	Curlew, Short-eared owl
Kype Muir	Operational	47.5km/ S	26	ES (2011)	Curlew
Auchrobert	Operational	47.7km/ S	12	ES (2012)	Curlew
Calder Water	Operational	47.7km/ SSW	14	ES (2009)	Curlew, lapwing
Broken Cross	Consented	51.7km/ S	10	EIA Report (2019)	Curlew
Dalquhandy	Operational	53.9km/ S	15	Information in Hagshaw Hill Repowering ES (2018) & Broken Cross EIA	Curlew
Cumberhead	Operational	55.2km/ S	11	EIA Report (2018)	Curlew
Nutberry	Operational	55.2km/ S	6	Information in Hagshaw Hill Repowering ES (2018)	Curlew
Douglas West	Operational	55.7km/ S	15	EIA Report (2015)	Curlew
Douglas West Extension	In planning	55.5km/ S	13	EIA Report (2019)	Curlew, Lapwing

Project	Status	Distance (km)/ Direction from Proposed Development Site	No. of Turbines	Information Available	Species Assessed
Hagshaw Hill Extension	Operational	56.9km/ S	20	Information in Hagshaw Hill Repowering ES (2018)	Curlew
Hagshaw Hill Repowering	Operational	56.9km/ S	14	ES (2018)	Curlew
Galawhistle	Operational	56.8km/ S	22	ES (2010)	Curlew
Assel Valley	Operational	107.0km/ SSW	11	ES (2011)	Curlew, Lapwing, Kestrel

Potential cumulative effects from the Proposed Development include:

- lapwing (potential habitat loss and disturbance/ displacement effects);
- common snipe (potential habitat loss and disturbance/ displacement effects);
- curlew (potential habitat loss, disturbance/ displacement effects and collision mortality effects);
- short-eared owl (potential habitat loss, disturbance/ displacement effects and collision mortality effects); and
- kestrel (potential collision mortality effects).

Lapwing

Potential cumulative effects are summarised in Table 7-8.

Table 7-8: Summary of Potential Cumulative Effects for Lapwing, NHZ 17

Project	Habitat Loss	Disturbance/ Displacement
Operational		
Tod Hill	Negligible/ Not Significant	Negligible/ Not Significant
Greengairs	Not assessed	Potential loss of 1 territory. Not Significant.
Calder Water	Very Low	Very Low to Low
Assel Valley	Not assessed	Low magnitude/ Negligible significance
Consented		
Forrestfield	Not assessed	Low magnitude/ Not Significant.
In planning		
Earlsburn (North Extension)	Negligible	Negligible
Douglas West Extension	Not assessed	Minor adverse/ Not Significant
Cumulative Total	Negligible/ Very Low	Operational - potential loss of 1 territory, but with information gaps. Consented – Not Significant but with information gaps. In planning – Not Significant but with information gaps.
Proposed Development	Not significant	1 pair within 450m (negligible potential for displacement)/ Not Significant.

A number of projects in NHZ 17 identified lapwing as an IOF, however it is difficult to quantify the amount of associated habitat loss and extent of disturbance/ displacement, as these are generally based on qualitative not quantitative assessments.

There are gaps in the information available within assessments, and a lack of available information from post consent monitoring from wind farms with and without a Habitat Management Plan.

Despite these caveats, due to the fact that the Proposed Development alone will not result in significant habitat loss or disturbance/ displacement, the resulting cumulative effects are also considered likely to be **not significant** on the conservation status of lapwing in the NHZ.

The main causes of population declines for lapwing are habitat loss and degradation due to the intensification of farming which has reduced breeding productivity.

Curlew

Potential cumulative effects are summarised in Table 7-9.

Table 7-9: Summary of Potential Cumulative Effects for Curlew, NHZ 17

Project	Habitat Loss	Disturbance/ Displacement	Collision Mortality
Operational			
Craigengelt	Not assessed	Present but probably not breeding within the potential impact zone	Not fully assessed (flight rate of 0.14 birds per hr in breeding season)
Earlsburn/ Kingsburn	Not assessed	Not assessed	0.027 (Kingsburn)
Greengairs	Not assessed	Potential loss of 1 territory	Not assessed
Torrance Farm	Insufficient information	Insufficient information	Insufficient information
Black Law Extension	Insufficient information	Potential loss of 3 territories; but potential for increase in population when considering the Black Law HMP area	Insufficient information
Black Law Extension Grid Connection	Not assessed	Potential temporary loss of 1 territory	0.8
West Browncastle	Not assessed	Partial displacement of 5 pairs	Not assessed
Kype Muir	Negligible – potentially net increase in habitat following HMP implementation	Potential temporary loss of 1 territory	Not Significant
Auchrobert	Not assessed	Potential loss of 1-3 territories	None
Calder Water	None	None	Very low
Broken Cross	None	None	0.002
Cumberhead	None	Potential temporary loss of 5 territories	0.013
Dalquhandy	Insufficient information	Potential loss of up to 3 territories	0.0035
Nutberry	Insufficient information	Potential loss of up to 5 territories	0.178 (95% avoidance); 0.0712 (98% avoidance)
Douglas West	Not assessed	Potential temporary loss of 1 territory	0.14
Hagshaw Hill Extension	Insufficient information	Potential loss of up to 5 territories	None
Galawhistle	Insufficient information	Potential loss of up to 3	0.127

Project	Habitat Loss	Disturbance/ Displacement	Collision Mortality
		territories	
Assel Valley	Negligible	Potential loss of 1 territory	Negligible
Consented			
Shelloch	Negligible	Potential loss of 3-5 territories	0.0698
Forrestfield	Negligible	Low magnitude/ Not Significant	CRM not undertaken
Hagshaw Hill Repowering	Negligible	Potential loss of up to 3 territories	None
In-planning			
Douglas West Extension	Negligible	Negligible	Negligible
Earlsburn Extension	Negligible	Potential loss of 1 territory	0.02 – 0.04
Cumulative Total	Negligible/ Very Low	Operational: potential temporary loss of 8 territories and potential permanent loss of 27 territories. Consented: potential permanent loss of 8 territories. In planning: potential loss of 1 territory.	Operational: 1.1837 Consented: 0.0698 In planning: 0.02 – 0.04
Proposed Development	Not significant	Potential loss of up to 2 territories	0.079

In terms of habitat loss for curlew from wind farm projects in NHZ 17, there is insufficient information to quantify the cumulative impacts. In addition, it is not possible to account for the potential beneficial outcomes of mitigation through habitat management. However, overall it is considered that there would be **no significant cumulative effect** on the conservation status of curlew in terms of habitat loss.

In terms of disturbance/ displacement, based on the available information, the potential loss of 2 territories due to disturbance/ displacement from the Proposed Development alone along with the potential permanent loss of 27 pairs from operational projects and 8 pairs from consented but not yet built wind farms results in the possible loss of 37 pairs (1.6% of the NHZ 17 population).

On this basis it is considered that there would be **a potential significant cumulative effect** on the conservation status of curlew in terms of disturbance/ displacement. However, as above for habitat loss, this does not account for the potential beneficial outcomes of mitigation through habitat management that has already occurred at operational wind farms. Therefore, this assessment is not certain.

In terms of collision mortality, based on the available information, the potential loss of 0.08 birds per year due to collision mortality caused by the Proposed Development alone along with the potential loss of 1.2 birds per year from operational projects and 0.1 birds per year from consented but not yet built wind farms results in the possible loss of 1.4 birds per year.

Assuming a worst-case scenario that the mortality would all involve breeding adults, the annual predicted collision mortality rate of 1.4 represents a negligible proportion of both the estimated Scottish and NHZ 17 breeding populations (60,388 and 4,606 adults respectively). Against background annual mortality of 10.1% for adults (BTO BirdFacts) (which amounts to 465.2 birds in NHZ 17), this represents an increase of 0.3% in adult mortality in NHZ 17. On this basis it is considered that there would be **no significant cumulative effect** on the conservation status of curlew in terms of collision mortality.

Common Snipe

Potential cumulative effects are summarised in Table 7-10.

Table 7-10: Summary of Potential Cumulative Effects for Common Snipe, NHZ 17

Project	Habitat Loss	Disturbance/ Displacement
Operational		
Torrance Farm	Neutral/ Not Significant	Potential loss of 2 territories. Not Significant
Muirhall South	Not assessed	None predicted.
Cumulative Total	Negligible/ Very Low	Operational - potential loss of 2 territories, but with information gaps.
Proposed Development	Not significant	Potential loss of 0-1 territories. Not significant.

As for lapwing (above), there are information gaps for other projects within NHZ17. Based on the available information, the potential loss of 1 pair due to disturbance/ displacement from the Proposed Development alone along with the potential loss of 2 pairs from operational wind farms results in the possible loss of 3 pairs (0.5% of the NHZ17 population).

On this basis it is considered that there would be **no significant cumulative effect** on the conservation status of snipe in terms of habitat loss and disturbance/ displacement.

Short-eared Owl

Potential cumulative effects are summarised in Table 7-11.

Table 7-11: Summary of Potential Cumulative Effects for Short-eared Owl, NHZ 17

Project	Habitat Loss	Disturbance/ Displacement	Collision Mortality
Operational			
Earlsburn/ Kingsburn	Insufficient information	Insufficient information	0.011 (95% avoidance) 0.0044 (98% avoidance)
Greengairs	N/A	Winter roost only	None
Black Law Extension Grid Connection	Negligible	Negligible	0.11
West Browncastle	Negligible	Negligible	0.02
In planning			
Earlsburn Extension	Minor	Minor	Minor
Cumulative Total	Minor/ Not Significant	Operational and in	Operational –

Project	Habitat Loss	Disturbance/ Displacement	Collision Mortality
		planning projects: minor but with information gaps	0.1344 In planning - Minor
Proposed Development	Not Significant	Potential loss of 1 territory	0.2102

In terms of habitat loss and disturbance/ displacement for short-eared owl from wind farm projects in NHZ 17, it is not possible to quantify the cumulative impacts due to the nomadic habits of the species. Overall, it is considered that there would be **no significant cumulative effect** on the conservation status of short-eared owl in terms of habitat loss and disturbance/ displacement.

In terms of collision mortality, based on the available information, the potential loss of 0.21 birds per year due to collision mortality caused by the Proposed Development alone along with the potential loss of 0.13 birds per year from operational projects results in the possible loss of 0.34 birds per year.

As stated in the assessment of collision risk for the Proposed Development alone, short-eared owls are nomadic and move around in response to fluctuations in vole populations, and therefore population data are 'loosely indicative'.

Against the background annual mortality of 41.0% the cumulative total of 0.34 birds per year is not likely to be significant. On this basis it is considered that there would be **no significant cumulative effect** on the conservation status of short-eared owl in terms of collision mortality.

Kestrel

Potential cumulative effects are summarised in Table 7-12.

Table 7-12: Summary of Potential Cumulative Effects for Kestrel, NHZ 17

Project	Collision Mortality
Operational	
Torrance Farm	Low collision risk (2 flights in 18 hours of observation)
Assel Valley	CRM not conducted (two flights totalling 170 seconds of at-risk activity in 149.5 hours of observation)
In-planning	
Forrestfield	CRM not conducted (recorded only as secondary species – 11 registrations of single birds in 144 hours of observation)
Cumulative Total	Operational – Low Risk, but with information gaps In-planning – Low Risk, but with information gaps
Proposed Development	0.3317

In terms of collision mortality, only three other projects in NHZ 17 considered kestrel to be an IOF. This is likely to have resulted in an under-estimate of cumulative collision mortality. However, on the basis of the available information it is considered that there would be **no significant cumulative effect** on the conservation status of kestrel in terms of collision mortality.

7.5 Residual Effects and Conclusions

7.5.1 Proposed Mitigation/Monitoring

Good practice measures, as outlined below, would be employed to reduce the possibility of damage and destruction (and disturbance in the case of sensitive species such as breeding waders and short-eared owl), to occupied bird nests during the construction phase.

Timing of Works, Pre-Commencement Surveys and Implementation of Disturbance-Free Buffer Zones

Under the Wildlife and Countryside Act 1981, it is an offence, with only limited exceptions, to:

- Intentionally or recklessly take, interfere with, damage or destroy the nest of any wild bird whilst it is in use or being built (applies year round for nests of birds included in Schedule A1);
- Obstruct or prevent any wild bird from using its nest;
- Intentionally or recklessly take, interfere with or destroy the egg of any wild bird;
- Intentionally or recklessly disturb any wild bird listed in Schedule 1 while it is nest building, or at (or near) a nest containing eggs or young, or disturb the dependent young of such a bird;
- Intentionally or recklessly harass any wild bird included in Schedule 1A; or
- Knowingly cause or permit any of the above acts.

Avoidance of damage to, or destruction of nests, or disturbance to sensitive species whilst nesting can be achieved through careful timing of construction activities; for example restricting activities in sensitive areas as far as practicable in the early part of the breeding season until the location and breeding status of nesting birds has been established.

A BPP would be developed by a suitably experienced ornithologist, and agreed in consultation with NatureScot, in advance of works commencing on the site. The BPP would set out in sufficient detail the measures and procedures that would be followed to ensure the protection of sensitive species as well as legally protected species during construction.

If site clearance and construction activities are required to take place during the main breeding bird season, from mid-March to August inclusive, pre-commencement survey work would be undertaken to ensure that nest destruction and disturbance to sensitive species (i.e., breeding raptors and waders) are avoided.

Where applicable, construction would not take place within specified disturbance-free buffer zones for certain sensitive species during the breeding season.

Disturbance-free buffer zones around nest sites of sensitive species would be applied and monitored closely. For breeding waders, disturbance-free buffer zones are only required until chicks have hatched and are capable of walking away from any sources of disturbance.

Disturbance-Free Buffer Zones

Based on 2020 survey data and the relevant literature (e.g., Goodship and Furness 2022), the following disturbance-free buffer zones are considered likely to be required to help prevent nest failure due to disturbance during construction. It should be noted that these represent a guide only and may vary according to topography and other factors at each nest site:

- Lapwing – 300m;
- Curlew – 300m;
- Snipe – 300m;
- Short-eared owl – 500m

A Bird Protection Plan (BPP) would be developed by a suitably experienced ornithologist, and agreed in consultation with NatureScot, in advance of works commencing on the site. The BPP would set out in sufficient detail the measures and procedures that would be followed to ensure the protection of sensitive species as well as legally protected species during construction.

Environmental Clerk of Works

A suitably qualified Environmental Clerk of Works (EnvCoW) would be employed to oversee activity at key points for the duration of the construction and reinstatement periods (at a frequency to be agreed with Stirling Council and NatureScot), to ensure natural heritage interests are safeguarded. The role of the EnvCoW would include the following specific roles with regard to the ornithology interest of the site:

- Prior to the start of construction and/or the breeding bird season, the EnvCoW would make contractors aware of the ornithological sensitivities within the site (particularly with regard to the potential presence of sensitive breeding species, i.e. breeding waders and raptors); and
- The EnvCoW would undertake 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.

Mitigation, Compensation and Enhancement

As part of the Proposed Development, approximately 21.6ha of habitat will be enhanced through outline HMP measures (i.e., peatland restoration (8.8ha), wet grassland creation (6.6ha) and heathland enhancement (6.2ha)) (See Technical Appendix 6-5 for details). The enhancement of peatland and grassland habitats should increase habitat suitability for waders, with an increase in both nesting and foraging habitat. Heathland enhancement aims to increase suitable nesting and foraging habitat for breeding short-eared owl in an area away from the influence of the wind turbines.

Habitat change and disturbance for birds during the construction works will be further considered in the final HMP and BPP once final construction phasing is known.

7.5.2 Residual Effects

No significant residual effects are anticipated for any IOF. A summary of the assessment of the effects of the proposed development, proposed mitigation and the residual effects are provided for each IOF in Table 7-13.

Table 7-13: Summary of Residual Effects

Likely Significant Effect	Receptor	Mitigation Measures	Means of Implementation	Residual Effect
Nest damage or destruction during construction	All species	Implementation of good practice	CEMP and BPP. Timing of Works, Pre-Commencement Surveys and Implementation of Disturbance-Free Buffer Zones	No significant negative effects
Direct habitat loss and change	All species	None required	-	No significant negative effects
Disturbance/ displacement during construction	All species, including lapwing, curlew, snipe and short-eared owl.	Implementation of good practice. Disturbance free zone of 300m around any lapwing, snipe and curlew nests and 500m around any short-eared owl nests	CEMP and BPP. Timing of Works, Pre-Commencement Surveys and Implementation of Disturbance-Free Buffer Zones	No significant negative effects
Disturbance/ displacement during operation	All species, including lapwing, curlew, snipe and short-eared owl.	Habitat Enhancement Operational monitoring	HMP Breeding bird surveys	No significant negative effects
Collision with turbines during operation	All species including kestrel, curlew and short-eared owl.	No formal monitoring required. Any dead birds to be reported to Nature Scot.	-	No significant negative effects

Further Survey Requirement and Monitoring

The key issues for consideration are wader and raptor/ owl breeding and flight activity, and the potential for displacement from the Proposed Development to other adjacent areas. and the potential for collision with turbines.

It is therefore important that any monitoring programme addresses the species that may be affected by the Proposed Development. It should be recognised however that such monitoring should only be required where there is a gap in understanding or where the scale and extent of impact is uncertain' (SNH, 2009).

The exact scope of works would be confirmed after consultation but is likely to include collision monitoring, flight activity surveys and breeding wader and raptor/ owl surveys. It is important that any monitoring is designed to assess the actual versus predicted impacts on birds and to allow for a flexible monitoring plan to be undertaken during the post construction period.

It is proposed that ornithological monitoring should take place during and post-construction, in line with NatureScot guidance (SNH, 2009). The approach is outlined as follows:

- Year-round collision monitoring: no formal monitoring is proposed but carcasses of all species found on site should be recorded.
- Targeted wader surveys should also be undertaken to monitor the status of nesting wader species within the vicinity of the Proposed Development, in order to further determine the displacement effect, and the effectiveness of the HMP. These surveys should be undertaken in Year 0, 1, 2, 3, 5, and 10. Upon completion of surveys in Year 10, the need for further monitoring should be assessed.

7.5.3 Residual Cumulative Effects

No significant residual effects are anticipated for any IOF. A summary of the cumulative effects of the Proposed Development along with other projects in NHZ 17 are provided for each IOF in Table 7-14.

Table 7-14: Summary of Residual Cumulative Effects in NHZ 17 on the IOFs

IOF	Effect	Assessment of Cumulative Effect	Significance of Cumulative Effect
Lapwing	Habitat Loss, Disturbance/ Displacement	Potential loss of 1 territory	Not significant
Curlew	Habitat Loss	Minor habitat loss (not including mitigation & enhancement)	Not significant
	Disturbance/ Displacement	Potential loss of 38 territories (not including mitigation & enhancement)	Potentially significant without mitigation & enhancement. Residual effect likely to be not significant.
	Collision Mortality	Predicted mortality of 1.4 birds per year	Not significant
Snipe	Habitat Loss, Disturbance/ Displacement	Potential loss of 3 territories	Not significant
Short-eared owl	Habitat Loss, Disturbance/ Displacement	Minor habitat loss & potential loss of 1 territory	Not significant
	Collision Mortality	Predicted mortality of 0.36 birds per year	Not significant
Kestrel	Collision Mortality	Predicted mortality of 0.33 birds per year	Not significant

7.6 Summary and Statement of Significance

Potential significant effects were assessed for the following IOFs;

- Lapwing
  - Habitat Loss: no significant effects
  - Disturbance/ Displacement: no significant effects
- Curlew
  - Habitat Loss: no significant effects
  - Disturbance/ Displacement: no significant effects
  - Collision Risk: no significant effects
- Snipe
  - Habitat Loss: no significant effects
  - Disturbance/ Displacement: no significant effects
- Short-eared owl
  - Habitat Loss: no significant effects

  - Disturbance/ Displacement: no significant effects
  - Collision Risk: no significant effects
- Kestrel
  - Collision Risk: no significant effects

Following the implementation of good practice measures no significant negative effects are predicted during the construction, operational or decommissioning phases of the Proposed Development. Good practice measures during construction include timing of works, pre-commencement surveys and Implementation of disturbance-free buffer zones.

Habitat enhancement measures are proposed to benefit breeding waders which may be displaced by the Proposed Development.

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Chapter 8: Hydrology, Geology and Hydrogeology

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 (EIA Regulations)
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1

List of Abbreviations

Abbreviation	Description
BGS	British Geological Survey
CEMP	Construction Environment Management Plan
CMS	Construction Method Statement
DIA	Drainage Impact Assessment
DMP	Drainage Management Plan
DWPA	Drinking Water Protected Area
EnvCoW	Ecological/Environmental Clerk of Works
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EC	European Commission
GWDTE	Groundwater Dependent Terrestrial Ecosystem
Ha	Hectare
HMP	Habitat Management Plan
m AOD	Metres above Ordnance Datum
NGR	National Grid Reference
NTS	Non-Technical Summary
NVC	National Vegetation Classification
PLRHA	Peat Landslide Risk Hazard Assessment
OPMP	Outline Peat Management Plan
PPP	Pollution Prevention Plan
PWS	Private Water Supply/Supplies
SAC	Special Area of Conservation
SC	Stirling Council
SEPA	Scottish Environment Protection Agency
SSSI	Site of Special Scientific Interest

Abbreviation	Description
WFD	Water Framework Directive
WQMP	Water Quality Monitoring Plan

8 Hydrology, Geology and Hydrogeology

8.1 Introduction

8.1.1 Scope

This Chapter of the EIA Report assesses the effects of the Proposed Development on hydrology, geology and hydrogeology. The methodology, standards, surveys and data sources used in the assessment are described in section 8.2. A baseline has been determined which identifies, describes and assigns sensitivity to potential receptors.

Potential effects of activities during construction, operation and decommissioning on these sensitive receptors are assessed against the baseline after embedded mitigation is taken into account. Cumulative potential effects with other nearby developments are also assessed. Potential effects are classed as Negligible, Minor, Moderate or Major. Mitigation is developed for predicted Significant, i.e. Moderate or Major effects.

This Chapter is supported by the following Technical Appendices:

- TA 8-1 Watercourse Crossing Assessment;
- TA 8-2 Peat Landslide Hazard and Risk Assessment; and
- TA 8-3 Outline Peat Management Plan.

This Chapter has been prepared by John Ferry, an independent Chartered Hydrogeologist. His technical expertise is geology, hydrology, hydrogeology and hydro-ecology. He has advised on numerous wind farms at the pre-consent, planning and post planning construction stage, and has acted as expert witness on the water environment.

8.1.2 Study Area

The assessment is primarily concerned with a hydrological and hydrogeological study area comprising the Proposed Development Site plus a 250m buffer (for Groundwater Dependent Terrestrial Ecosystem (GWDTE) assessment).

The assessment has considered a wider study area where a hydrological connection in respect of potential effects deems it necessary, such as for hydrological connectivity along watercourses and for private water supplies. These considerations have extended the study area up to and beyond 2km, from the Proposed Development Site as shown in Figure 8-1 Water Features Plan.

8.1.3 Proposed Development

The Proposed Development consists of four turbines up to a maximum 180m tip height with an indicative electricity export capacity of approximately 30MW and associated infrastructure.

The associated infrastructure includes:

- New access tracks;
- Construction of turbine foundations, crane hardstandings and storage areas;
- Underground cabling;

- One onsite substation which would accommodate 33KV equipment to collect electricity from the site. The substation compound would include a control and metering building;
- Construction compound;
- Up to four borrow pits; and
- Up to six watercourse crossings.

8.2 Methodology and Approach

8.2.1 Legislation, Planning Policy and Guidance

Relevant statutory environmental legislation/regulation and established best practice guidance which has been taken into account in this assessment, includes the following:

Planning Policy

- National Planning Framework 4 (2023)
  - Policy 1: Tackling the Climate and Nature Crisis;
  - Policy 5: Soils;
  - Policy 11: Energy; and
  - Policy 22: Flood Risk and Water Management.
- Stirling Council Local Development Plan (2018)
  - Policy 4.2: Protection of Carbon Rich Soils;
  - Policy 5: Flood Risk Management;
  - Policy 12 Renewable Energy; and
  - Policy 13: The Water Environment.

Legislation

- Agriculture Act, 1986;
- Control of Pollution Act (1974);
- COSHH Regulations (2002) (amended);
- Dangerous Substances Directive (2006/11/EC);
- Environment Act (1995);
- Environmental Protection Act (1990);
- Environmental Liability Directive (2004/35/EEC);
- Environmental Liability (Scotland) Regulations (2009);
- EU Water Framework Directive (2000/60/EC);
- EC Freshwater Fish Directive (2006/44/EC);
- Flood Risk Management (Scotland) Act (2009);
- Flood Risk Regulations (2009);
- Land Drainage Act (1991 and 1994);
- Groundwater Daughter Directive (2006/118/EEC);
- Groundwater Directive (1980/168/EEC);
- Pollution Prevention and Control Act (1999);

- Nature Conservation (Scotland) Act (2004);
- Pollution Prevention and Control (Scotland) Regulations (2012);
- The Private Water Supplies (Scotland) Regulations (2006);
- The Water Intended for Human Consumption (Private Supplies) Scotland Regulations (2017);
- Water Environment and Water Services (Scotland) Act (2003 WEWS Act);
- Water Environment (Controlled Activities) (Scotland) Regulations (2011 CAR);
- The Water Environment (Controlled Activities) (Scotland) Amendment Regulations (2021);
- Water Environment (Drinking water Protection) (Scotland) Act (2013);
- Water Environment (Oil Storage) (Scotland) Regulations (2006);
- Water Environment (Register of Protected Areas) (Scotland) Regulations 2014
- Water Framework Directive (2000/60/EC);
- Water (Scotland) Act (1980); and
- Water Quality (Scotland) Regulations (2010).

Guidance

- CIRIA publications:
  - Control of groundwater for temporary works, R113;
  - Control of water pollution from construction sites, C532;
  - Control of Water from linear construction projects, C649;
  - Culvert Design and Operation Guide, C689;
  - Development and Flood Risk – guidance for the Construction Industry, C624;
  - Environmental Good Practice on site, C741;
  - Groundwater control: design and practice, C750;
  - SUDS Manual, C753; and
  - Site Handbook for the Construction of SUDS.
- Department for Environment, Food and Rural Affairs (DEFRA), 2009, Construction Code of Practice for the sustainable use of soils on construction sites;
- Forestry Commission (2017). The UK Forestry Standard;
- Forestry Commission Forests and Water, 2011 UK Forestry Standard Guidelines;
- Forestry Commission (2019). Managing forest operations to protect the water environment. Forestry Commission Practice Guide;
- Forestry Commission Scotland, SNH, 2010, Floating Roads on Peat;
- Ministry of Agriculture Food and Fisheries (MAFF), 2000, Good practice guide for handling soils;
- SEPA, Guidance for Pollution Prevention (GPP, and older PPG:
  - GPP 1: Understanding your environmental responsibilities - good environmental practices, (2020);
  - GPP 2: Above ground oil storage tanks, (2018);
  - PPG 3 Use and Design of Oil Separators in Surface Water Drainage Systems, (2006);

  - GPP 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer (2017);
  - GPP 5 Works and maintenance in or near water in or water, (2018);
  - PPG 6 Working at construction and demolition sites (2012);
  - PPG 7 Safe storage - The safe operation of refuelling facilities (2011);
  - GPP 8: Safe storage and disposal of used oils, (2017);
  - GPP 13 Vehicle washing and cleaning, (2017);
  - GPP 21: Pollution incident response planning, (2021); and
  - GPP 22: Dealing with spills, (2018).
- SEPA, 2009, Groundwater protection policy for Scotland SEPA, Policy 19;
- SEPA, 2009, Engineering in the Water Environment, Good Practice Guide, Temporary Construction;
- SEPA, 2010, Regulatory Position Statement – Developments on Peat;
- SEPA, 2014, LUPS, Guidance Note 4 Planning guidance on on-shore windfarm developments, Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste;
- SEPA, 2006, WAT-SG-31 Prevention of pollution from Civil Engineering Contracts, Special Requirements, version 2;
- SEPA, 2008, WAT–SG-23, Engineering in the Water Environment, Good Practice Guide, Bank Protection rivers and lochs;
- SEPA, 2009, WAT-SG-29, Temporary Construction Methods;
- SEPA, 2009, WAT-SG-26, Engineering in the Water Environment, Good Practice Guide, Sediment Management, version 1;
- SEPA, 2010, WAT-SG-25, Engineering in the Water Environment, Good Practice Guide, river Crossings, Version 2;
- SEPA, 2012, WAT-SG-78, Sediment Management Authorisation;
- SEPA, 2012, WAT-PS-07-02: Bank Protection;
- SEPA, 2015, WAT-PS-06-02: Culverting of Watercourses;
- SEPA, 2022, CAR – A Practical Guide Version 9;
- SEPA, 2017, LUPS Guidance 31, Guidance on Assessment Impacts of Wind Farm Development Proposals on groundwater abstractions and GWDTE;
- SEPA, 2019, Development at Risk of Flooding, Advice and consultation;
- Scottish Government (SG), 2006, Peat Landslide Hazard and /Risk Assessment, Best Practice Guide for Proposed Electricity Developments;
- SG, 2010, Zero Waste Plan;
- SG, 2013, Specific Advice on Onshore Wind Turbines;
- SG, SNH SEPA, 2017, Peatland Survey. Guidance on Developments on Peatland;
- SNH, 2013, Constructed Tracks in the Scottish Uplands;
- Scottish Renewables, SNH, SEPA, FCS, MSC, HES, 2019, Good Practice during Wind Farm Construction; and
- SR, SEPA, 2012, Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste. Version 1.

8.2.2 Assessment Methodology

The following process was followed with the findings of each stage considered in the assessment:

- Compilation of available baseline data (including peat probing data);
- Consultations with relevant stakeholders through the pre-application and EIA Scoping processes and follow up discussions;
- Site visits on 20 April 2021 and 3 February 2023;
- Description of the current baseline hydrological and hydrogeological conditions based on the above;
- Identification of sensitive water environment receptors;
- Identification of activities with the potential to affect the sensitive receptors;
- Assessment of hydrological connectivity and potential impact pathways;
- Assessment and prediction of potential effects upon sensitive receptors;
- Input into design to mitigate potential impacts (embedded mitigation);
- Assessment of cumulative effects with other wind farms;
- Identification of mitigation required to avoid, minimise or mitigate predicted adverse effects and enhance positive effects; and
- Assessment of residual effects, which will remain after mitigation.

8.2.3 Potential Effect Criteria

Receptor Sensitivity

Receptor sensitivity is determined from the baseline as informed by site surveys and by international, national and local standards.

Sensitivity criteria for the three grades of sensitivity (High, Medium and Low) are presented in Table 8-1.

Table 8-1: Sensitivity Criteria - Hydrology, Hydrogeology and Geology

Sensitivity	Importance	Water and Soil Definition
High	Attribute has a high quality and rarity on a national or international scale	• Water bodies of good ecological status, watercourses or waterbodies with 'high' or 'good' Water Framework Directive (WFD) overall status, currently or in the long term. • Sites protected/designated under European Commission (EC) or UK habitat legislation (Special Area of Conservation (SAC), Special Protection Area (SPA), Site of Special Scientific Interest (SSSI), Water Protection Zone (WPZ), Ramsar site, and Salmonid water. • Important on a European or global level/protected habitat sites, e.g. Atlantic salmon Salmo salar or Freshwater Pearl Mussel Margaritifera margaritifera. • National Nature Reserve (NNR). • Watercourses that support species protected under EC or UK habitat legislation but is not a designated site. • Areas with a high risk of flooding. • Primary/high productivity aquifer with high aquifer vulnerability. • Groundwater that supports highly dependent groundwater dependent terrestrial ecosystems (GWDTEs). • Falls within a DWPA or within a public water supply source

		catchment. • Local water supply sources, including private water supplies for human consumption where there is no alternative to private supplies and used for drinking water. • Pristine or active peat bog hydrological units (Class 1). • Areas of High Development Risk, Shafts, adits and shallow mine workings on site due to historic mining.
Medium	Attribute has a high quality and rarity on a regional scale	• Water bodies of moderate WFD ecological status. • Highly productive aquifer with low to medium vulnerability or Secondary/minor aquifers. • Groundwater that supports moderately dependent groundwater dependent terrestrial ecosystems (GWDTEs). • Areas with a medium risk of flooding. • Important in the context of the region/district; e.g. Local Nature Reserves. • Upstream of a DWPA or a public water supply water catchment. • Private water supplies for non-potable supply. • Peat body hydrological unit which could recover to pristine status (Class 2).
Low	Attribute has a low quality and rarity on a local scale	• Watercourses or waterbodies with WFD 'poor' or 'bad' overall status. • Low productivity aquifer/non aquifer/ low groundwater vulnerability. • Area at little or no risk of flooding. • Degraded drained peat; small isolated areas of peat. • No private water supplies. • No public water supply catchments.

Magnitude of Effect

Table 8-2 provides guidance as to the magnitude of potential effects on a receptor.

Table 8-2: Magnitude of Effect - Generic

Magnitude of Effect	Definition
Substantial	Total loss of or major alteration to key elements or features of the pre-development conditions, such that the post-development character or composition of the feature would be fundamentally changed.
Medium	Loss of or alteration to key elements or features of the pre-development conditions, such that the post-development character of the feature would be partially changed.
Low	Minor alteration from pre-development conditions.
No change	No or unquantifiable change to pre-development conditions.

The magnitude of potential effects is evaluated through a mixture of professional judgement and standards with reference to some or all of the criteria listed in Table 8-3.

Table 8-3: Effect Magnitude Criteria: Hydrology, Hydrogeology and Geology

Magnitude of effect	Substantial	Medium	Low
Runoff and surface water flow regime	Change in proportion of site rainfall runoff, resulting in a measurable long-term change in surface water	Change in proportion of site rainfall runoff, resulting in a measurable temporary change in surface	No easily measurable change in proportion of site rainfall runoff and associated aspects.

Magnitude of effect	Substantial	Medium	Low
	flows, dilution capacity or flood risk.	water flows, dilution capacity or flood risk.	
Water Quality	Long term change in SEPA WFD water quality status (SEPA 1, 2) due to e.g. (sediment, oil pollution).	Temporary change in SEPA WFD water quality status for < one month.	No measurable change in water quality and no change with respect to SEPA WFD Status.
Private Water Supply	Long term reduction in water pressure, flow or water quality affecting consumption and/or loss of supply requiring alternative supply or other intervention.	Temporary water pressure or flow reduction or water quality but not affecting consumption.	No easily measurable change in water pressure or flow or water quality.
Riverine Morphology and Habitat	Measurable changes in erosion, river bed, riverine habitats and risk to aquatic conservation interests.	Some change in deposition and erosion regimes, no measurable change to aquatic conservation or riverine habitats.	Very short term and minor change in river bed, minor rates of erosion. No change to riverine habitats or aquatic conservation risk.
Groundwater flow and levels	Long term change to the recharge, flow or discharge of groundwater affecting water supplies, river or stream base flows and GWDTE.	Measurable change to the recharge, flow or discharge of groundwater but causing only temporary change to water supplies, GWDTE and base flows.	Measurable change in groundwater levels, though no appreciable change to the recharge or discharge of groundwater. No effect on GWDTE or base flows or river supplies.
GWDTE	Direct or indirect loss of >10% of highly groundwater dependent GWDTE, or >25% loss of moderately groundwater dependent GWDTE.	Direct or indirect loss of >5% of highly groundwater dependent GWDTE or > 15% of moderately groundwater dependent GWDTE.	Loss of >1% of highly groundwater dependent GWDTE, or 10% of moderately groundwater dependent GWDTE.
Mining Risk	Site in High Risk Development Area and current or historic shallow mine workings or mine entries recorded on site. Risk of shallow unrecorded mine workings. Risk of mine gas and subsequent migration of voids to the surface.	Site in High Risk Development Area. No recorded current or historic mine workings or mine entries. Low but unproven risk of mine gas.	Not in High Risk Development Area.
Geology and soils including peat	Direct or indirect loss of deep peat without reuse on site. Long term alteration to	Direct or indirect loss of >5% of deep peat without reuse on site. Localised largely	Loss of minor volumes of deep peat and/or no alterations to peat hydrology.

Magnitude of effect	Substantial	Medium	Low
	extent, structure and/or hydrology of peat bodies. High peat landslide likelihood.	temporary alteration to extent, structure and/or hydrology of peat bodies. Moderate peat slide risk likelihood.	Low peat landslide likelihood.
Relevant Statutory Designation	Disturbance or loss of cited features of geological or hydrological features of nationally or internationally designated sites, e.g. SAC, SSSI.	No harm to the integrity of geological or hydrological features of designated sites. Minor harm to Regional or local sites.	No disturbance or loss to designated sites.

8.2.4 Assessment Levels of Effect

The assessments have been split into the three development phases as each phase has the potential to give rise to different effects:

- **Construction** - generally temporary/short-term effects that occur during the construction of the Proposed Development;
- **Operation** - effects resulting from the use of the Proposed Development throughout its operational lifetime; and
- **Decommissioning** - effects arising from the removal of infrastructure and restoration of the Proposed Development.

Predicted effects of the Proposed Development on the hydrology and hydrogeology are a function of magnitude of effects and receptor sensitivities.

The degree to which receptors are affected will depend upon whether the receptor is present, whether and to what degree it is in hydraulic and/or hydrogeological connectivity with the Proposed Development, and whether it is at risk from or poses a risk to the Proposed Development.

The assessment of effect takes into account effect duration and nature, whether it is:

- Short (construction), medium or long-term;
- Direct or indirect;
- Reversible or permanent;
- Adverse, neutral or beneficial;
- In isolation, or cumulative.

Effects are defined as:

- **Negligible** – no discernible deterioration or improvement to the existing environment;
- **Minor** (positive or negative) – where the Proposed Development will cause a small improvement (or deterioration) to the existing environment;
- **Moderate** (positive or negative) – where the Proposed Development will cause a noticeable improvement (or deterioration) to the existing environment; and
- **Major** (positive or negative) – where the Proposed Development will cause a substantial improvement (or deterioration) to the existing environment.

Table 8-4 shows the interrelationship between the magnitude and the sensitivity or importance of the feature.

Major and Moderate Effects are considered Significant. These are shown greyed out in the matrix in Table 8-4.

Table 8-4: Assessment Criteria

Receptor Sensitivity Importance	Magnitude of Effects			
	Substantial	**Medium**	**Low**	**No Change**
High	Major	Major	Moderate	Negligible
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
No importance	Minor	Negligible	Negligible	Negligible

8.2.5 Mitigation Measures

Mitigation measures are measures to prevent, reduce, control and/or offset adverse effects on sensitive receptors.

Various forms of mitigation are applied at different stages including:

- Embedded mitigation – changes to the Proposed Development design;
- Best Practice mitigation – physical measures to be adopted by the Proposed Development in its lifecycle; and
- Additional Mitigation – following embedded and best practice mitigation and initial assessment, and wherever reasonably practical, additional mitigation measures are proposed to reduce the effect level of Significant Effects (Major and/or Moderate) to non-Significant (Minor or Negligible).

8.3 Data and Consultation

8.3.1 Data Sources

The baseline is based upon the collection of information from a variety of data sources including published material. Table 8-5 details the data sources referred to throughout this assessment.

Table 8-5: Data Sources

Topic	Sources of Data and Information
Climate Rainfall	CEH National River Flow Archive Data https://www2.sepa.org.uk/rainfall/ (accessed 123/04/24)
Topography Elevation Relief	Ordnance Survey mapping, https://www.bing.com/maps/
Historic Maps	National Library of Scotland map images(accessed 24/11/23) including Stirlingshire Sheet nXXIII.NW (revised 1946, published 1951 and nXXII (published: 1952)
Surface Water WFD Status	SEPA water Classification Hub https://www.sepa.org.uk/data-visualisation/water-classification-hub/ (accessed 25/04/24) SEPA Water Environment Hub (accessed 25/04/24) https://www.sepa.org.uk/data-visualisation/water-

Topic	Sources of Data and Information
	environment-hub/
Flooding	Flood Risk Management Maps SEPA (accessed 25/04/24) https://map.sepa.org.uk/floodmap/map.htm
Groundwater	SEPA Water Classification Hub (accessed 25/04/04) https://www.sepa.org.uk/data-visualisation/water-classification-hub/ Groundwater Vulnerability Mapping of Scotland (1:625,000) Hydrogeological Map of Scotland (scale 1:625,000)
Geology	BGS Geology of Britain Viewer – bedrock and superficial deposits8https://mapapps.bgs.ac.uk/geologyofbritain/home.htmlr (accessed 09/07/23) BGS Geo index accessed xxx https://www.bgs.ac.uk/map-viewers/geoindex-onshore/ 1: 50 000 scale geology (including faults) BGS Lexicon (accessed 18/03/24) https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=ALV
Soil	Carbon and Peatland Map (accessed 25/04/24) https://soils.environment.gov.scot/maps/thematic-maps/carbon-and-peatland-2016-map/ Soil Survey of Scotland (accessed 25/04/24) https://map.environment.gov.scot/Soil_maps/?layer=2
Environmental Designations	https://magic.defra.gov.uk/MagicMap.aspx [Accessed xxx. https://www.nature.scot/professional-advice/protected-areas-and-species/protected-areas/national-designations/sites-special-scientific-interest-sssis
Mining	Coal Authority Interactive Maps (accessed (15/04/24) http://mapapps2.bgs.ac.uk/coalauthority/home.html
Private Water Supplies (PWS)	Details from PWS Register in consultation with THC
Scottish Water Assets	Site Investigation Services (Limited)
Drinking Water Protection Area	https://www.gov.scot/publications/drinking-water-protected-areas-scotland-river-basin-district-maps/ (accessed 25/04/24)
Nutrient Sensitive Areas	https://www.gov.scot/publications/nitrate-vulnerable-zones-maps/ (accessed 18/04/24)

8.3.2 Surveys

Site Visits

Several hydrological and hydrogeological site visits were conducted by John Ferry on 20 April 2021 and 3 February 2023.

The objective of the site visits was to map out and confirm water features on the ground, These included: watercourses, geo-morphology, soils, geology, existing tracks, watercourse crossings and potential GWDTE within the survey area.

Potential locations for the Proposed Development infrastructure were visited, as were several potential PWS sources. The purpose was to support provisional layouts, provide embedded mitigation design advice and to inform the hydrology and hydrogeology chapter.

Ecological Surveys

This Chapter relies upon the following surveys of the Proposed Development, as reported in Chapter 6: Ecology of this EIA Report:

- Extended Phase 1 Habitat survey - conducted in February 2023 following previous surveys in May 2020. The report was updated in April 2024 to reflect design freeze of the Proposed Development (see Technical Appendix 6-1: Extended Phase 1); and
- NVC surveys carried out of the Proposed Development plus a 250m buffer from the edge of the Proposed Development Site boundary - conducted in April 2023 following previous surveys in September 2020 and July 2021.

Peat

The British Geological Society (BGS) Geology of Britain Viewer (BGS, undated) was used to determine the likely presence of peat within the Proposed Development Site and to inform the scope of assessment required.

Peat depth probing was undertaken in multiple phases between 2021 and 2023 in accordance with Scottish Government Peatland Survey. Guidance on Developments on Peatland (2017) guidance. Probing efforts are summarised below:

- Phase 1 peat probing was undertaken in a number of phases, initially in the main wind turbine areas and then subsequently at lower elevations in the vicinity of potential access tracks – in total c. 2404 probes were taken on a 100m x 100m grid; and
- Subsequent (Phase 2) probing focused on refining infrastructure locations using a variety of grid spacing. The probing comprised:
    - A 10m x 10m grid within 50m of proposed turbines and at the proposed substation location;
    - A 25m x 25m grid between 50m and a 100m from proposed turbines and at proposed borrow pits and construction compounds; and
    - Five probes every 50m along proposed access tracks, set perpendicular to the track orientation and with a 10m spacing between each probe.

In total, 2,340 locations were probed.

Interpolation of peat depths was undertaken in the ArcMap GIS environment using a natural neighbour approach (Figure 8-3 Interpolated Peat Depths).

8.3.3 Consultation

The assessment process has been informed by:

- Stirling Council (SC) Pre-application Advice (Ref: PREAPP-2020-0093) dated 12/05/2020;
- EIA Scoping Report prepared by Atmos dated 17/07/2020;
- SCSC EIA Scoping Opinion dated 23/10/2020;
- SEPA EIA Scoping response (Ref: PCS/172780) dated 01/09/2020;
- Scottish Water EIA Scoping response (Ref: DSCAS-0021130-2Y4) dated 23/10/2020; and
- NatureScot EIA Scoping response (Ref: CEA160368/A3304723) dated 17/09/2020.

Following design iterations and additional surveys, further consultation was carried out prior to design freeze, as follows:

- SEPA Planning consultation email exchanges - 02/11/2022;
- SEPA Planning consultation email exchanges - 17/05/2023;
- Scottish Water response to a request for Environmental Information - 21/05/2024; and
- Stirling Council (SC) Environmental Health Officer - Private Water Supplies data within 3km of the Proposed Development Site (05/10/2023).

A summary of the key consultation responses is described in Table 8-6, together with a description of where and how these are addressed.

Table 8-6: Consultation

Consultee	Summary of Consultee Response	Where addressed within this Report
General		
SEPA (Pre-App)	Submit in support of the application. a) Map and assessment of all engineering activities in or impacting on the water environment including proposed buffers, details of any flood risk assessment and details of any related CAR applications. b) Map and assessment of impacts upon Groundwater Dependent Terrestrial Ecosystems and buffers. c) Map and assessment of impacts upon groundwater abstractions and buffers. d) Peat depth survey and table detailing re-use proposals. f) Map and site layout of borrow pits. g) Schedule of mitigation including pollution prevention measures. h) Borrow Pit Site Management Plan of pollution prevention measures. i) Map of proposed waste water drainage layout. j) Map of proposed surface water drainage layout. k) Map of proposed water abstractions including details of the proposed operating regime. l) Decommissioning statement.	These requirements are addressed in: • Figures 1-2 and 8-1 to 8-6; • Technical Appendix 15-1 Outline Construction Environmental Management Plan (CEMP); • Technical Appendix 8-3 Outline Peat Management Plan; • Section 8.7 of this Chapter (Mitigation). It is worth noting that: • Borrow pit layouts and management plans will be completed post consent, although the environmental context of borrow pits are shown on the figures; • Drainage layout, which will be produced post consent; • CAR applications will be prepared post consent as required; and • A decommissioning statement will be prepared post consent.
SEPA (Scoping) September 2020	The site layout must be designed to avoid impacts upon the water environment. Where activities such as watercourse crossings, watercourse diversions or other engineering activities in or impacting on the water environment cannot be avoided then the submission must include justification of this and a map showing: a) All proposed temporary or permanent infrastructure overlain with all lochs and watercourses. b) A minimum buffer of 50m around each loch or watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse and drawings of what is proposed in terms of engineering works. c) Detailed layout of all proposed mitigation including all cut off drains,	• Embedded Mitigation is described in section 8.5 and includes mitigation and sensitive design of water course crossings and 50m watercourse buffers wherever possible. In some cases existing track within the buffer will be used. Those which are not will be provided and numbered on a plan with photos etc. Following micrositing as final locations of infrastructure can still move (within 50m). These are discussed further in sections 8.5 (Assessment of Effects) and 8.7(Mitigation).) • Figures 8-1 to 8-6 all contain environmental data overlain on proposed infrastructure.

Consultee	Summary of Consultee Response	Where addressed within this Report
	location, number and size of settlement ponds.	• The detailed drainage design and layout will be completed post consent.
SEPA (pre-design Freeze) 2023	A CEMP has not been submitted at this stage but it is presumed that it will be and will incorporate detailed pollution prevention and mitigation measures for all elements of the proposal potentially capable of giving rise to pollution during all phases of construction, reinstatement after construction and final site decommissioning. This should cover all the environmental sensitivities, pollution prevention and mitigation measures identified to avoid or minimise environmental effects. Please refer to the Pollution prevention guidelines. As part of the CEMP, a construction method statement will be required for all works likely to affect water quality, such as road and turbine base construction, site compound, river crossings and borrow pits. Best practice advice prepared by SNH, SEPA and the windfarm industry Good Practice During Windfarm Construction should be referred to.	• An outline CEMP is included in Technical Appendix 15-1. This will be the initial iteration of the dynamic CEMP. • Post consent it will be supported and further informed by a Construction Method Statement (see Mitigation Schedule Table 8-25).
Surface Water Management/Drainage		
SEPA (pre-design freeze 2022)	The drainage impact assessment should identify natural drainage pathways and ensure they are not significantly impacted by any infrastructure (including the access roads and borrow pits). This would include any impact upon undisturbed peat depths nearby.	A Drainage Impact Assessment and detailed Drainage Management Plan will be prepared post consent. See 8.7.3 (Mitigation – Water Quality) and Mitigation Schedule Table 8-25.
SEPA (pre-design freeze 2022)	We welcome the use of the existing Craigengelt windfarm track for part of the access route as crossings on this section have already been authorised by SEPA. Where new crossings are identified (crossing tributaries of the Buckie and Bannock Burns?), these may require authorisation by way of a CAR application to SEPA.	The existing Craigengelt wind farm track has not been utilised as part of the Proposed Development. CAR applications will be applied for post consent for watercourse crossings. It should be noted that the Applicant is in discussions with the neighbouring Craigengelt Wind Farm to explore shared access opportunities, however due to the early stages of these discussions it has not been considered in this assessment.
SEPA (pre-design freeze 2022)	The Buckie Burn discharges into the Buckieburn reservoir, owned by Scottish Water. The reservoir is not a drinking water supply but provides water for the University of Stirling's Niall Bromage Research Unit at Easter Buckieburn. Any silt released during the construction works will flow into Buckieburn reservoir and will impact on water quality for NRBU, potentially increasing their water treatment	There is no connectivity with Buckieburn reservoir as shown on Figure 8-1 and discussed in 8.4.2 (Hydrology) and 8.4.7 (Public water supply).

Consultee	Summary of Consultee Response	Where addressed within this Report
	costs. The developers will need to have a robust management plan in place for the works.	
SEPA (pre-design Freeze) 2023	We recommend that a Drainage Management Plan is included within the CEMP. The applicant should consider the surface water drainage from all access roads, turbine foundations, site compounds, site buildings and borrow pits. Appropriate treatment must be provided prior to discharge to the water environment including settlement lagoons. The surface water from the site compound, turbine bases, tracks, roads and material stockpiles should be treated by a suitable SUDS system in accordance with General Binding Rule 10 of CAR.	A Drainage Management Plan will be included as sub plan to the next iteration of the outline CEMP. Discussed in mitigation section 8.7.3 (Mitigation – Water Quality) and Table 8-25.
SEPA (pre-design Freeze) 2023	In terms of the treatment of construction runoff from turbine bases and access roads, runoff should shed at regular intervals to grassland/blind ditches/silt settlement areas, particularly on steep slopes. Provision of adequately sized silt settlement lagoons will need to be provided in all areas of risk, particularly at borrow pits and with roads on steep inclines leading to watercourse crossing points.	As above
Public Water Supply		
Scottish Water (Pre-App and Scoping)	A review of our records indicates that the proposed activity falls within a drinking water catchment where a Scottish Water abstraction is located. Scottish Water abstractions are designated as DWPA under Article 7 of the Water Framework Directive. Craigengelt supplies Carron Valley Water Treatment Works (WTW) and it is essential that water quality and water quantity in the area are protected. It is confirmed the activity is likely to be low risk and is unlikely to impact on water quality at the Water Treatment Works. The site falls within a DWPA under Article 7 of the Water Framework Directive. Craigengelt supplies Carron Valley Water Treatment Works and it is essential that water quality and quantity in the area are protected. Scottish Water has produced a list of precautions for a range of activities. This details protection measures to be taken within a DWPA, the wider drinking water catchment and if there are assets in the area. Please note that site specific risks and mitigation measures will require to be assessed and implemented.	The Proposed Development Site is downgradient and not hydrologically connected to the Craigengelt DWPA. This is discussed further in section 8.4.7 (Public Water Supply). There are no public water supplies in hydrological connectivity and no associated DWPA this is discussed further in section 8.4.7 (Public Water Supply). Predicted effects and necessary mitigation are assessed in section 8.5.9 (Predicted Effects – Public Water Supplies) and section 8.7.6 (Mitigation – GWDTE).
Scottish Water	We welcome that reference has been made to the Scottish Water drinking	This is addressed in section 8.4.7 (Baseline for Public

Consultee	Summary of Consultee Response	Where addressed within this Report
	water catchment. The fact that this area is located within a drinking water catchment should be noted in future documentation. Also anyone working on site should be made aware of this during site inductions.	Water Supply), section 8.5.9(Potential Effects – Public Water Supply) and in section 8.7.6 (Mitigation – GWDTE)/Table 8-25 Mitigation Schedule.
Scottish Water Response to Environmental information request	North Third and Loch Coulter reservoirs are not in use to supply the public. They are used for compensation purposes. Scottish Water confirm this information is not available online and has to be obtained through the Freedom of Information process.	This is included in section 8.4.7 (Baseline Public Water Supply) and section 8.5.9 (Predicted Effects).
Private water supplies		
SC Environmental Health (Pre-App)	Watercourse crossing and their effect on existing private water course supplies are areas of concern.	There are no assessed effects from watercourse crossings on private water supplies (PWS). Watercourse crossings have been inspected and assessed. The findings are reported in sections 8.5.2 (Activities with Potential for Effects), 8.5.3 (Potential Effects), 8.5.4 (Embedded Mitigation), and 8.5.5 (Predicted Effects – Surface Water). Mitigations are addressed in section 8.7.5 (Mitigation – Private Water Supplies) for PWS and section 8.7.3 (Mitigation – Water Quality) for watercourse crossings.
SEPA (Scoping)	Excavations and other construction works can disrupt groundwater flow and impact on existing groundwater abstractions. The submission must include: a) A map demonstrating that all existing groundwater abstractions are outwith a 100m radius of all excavations shallower than 1m and outwith 250m of all excavations deeper than 1m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the site boundary where the distances require it. b) If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all existing groundwater abstractions affected.	PWS within a 3km radius are mapped on Figure 8-6. Hydrological and hydrogeological screenings for the 29 PWS identified are listed and screened in section 8.4.6 (Private Water Supply). Only one registered PWS and one unregistered pond were assessed as being within 250m of proposed infrastructure and in likely hydrological connectivity. These are further risk assessed in section 8.5.8 (Predicted Effects – Private Water Supplies) and mitigation discussed and recommended in section 8.7.5 (Mitigation – Private Water Supplies) and Table 8-25.

Consultee	Summary of Consultee Response	Where addressed within this Report
Peat		
SEPA (Scoping)	The submission must include: a) A detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland – Peatland Survey (2017)) with all the built elements (including peat storage areas) overlain to demonstrate how the development avoids areas of deep peat b) A table which details the quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement. Details of the proposed widths and depths of peat to be re-used and how it will be kept wet permanently must be included.	A detailed interpolated peat map overlain by the proposed infrastructure is provided in Figure 8-3. Peat surveys and their findings are described in this Chapter and in Technical Appendix 8.2 (Outline Peat Management Plan) and section 8.4.4 (Peat). An Outline Peat Management Plan (OPMP) is provided as Technical Appendix 8-3. This includes peat balance and details of peat management. The details of avoidance of peat are contained in the OPMP and in the Embedded Mitigation section discussion in this Chapter. Reuse of peat is described in the OPMP and summarised in the sections below together with proposed peat mitigations.
SEPA (Scoping)	Dependent upon the volumes of peat likely to be encountered and the scale of the development, applicants must consider whether a full Peat Management Plan is required or whether the information would be best submitted as part of the schedule of mitigation	An Outline Peat Management Plan is provided as Technical Appendix 8-3, with a full PMP proposed as mitigation
SEPA (pre-design freeze – 2022)	There are a couple of places where the new track appears to cross areas of peat identified as potentially greater than 1.5m deep. SEPA would need to know what type of peat this is, what condition it is on and whether it is part of a GWDTE. Where crossing peat cannot be avoided (by micro siting) the developer should indicate how much peat is to be disturbed and how it can be re-used on site for restoration purposes (details to be provided in a peat Management Plan). There may be a chance for joined up thinking here as there is a neighbouring site where a windfarm is proposed (Fairburn 2). Potentially, there could be an option to increase the amount of peat restoration on the two sites or on land in-between, if one site is excavating more peat than it can use for restoration. In the 2020 layout, a construction compound was marked in the southern section, On the peat depth map, tis correlates to a deeper area of peat. There	Excavation of peat >1.0m in depth by infrastructure has been avoided with the exception of two very small pockets at Turbine 3 and one small point at Turbine 4. Details of peat disturbance are provided in the OPMP. The construction compound is located on soil with no peat except for a small percentage. Its location is linked to the access track, and will be temporary. Its location is included on the interpolated peat Figure 8-3.

Consultee	Summary of Consultee Response	Where addressed within this Report
	is no indication in the 2022 Interpolated peat Depth map as to where the construction compound will be sited.	
SEPA (pre-design freeze 2023)	There are no quantification details provided with regards to the amount of waste peat this proposal will generate as there will be some peat disturbed but there is no information provided on the quantity. We will require a table which details the quantities of peat (including acrotelmic, catotelmic and amorphous) which will be excavated for each element and where it will be re-used during reinstatement. Details of the proposed widths and depths of any peat to be re-used and how it will be kept wet must be included. Dependent upon the volumes of peat likely to be encountered and the scale of the development, the applicant must consider whether a full Peat Management Plan (as detailed in the above guidance) is required or whether the above information would be best submitted as part of the schedule of mitigation. Also, floating roads are not mentioned. Are they planned as part of the Proposed Development?	There is an Outline Peat Management Plan, Technical Appendix 8-3. This states that no disposal of peat (i.e. export from the Proposed Development Site as waste) is proposed. This is backed up by a detailed peat balance within the OPMP.
SEPA (Post-Design Freeze) 2023	With regard to the excavation of turf and arisings, these should be stockpiled on impervious sheeting, away from any watercourses and not on any wetlands, before being backfilled into the trench to prevent drying out. Turfs should be cut in a random fashion to prevent the surface, on reinstatement, becoming preferential pathways for water. Reinstatement should replace the soils in the original layering.	These peat management issues are addressed in the OPMP (Technical Appendix 8-3).
GWDTE		
SEPA (Scoping)	A map demonstrating that all GWDTE are outwith a 100m radius of all excavations shallower than 1m and outwith 250m of all excavations deeper than 1m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the site boundary where the distances require it. If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all GWDTE affected.	Potential GWDTE NVC are shown on Figure 8-5a and Assessed GWDTE on Figure 8-5b. Embedded GWDTE avoidance mitigation is discussed in section 8.5.3 (Potential Effects). Their occurrence and ecological/hydrogeological risk assessments are discussed in section 8.4.8 (GWDTE). Predicted effects are given in section 8.5.10 (Predicted Effects – GWDTE) and recommended mitigations identified in section 8.7.7 (Mitigation

Consultee	Summary of Consultee Response	Where addressed within this Report
		Schedule).
SEPA (pre-design freeze) 2023	There are many watercourses and flushes present on the proposed site. The GWDTE and flush areas marked on the map should be avoided by micro-siting infrastructure where possible. However, the eastern-most borrow pit appears to be within a flush habitat. Can it be moved?	Design layout avoidance of potential GWDTE is discussed in the Embedded Mitigation section of this Chapter.
SEPA (pre-design freeze) 2023	Mitigation measures to maintain the functionality of wetlands and prevent structures from becoming preferential conduits of water should be included within the CEMP where avoidance is not possible. It is recommended that the time between excavating and backfilling of individual sections of cable trench is minimised near GWDTEs. As a rule, we advise backfilling within three days to minimise drying and disturbance. Where the cable trench passes through sensitive GWDTE habitat, construction should include impermeable barriers and/or clay plugs to avoid the trench acting as a preferential conduit of groundwater. Areas of identified sensitivity (GWDTE and flushes) should be marked out / fenced-off to prevent accidental vehicular access. Any areas identified as wetlands should not be used to treat contaminated water.	Specific mitigation in relation to construction activities will be included in the CEMP.
Designated Sites		
Nature Scot (Scoping)	No Sites of Special Scientific Interest (SSSIs) or Special Areas of Conservation (SACs) are likely to be impacted by this Proposed Development due to the distance from the site and the nature of the protected features. We agree it is therefore appropriate to scope these out of further assessment.	These are included in baseline in section 8.4.10 (Designated Sites) and confirmed as scoped out.
Borrow Pits		
SEPA (Scoping)	The following information should also be submitted for each borrow pit: a) A map showing the location, size, depths and dimensions. b) A map showing any stocks of rock, overburden, soils and temporary and permanent infrastructure including tracks, buildings, oil storage, pipes and drainage, overlain with all lochs and watercourses to a distance of 250 metres. Demonstrate that a minimum 10m buffer can be achieved around each loch or watercourse. c) Provide a justification for the proposed location of borrow pits and evidence of the suitability of the material to be excavated for the proposed use, including any risk of pollution caused by degradation of the rock.	Proposed infrastructure is illustrated on Figure 1-2 and overlain onto Figures 8-1 to 8-6. This includes the locations and extent of the borrow pits demonstrating that they are outside of 50m watercourse buffers. Watercourses and waterbodies are marked on water feature plan Figure 8-1. A preliminary borrow pit appraisal has been undertaken and is included in Technical Appendix 3-1. This will be expanded further following consent

Consultee	Summary of Consultee Response	Where addressed within this Report
	d) A ground investigation report giving existing seasonally highest water table including sections showing the maximum area, depth and profile of working in relation to the water table. e) A site map showing cut-off drains, silt management devices and settlement lagoons to manage surface water and dewatering discharge. Cut-off drains must be installed to maximise diversion of water from entering quarry works. f) A site map showing proposed water abstractions with details of the volumes and timings of abstractions. g) A site map showing the location of pollution prevention measures such as spill kits, oil interceptors, drainage associated with welfare facilities, recycling and bin storage and vehicle washing areas. The drawing notes should include a commitment to check daily. h) A site map showing where soils and overburden will be stored including details of the heights and dimensions of each store, how long the material will be stored for and how soils will be kept fit for restoration purposes i) Sections and plans detailing how restoration will be progressed including the phasing, profiles, depths and types of material to be used. j) Details of how the rock will be processed in order to produce a grade of rock that will not cause siltation problems during its end use on tracks, trenches and other hardstanding.	and additional ground investigations and will include consideration of depths, likely silt arisings and management and overburden. Following this, design of borrow pits will also be prepared and provided post consent. These will include details of borrow pit depths, water table configurations, planned dewatering, drainage, overburdens, material storage, pollution prevention and management, etc.
Pollution Prevention		
SEPA (Scoping)	One of our key interests in relation to developments is pollution prevention measures during the periods of construction, operation, maintenance, demolition and restoration. A schedule of mitigation supported by the above site specific maps and plans must be submitted. These must include reference to best practice pollution prevention and construction techniques (for example, limiting the maximum area to be stripped of soils at any one time) and regulatory requirements. They should set out the daily responsibilities of ECOWs, how site inspections will be recorded and acted upon and proposals for a planning monitoring enforcement officer.	A pollution prevention plan will be included as part of the CEMP post-consent.

8.4 Baseline Conditions

8.4.1 Topography, Setting and Land Use

The Proposed Development Site is located in approximately 10km southwest of Stirling in the Fintry, Gargunnock and Touch Hills as shown on Figures 1-2. Sheep and cattle grazing are the main land uses within the Proposed Development Site with occasional grouse shooting.

The Proposed Development Site covers an area of land c. 4km in length from west to east, and 1.5km wide north to south.

The northern boundary of the Proposed Development Site is the Bannock Burn which runs in a deep valley with occasional gorges with waterfalls. The southern boundary is the track to Craigengelt Wind Farm, although at the time of writing this assessment, this will not be used for the Proposed Development.

The western boundary is a minor road connecting the B818 (in the south) to the Polmaise Road in the north. The southeast boundary is the New Line minor road and the northeast boundary is plantation.

The Proposed Development Site is located over low hills with elevation rising from c.206 m Above Ordnance Datum (AOD) on the eastern site boundary, via Muirpark Farm at 220m AOD, to Drummarnock Hill at 278m AOD in the centre. Elevation continues to rise westwards to several unnamed eastern hills (373 and 357m AOD), then falls away to the south and north. Earls Hill at 441m AOD rises on the other side of the western boundary.

A central water divide runs across the Proposed Development Site from west to east separating the Bannock Burn catchment in the north from Buckie Burn and Loch Coulter Burn catchments in the southwest and the southeast respectively. There are two central wetland peat filled valleys at c265m AOD, flowing north and south into the Bannock and Buckie Burns respectively.

An existing farm track from New Line Road runs west through Muirpark Farm and north of Drummarnock Hill, and stops at the central valley. There are no existing tracks on the western part of the Proposed Development Site.

8.4.2 Hydrology

General

A Water Features Plan showing surface water catchments is presented in Figure 8-1.

The Proposed Development Site drains into three SEPA WFD surface waterbodies:

- Bannock Burn (Source to Sauchie Burn confluence) waterbody;
- River Carron (Carron Valley Reservoir to Avon Burn Confluence) waterbody via the Buckie Burn sub catchment; and
- Auchenbowie Burn (Loch Coulter Reservoir to River Carron) waterbody, via Loch Coulter Burn.

The hydrology of the surface waterbodies, and the Proposed Development infrastructure within each, is discussed below. The waterbodies WFD status and classification details are given in Tables 8-7, 8-8 and 8-9.

Bannock Burn (Source to Sauchie Burn confluence) Waterbody

The north of the Proposed Development Site drains directly into the Bannock Burn (Source to Sauchie Burn confluence) waterbody (ID: 6831) in the Stirling Coastal catchment of the Scotland river basin district. It is designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water storage, namely for hydroelectricity generation.

The Bannock Burn rises south and west of Touchadam Muir, north of Earls Hill, and several km northwest of the Proposed Development Site. It flows east along the northern boundary and is joined by several small unnamed north flowing tributaries from within the northern edges of the Proposed Development Site.

These in turn are fed by flushes, rills, springs and seepages. The Bannock Burn flows off site in the northeast to join the North Third reservoir (also used for hydroelectric purposes) 750m downstream. The Bannock Burn continues through the reservoir for approximately 1km, and then emerges to flow around south Stirling and onwards into the upper Forth Estuary.

Several of the proposed borrow pits, and approximately 1.7km of proposed access track drain into the Bannock Burn and its tributaries. There are three watercourse crossings (WC4, WC5 and WC6) of unnamed tributaries of the Bannock Burn.

North Third reservoir is in this catchment and is used for compensation purposes. Typically, this is to provide a discharge of water (known as a compensation flow) to the downstream watercourse.

The Bannock Burn waterbody overall status is 'Poor' but with an objective to improve to Good by 2027. It has high water quality status, moderate to good water flows and hydrology condition, but poor ecology and fish status.

Table 8-7: WFD Status - Bannock Burn (Source to Sauchie Burn Confluence)

Parameter	SEPA Classification Hub 2020	SEPA Environment Hub conditions in 2021	2027 Objective
Overall Status	Poor	Good	Good
Overall Ecology	Poor	N/A	N/A
Fish	Poor	N/A	N/A
Access for fish migration/barriers to fish	Good	Good	Good
Water Flows and Level/Overall Hydrology	Moderate	Good	Good
Physical condition/hydro-morphology	Moderate	Good	Good
Freedom from Invasive Species	N/A	High	High
Water Quality	High	High	High

River Carron (Carron Valley Reservoir to Avon Burn Confluence) WaterbodyW

The Proposed Development Site drains via multiple east and southeast flowing tributaries into the Buckie Burn, a tributary of the River Carron. Thus, indirectly, the Proposed Development is part of the River Carron (Carron Valley Reservoir to Avon Burn Confluence) waterbody (ID: 4202) in the River Carron (Falkirk catchment) of the Scotland river basin district. The Proposed Development Site does not drain directly into this water body.

This water body is designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water storage for public drinking water. This is mainly due to the major Scottish Water Carron reservoir 8km upstream of the Proposed Development Site.

The Buckieburn reservoir, 1.5km south of the Proposed Development Site, is located on a southern tributary of the Buckie Burn. It is in the same surface water body as the Proposed Development but is 44km upgradient.

The Buckie Burn rises on site in two main tributaries in the west of the Proposed Development Site. These flow southeast through the west of the Proposed Development.

These tributaries in turn are sourced from emerging flushes, rills, springs and seepages on the undulating hills and from discharge from within blanket mires along their length. The tributaries join together into a single Buckie Burn stem in the centre and flows out of the Proposed Development Site in the centre southwest of the Hill of Drummarnock. The Buckie Burn joins the River Carron 3.5km southeast of the Proposed Development Site.

Over 3km of the proposed access tracks, the four wind turbines and parts of two borrow pit search areas, drain into the Buckie Burn and its tributaries. There are no proposed watercourse crossings in this waterbody.

The waterbody has an overall ‘Good’ environmental status. It has ‘High’ status for water quality and fish and moderate ecology but Moderate to Good water flows, hydrology and physical condition.

Table 8-8: WFD Status - River Carron (Carron Valley Reservoir to Avon Burn Confluence)

Parameter	SEPA Classification Hub 2020	SEPA Environment Hub conditions in 2021	2027 Objective
Overall Status	Good	Good	Good
Overall Ecology	Moderate	N/A	N/A
Fish	High	N/A	N/A
Access for fish migration/barriers to fish	High	Good	Good
Water Flows and Level/Overall Hydrology	Moderate	Good	Good
Physical condition/hydro-morphology	Moderate	Good	Good
Freedom from Invasive Species	N/A	High	High
Water Quality	High	Good	Good

Auchenbowie Burn (Loch Coulter Reservoir to River Carron) Waterbody

The east of the Proposed Development Site (apart from a small northern slice) is part of the Auchenbowie Burn (Loch Coulter Reservoir to River Carron) waterbody, a river (ID: 4210), in the River Carron (Falkirk) catchment of the Scotland river basin district.

Approximately 1.5km of the proposed eastern access track, access track Options A and B, and two watercourse crossings WC1 and WC2, the substation and the temporary construction compound are present in this waterbody.

Much of the eastern half of the Proposed Development Site drains east and southeast from the Hill of Drummarnock, via a network of drain watercourses, especially in the marshy land west of Muirpark. The watercourses and drains are sourced from emerging flushes and seepages in and around Drummarnock Hill and are further fed by spring and groundwater along their length.

The drainage joins a northern tributary of Loch Coulter Burn 1.5km further northeast and downgradient of Loch Coulter. Loch Coulter Burn in turn flows into Auchenbowie Burn a further 2km east, then into the River Carron, 9km southeast of the Proposed Development Site and then into the Middle Forth estuary.

The drainage alterations have been extensive over the last 80 years as shown by the historic OS maps. In these areas, the ground is still wet and marshy, despite the relatively wide drainage network that has been cut.

The Auchenbowie Burn waterbody is also designated as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact on water storage for public drinking water.

Loch Coulter reservoir is in this catchment and is used for compensation purposes. Typically, this is to provide a discharge of water (known as a compensation flow) to the downstream watercourse.

The overall status of the waterbody is 'Moderate' with an objective to improve to 'Good' by 2027. Water Quality and fish status are high but water levels and flow are only moderate.

Other morphology pressures on the water body leading to the moderate ecological potential of this waterbody are mixed farming and weirs/offtakes associated with a fishery.

The diversion of flow from the Auchenbowie Burn to the Bannock Burn in the adjacent Stirling coastal catchment has recently been identified by the River Carron Fisheries Management Group as a pressure on the Auchenbowie Burn. SEPA are currently investigating this, and a flow regulation pressure will be added to the water body and future classification amended accordingly.

Table 8-9: WFD Status - Auchenbowie Burn (Loch Coulter Reservoir to River Carron)

Parameter	SEPA Classification Hub 2020	SEPA Environment Hub conditions in 2021	2027 Objective
Overall Status	Moderate	Moderate	Good
Overall Ecology	Poor	N/A	N/A
Fish	High	High	High
Access for fish migration/barriers to fish	High	High	

Parameter	SEPA Classification Hub 2020	SEPA Environment Hub conditions in 2021	2027 Objective
Water Flows and Level/Overall Hydrology	Moderate	Moderate	Good
Physical condition/hydro-morphology	Poor	Moderate	Good
Freedom from Invasive Species	N/A	High	High
Water Quality	High	High	High

8.4.3 Geology

Geological maps of the study areas are presented as Figure 8-2a Superficial Geology, and Figure 8-2b Bedrock Geology. These are mapped from 1:50,000 scale publicly available BGS digital data.

Bedrock

The bedrock geology is mostly Carboniferous Gargunnock Hills Lava Member Igneous (basaltic) bedrock. These basaltic rocks are likely to be exploited for the proposed borrow pits. Small parts of the northeast along the Bannock Burn overly the Carboniferous Midland Valley Sill-Complex with micro-gabbros, and the Hurlet and Limestone Coal Formation limestones.

Superficial

BGS digital data maps show that the superficial geology overlying the bedrock on the majority of the western half of the Proposed Development Site is largely peat with a smaller sporadic coverage of peat in the east. There are several small areas of hummocky glacial deposits and till amongst the peat in the west. It is presumed the peat is founded on these relatively low permeability glacial deposits.

The bulk of the Proposed Development Site in the east is mapped as being on Devensian diamicton till. Alluvium deposits (clay, very soft to very stiff, silt, sand and gravel) are mapped along the Bannock Burn in the northeast and in the central southern Buckie burn watercourses.

The properties of the cohesive till (firm to very stiff or hard slightly gravelly sandy clay with few cobbles and boulders) will cause excavations to be stable in the short term, but the water-bearing layers/lenses of silt, sand and gravel and the presence of fissures can significantly decrease stability.

Mining

There is no record of coal mining within the Proposed Development Site. The nearest Coal Mining Reporting area is approximately 1km northeast and 2km2 east. There are several small sand pit quarries in the southwest off site near Craigengelt Hill.

Soils

The soils underlying the centre and east of the Proposed Development Site are mapped on Scotland's National Soil maps as Darleith Soil Association with non-calcareous and humic gleys component soils, derived from basaltic rocks.

The soils in the higher ground to the west are also Darleith Soil Association but with peaty gleyed podzols and gleys reflecting the wider abundance of peat.

The soil map of Scotland shows a more complex suite of soils:

- Poorly drained peaty gleys of the Myres Soil Map Unit in the marshy land around Muirpark and in the west;
- Imperfectly drained non calcareous gleys of the Dunlop Soil Map Unit in the centre; and
- Peaty gleyed podzols freely drained below iron pan, of the Baidland Soil Map Unit in the uplands in the west.

8.4.4 Peat

Details of peat on the Proposed Development Site can be found in the Outline Peat Management Plan (Technical Appendix 8-3) which provides a detailed description of peat and site geomorphology. The interpolated peat depth model is presented in Figure 8--3 with the Proposed Development layout superimposed.

While peat is present over much of the main infrastructure area in the west, it is fairly shallow, rarely exceeding 1m in depth, and where it does so, only in isolated pockets. These pockets can however contain deep peat up to 2m thick. In the eastern half of the Proposed Development Site, peat is generally absent, except for a few localised areas, and only exceeds 1 m in thickness in one of these areas.

Peat is formed over undulating bedrock or on relatively impermeable glacial deposits. It thickens to form planar deposits between local topographic highs. While sphagnum is locally present, it is not necessarily widespread and heather and grasses dominate.

There is little evidence of erosion in terms of gullying or other typical peatland geomorphological features. Peat is sufficiently thin that no pipes were identified during walkover. No signs of incipient instability were noted. No amorphous peat was found on site.

The inset map on Figure 8-3 shows the Carbon and Peatland (2016) Map. This indicates that much of the western hills comprise Class 4 (area unlikely to be associated with peatland habitats) and Class 5 soils (no peatland habitat recorded).

In the east, the map portrays mineral or Class 3 soils (dominant vegetation is not priority peatland habitat). NVC mapping (see Chapter 6 of the EIAR) shows priority ‘blanket bog’ and ‘upland flushes and rush pastures’ peatland habitats across much of the western half of the Proposed Development Site.

Peat sensitivity is regarded as Medium as there is no class 1 or Class 2 peat, although there are priority peatland habitats, especially in the west.

8.4.5 Hydrogeology

Description

The BGS Hydrogeological map of Scotland classifies the Proposed Development Site as in a region ‘underlain by impermeable extrusive rocks, generally without groundwater except at shallow depths, although rare springs may occur from systems of near surface joints’.

The BGS Groundwater Vulnerability map of Scotland classifies the majority of the area, the igneous extrusive lava members, as weakly permeable. These are defined as; '*…formations of generally low permeability that do not widely contain groundwater in exploitable quantities, although some formations can locally yield groundwater supplies in sufficient quantities for private/domestic use*'.

There are several very small areas of moderately permeable geological strata. These coincide with areas where alluvium is mapped along watercourses. These areas are in the south central Buckie Burn and in northeast along Bannock Burn.

No significant springs were identified on site. However, old and current historic OS maps show springs or 'collects' or 'rises' occurring:

- On the north and the eastern flanks of Craigengelt Hill at 310-330m AOD;
- On high ground in the west of the Proposed Development Site, between 310 and 330m AOD;
- As a further set of springs on relatively lower ground in the centre and east of the catchment, 150m NNW and 300m South of Muirpark, at 220-230m AOD; and
- In the northeast corner of the Proposed Development Site.

These springs give rise to tributaries of the Buckie and Bannock Burns.

The western high level springs are close to the catchment divide and arise from return flow on the hillsides. They may correspond to interfaces between peat and more permeable glacial hummocky deposits. The eastern lower level springs may be associated with interactions between alluvial and less permeable diamicton deposits.

WFD Groundwater Bodies

The Proposed Development Site is located within two groundwater waterbodies as shown on Figure 8-1.

Carron and Touch Groundwater Body

The majority of the Proposed Development Site is underlain by the eastern part of this 125km^2 groundwater waterbody which corresponds to the Gargunnock Hill lavas. Its water quality status is given in Table 8-10. Both quantitative and qualitative status, water quality and water flows and levels are 'Good'.

Table 8-10: WFD Status – Carron and Touch Groundwater Body

Parameter	Water Classification Hub 2022	Water Environment Hub 2021	Water Environment Hub Long term Objective
Overall status	Good	Good	Good
Water Flows and Level	N/A	Good	Good
Water Quality	Good	Good	Good
Quantitative Status	Good	N/A	N/A
Chemical Status	Good	N/A	N/A

Stirling Groundwater Body

The north and northeast of the Proposed Development Site is underlain by the western edge of this of this 92km^2 groundwater waterbody. This part of the Stirling groundwater body maps to the underlying Midland Valley Sill complex and the Carboniferous Hurlet limestone.

Its water quality status is given in Table 8-11. Its overall status is 'Poor' due to Poor water quality from pollution mining legacy. SEPA considers this can only recover slowly by natural means which accounts for the Good upgrade objective by 2027.

Table 8-11: WFD Status – Stirling groundwater body

Parameter	Water Classification Hub 2022	Water Environment Hub 2021	Water Environment Hub Objective 2027
Overall status	Good	Poor	Good
Water Flows and Level	N/A	Good	Good
Water Quality	Poor	Poor	Good
Quantitative Status	Good	N/A	N/A
Chemical Status	Poor	N/A	N/A

All of Scotland is in a Drinking Water Protected Area for groundwater.

8.4.6 Private Water Supply (PWS)

SC provided details of PWS within 3km of the Proposed Development Site from their public register database. They also advised that their main register for PWS is at least 5 years out of date.

Details were provided for 29 PWS. The list of PWS is given in Table 8-12. The plotted location of the PWS is shown on Figure 8--6. For each water supply details comprised: the address, NGR and source type (borehole, burn, spring or well). No ID number was supplied.

It is not clear whether the address is the supply source location or the venue supplied. The data also gave no indication of type, i.e. whether domestic, holiday let, commercial, agricultural, nor the number of people supplied, nor other indication of volume of use. As such it is incomplete.

However, the data was sufficient for screening to be carried out as to potential hydrological connectivity. The results of the screening of the PWS with respect to the potential for hydrological or hydrogeological connectivity with the Proposed Development are summarised in Table 8-12.

With only one exception, the PWS are scoped out for one of the following reasons:

- The PWS is a surface water abstraction and is not within the same surface waterbody as the Proposed Development;
- The PWS is a surface water abstraction and is within the same surface waterbody but is upgradient of the Proposed Development;
- The PWS is a surface water abstraction and is several km downgradient of the Proposed Development with other watercourses in between; and
- The PWS is a groundwater abstraction but distant from the Proposed Development such that the local character of the groundwater suggests that the PWS supply derives from a different groundwater flow path.

The only PWS considered to be potentially in hydrological connectivity with the Proposed Development is Muirpark Farm spring PWS. This will therefore be subject to a hydrogeological and hydrological assessment in section 8.5.

Table 8-12: Private Water Supplies Within 3km

Address	Source	N	E	Hydrogeological Screening
Berryhill, Polmaise Road, Cambusbarron,, FK7 9QT	Spring	275220	690077	Located 2.5km N of nearest infrastructure. It is north of Bannock Burn and with different unconnected hydrogeology and hydrology so no connectivity.
Shieldbrae house, Polmaise Road, Cambusbarron,, FK7 9QT	Burn	275249	689722	Located 2.25km N of nearest infrastructure. It is also north of Bannock Burn and with different unconnected hydrogeology and hydrology so no connectivity.
Townhead Farm, Greathill Road, Stirling FK7 9QS	Spring	274856	689060	Located 1.5km N of nearest infrastructure north of Bannock Burn and with different unconnected hydrogeology and hydrology so no connectivity.
Greathill House, Greathill Road, Stirling,, FK7 9QS	Spring	275231	688920	Located 1.5km N of nearest infrastructure close to North Third reservoir and north of Bannock Burn Bannock Burn and with different unconnected hydrogeology and hydrology so no connectivity.
Woodside Cottage, Sauchieburn, Stirling,, FK7 9PZ	Burn	278525	689561	Located >3km NW of nearest infrastructure and on other side of North Third reservoir. No hydrological or hydrogeological connectivity with Proposed Development.
Sauchieburn Mansion House, Sauchieburn, Stirling,, FK9 9PZ	Spring	277416	689236	Located 2.25km N of nearest infrastructure and on the opposite side of North Third reservoir. No hydrological or hydrogeological connectivity with Proposed Development.
Badgers Cottage, Sauchieburn, Stirling,, FK9 9PZ	Spring	277931	688962	No hydrological or hydrogeological connectivity with Proposed Development. As several kilometres downgradient
Todholes Cottage, Greathill Road, Stirling,, FK7 9QS	Burn	275244	688020	Located N of Bannock Burn and with different unconnected hydrogeology so no connectivity.
Muirpark Farm, Carronbridge,, FK7 9QS	Spring	275554	687124	The NGR given is for the supply destination, not the source. The farmhouse is fed by a spring to the SWof the property. The exact source location is unknown. It is possibly within 250m of proposed watercourse crossing and proposed access track

Address	Source	N	E	Hydrogeological Screening
				(Option B). As such it may be in hydrological or hydrogeological connectivity with the Proposed Development.
	Pond (unregistered agricultural pond)			There is a pond belonging to Muirpark farm adjacent (5m) to WC3. This is not a registered PWS and is used for agricultural use. It is in direct hydrological connectivity with that element of the infrastructure. However it is believed that it is owned by the landowner
Craigquarter Farm, Canglour, Chartershall, Stirling, FK7 9QP	Spring	278191	687409	Located 2km E of nearest infrastructure and on the opposite side of Canglour Glen. No hydrological or hydrogeological connectivity with Proposed Development Site.
Shankhead Farm, Carronbridge, FK7 9QS	Burn	275016	685909	Located 1.5km S of nearest infrastructure. Although in same surface waterbody and downgradient of drainage from Proposed Development, it is separated by several watercourses. No hydrological or hydrogeological connectivity with the Proposed Development Site.
Doghillock Cottage, Canglour, Stirling, FK7 9QP	Borehole	278289	686465	Located 2.25km ESE from the nearest infrastructure and in entirely different waterbody. No hydrological or hydrogeological connectivity with Proposed Development Site.
Meikle Canglour Farm, Stirling, FK7 9QP	Spring	277574	686470	Located 1.75km ESE from the nearest infrastructure and in entirely different waterbody. No hydrological connectivity with site.
Hallquarter House, Canglour, Stirling, FK7 9QP	Borehole	278284	686024	Located 2.4km ESE from the nearest infrastructure and in entirely different waterbody. No hydrological or hydrogeological connectivity with site.
Hallquarter North Cottage, Canglour, Stirling, FK7 9QP	Borehole	278275	686346	Located 2.3km ESEESE from the nearest infrastructure and in entirely different waterbody. No hydrological or hydrogeological connectivity with site.
Myres Farm, Chartershall, Stirling, FK9 9QP	Borehole	278768	686461	Located 2.8km ESE from the nearest infrastructure and in entirely different waterbody. No hydrological or hydrogeological connectivity with site.
Easter Buckieburn Farm, Carronbridge, FK6 5JJ	Well	275393	685599	Located almost 2km S of nearest infrastructure. A well is marked on

Address	Source	N	E	Hydrogeological Screening
				OS here. The shallow geology is of boulder clay. The well is separated from the site by the large distance and multiple small hills and watercourses and discontinuous hydrogeological connectivity. No hydrogeological connectivity.
Lochend Farm, Carronbridge, FK6 5JJ	Spring	275878	685530	1.75km S of nearest infrastructure. Not in surface water connectivity as different surface waterbody, highly unlikely to be shallow hydrogeological connectivity.
Ryecroft, Polmaise Road, Fintry, FK7 9QX	Spring	272527	688125	Although SC PWS register states the source is a burn as per, this property is not fed by a burn, but rather a spring to the northwest of the property. Although the exact location is undefined, it is on the SW slopes of Earls Hill above a tributary of the Bannock Burn and upgradient and at least 600m NW of the nearest infrastructure of wind turbine 1 and proposed track construction areas. No hydrological or hydrogeological connectivity.
Earlsburn Cottage, Polmaise Road, Fintry, FK7 9QX	Burn	270650	688313	Located approximately 3km south of nearest infrastructure. On the opposite side of BuckieBurn reservoir. No hydrological connectivity.
Easter Cringate Cottage, Polmaise Road, Fintry, FK7 9QX	Spring	271735	687540	Although the source is listed as a burn on SC PWS register, this property is not fed by a burn, but rather a spring to the north of the property. There is a spring marked on OS maps 100m E of Easter Cringate, but the actual spring is purported to be 100m N. It is located in hummocky glacial deposits and is at least one km W and entirely upgradient of the nearest infrastructure (wind turbine 1 and access tracks).) It is separated by several tributaries of the Buckie Burn. There is no hydrogeological connectivity.
Cairnoch Lodge, Polmaise Road, Fintry, FK7 9QX	Burn	270414	686812	Located 2,4km and upgradient of the nearest infrastructure and in a different surface waterbody. No connectivity.
Townfoot of Dundaff, Carronbridge, FK6 5JJ	Spring	274975	684640	Located 2.7km SE of nearest infrastructure. The well is separated from the site by the large distance and multiple small

Address	Source	N	E	Hydrogeological Screening
				hills and watercourses and discontinuous hydrogeological connectivity, no groundwater connectivity.
Shielwalls, Carronbridge, FK6 5JJ	Spring	274556	684633	Located 2.75km S of nearest infrastructure in different hydrogeological settings from Proposed Development, no groundwater connectivity.
Drum Farm, Carronbridge, FK6 5JL	Burn	272769	684398	>3l km SE of infrastructure and upgradient - no hydrological connectivity.
Easterton Cottage, Carronbridge, FK6 5JL	Burn	272209	684183	Several km SE of infrastructure and across Earls Burn - no hydrological connectivity.
Craigannet Farm, Carronbridge, FK6 5JL	Burn	271817	684077	Several km SE of infrastructure and across Earls Burn - no hydrological connectivity.
Earlsburn Cottage, Carronbridge, FK6 5JL	Burn	272902	684034	Several km SE of infrastructure and across Earls Burn - no hydrological connectivity.

8.4.7 Public Water Supply

Surface Water

Scottish Water advised in their EIA Scoping response that;

> *"…the proposed activity falls within a drinking water catchment where a Scottish Water abstraction is located. Scottish Water abstractions are designated as Drinking Water Protected Areas (DWPA) under Article 7 of the Water Framework Directive. Craigengelt supplies Carron Valley Water Treatment Works (WTW) and it is essential that water quality and water quantity in the area are protected".*

The Craigengelt DWPA mentioned by Scottish Water is the nearest DWPA to the Proposed Development. This DWPA comprises a large area west and southwest and feeds into Loch Carron reservoir.

However, the surface water catchments shown on the Water Feature plan, Figure 8-1, and discussed in 8.4.2, identify that this DWPA is entirely upgradient of the Proposed Development. There is therefore no hydrological connectivity.

Parts of the Proposed Development are in the same River Carron (Carron Valley Reservoir to Avon Burn Confluence) waterbody as the Buckieburn reservoir owned by Scottish Water.

As part of their consultation response (section 8.3.3), SEPA advised that The Buckie Burn discharges into the Buckieburn and noted that, although the reservoir is not a drinking water supply it provides water for the University of Stirling's Niall Bromage Research Unit at Easter Buckieburn. Accordingly, they recommend protective measures.

However, the surface water catchments shown on the Water Feature plan, Figure 8-1 and discussed in 8.4.2, identify that the Buckieburn reservoir is 1km south and in a different sub catchment from the Proposed Development.

Only southern tributaries of the Buckie Burn which are not connected with the Proposed Development supply Buckieburn reservoir. The Proposed Development Site is therefore upgradient of and does not drain to Buckieburn reservoir. There is therefore no hydrological connectivity.

Scottish Water has advised that North Third reservoir and Loch Coulter reservoirs are not in use to supply the public. The Scottish Government maps of surface water DWPAs in the Scotland River Basin District (RBD) show there are no formal DWPA associated with these reservoirs.

North Third Reservoir is less than 1km downgradient of the Proposed Development Site and is in hydrological connectivity via the Bannock Burn.

There is no proposed infrastructure in Loch Coulter Reservoir catchment and therefore no down gradient hydrological connectivity.

8.4.8 GWDTE

Definition

UKTAG (2004) guidance defines GWDTE as;

> *"…a terrestrial ecosystem of importance at Member State level that is directly dependent on the water level in or flow of water from a groundwater body (that is, in or from the saturated zone). Such an ecosystem may also be dependent on the concentrations of substances (and potential pollutants) within that groundwater body, but there must be a direct hydraulic connection with the groundwater body."*

A groundwater body in turn is defined by the WFD (2006) as;

> *"…a distinct volume of groundwater within an aquifer or aquifers where an aquifer is a subsurface layer or layers of rocks or other geological strata that is capable of supporting abstraction of 10 cubic meters per day on average or sufficient to serve 50 or more people; or provides a flow of groundwater the reduction of which may result in a significant diminution of the ecological quality of an associated surface water body, or significant damage to a directly dependent terrestrial ecosystem."*

Ecological GWDTE Assessment

Technical Appendix 6-2 National Vegetation Classification Survey reports that the following vegetation communities occur within the Proposed Development Site, as shown on Figure 8-4:

- Dry Heaths - H9, H21;
- Grasslands and tall herb communities - MG10, U2U4, U6;
- Mires - M2, M4, M6, M9, M25;
- Blanket and raised Mire - M19, M20;
- Rush Pasture - M23; and

- Rill and spring – M35.

The ecological assessment of potential GWDTE is reported in Chapter 6 Ecology. Habitat types likely to be moderately or highly groundwater dependent (according to SEPA (2017)) are identified in Table 8-13. Areas of potential GWDTE within 250 m of infrastructure is shown on Figure 8--5a.

Table 8-13: Potential GWDTE Communities within the Proposed Development Site

NVC code	NVC community name	Potential groundwater dependency	Area within 250m of Infrastructure (ha)
M6	Carex echinata – Sphagnum fallax mire	High	11.26
M23	Juncus effusus/acutiflorus - Galium palustre rush pasture	High	31.76
M35	Ranunculus omiophyllus – Montia fontana rill	High	0.17
M9	Carex rostrata - Calliergon cuspidatum/C.giganteum mire	High	0.014
M25	Molinia caerulea – Potentilla erecta mire	Moderate	7.05
MG10	Holcus lanatus - Juncus effusus rush pasture	Moderate	74.62
U6	Juncus squarrosus - Festuca ovina grassland	Moderate	3.14

Hydrogeological Risk Assessment

A hydrogeological risk assessment was carried out to determine whether these potentially highly or moderately dependent GWDTE identified in the ecological assessment are actually groundwater dependent and in what degree, according to the following descriptions:

- High likelihood of groundwater dependence, is where plant communities are highly reliant on groundwater flows levels or chemistry with negligible reliance on other sources of water; or
- Moderate likelihood of groundwater dependence is where plant communities are moderately reliant on groundwater flows, levels or chemistry, but may also be reliant on other sources (e.g. rainfall, surface water).

GWDTE Overview

The eastern half of the Proposed Development Site drains into Loch Coulter Burn and has extensive artificial drainage dominated by mesotrophic grassland, mostly MG10 rush pasture but also some M23 rush pastures in low wet depressions with one tiny area of M9 mire. These are on thin peats or peaty and mineral soils.

The east and west of the Proposed Development Site are separated by a linear wetland valley some 80-100m wide. This drains both north into the Bannock Burn and south into the Buckie Burn. The valley is filled with peat and there are slow flowing channels, stagnant water and deep pools. Vegetation communities are M20 raised mires, M6 flushes and M25 mires amongst blanket bog.

The western half of the Proposed Development Site has partial peat coverage. Habitats are a mosaic of rain fed blanket bog, shrub heath and unimproved acid grassland with M6 acid flushes and M23 rush pastures on sides of hills and valley bottoms. These become minor watercourses in the lower slopes. While sphagnum is locally present, it is not necessarily widespread and heather and grasses dominate.

M6 *Carex echinata – Sphagnum fallax* mire

M6 is considered by SEPA (2017) as potentially highly groundwater dependent. It is a poor-fen with small sedges or rushes dominating over a carpet of oligotrophic and base-intolerant Sphagnum spp.

It is the major soligenous mire community found on peat substrates irrigated by acidic waters. It typically occurs as small stands among other mire communities, grassland and heaths and sometimes with swamp and spring vegetation.

At the Proposed Development Site it occurs as strips up to 30m wide in valley bottoms, sloping valley sides or channels either side of Buckie Burn and Bannock Burn tributaries. Where multiple watercourses converge and in depressions in the landscape, there can be a wider area of M6. M23 is also found in the south of the 80 -100m wide central wetland valley. There is very little occurrence in the east.

The M6 is often in peat valleys fed by lateral seepage of groundwater from blanket bogs or raised mires. It is also fed by surface water run-off and flow water. However, it is considered that the fundamental water supply is groundwater flushes and seepages and as such the M6 is confirmed as highly groundwater dependent GWDTE.

M23 *Juncus effusus/acutiflorus - Galium palustre* rush pasture

M23 is considered by SEPA (2017) as potentially highly groundwater dependent. M23 rush pasture is a community of gently-sloping ground around the margins of soligenous flushes, as a zone around topogenous mires and wet heaths, and is found in ill-drained, comparatively unimproved or reverted pasture. It occurs over moist to wet, lowland, peaty and mineral soils.

At the Proposed Development Site, it is found in a similar hydrogeological and geo-morphological habit as the M6. There are many linear watercourse margin M23 patches in the western half of the site. These are up to 200m long x 30 - 100m wide and typically on peat substrate.

Watercourse valleys in the east and the west are generally either M6 or M23. The larger M23 basin east of Muirpark through which the track passes is on poorly drained pastures.

The M23 areas are noticeably very wet, often fully saturated, and are located on wet peat. Water supply for M23 is very similar to that for M6. The main water supply is groundwater flushes and groundwater bottoms. It is therefore considered that the fundamental water supply is groundwater and as such the M23 is also confirmed as highly groundwater dependent GWDTE.

M9 Carex rostrata - Calliergon cuspidatum/C.giganteum mire

M9 sedge mire is here present as 0.014 ha in amongst a much larger patch of M23. This is typically a community characteristic of soft, spongy peats kept permanently moist by at least moderately base-rich and calcareous waters usually above 6. It is commonest in wetter parts of topogenous mires in hollows or old peat workings, but also around springs raised mires and marshes. It is typically too wet to be grazed. Here, it is not on deep peat but is likely on a deep drain. It is treated as part of the M23 habitat and highly groundwater dependent GWDTE.

M35 *Ranunculus omiophyllus – Montia fontana* rill

M35 is considered by SEPA (2017) as potentially highly groundwater dependent. It is considered nationally scarce (Pescott, 2016). M25 and a rare moss, *Hamatocaulis vernicosus,* were recorded on a small area of M35 on the slope above the east edge of the central wetland valley, northwest of Drummarnock Hill.

The moss is a species that is protected under Schedule 8 of the Wildlife & Countryside Act 1981 (as amended) it is also listed on Annex II of the EC Habitats & Species Directive, and Appendix I of the Bern Convention. Strictly its protection and assessment are a matter for ecology but as it is found in potentially highly groundwater dependent M35, the same impact pathway will apply to both M35 and the rare moss.

M35 is a diverse community that is often small in size and found in wet runnels, springs or depressions in the landscape where there is irrigation by circumneutral and probably quite oligotrophic waters with pH values ranging from 4.5 to 6.5 over acidic rocks. These rills typically have a cover of vascular plants and bryophytes. Much of the growth is often submerged in the shallow waters, with a floating or shortly emergent canopy.

The source of the water for the two occurrences at Drummarnock is springheads on the edge of the wetland valley and a seepage line along a watercourse valley in the east. As such, M35 is confirmed as a highly groundwater dependent community.

M25 *Molinia caerulea – Potentilla erecta* mire

M25 is considered by SEPA (2017) as potentially moderately groundwater dependent. This community occurs on moderately wet, shallow peat and is found where there is a transition from the areas of deeper peat (M19 + M20 communities) and the more improved marshy grasslands or heath.

At the Proposed Development Site M25 is found in a small area in the south of the central wetland valley next to blanket bog above a watercourse and on a southern hillside in the east, both in peat. Both are in hydrological settings similar to the M23 and M6 and are considered to be moderately groundwater dependent.

Some M25 is found in mosaic with M19 blanket mire. These occurrences are not considered to be at most, low to moderate GWDTE.

MG10 *Juncus effusus – Holcus lanatus* rush pasture

MG10 is listed by SEPA (2017) as potentially moderately groundwater dependent. This mesotrophic grassland community is associated with neutral, poorly drained, permanent pastures on permanently moist soils. It is maintained by grazing.

At the Proposed Development Site it is widespread and the main vegetation community in the eastern half of the site. True to type, it is associated with the extensively drained areas in the east which are no longer completely waterlogged. They are largely found on the mineral soils or in some places thin peaty soils. The wetter patches are M23 rush pastures.

The M25 then is on moist but not saturated soils and will be supplied by a combination of rainfall and surface run-off as well as a deeper fluctuating water table. M25 is considered as moderately groundwater dependent GWDTE.

U6 *Juncus squarrosus - Festuca ovina* grassland

U6 is considered by SEPA (2017) as potentially moderately groundwater dependent. The community is found on low altitude meadow or pasture land. It is often associated with a diversity of bog, grassland or heath associates, and is dominated by Heath Rush *Juncus squarrosus*. It typically occurs on poorly-drained peaty podzol managed systems which are used to provide winter feed (hay) or grazing for domestic livestock.

There is only a very limited occurrence here on an elevated hilltops in the south centre amongst widespread MG10. It is not considered to be groundwater dependent.

GWDTE Summary Finding

The ecological and hydrogeological assessments are summarised in Table 8-14 and shown in Figures 8--5a and Figure 8-5b.

Table 8-14: Hydrogeological GWDTE Assessment

NVC Community	Ecological Dependency Assessment	Hydrogeological Dependency Assessment	Area within 250m of Infrastructure (ha)
M35 Ranunculus omiophyllus – Montia fontana rill	High	High	0.17
M6 Carex echinata-Sphagnum fallax /denticulatum mire	High	High	11.26
M23 Juncus effusus/acutiflorus - Galium palustre rush pasture	High	High	31.76
M9 Carex rostrata - Calliergon cuspidatum/C.giganteum mire	High	High	0.014
M25 Molinia caerulea – Potentilla erecta mire	Moderate	Moderate	7.05
MG10 Holcus lanatus – Juncus effusus rush-pasture	Moderate	Moderate	74.62
U6 Juncus squarrosus - Festuca ovina grassland	Moderate	Not GWDTE	3.14

These potential GWDTE habitats do not occur on a major groundwater body, nor derive from an aquifer or aquifers capable of supporting abstraction of 10 cubic meters per day. The groundwater body they come from is very discontinuous and interference with the GWDTE will hardly result in a significant diminution of the ecological quality of associated surface water bodies.

8.4.9 Flooding

Based on the Scottish Environment Protection Agency (SEPA) Flood Map, there is no mapped risk of river flooding, surface water flooding, or coastal flooding on the Proposed Development Site, other than in the watercourses on site. Flooding is regarded as Low sensitivity.

8.4.10 Designated Sites

There are no environmental designations within the Proposed Development Site.

Within 6km of the Proposed Development Site boundary, the following environmental designations with hydrological qualifying features are present. These have been screened for hydrological connectivity, as discussed below. Their locations are illustrated on Figure 1-3.

Denny Muir SSSI

Denny Muir is located 4km from the Proposed Development Site boundary. Its hydrological qualifying features are: Basin fen, Blanket bog and subalpine acid grassland. Blanket bog is entirely rain fed whilst basin fen will have local surface water and groundwater supplies. Although in the same River Carron (Carron Valley reservoir to Avon Burn) surface waterbody as the Proposed Development, Denny Muir lies south of the River Carron from the Proposed Development, there can therefore be no surface water connectivity. Similarly, though it is in the same large Carron and Touch groundwater waterbody as the Proposed Development, the groundwater in this is generally very local and likely to be associated with local surface water basins. Water supply to Denny Muir will therefore not derive from the area of the Proposed Development.

Balquhidderock Wood SSSI

Balquhidderock Wood is located 5km east of the Proposed Development on the east side of Stirling. It is an ancient, wet woodland, mainly alder and oak, with a particularly diverse ground-flora. It is also has a variety of other smaller habitat 'pockets' (such as spring and flush areas) which add to its ecological interest. It is located on a steep slope and contains several burns, and wet, marshy areas. One of the management objectives is 'To maintain the wet conditions in the woodland'.

The SSSI is in a different surface waterbody - Bannock Burn (Sauchie Burn confluence to Steuarthall Farm) than that on the Proposed Development Site. The SSSI is also 9km distant via the watercourse. There is not considered to be hydrological connectivity either with surface or groundwater.

8.4.11 Sensitivity of Potential Receptors

Receptor sensitivities are assigned in Table 8-15. These are assessed with respect to the foregoing baseline findings and the sensitivity criteria in Table 8-2.

Table 8-15: Receptor Sensitivity

Receptor	Assessed Sensitivity	Reason
Surface Water Quality and Physical condition	High	The Proposed Development drains to three surface waterbodies with a range of overall WFD status – Poor, Moderate and Good, All have an objective of 'Good' Status by 2027. One of the waterbodies drains into North Third reservoir used by Scottish Water for compensation. All the surface waterbodies have High to Good water quality but only Poor to Moderate ecology and hydrology.
Groundwater bodies	Medium	The Proposed Development is weakly or largely impermeable except for shallow groundwater.
GWDTE	High - moderate	The groundwater does support a number of highly groundwater dependent GWDTE occurrences, viz. M6, M23 and M35 and several moderately groundwater dependent GWDTE, viz. MG10 and M25, within 250m of infrastructure.

Registered Private Water Supply (PWS)	High	There is one PWS in potential hydrological continuity - Muirpark PWS - in the centre of the eastern side of the Proposed Development.
Un registered agricultural water supply	Medium	There is an agricultural pond in direct proximal contact with and downgradient of infrastructure. However it is unregistered and owned by wind farm land owner.
Public Water Supply	High	The Proposed Development is not in a DWPA and there are no downstream public water supplies.
Flooding	Low	Apart from watercourses and their immediate flood plains, there are no areas of river or surface water flood risk.
Mining	Low	There are no current or legacy mining areas within the Proposed Development Site.
Statutory Designated Sites	Low	There no hydrologically connected or geologically designated sites.
Peat	Medium	There is no class 1 or Class 2 peat although there are some priority peatland ‘blanket bog’ and ‘upland flushes and rush pastures’ habitats, especially in the west.

8.4.12 Future Baseline

It is assumed that the natural baseline will remain unaltered through the lifetime of the Proposed Development.

8.5 Assessment of Effects

8.5.1 Introduction

Sensitive hydrology, geology and hydrogeology receptors are:

- High sensitivity – Surface and groundwater quality, high groundwater dependent GWDTE, Private and Public Water supplies; and
- Medium sensitivity – Peat, medium groundwater dependent GWDTE and unregistered agricultural pond and groundwater.

Mining, flood risk and designated sites are scoped out as they are not sensitive receptors at the Proposed Development.

Activities with the potential to cause effects on these sensitive receptors, and the type of potential effect are identified in section 8.5.2 and 8.5.3 respectively. The assessment of potential effects takes into account the embedded mitigation by design as listed in section 8.5.4. Predicted effects are assessed and reported in Sections 8.5.5 to 8.5.10 for each set of sensitive receptors for construction, operation and decommissioning.

8.5.2 Activities with Potential for Effects

A description of the development and activities is given in Chapter 3, summarised in 8.1.2, and detailed further below under ‘Construction’. A plan of the Proposed Development Site is shown on Figure 3-1a Detailed site layout. The activities which may give rise to potential effects are:

Construction

- Duration of construction will be 12 months;

- 6.59km of new access tracks, of which up to 5.8km is anticipated to be constructed, dependent upon the access option utilised, with 0.5m verges with several turning heads and spur junctions will be excavated and constructed;
- 0.6km of floating track will be constructed with no excavation. The access tracks will be constructed using 'cut and fill track' design. Topsoil is stripped to expose a suitable rock or sub-soil horizon on which to build the track. Subject to final design by a qualified contractor, it is likely the track will then be built up on a geotextile layer by laying and compacting crushed rock to a depth dependent on ground conditions and topography;
- Cables will be laid within trenches excavated in track access verges at a depth of 50cm. All peat and soil excavated prior to cable placement will be directly reinstated after installation;;
- Four turbines will be installed. Their foundations will be circa 3m deep, or to bedrock. Each turbine will have a circular foundation (indicatively 27.4m diameter). Each turbine will have a permanent primary crane hardstanding hard standings and temporary installation areas.
- Secondary temporary hardstanding will be constructed at each turbine for the nacelle storage area, blade storage area and working areas during construction.
- Up to six new watercourse crossings will be constructed. Existing crossings will need significantly strengthened/upgraded;
- One temporary construction compound, 100m x 80m;
- Permanent excavation and construction of a substation compound, 35m x 30m;
- Up to four borrow pits at a maximum of 5m depth. No site investigation of soils or bedrock has been carried out to date. Site investigations are required to assess the extent of the geological unit and the soil and rock characteristics at the four identified borrow pit search areas;
- Earthworks (cut and fill);
- Dewatering of excavations and trenches;
- Installation of drains, temporary and permanent;
- Stockpiling of soils and peat;
- Exposure of bare earth;
- Discharge of water;
- Storage and use of oils, fuels and chemicals;
- Concrete pouring;
- Site reinstatement; and
- Vehicle use.

Operation

- Duration up to 40 years;
- Ongoing use of access tracks;
- Ongoing use of substation;
- Permanent drainage;
- Storage and use of oils; and
- Maintenance of turbines, hardstandings, access tracks and cables.

Decommissioning

- Duration 12 months;
- Removal of all major equipment and structures;
- The upper sections of the foundations will be removed to a depth which will permit the continuation of current land use practices;
- Additional on-site access tracks will be removed and the affected area reinstated, unless required for land management;
- Underground cables will be left in place and de-energised;
- The crane hardstanding adjacent to a turbine will be removed, and reinstated;
- Stockpiling of soils and peat;
- Some drainage will remain;
- Use of reactivated temporary compounds, storage and use of oils, fuels and chemicals; and
- Vehicle use.

8.5.3 Potential Effects

Potential effects of the Proposed Development on hydrological, geological and hydrogeological receptors include:

- Potential effects on surface water quality from sediment and other pollution releases, and on surface water flow;
- Potential effects on groundwater quality and groundwater flow;
- Potential effects on GWDTE, including direct and indirect loss and disturbance;
- Potential effects associated with in scope private and public water supply abstractions, linked to reduction in yield and contamination; and
- Potential effects including direct and indirect loss and disturbance of peat habitats, carbon rich deep peat soils and their hydrology.

8.5.4 Embedded Mitigation

Embedded mitigation is mitigation which has been built into the layout design. The Proposed Development design process prior to design freeze has iteratively, since 2020, taken into account a series of constraints including:

- Landscape character and visual amenity;
- Ground conditions, topography and peat;
- Proximity to noise sensitive receptors;
- Presence of watercourses, private water supplies and related infrastructure;
- Presence of sensitive ecology receptors;
- Presence of sensitive cultural heritage features;
- Presence of telecommunication and aviation/radar constraints; and
- Proximity to suitable grid connection.

The key design iterations that have taken place are described in Chapter 3 – Description of Development. These include Scoping layout, post Scoping layout (Design Chill) and final layout (Design Freeze).

Specifically of interest to this Chapter, embedded mitigation included the avoidance and minimisation of disturbance to sensitive hydrology and hydrogeology receptors mainly water quality, peat and GWDTE. Knowledge of these was based on the findings of the desk and field-based surveys and implemented within the wider constraints. Key relevant layout embedded mitigations are discussed below.

Whilst the incorporation of these measures has helped to reduce the magnitude or likelihood of some potential hydrological, hydrogeological and peat effects occurring, it was not always possible to avoid connectivity with or disturbance of sensitive receptors.

Specific embedded mitigation for hydrology, hydrogeology and peat are discussed below:

General Layout

Multiple changes were made to onsite access track routes including:

- Access from the east rather than the south and west;
- Reduction to four turbines from original six turbines; and
- Changes in locations of substation, borrow pits and construction compound.

Floating Tracks

Floating tracks will be used, thereby avoiding excavation, where peat depths >0.5m, where gradients allow and where lengths and cut and fill requirements do not preclude their construction. Circa 6,340m^3 of peat excavation has been avoided through the use of floating track. Crushed stone layers (depth dependent on ground conditions) will be laid on geotextile/geogrid reinforcement to form the track, which results in the site track being raised above the peat surface.

Water Quality

The Proposed Development has been designed to minimise construction works in the vicinity of mapped watercourses and to minimise the need for new water crossings in order to reduce the risk of pollution and changes to watercourse morphology. Tracks skirt above headwaters of watercourses wherever possible.

A 50m buffer was maintained on watercourses mapped on 1:50,000 (OS base mapping) and a 20m buffer on smaller watercourses that appear on 1:10,000 mapping, as shown on Figure 8-1. This could not always be achieved and is summarised further below:

- On the existing southern access track B, where it is deemed there is less impact by utilising existing tracks where possible;
- When tracks approach a watercourse crossing;
- On water divides between two opposite flowing watercourses; and
- On small stretches of the central approach track, due to need to maintain suitable gradients and avoid deep peat.

GWDTE

Direct and indirect loss of potentially high groundwater dependent GWDTE was avoided as far as possible. This is clearly shown by comparison of the widespread occurrence of potentially highly groundwater dependent NVC and the significant avoidance shown on Figures 8- 8-5b. Specifically:

- Turbine 2 was moved to reduce impacts on potential Groundwater Dependent Terrestrial Ecosystems (GWDTE);
- Highly dependent M23 and M6 were generally avoided as they are within the 50m watercourse buffers where the M6 flushes and much of the rush pasture M23 typically occur;
- One of the borrow pits in the centre of the Proposed Development Site was moved east to minimise deep peat and to avoid M23 rush pasture high dependency GWDTE;
- The track close to WC5 was oved south to avoid disturbance of M35 *Ranunculus omiophyllus - Montia fontana* rill and associated rare moss.

Peat

Although peat is relatively widespread in the western infrastructure area, overlap with deep peat has been minimised as far as possible given other constraints. This is demonstrated on Figure 8-3 and further itemised in Technical Appendix 8-3 Outline Peat Management Plan. This has resulted in:

- Turbines 1 and 4 were moved outwith deeper peat areas;
- Avoidance of peat >1.0m in depth by excavated infrastructure (with the exception of two very small pockets at Turbine 3 and one small point at Turbine 4);
- Routing of tracks to thinner areas of peat or to areas of soil;
- Adoption of floating track (thereby avoiding excavation) where peat depths > 0.5m, where gradients allow and where lengths and cut and fill requirements do not preclude their construction.

8.5.5 Predicted Effects – Surface Water

Sediment pollution of watercourses

There is a high potential for turbid sediment laden surface water run-off from rainfall onto exposed bare earth, exposed peat, stockpiles of excavated materials, and access tracks. The sediment run off will occur during construction from excavation works for turbine, hardstanding foundations, cabling and access tracks and operation and development of borrow pits and construction compounds. Further sediment releases may arise from temporary watercourse diversions and drainage discharge.

Such sediment run off could degrade surface water quality and associated hydro morphology, fauna and flora and other uses of water including compensation flow downstream of North Third reservoir. The fine sediments and other pollutants can smother or poison plants and animals directly or the habitats they depend on. These risks will be exacerbated by the increased pathways for such pollution to move fast given the likely extensive temporary and permanent drainage.

There is direct hydrological connectivity with the Buckie Burn, Bannock Burn and Loch Coulter Burn and their tributaries, and there is infrastructure in all three waterbodies. There is no connectivity with Loch Coulter reservoir, but there is connectivity with North Third reservoir, used for compensation flow downstream.

Infrastructure within the North Third reservoir catchment comprises: several borrow pits, circa 1.7km of track and three watercourse crossings (WC4, WC5 and WC6) of unnamed tributaries of the Bannock Burn. There is already very significant embedded mitigation around these watercourses as well as major dilution from the Bannock Burn. The track, borrow pits and WC5 are between 2.5km and 3km west and upgradient from the reservoir. This affords significant further dilution of releases. The small area of track and WC6 are closest to North Third reservoir but the crossed watercourse is short with little flow and is 0.5km upgradient. In addition to the significant dilution and diffusion, the area affected by the activities within the catchment is very small. Changes in the surface drainage patterns will be very limited and temporary and effectively, these changes will be negligible in relation to the extensive flow feeding North Third reservoir. It is therefore unlikely that the proposal will impact on the use of North Third reservoir for compensation.

All waterbodies have High or Good water quality status although ecological status is at best Moderate, but also Poor in some waterbodies. There is embedded mitigation with 50m watercourse buffers in place and track layout avoidance of drained and wet areas and watercourses.

It is concluded that there is a risk of impact on surface water quality from sediment release. This is particularly likely during construction and heavy rainfall periods where mobilisation of this sediment by rainfall run-off can overwhelm drainage protection. The effect may occur but to a much lesser effect during operation of access tracks, and during decommissioning.

- **During Construction** - the effects occurring are direct, probable and adverse, and medium term. The magnitude of the predicted effects is *Medium*. Given the high sensitivity of watercourses, the predicted effect without additional mitigation is *Major* and therefore *Significant*.
- **During Operation** - with a functioning permanent drainage system installed with settlement ponds and swales, and borrow pits no longer operational, it is considered that there will be reduced sediment available for mobilisation. The magnitude will reduce to *Low*. Consequently, the predicted effect during operation is *Moderate* and therefore *Significant*.
- **During Decommissioning** - there will be very limited excavation and bare earth due to leaving buried infrastructure in the ground and allowing track to naturally regenerate. There will be slight increased risks over the operational period of the wind farm but the magnitude will remain *Low*. The predicted effect is *Moderate* and therefore *Significant*.

Surface Water Chemical and Hydrocarbon Pollution

There is potential for accidental spills, leakage and spillage of polluting substances. The risks will arise from accidents with vehicle and plant movement, pouring or leaching of concrete, use of temporary compounds and from borrow pit operation, including for refuelling, the use and storage of fuels, oils and other potentially polluting substances.

This risk will be exacerbated by the increased pathways for such pollution to move fast given the extensive temporary and permanent drainage. If realised, these risks will lead to potential pollution of surface water and associated flora and fauna.

There is embedded mitigation including avoidance of surface water features and further attenuation due to watercourse buffers.

- **During Construction -** effects will occur during Construction given the high level of activity necessitating chemicals, fuel etc. on site and will be adverse, direct and medium term. The magnitude of the predicted effects is considered *Medium*. Given the high sensitivity of watercourses, the predicted effect is *Major* and therefore *Significant*.
- **During Operation** - it is considered that there will be reduced use and storage of polluting substances on site and as borrow pits will no longer be operational. The magnitude is therefore considered to be *No Change*. The predicted effect during operation is *Negligible* and therefore *Not Significant*.
- **During Decommissioning** - will have slightly increased risks over operation but as there will be very limited excavation and bare earth, the magnitude will be *Low*. Therefore, the predicted effect is *Moderate* and therefore *Significant*.

Watercourse Crossings

Embedded mitigation in the layout design has avoided water course crossings as much as possible with tracks designed to skirt above headwaters of watercourses wherever possible. These are the main areas where there is no 50m buffer zone, for obvious reasons. It is also likely that there will be some flow diversion associated with watercourse construction.

Further water quality risks from sediment and other pollution will arise from watercourse crossing construction and operation. Watercourses were identified as those marked on the OS 1:50,000 scale map which will require crossings. Crossings of minor watercourses were also identified at OS 1:25,000 scale mapping, where possible.

Dependent on which access route option is constructed up to six watercourse crossings will be constructed on the Proposed Development Site. These are described in detail in Technical Appendix 8-1 and shown on Figure 8-1.

The water crossings are located on tributaries of Loch Coulter Burn and Bannock Burn. There are no watercourse crossings in the Buckie Burn catchment or waterbody and non-named watercourses will be crossed.

- WC1, WC2 and WC3 already exist but will require substantial upgrade. The existing crossing locations may have to move slightly due to earthworks on new access track. All three of these water course crossings cross tributaries of the Buckie Burn.
- WC4, WC5 and WC6 are on tributaries of the Bannock Burn. WC4 currently exists but will require upgrades and WC5 and WC6C will be new crossings.

The risks to water quality are considered greatest:

- At the new crossings WC5 and WC6;
- At existing cossing WC3 imemediately upgradient of an agricutural pond; and
- At WC1 which has the largest flow of the watercourse crossings.

WC2 is a relatively minor crossing as is WC4 which is essentially a drain crossing only.

WC5 is required to allow access to the wind turbines which are located on the west side of the Proposed Development Site. It crosses the sensitive central peat filled valley with watercourse channels and pools. Given the sensitivity of this area, significant efforts were made to relocate it. Ultimately, however, no matter where the WC is placed this central peat and GWDTE filled wetland has to be crossed and there will be effects on the wetland. The design presented is considered the optimum way to cross this complex area and minimise disruption to peat, blanket bog and GWDTE.

WC 1 is also essential to allow practical access given the planned avoidance and prioirity to avoid other constraints.

It is worth noting that should access Option A be constructed, WC1 would not be required. Similarly, should access Option B be constructed, WC6 would not be required.

- **During Construction** - the sediment and other pollution effects occurring at watercourse crossings are particularly likely during Construction and would be medium term, adverse and direct. The magnitude of the predicted effects is potentially *Substantial* at WC1, WC3, WC5 and WC6 and *Medium* at WC4 and WC2. Given the high sensitivity of watercourses, the predicted effect is *Major* and therefore *Significant*.
- **During Operation** - it is considered that there will be very much reduced sediment or other pollution available for mobilisation. The magnitude of the predicted effect is therefore *Low*. Consequently, the predicted effect during operation is *Moderate* and therefore *Significant*.
- **During Decommissioning** – this phase will have slightly increased risks over operation but as there will still be very limited excavation and bare earth due to leaving buried infrastructure in the ground and allowing track to naturally regenerate, the magnitude will remain *Low*. The predicted effect is *Moderate* and therefore *Significant*.

Change in surface water flow

Some increased surface water run-off is likely due to the increased areas of new permanent hardstanding and access tracks and an increase and/or change in drainage both temporary and permanent. Further changes in flow will arise from dewatering of excavations and discharge of water and removal or blocking of existing field drains.

The consequent change in the surface water flow regime will affect the natural drainage patterns, baseflow, volume, retention, infiltration and run-off rates. These in turn will potentially damage hydro-morphology, fish, other fauna and flora and the WFD Status of the receiving watercourses.

Assessment of the potential for changes in surface water flow affecting private and public water supply are given in section 8.5.8 and section 8.5.9.

- **During Construction** - the initial effects will occur during and after *Construction*. The magnitude of the predicted effects is considered *No change*. Given the high sensitivity of watercourses, the predicted effect is *Negligible* and therefore *Not Significant*.
- **During Operation** - it is considered that there will be little further change in surface water flow. The magnitude is considered to be *No Change*. The predicted effect during operation is *Negligible* and therefore *Not Significant*.
- **During Decommissioning** - will have slightly increased risks over operation but as there will be very limited excavation and bare earth, the magnitude will be *No Change* and therefore predicted effect is *Negligible* and therefore *Not Significant*.

8.5.6 Predicted Effects – Groundwater

Groundwater effects on PWS and GWDTE from the activities are considered separately in section 8.5.8 and section 8.5.10.

Change in groundwater flow regime

The majority of the Proposed Development Site is underlain by the lavas of the Carron and Touch groundwater body. These are of Good overall WFD status. They are only weakly permeable. Contained groundwater is shallow and discontinuous, often emerging as springs and seepages feeding the many watercourses in the area.

In the northeast corner the Stirling groundwater body occurs, comprising Midland Valley Sill complex and the Carboniferous Hurlet limestone. It has poor overall WFD Status. These and overlying valley alluvium are moderately permeable but also contain only shallow near surface groundwater and also giving rise to springs, issues and seepage lines feeding the watercourses.

There are no national or locally important aquifers .

There is no specific groundwater related embedded mitigation.

Changes in the groundwater recharge and flow regime will occur due to increased hard standings, buried foundations, excavations and temporary groundwater dewatering and discharge from excavations; and the long term presence of access track substrate. Such changes will alter shallow groundwater infiltration recharge patterns locally and will potentially affect baseflow to watercourses. However, it is considered that such changes will be very local and minimal given the shallow discontinuous nature of the groundwater and the widespread small watercourses in part fed by groundwater.

- **During Construction** - there is unlikely to be identifiable change to stream flow due to changes in groundwater base flow. Changes to recharge will be relatively minor and local. The magnitude of the predicted effects will therefore be *Low*. The predicted effect, given the medium sensitivity of the groundwater is *Minor* and therefore *Not Significant*.
- **During Operation** - it is considered that there will be little further change in ground water flow. The magnitude is considered to be *No Change*. The predicted effect during operation is *Negligible* and therefore *Not Significant*.
- **During Decommissioning** - will have no further effect. The magnitude will be *No Change* and therefore predicted effect is *Negligible* and therefore *Not Significant*.

Change in groundwater quality

Activities which will cause the effect are releases of contaminating chemical, fuel and other spills and leaks into groundwater. This will affect streams via contaminated base flow. These will occur via drainage, dewatering, spills from vehicle and plant movement, mixing, pouring and leaching of concrete and use of temporary compounds, all of which have the potential to use and store fuels, oils and other potentially polluting substances.

- **During Construction** - by far the most use of potential polluting substances will be in the *Construction* phase. The magnitude of the predicted effects is considered *Low* as the groundwater flow paths are short especially in comparison to surface drainage and flow. The predicted effect is *Minor* and therefore *Not Significant*.

- **During Operation** - it is considered that there will be low risk of spills to groundwater. The magnitude is considered to be *No Change*. The predicted effect during operation given the medium Sensitivity of the groundwater is *Negligible* and therefore *Not Significant*.
- **During Decommissioning** - will have slightly more chemicals etc. than operationally, on site. Magnitude is considered *Low*. Therefore, the predicted effect is *Negligible* and therefore *Not Significant*.

8.5.7 Predicted Effects – Peat

Loss, disturbance and degradation of peat

Embedded mitigation design avoided and minimised peat disturbance and sought to maintain peat hydrology as much as possible. Embedded design mitigation and best practice with regard to peat is described in sections 8.5.4 and in the PMP Technical Appendix 8-3.

However, due to the nature of occurrence of peat, it was not possible to completely avoid deepest peat. Some unavoidable disturbance to peat will take place.

For the much of the Proposed Development Site, no peat will be excavated. A small number of localised areas of cut track are required in peat, but these are typically on the approaches to hardstanding or over short distances of peat where transition pieces between cut and fill and floating track will limit the length of floating track to the point of it offering little excavation saving.

With the cut and fill earthworks, the underlying soil or peat will be removed to either accommodate the ‘cut’ or provide a sound substrate for ‘fill’ materials. Earthworks around temporary infrastructure are treated as temporary sites.

Permanently excavated peat and soil will be removed from the infrastructure sites and stored locally for future reuse. Other infrastructure turbine-related infrastructure will be temporarily excavated; materials including peat will be removed from the infrastructure Site, stored locally and fully reinstated at the point of excavation post-construction.

The volume of peat, broken down into acrotelm and catotelm, anticipated to be excavated is given in Table 8-16 by infrastructure component. This is summarised in Table 8-17.

Organic soils < 0.5m in depth are classed as soil. Where peat occurs, the upper 0.3m of the peat profile is assumed to be acrotelm. A 0.3m thickness of turf and underlying peat is a sufficiently thick continuous layer to avoid damaging the roots of the excavated vegetation and provide a coherent ‘turf’ to relay. The remaining depth is assumed to be catotelm. No amorphous peat was found.

Table 8-16: Peat excavation volumes for all infrastructure

Infrastructure	Type of Excavation	Excavation Volume (m3)			
		Acrotelm	Catotelm	Peat Total	Soil
Turbine foundation	Permanent	384	457	841	426
Main crane hardstanding	Permanent	513	983	1,495	725
Auxiliary crane hardstanding	Permanent	320	540	860	393

Infrastructure	Type of Excavation	Excavation Volume (m3)			
		Acrotelm	Catotelm	Peat Total	Soil
Tower storage area	Permanent	184	281	465	774
Substation	Permanent	0	0	0	125
Borrow Pits	Permanent	1,065	923	1,988	10,904
Onsite access track (cut and fill)	Permanent	1,625	1,972	3,597	6,426
Turning head	Permanent	36	35	71	773
Earthworks – cut	Permanent	3,651	4,678	8,329	8,962
Earthworks – fill	Permanent	387	542	929	1,854
	Subtotal	**8,165**	**10,411**	**18,575**	**31,362**
Nacelle storage area	Temporary	274	337	611	28
Blade storage area	Temporary	639	737	1,376	1,150
Boom assembly area	Temporary	443	576	1,019	646
Construction compound	Temporary	464	679	1,143	1,775
	Totals	**9,985**	**12,740**	**22,724**	**34,961**

Table 8-17: Summary of Peat Excavation volumes for all infrastructure

Type	Excavation Volume (m3)			
	Acrotelm	Catotelm	Total Peat	Soil
Permanent	8,165	10,411	18,575	31,362
Temporary	1,820	2,329	4,149	3,599
Totals	**9,985**	**12,740**	**22,724**	**34,961**

Overall, 22,724m^3 of peat will be excavated. Of this, 4,149m^3 (Acrotelm: 1,820m^3, Catotelm: 2,329m^3) will be directly reinstated at blade finger, and ancillary hardstanding and construction compound locations. In addition, there will be 31,362m^3 of soil excavated.

Peat on site is assessed at medium sensitivity (8.4.10). The potential effects of excavation of peat relate to the loss of carbon rich peat, and changes to the hydrology of the peat causing deterioration in peat and further carbon loss due to drying out and erosion of peat.

No Pristine or active peat bog hydrological units or other nationally important peat habitats will be affected. There will be few areas of deep continuous peat affected. There is no blanket mire or other areas of priority habitat affected.

- **During Construction** - The bulk of the potential effects on peat will occur during Construction and will be adverse, and a combination of permanent and temporary and direct and indirect. The magnitude of the potential effect on peat, given the volumes and character of the peat is *Substantial*. This will result in a *Major* Predicted Effect which is therefore *Significant*.
- **During Operation** - there will be no further change to the peat resource conditions other than those set during construction. The magnitude of the predicted effect is *No Change*. Consequently, the predicted effect during operation is *Negligible* and therefore *Not Significant*.

- **During Decommissioning** - likewise will not alter the status of peat further. The magnitude will be *No Change*. The predicted effect is *Negligible* and therefore *Not Significant*.

Peat Stability

Peat Stability is assessed in the Peat Landslide Hazard Risk Assessment (PLHRA) TA 8-2. The PLHRA determined the likelihood of a future peat landslide under natural conditions and in association with construction activities. It addressed this by:

- Characterising the peatland geomorphology of the Proposed Development Site to determine whether prior incidences of instability have occurred;
- Reviewing contributory factors present across the Proposed Development Site that might lead to instability in the future;
- Identifying potential receptors that might be affected by peat landslides; and
- Quantifying the associated risks.

The PLHRA approaches assessment of peat instability through both a qualitative contributory factor-based approach, and via a more conventional stability analysis (through limit equilibrium or Factor of Safety (FoS) analysis). Outputs from each approach were integrated in the assessment of landslide likelihood.

The PLHRA found that overall, risks are no higher than "*Low*" or "*Negligible*" across the Proposed Development Site which is therefore assessed as stable in areas where infrastructure is proposed. There are no areas where Factor of Safety (using Best Estimate parameters) is <1.4, nor where the landslide susceptibility approach has calculated Moderate likelihood or greater, and therefore risks cannot exceed Low.

Therefore, a consequence assessment is not required and good practice construction methods will be sufficient to manage and minimise landslide risks. This is considered further in section 8.7.4.

- **During Construction** - potential effects due to peat instability during construction will not have a magnitude greater than *Low*. However, with the high sensitivity of peat, this will result in a *Minor* Predicted Effect which is therefore *Not Significant.*
- **During Operation** - there will be no further change to the peat stability beyond those during construction. The magnitude of the predicted effect is *No Change*. Consequently, the predicted effect during operation is *Negligible* and therefore *Not Significant*.
- **During Decommissioning** - likewise will not alter the status of peat further. The magnitude will be *No Change*. The predicted effect is *Negligible* and therefore *Not Significant*.

8.5.8 Predicted Effects – Private Water Supplies (PWS)

Muirpark Registered PWS

The only PWS considered to be potentially in hydrological connectivity with the Proposed Development is Muirpark Farm PWS. This is registered with SC as a spring source. In accordance with SEPA (2017) Guidance, this is subjected to a hydrogeological risk assessment to assess the potential impacts and risks to the quantity and quality of abstracted water, and mitigation which will be provided.

SC advised that their main register for PWS is at least 5 years out of date. The PWS Register data supplied gave no indication of type, i.e. domestic, holiday let, commercial, agricultural, nor the number of people supplied or indication of volume of use. The grid reference given by SCSC is for the supply destination, not the source, and the register does not give the exact source location.

Following receipt of SC data, the landowner was consulted and advised that the farmhouse is actually fed by a spring to the southwest of the property. However, the distance and precise location was not recorded. The delivery pipework route and details of treatment are unknown.

The land southwest of Muirpark rises up from 210-215m AOD at Muirpark to 250m AOD, on the eastern slopes of Drummarnock Hill. The area is mapped as MG10 NVC marshy grassland vegetation community and it is assessed as moderately groundwater dependent (see section 8.5.10). Multiple watercourses arise in the area from springs and seepages. BGS identify the geology of the area as Diamicton till overlying Gargunnock Hills Lava. The groundwater is likely to be very shallow and occurring in more permeable areas of the till only with it likely being quite responsive to rainfall and as such is vulnerable to pollution.

If the source is southwest of the site, as advised by the landowner, it is upgradient but possibly within 100-250m of the WC2 and WC3 watercourse crossings, access option track B, the construction compound and the substation. It is unlikely that the spring will be affected hydrologically. However, this depends upon the precise location and the distance and elevation from these construction activities. It has not therefore been possible to carry out a detailed hydrogeological investigation.

Similarly, assuming the source is southwest of the farm, delivery pipework will not cross Infrastructure construction so will not therefore be disturbed.

- **During Construction** - effects on the PWS water supply and water quality are most likely during construction. Predicted effects are regarded as unlikely as the source is upgradient of infrastructure. However, given the lack of exact source location, the assessed predicted effect will have a precautionary component. Effects would then be adverse, medium term and indirect. Magnitude is therefore assessed at *Medium*. Given the high sensitivity of PWS, the predicted effect is *Major* and therefore *Significant*.
- **During Operation** it is considered that there will be very much reduced activity and potential for source disturbance. The magnitude of the predicted effect is therefore *No change*. Consequently, the predicted effect is *Negligible* and therefore *Not Significant*.
- **During Decommissioning** - phase will have slightly increased risks over operation. There will still be very limited excavation and bare earth due to leaving buried infrastructure. There will be no change in the ground and allowing track to naturally regenerate, the magnitude will be *No change* The predicted effect is *Negligible* and therefore *Not Significant*.

Muirpark Un-registered agricultural pond

A pond belonging to Muirpark farm is adjacent to WC3 and access option track B. The pond is down gradient and in direct hydrological connectivity with those elements of the Proposed Development infrastructure. It is not a registered PWS and is used for agricultural use.

- **During Construction** - potential effects on the agricultural pond will be temporary flow changes and risks from sediment and other pollution associated with the watercourse crossing and track upgrading. These are likely during *Construction* given the proximity of the infrastructure. The magnitude of the predicted effects is regarded as *Medium*. As the sensitivity is medium, the predicted effect is therefore assessed at *Moderate* and therefore *Significant*.
- **During Operation** - it is considered that there will be very much reduced activity and potential for source disturbance. The magnitude of the predicted effect is *No change*. Consequently, the predicted effect is *Negligible* and therefore *Not Significant*.
- **During Decommissioning** - phase will have slightly increased risks over operation but as there will still be very limited excavation and bare earth due to leaving buried infrastructure in the ground and allowing track to naturally regenerate, the magnitude will be *Low*. The predicted effect is *Minor* and therefore *Not Significant*.

8.5.9 Predicted Effects – Public Water Supplies

The Proposed Development Site is not hydraulically connected to the Craigengelt DWPA, nor to Buckieburn or Loch Coulter reservoirs. However, those parts of the Proposed Development Site that lie within The Bannock Burn catchment are hydraulically connected to the North Third reservoir located <1km downgradient of the Proposed Development Site.

Scottish Water has confirmed that North Third reservoir and Loch Coulter reservoirs are not in use to supply the public. Their catchments are not DWPA under Article 7 of the Water Framework Directive.

- **During Construction, Operation and Decommissioning** - The magnitude of potential predicted effects on public water supply water quality is *No Change*. The predicted effect is therefore *Negligible* and therefore *Not Significant*.

8.5.10 Predicted Effects – GWDTE

In accordance with the SEPA (2017) Guidance, a hydrogeological risk assessment has been carried out for those NVC communities assessed as highly or moderately groundwater dependent and which occur within 250m of infrastructure, Figure 8-5a. The findings of the hydrogeological risk groundwater dependency assessment are summarised in Table 8-18.

Table 8-18: GWDTE Dependency

NVC	Assessed groundwater dependency
M35 *Ranunculus omiophyllus – Montia fontana* rill	High
M6 *Carex echinata-Sphagnum fallax /denticulatum* mire	High
M23 *Ranunculus omiophyllus – Montia fontana* rill	High
M9 *Carex rostrata - Calliergon cuspidatum/C.giganteum* mire	High

NVC	Assessed groundwater dependency
M25 *Molinia caerulea – Potentilla erecta* mire	Moderate
MG10 *Holcus lanatus - Juncus effusus* rush pasture	Moderate

Embedded mitigation of GWDTE by design included substantial and deliberate avoidance of direct and indirect loss of potentially high and moderate groundwater dependent GWDTE. This is clearly seen by comparison of the widespread occurrence of potentially high and moderate groundwater dependent habitats on the NVC Figure 8-4 and the very substantial avoidance shown on Figure 8-5a GWDTE. Specific GWDTE avoidance in layout includes:

- Highly dependent M23 and M6 were largely avoided as they are within the 50m watercourse buffers where M6 flushes and much of the rush pasture M23 typically occur. Where the GWDTE extended outside these then the buffers were extended wherever possible;
- The centre borrow pit was moved east to minimise deep peat and to avoid M23 rush pasture high dependency GWDTE. However, a small part of this still impinges on M6;
- The track close to WC5 was moved south to avoid disturbance of rare and highly groundwater dependent M35 *Ranunculus omiophyllus - Montia fontana* rill; and
- The track close to WC5 was moved north to avoid a large patch of M6 flush habitat.

Direct Loss of GWDTE

It has not been possible to fully avoid direct loss of highly and moderately groundwater dependent GWDTE receptors. Direct loss areas, shown in Figure 8-5b, are:

- 75m of M23 flush is crossed in the small valley in the northeast corner on access track Option A. Springs emerge in this valley from the surrounding hills to supply the GWDTE and form a small watercourse which is crossed by WC6. This is unavoidable as this is the optimum track location;
- Option B access track crosses a 70m stretch of M23 rush pasture, albeit this is a pre-existing track;
- The eastern borrow pit impinges onto the central wetland M6 (approx. 100m x 25m);
- A turning head extends for 50m into M23/M25, on the track immediately northeast of the west borrow pit; and
- A thin elongated linear patch of M6 flush is crossed (approx. 40 x 60m) by track and associated cuttings to the northwest of T3.

Predicted Effects are as follows:

- **During Construction**
  - Direct loss of high dependency GWDTE will be 0.58ha. This represents 1.34% of the 43.19 ha of highly dependent GWDTE within 250m of infrastructure. The magnitude of this loss is *Low*. Therefore, the predicted effect due to direct loss of highly dependent GWDTE is *Moderate* and *Significant*.
  - Direct loss of moderate dependency GWDTE will be 2.45 ha. This represents 2.99% of the 81.67 ha of moderately dependent GWDTE within 250m of infrastructure. The magnitude of this loss is *Low*. Therefore, the predicted effect

due to loss of moderate dependent GWDTE is *Minor* and therefore *Not Significant*.

- **During Operation** - it is considered there will be no further direct or indirect loss of high or moderately dependent GWDTE over that during construction. The magnitude of the predicted effect is *No Change*. Consequently, the predicted effect during operation is *Negligible* and therefore *Not Significant*.
- **During Decommissioning** – there will also be a magnitude of *No Change* in respect of direct loss of GWDTE. The predicted effect is *Negligible* and therefore *Not Significant.*

Indirect loss of GWDTE

Highly and moderately dependent sensitive GWDTE receptors which are not directly lost may be sensitive to changes in groundwater flow (e.g., dewatering or flow barriers) and in groundwater quality (e.g. change in base rich groundwater). Despite significant mitigation, it will not be possible to fully avoid indirect loss of highly and moderately dependent GWDTE within 250m from site infrastructure.

The key areas where these GWDTE occur close to the infrastructure are shown in Figure 8-5b and are itemised below. In these areas it is possible that the groundwater supply to the GWDTE will be disturbed or cut off thereby altering the GWDTE.

- High dependency M6 flush has been deliberately avoided by design of the track and WC5 in the central wetland valley in favour of crossing M20 rain fed bog. However, the track and crossing remains immediately downgradient of the M6 flush.
- Other parts of this central wetland M6 flush will be indirectly affected by the eastern borrow pit which impinges on the M6 and is the likely source of M6 groundwater water supply.
- On the track north of Turbine 3 upgradient of M6 in the valley below.
- The small patch of M35 is upslope and up-gradient of the new track so the water supply and is unlikely to be cut-off. However, as the M35 is within 100m of proposed infrastructure it is recommended that the micro-siting allowance of 50m is used to move the working corridor outwith the ZOI of the M35.
- Although the direct loss component of effect has been avoided, a large area of M25 mire is immediately adjacent to the northern edge of the western borrow pit.
- On the cut and fill and track north of turbine 1 above a valley with M23.

Predicted effects are as follows:

- **During *Construction***
  - Indirect loss of high dependency M6 GWDTE, mostly in the central wetland. This is estimated at between 5% and 1% of the central wetland M6 and as such is of *Low* magnitude. The predicted effect is therefore *Moderate* and *Significant*.
  - Indirect loss or disturbance of moderately dependent GWDTE is estimated at <1% of the moderately dependent GWDTE within the infrastructure 250 buffer. This magnitude is effectively *No Change*. The predicted effect is therefore *Minor* and *therefore Not Significant.*
- **During Operation** - it is considered there will be no further indirect loss of high or moderately dependent GWDTE over that during construction. The magnitude of

the predicted effect is *No Change*. Consequently, the predicted effect during operation is *Negligible* and therefore *Not Significant*.

- **During Decommissioning** – There will also have a magnitude of *No Change* in respect of direct loss of GWDTE. The predicted effect is *Negligible* and therefore *Not Significant*.

8.6 Assessment of Cumulative Effects

Cumulative effects could result from incremental changes caused by other past, present or reasonably foreseeable actions together with the Proposed Development. This section assesses the combined effects of development schemes which may, on an individual basis be insignificant but, cumulatively, have a greater effect.

The cumulative schemes to be assessed by the technical chapters have been provided by the Atmos Project Management Team. The three wind farm developments within a 5km radius of the Proposed Development Site are assessed for cumulative hydrology, hydrogeology or geology effects. Beyond this distance, it is highly unlikely for there to be cumulative hydrological effects. The locations of the three developments considered for cumulative effects and their status are listed in Table 8-19 and are shown on the map in Figure 1--4.

Table 8-19: Cumulative Developments within 5km

Site Name	No of Turbines	Distance and direction from Proposed Development Site	Status
Craigengelt	8	Adjacent to and extending up to one km in southwest	Operational
Earlsburn	17	Between 3km and 4.5km west and northwest	Operational
Earlsburn Extension	11	Between 1.25km and 4km northwest	In Planning

The cumulative effects from the identified developments are assessed for potential combined effect on the same sensitive receptor(s) as those identified for the Proposed Development (section 8.4.10). The assessment is based on the principle that there would be similar predicted effects for individual wind farms to that for the Proposed Development.

All infrastructure for these developments are in the same Carron & Touch groundwater body. However, this is a very large regional groundwater body and groundwater flow paths are very local. Therefore there will be no groundwater connectivity between the Proposed Development and these three developments.

The cumulative assessment is considered to be particularly relevant in terms of sediment pollution and/or changes in flow to surface watercourses given the long potential pathways for potential effects. The cumulative surface water effects are considered below.

Craigengelt Wind Farm

- Nearest turbine is 0.5km south west of Proposed Development Site;

- Only four of the seven turbines of Craigengelt are in the same Buckie Burn sub-catchment tributary to River Carron;
- These are 3km upstream of surface water tributary before it meets with the Buckie Burn stem which drains the Proposed Development from Turbines 2 and 3 and associated track. There will be very substantial dilution and dispersion;
- Already in operation, so unlikely to be any significant sedimentation from Craigengelt; and
- Therefore, no cumulative effects.

Earlsburn Wind Farm

- Nearest turbine is more than 2km northwest of Proposed Development Site;
- All turbines are on the summit of ridge containing Hart Hill or further west, and in the Earls Burn catchment;
- Already in operation, so unlikely to be any significant sedimentation from Craigengelt;
- Nearest connectivity with drainage from the Proposed Development is 10km southwest in into the River Carron; and
- Therefore, it is considered to have negligible hydrological connectivity with the Proposed Development Site.

Earlsburn Extension Wind Farm

- Nearest turbines of this proposed wind farm are several km northwest but all are in Earls Burn catchment or Touch Burn catchments;
- This in planning. Conceivably construction could overlap with the Proposed Development if both were to be consented;
- However, there is no or negligible hydrological connectivity with the Proposed Development as:
  - Half the Earlsburn Extension turbines will drain south into Earlsburn Reservoirs, then Earls Burn, then River Carron >10km east before the nearest connectivity with drainage from the Proposed Development. There will be huge dilution and dispersion. This effectively means negligible hydrological connectivity with the Proposed Development Site; and
  - The other half of the Earlsburn Extension turbines and infrastructure will drain north Craigrock Burn then Touch Burn then River Forth with no hydrological connectivity with the Proposed Development Site.

None of the developments drain into North Third Reservoir public water supply.

It is therefore considered that there would be *no* further cumulative effect.

8.7 Mitigation

8.7.1 Review of Predicted Effects

The assessed significant predicted effects for construction, operation and decommissioning phases pre mitigation are summarised in Table 8-20, Table 8-21 and Table 8-22 respectively. Significant predicted effects are those assessed at Major and/or Moderate and are post embedded mitigation and post cumulative assessment. They are italicised in the Tables.

Significant Predicted effects occur mostly during the Construction phase, but also during Operation and Decommissioning.

Further additional mitigation has been developed for these predicted adverse significant effects in sections 8.7.3 – 8.7.7. The aim is to reduce the predicted effect to Non-Significant. A Mitigation Schedule is included as Table 8-25.

Construction

Table 8-20: Predicted Effects During Construction Phase pre mitigation

Potential Effect	Sensitivity	Magnitude	Predicted Effect	Additional Mitigation Required
Sediment pollution of watercourses	High	Medium	Major	Yes
Other pollution of surface water	High	Medium	Major	Yes
Watercourse crossings –WC1.3.,5 and 6	High	Substantial	Major	Yes
Watercourse crossings –WC2 and WC4	High	Medium	Major	Yes
Change in surface water flow	High	No change	Negligible	No
Change in groundwater flow	High	Low	Minor	No
Change in groundwater quality	High	Low	Minor	No
Peat Loss and Disturbance.	Medium	Substantial	Major	Yes
Peat Stability	Medium	No Change	Negligible	No
Public water supply	High	No Change	Negligible	No
Private Water supply – Muirpark PWS	High	Medium	Major	Yes
Muirpark Agricultural pond	Medium	Medium	Moderate	Yes
GWDTE – direct loss - High dependent Moderate dependent	 High Medium	 Low Low	 Moderate Minor	 Yes No
GWDTE – indirect loss High dependent Moderate dependent	 High Medium	 Low No Change	 Moderate Minor	 Yes No

Operation

Table 8-21: Predicted Effects During Operation Phase pre mitigation

Potential Effect	Sensitivity	Magnitude	Effect	Additional Mitigation Required
Sediment pollution of	High	Low	Moderate	Yes

Potential Effect	Sensitivity	Magnitude	Effect	Additional Mitigation Required
watercourses				
Other pollution of surface water	High	Low	Moderate	Yes
Watercourse crossings – WC1, WC3, WC5 and WC6	High	Low	Moderate	Yes
Watercourse crossings –WC2 and WC4	High	Low	Moderate	Yes
Change in surface water flow	High	No change	Negligible	No
Change in groundwater flow	Medium	Low	Minor	No
Change in groundwater quality	Medium	Low	Minor	No
Peat Loss and Disturbance.	Medium	No change	Negligible	No
Peat Stability	Medium	No change	Negligible	No
Public water supply	High	No change	Negligible	No
Private Water supply – Muirpark PWS	High	No change	Negligible	No
Muirpark Agricultural pond	Medium	Low	Minor	No
GWDTE – direct loss	High	No change	Negligible	No
GWDTE – indirect loss	High	No change	Negligible	No

Decommissioning

Table 8-22: Predicted Effects During Decomissioning Phase pre mitigation

Potential Effect	Sensitivity	Magnitude	Effect	Additional Mitigation Required
Sediment pollution of watercourses	High	Low	Moderate	Yes
Other pollution of surface water	High	No change	Moderate	Yes
Watercourse crossings	High	Low	Moderate	Yes
Change in surface water flow	High	No change	Negligible	No
Change in groundwater flow	Medium	No change	Negligible	No
Change in groundwater quality	Medium	No change	Negligible	No
Peat Loss and Disturbance.	Medium	No Change	Negligible	No
Peat Stability	Medium	No change	Negligible	No
Public water supply	High	Low	Minor	No

Potential Effect	Sensitivity	Magnitude	Effect	Additional Mitigation Required
Private Water supply – Muirpark PWS	High	No change	Negligible	No
Muirpark Agricultural pond	Medium	Low	Minor	No
GWDTE – direct loss	High	No change	Negligible	No
GWDTE – indirect loss	High	No change	Negligible	No

8.7.2 General Mitigation

It is anticipated that the preparation of a series of environment plans and documents and approaches will be conditioned as part of the planning permission. These plans will be submitted to and agreed with SEPA before commencing construction. Aspects of these will apply also during operation and decommissioning.

Only those parts relevant to hydrology, hydrogeology and geology are itemised below.

Construction Environmental Management Plan (CEMP)

An outline CEMP has been prepared as part of the EIA Report (Technical Appendix 15-1). The outline CEMP details the principles and procedures for the environmental management of the Proposed Development during construction. It addresses all environmental issues, not just those relating to hydrology, hydrogeology, geology and peat.

It is intended to be read as an indicative document, noting that the final CEMP will be developed in collaboration with SC and will comply with the terms of any planning consent and attendant planning conditions as well as any other relevant agreements and commitments made during the consenting process. The CEMP will be linked to a Construction Method Statement and a Construction Risk Register.

The outline CEMP is considered a live document and methods and processes provided in the document are for guidance only and will be expanded upon and/or amended prior to construction. It will be subject to review at various stages post consent and pre construction and during construction.

An outline of its main functions and contents are given below:

- Role of CEMP in contract documents;
- CEMP supporting plans and related plans, not limited to, but including:
  - Planning conditions, environmental approvals and consents and CAR Licencing;
  - Environmental roles and responsibilities and contact details, including EnvCOW;
  - Change control process;
  - Site induction and training;
  - Relevant guidance and legislation;
  - Pre-construction surveys;
  - Micrositing protocols;
  - Mitigation;
  - Environmental monitoring, auditing and reporting requirements;

- Phasing of activities;
- Controls on temporary watercourse diversions, water abstraction and dewatering;
- Drainage, storm water and sediment control;
- Materials management including excavation , stockpiles and other storage;
- Pollution Prevention Plan measures;
- Environmental reporting procedures and frequency; and
- Emergency response process.

There will be a number of sub plans to the CEMP. Those sub plans which have hydrological elements are listed below:

- Drainage Management Plan (DMP);
- Pollution Prevention Plan (PPP);
- Water Quality Monitoring Programme (WQMP);
- Detailed Peat Management Plan; and
- Elements of Habitat Management Plan (HMP).

A CEMP will also be prepared and implemented for decommissioning.

Environment Management

The risk of potential environmental impact will be managed by the Site Manager, with specialist advice as required from an Ecological/Environmental Clerk of Works (ECoW). The Site Manager will ensure that activities are carried out in accordance with the CEMP and mitigation measures outlined in the EIA Report and consent(s).

Works will be overseen by an Environmental Clerk of Works (EnvCOW). Their role and responsibilities will be detailed in the CEMP. Those activities relevant to hydrology and hydrogeology are outlined below.

The EnvCOW will:

- Monitor that activities remain compliant with legislation, planning conditions and good practice;
- Be responsible, alongside the Contractor's Environmental Manager for ensuring the requirements of the CEMP, DMP, PMP and HMRP are implemented;
- Be present during construction to undertake regular site inspections as required by the various environmental plans;
- Pay particular attention to water management and pollution control;
- Review the need for culverting of the many unmarked drains and channels which will have to be crossed to avoid blockages and local flooding;
- Oversee peat stripping and removal;
- Identify GWDTE at risk and oversee GWDTE drainage mitigation;
- Have the authority to stop works where significant GWDTE, water or peat related effects are considered likely to occur, and to instigate control/mitigation measures to rectify noncompliance;
- Oversee monitoring according to the WQMP;
- Be part of the team responsible for Emergency Spill Response;
- Be part of the team providing induction, briefings and toolbox talks; and

- Provide regular reports.

Pollution Prevention Plan (PPP)

A Pollution Risk Assessment will be carried out identifying materials, areas and activities of greatest risk and laying out controls on these. From this a Pollution Prevention Plan (PPP) will be prepared. The PPP will be a sub plan of the CEMP. A PPP will also be in place during operation and decommissioning phases.

The PPP will reference the extensive guidance and outline protocols for pollution control. It will include reference to fuel, oils, cementitious materials, other hazardous substances and prohibited materials.

The PPP will address such activities as use and storage, spillage kit and emergency procedures for chemical and hydrocarbon pollution of surface water, safe refuelling locations and protocols, concrete pouring and mixing protocols and use of construction compounds. Inspection and maintenance regimes will be identified for implementation.

Habitat Management and Reinstatement Plan (HMP)

A draft Habitat Management Plan has been prepared in Technical Appendix 6-5. It will be submitted to NatureScot for agreement. The HMP will jointly address ecological and hydro-ecological mitigations. The HMP will be implemented alongside the CEMP and other sub plans, especially the DMP and the PMP. It is likely that some aftercare actions within the HMP will extend into the Operational Phase.

Micro-siting

As identified in Chapter 3, up to 50m micro-siting of the precise location of site infrastructure will take place following detailed design post consent.

The micro-siting will be informed by the findings of the more detailed ground investigations that will be carried out as part of the preparations for construction. The purpose will be to achieve more favourable ground conditions, and to avoid encroachment into any environmentally sensitive or technically constrained areas such as GWDTE and peat.

In addition, micro siting provides scope to mitigate potential geo-environmental and geotechnical constraints which may be identified during detailed site investigation works or preparatory ground works.

8.7.3 Mitigation - Water Quality

There is a major predicted effect on surface watercourse quality from sediment and other pollution of watercourses during all phases. The effect which requires mitigation is to avoid and control sediment laden surface water run-off from rainfall onto exposed bare earth, peat and/or, stockpiles of excavated materials, access track and borrow pits and construction compounds. Further sediment releases may arise from temporary watercourse diversions and drainage discharge.

The following mitigations are recommended.

Drainage Impact Assessment (DIA) and Drainage Management Plan (DMP)

A Drainage Impact Assessment (DIA) will be carried out. It will inform the preparation of a Drainage Management Plan (DMP). The DMP will be submitted for agreement with SEPA. It will form a sub plan of the CEMP.

The DMP will comprise procedures and detailed methods and measures for the collection and treatment prior to discharge of surface water runoff. This will include runoff from excavated land, material stockpiles, hard standing areas, access tracks, turbine foundations, site compounds, site buildings and borrow pits. It will include details relating to both new and existing field drains.

Treated construction runoff will be designed to shed at regular intervals to grassland, blind ditches and/or silt settlement areas, particularly on steep slopes. Adequately sized silt settlement lagoons will be provided in areas of risk as defined in the DIA. Particular attention will be paid to drainage runoff from borrow pits and roads on steep inclines leading to watercourse crossing points.

The drainage design and management will comply with the Water Environment (Controlled Activities) (Scotland) Regulations (CAR) 2011 (as amended) (Scottish Government), 2011 and 2021). Track drainage design will comply with General Binding Rules (GBR's) 10, 11 and 21 for the track drainage Requirements for CAR Authorisations will be assessed and the necessary notifications, authorisations and permits as necessary will be sought. The Surface water drainage and treatment will be designed in line with Sustainable Drainage Systems (SuDS) principles and in accordance with General Binding Rule 10 of CAR.

There is a large body of best practice guidance for construction management, drainage design and control for the avoidance and minimisation of this potential effect. This will be incorporated into the DMP.

Watercourse Crossing Design

The six watercourse crossings are summarised in Table 3-44. It is worth noting that should access Option A be constructed, WC1 would not be required. Similarly, should access Option B be constructed, WC6 would not be required.

They will be designed based on best practice guidelines, including:

- SEPA, November 2010E, WAT-SG-25 - Engineering in the water environment: good practice guide, River crossings, Second edition;
- SEPA WAT-PS-06-02: Culverting of Watercourses – Position Statement to support the implementation of the Water Environment (Controlled Activities) (Scotland) Regulations 2011;
- SEPA, October 2019, The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended), A Practical Guide, Version 8.4; and
- SEPA, WAT-PS-06-02: Position Paper Culverting of Watercourses – Position Statement and Supporting Guidance.

The crossings will be WAT-SG-25 compliant and sized to accommodate the 1 in 200 year flow and with 20% added for climate change and freeboard over next 25 years. This will avoid increasing the risk of flooding. The design will take into account watercourse dimensions, flow characteristics, the nature and size of the crossing, fluvial scour, mammal and fish requirements.

Water Quality Monitoring Programme (WQMP)

A Water Quality Monitoring Programme (WQMP) will be designed as a sub plan to the CEMP. Its stated purpose will be to avoid deterioration of water quality and to protect fish populations within and downstream of the Proposed Development area. The Water Quality Monitoring Plan (WQMP) will be submitted to and approved in writing by the Planning Authority in consultation with Marine Scotland Science, SEPA and NatureScot. The WQMP survey and monitoring programmes will follow the MSS published guidance on survey/monitoring programmes associated with onshore wind farm developments.

Water quality monitoring will be implemented before and during construction, and during operation. Water quality sampling will be carried out at least 12 months prior to construction commencing, during construction and for at least 6 months after construction is complete. Water Quality monitoring results shall be submitted to the Planning Authority on a 6 monthly basis or on request.

The WQMP will contain a section outlining frequency of review of its findings and consequent appropriate site specific mitigation measures to be applied. This will link to a specific Water Environment Emergency Response Plan for incidents. The water quality monitoring plan will include key hydro chemical parameters, turbidity, and flow data, the identification of sampling locations (including control sites), frequency of sampling, sampling methodology, data analysis and reporting. It will include protocols for different rainfall and flow conditions.

Areas to be monitored will include:

- Buckie Burn
  - As there is no potential upstream control on tributaries of the Buckie Burn as these only rise east and downgradient of infrastructure, a control monitoring point will be identified on a similar tributary outside the potential influence of infrastructure;
  - Downstream on Buckie Burn beyond infrastructure.
- Bannock Burn
  - Upstream and downstream of WC5 and drain at WC4;
  - Upstream and downstream of WC6.
- Loch Coulter Burn
  - Identify significant control tributaries upstream of WC3;
  - Between WC2 and WC1;
  - downstream of WC1.

8.7.4 Mitigation - Peat

There has been extensive design embedded peat mitigation (8.5.4). As well as peat avoidance, this includes use of floating roads, Nonetheless there remains a predicted Major effect on peat during construction. Effects on peat during operarion and decommissioning are negligible. The Major predicted effect will stem from loss, disturbance and degradation of peat and peat soils and from changes to peat hydrology.

A series of peat mitigations have therefore been developed. Details of peat mitigation are reported in TA 8-3 and summarised below.

Peat Management Plan (OPMP)

An OPMP has been prepared as Technical Appendix 8-3. It follows guidance (Scottish Renewables & SEPA, 2012) on the assessment of peat excavation and reuse for wind farms in Scotland.

The OPMP will be further developed to a detailed PMP post consent. It will form a sub plan within the Construction Environmental Management Plan. The OPMP details:

- Peat conditions on site;
- Peat depth and habitats including a detailed map of peat depths (with the built elements (including peat storage areas) overlain;
- Avoidance and minimisation of disturbance to peat and consequential release of CO_2;
- Management of peat during construction including proposed phasing of soil stripping, temporary storage and monitoring of works affecting peat by an Environmental Clerk of Works (ECoW);
- Good Practice re Excavation and Handling, Storage, Reinstatement and Restoration and Monitoring;
- The quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement;
- Proposals for re-use of excavated peat in infrastructure and in restoration and rehabilitation, including a peat balance;
- Schedule of mitigation measures to minimise disturbance and impacts on peat.

Key good practice measures within the PMP will integrate with other related plans or control documents for construction, including, where applicable, the Construction and Decommissioning Environmental Management Plan, Site Waste Management Plan, Habitat Management Plan (where relevant) and Geotechnical Risk Register.

Through the different stages of the project, the strategy will be to prevent disturbance to and losses of peat through appropriate reuse, wherever possible. Micro-siting will be utilised to optimise infrastructure locations relative to final pre-construction information gathered on site.

The philosophy for excavated peat re-use is, depending on arisings and in order of priority:

- Reinstatement of temporary peat excavation areas;
- Reinstatement of infrastructure edges;
- Reinstatement of temporary excavations for infrastructure;
- Landscaping of permanent infrastructure to minimise visual impacts of infrastructure; and
- Appropriate Reuse.

Peat Reuse

There are no suitable restoration targets for use of excavated peat due to an absence of eroded gullies, peat pans, artificial drainage or cuttings on the Proposed Development Site. Therefore, the primary peat management reuse strategy is to reuse peat to reinstate borrow pits excavated adjacent to peatland areas within the Proposed Development Site.

Four borrow pits have been identified to support the extraction of aggregate for construction. Borrow pits will be excavated to substantially below ground level over most of their footprints and will therefore naturally collect moisture, increasing their viability as permanent peat stores for materials excavated from infrastructure locations. Careful borrow pit design will ensure peat stays wet.

Available accommodation space for peat has been calculated (Table 8-23) based on the footprints of each borrow pit, and target volumes of acrotelmic and catotelmic peat have been calculated in order to store the permanently excavated peat volume.

Table 8-23: Peat reuse volumes in borrow pits

Location	Areas and Volumes					
	Area (m2)	Target Acrotelm Depth (m)	Acrotelm Volume (m3)	Target Catotelm Depth (m)	Catotelm Volume (m3)	Total Peat Reuse (m3)
West (North)	8,034	0.3	2,410	0.5	4,017	6,427
West (South)	8,807	0.3	2,642	0.4	3,523	6,165
Central	3,782	0.3	1,135	0.4	1,513	2,647
East*	12,079	0.3	1,812	0.25	1,510*	3,322
Totals			**7,999**		**10,563**	**18,561**

The design principles for borrow pits reinstated with peat derived from elsewhere on site are:

- Following return of non-peat overburden to the floor of the borrow pit, the borrow pit base will be levelled with a minor reverse incline towards the pit headwall to ensure moisture retention;
- The unfinished base will then be lined with impermeable fill (clay or equivalent) to preclude free draining / dewatering from the base of the peat fill;
- Depending on the borrow pit footprint and the degree of remoulding of catotelmic peat excavated during construction, mineral berms will be constructed to create retention cells, within which peat will be placed – berm crests will be set to the top level of anticipated catotelmic fill;
- Catotelmic fill will be placed within each cell, directly over the impermeable liner and between mineral berms; and
- Acrotelmic turves will then be placed over the catotelmic fill and berms to produce a continuous vegetated top surface.

In order to ensure the reinstated borrow pits function as intended, a monitoring programme will be established to track vegetative recovery of the finished borrow pit surfaces, effectiveness of constructed berms in holding peat in place, and moisture content of the peat deposits.

Peat Balance

The peat and soil balance for the Proposed Development is shown in Table 8-24. The table indicates that there is sufficient peat to fully reinstate temporary infrastructure and enough soil to provide dressing of permanent infrastructure and earthworks.

Table 8-24: Peat Balance

Activity	Volume (m³)		
	Acrotelm	**Catotelm**	**Soil**
Excavation			
Total Permanent	8,165	10,412	31,362
Total Temporary	1,820	2,328	3,599
Totals	**9,985**	**12,740**	**34,961**
Reuse			
Directly Reinstated	1,820	2,328	3,599
Borrow Pits	7,999	10,563	10,904
Landscaping Earthworks	0	0	18,683
Totals	**9,819**	**12,891**	**34,961**
Balance	**164**	**-150**	**0**
	Surplus	**Deficit**	**Balance**

No disposal of peat or soil is required as part of the Proposed Development.

Peat Stability Risk Assessment

The OPMP was prepared in parallel with a Peat Landslide Hazard and Risk Assessment (PLHRA, Technical Appendix 8-2). Although there are no Predicted Significant effects on Peat Stability, nonetheless the Peat Landslide Hazard Risk Assessment (PLHRA) TA 8-2 provides precautionary appropriate mitigation and control measures. These aim to reduce risks to acceptable levels such that the Proposed Development is developed safely and with minimal risks to the environment.

These range from infrastructure specific measures (which may act to reduce peat landslide likelihood, and, in turn, risk) to general good practice that will be applied across the Proposed Development Site to engender awareness of peat instability and enable early identification of potential displacement and opportunities for mitigation.

Risks may be mitigated by:

- Post-consent site specific review of the ground conditions in areas of lower stability (Moderate likelihood), which may enable a reduction in likelihood through better understanding, and in turn, further reduction in risk;
- Precautionary construction measures – including use of monitoring, good practice and a geotechnical risk register;
- It is recommended that detailed intrusive site investigation and laboratory analysis are undertaken ahead of the construction period in order to characterise the strength of the peat soils in the areas in which excavations are proposed, particularly where these fall in areas of Low or greater likelihood. These investigations will be sufficient to:
  - Determine the strength of free-standing bare peat excavations;
  - Determine the strength of loaded peat (where excavators and plant are required to operate on floating hardstanding or track, or where operating directly on the bog surface);

  - Identify sub-surface water-filled voids or natural pipes delivering water to the excavation zone, e.g. through the use of ground penetrating radar or careful pre-excavation site observations;
- Preparing a comprehensive and live Geotechnical Risk Register post-consent but pre-construction, as detailed in TA 8-2;
- Following good practice during construction, again as detailed in TA 8-2; and
- Good Practice Post-Construction, again as detailed in TA 8-2 to include monitoring.

8.7.5 Mitigation - Private Water Supplies

Muirpark Registered PWS

There is a precautionary Major predicted effect on Muirpark registered spring source PWS during construction. Effects on the PWS during operation and decommissioning are negligible. The Major predicted effect will stem from loss or reduction in source yield and/or contamination of the supply by sediment, fuel, oil or other chemicals. There may also be a predicted effect due to damage to delivery pipework.

In accordance with the SEPA LUPS Guidance Note, V3, 2017, Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions, the following mitigation is proposed.

The owners of Muirpark supply should be approached pre-construction with a questionnaire on source location, supply details including location, treatment and delivery pipework and supply volumes and reliability.

The actual source should be visited, and a detailed risk assessment carried out. This would use the new information in the questionnaire and the site findings against the risks posed by the construction of the proposed development. The source supply mechanism and the land or watercourses or seepages for the source should be identified and vulnerability assessed.

Baseline monitoring of the source should commence, as follows:

- Undertake pre-construction monitoring for 6 months prior to the construction phase to define the baseline conditions;
- Monitor weekly in the field during construction for Water level, temperature, pH, electrical conductivity, turbidity to provide an early warning of adverse impacts;
- Monthly post construction to demonstrate that there is no significant impact;
- Take control and quarterly laboratory samples for analysis for alkalinity, ammoniacal nitrogen, TON, TOC, BOD, COD, TDS, Ca, Mg, Na, K, SO4, HCO3, Cl, Fe, Mn;
- If monitoring identifies statistically significant change to PWS, then the Applicant will immediately inform the supply owner and implement the agreed temporary solutions and implement remedial action within 6 months of this becoming apparent from the monitoring results. Similarly this will be applied immediately a complaint is received from the PWS owner;
- The monitoring should be included within the WQMP.

Depending upon the outcome of the risk assessment, it may be necessary to identify detailed mitigation, e.g.:

- Methods to safeguard spring water supply, such as avoiding dewatering or physical cut-off in areas adjacent to the PWS;
- Minimising lengths and depths of drainage ditches to reduce any potential lowering of the water table;
- Develop procedures to protect any supply pipe which may be intersected by infrastructure; and
- Informing construction workers of the necessity to protect and prevent pollution from impacting upon the PWS.

It would be wise to agree contingency plans including temporary or permanent replacement of the supply with the abstraction owner. These will aim to provide security of supply should there be interruptions to the PWS supply.

Muirpark Agricultural Pond

There is a Moderate predicted effect during construction on the pond belonging to Muirpark farm. Predicted effects during operation and decommissioning are Negligible. The effect would be caused by:

- Sediment and other pollution from construction related works in the adjacent WC3 and access track option B; and
- Changes and diversions in flow of the burn supplying the pond.

Mitigation of this should be discussed with the owner, and temporary contingency plans agreed in order to provide security of supply should there be interruptions to water demand to the pond supply.

The status of the pond should be regularly monitored during works adjacent to the pond. These would comprise visual, water level and turbidity measurements. The monitoring should be included within the WQMP along with an agreed response plan should there be adverse findings from the monitoring.

8.7.6 Mitigation – GWDTE

Direct and indirect loss of potentially high and moderate groundwater dependent GWDTE was avoided as far as possible. This is clearly shown by comparison of the widespread occurrence of potentially highly groundwater dependent NVC and the significant avoidance shown on Figures 8-4 and 8-5b .

There remains a Significant Moderate predicted effect due to direct loss and indirect loss of highly dependent GWDTE during construction. There will be no further direct loss predicted effects during operation and decommissioning.

Direct Loss

The following mitigations of direct loss of highly dependent M23 and M6, if applied, would change the predicted Moderate effect to Minor:

- Relocate the track turning head immediately northeast of the west borrow pit which currently extends for 60m into M23/M25; and
- Relocate the eastern borrow pit a minimum of 50m which currently extends into the central wetland M6, ideally 100m further east.

Mitigation of impacts on direct loss of GWDTE would be undertaken through detailed design and the use of micrositing allowances. Both the above mitigation measures are under consideration, however, there is insufficient design and construction information currently available to allow commitment to them specifically. Accordingly, the determination of the impact on direct loss for GWDTE as Moderate (Significant) is retained.

Indirect Loss

The following mitigations of indirect disturbance of highly dependent GWDTE are available to be implemented in the appropriate areas, which will be determined through detailed design:

- Install cross drains under tracks at regular intervals up gradient of highly dependent M6 GWDTE. The cross drains will initially catch the water on the uphill side of the track or yard and transfer it to a suitable diffuse outfall above the GWDTE on the down gradient side of the track where it will not cause new erosion or runoff issues; and
- Install permeable track bases and series of bottomless culverts across directly crossed GWDTE runs .

Final identification of the appropriate measures will be set out in detailed design and these may be applicable to the following areas:

- The track at WC6 which crosses a wide area of M23;
- The track upgradient of an area of M6 flush and WC5 in the central wetland;
- The area of M23/M25 mire immediately adjacent to the northern edge of the western borrow pit;
- The western edge of the eastern borrow pit area of M6 in the central wetland;
- Micro-siting the track further to outwith the zone of influence of the small central patch of M35 spring habitat;
- The track at Turbine 1 where it crosses M6 in the valley;
- The track north of Turbine 1 which crosses upgradient of M23; and
- The track north of Turbine 3 which crosses immediately upgradient of a valley containing M6.

In addition, indirect mitigation will include:

- Adding GWDTE photographs and locations to in site induction and advising on its importance and the nature and function of GWDTE mitigations;
- Micro siting to minimise wet heath take for turbines and associated infrastructure;
- Minimising any period of dewatering and discharging pumped groundwater direct to or via a small down-slope trench up-gradient of the surrounding GWDTE allowing infiltration back into the ground; and
- The work will be supervised by the EnvCOW and mandated in a CEMP. Designs will be incorporated into the DMP.

Accordingly, the determination of the impact on indirect loss for GWDTE as Moderate (Significant) is retained, however it is likely that this can be reduced to Minor (Not Significant) through the use of the mitigation measures detailed above, or alternative measures where these are not appropriate.

8.7.7 Mitigation Schedule

A Mitigation Schedule for the minimisation of potential effects arising from the Proposed Development on hydrology, hydrogeology and soil, including peat is given in Table 8-25.

Table 8-25: Schedule of Mitigation for Hydrology and Hydrogeology

Item	Mitigation measure	Phase	Reason
8.1	Construction Method Statement environmental and construction proposals component	Construction	To ensure safe environmental and water environment construction methods
8.2	Develop and implement Construction Environmental Management Plan (CEMP) preconstruction	Construction, Operation and Decommissioning	To contain specific measures for good practice and mitigation as required during construction to maintain legal, planning, best practice and the integrity of sensitive environmental receptors.
8.3	Develop Pollution Prevention Plan	Construction	To identify activities of greatest risk and prepare controls
8.4	Appointment of EnvCOW ensuring the requirements of the CEMP, DMP and PMP are implemented, undertake regular site inspections.	Construction	So that activities remain compliant with legislation, planning conditions and good practice.
8.5	All infrastructure and drainage to be positioned a minimum of 50m from watercourses. Where not possible, a post micrositing numbered plan with design and photos etc.of final locations of infrastructure will be provided).	Construction	To protect watercourses from sediment pollution and flow disturbance.
8.6	Develop a Drainage Impact Assessment and implement a Drainage Management Plan (DMP) with detailed methods for the collection and treatment of surface water runoff.	Construction, Operation and Decommissioning	To understand drainage inch points, protect watercourses and install precautionary drainage. The DIA will inform the temporary and permanent drainage design and the DMP to protect watercourses.
8.7	All watercourse	Construction	To avoid effects on the

Item	Mitigation measure	Phase	Reason
	crossings to be WAT-SG-25 compliant, and designed to accommodate the 1 in 200 year event with 20% added for climate change.		flow, bottom, banks and ecology of watercourses.
8.8	Prepare and implement a Water Quality Monitoring Plan (WQMP) to address surface and ground water quality and protection and include measures for different rainfall and flow conditions.	Construction, Operation and Decommissioning	To record the existing water condition, inform design requirements, and avoid deterioration to water quality during construction.
8.9	Develop the OPMP into a detailed Peat Management Plan (PMP).	Construction and Operation	To minimise peat disturbance and maximise re use of peat soil
8.10	Achieve a peat balance between peat excavation, reinstatement and reuse.	Construction	To avoid the need for residual peat excavations to be taken off site.
8.11	Carry out monitoring of vegetative recovery of the finished borrow pit surfaces, effectiveness of constructed berms in holding peat in place, and moisture content of the peat deposits	Construction and Operation	To measure the effectiveness of peat reuse in borrow pits.
8.12	Implement precautionary appropriate mitigation and control measures for working in peat as in PLHRA TA 8-2	Construction	To avoid Peat landslides.
8.13	Carry out further data collection, site visit and risk assessment of Muirpark PWS.	Construction and Operation	to provide security of supply should there be interruptions to the PWS supply.
8.14	Baseline monitoring of the Muirpark PWS source including pre and post construction monitoring.	Construction and Operation	
8.15	Agree temporary contingency plans with owner of Muirpark	Construction	To provide security of registered PWS supply should there be

Item	Mitigation measure	Phase	Reason
	agricultural pond.		interruptions or contamination.
8.16	Regularly monitor water flow and quality during works adjacent to the pond.	Construction	To provide security to agricultural use of the pond supply,

8.8 Residual Effects and Conclusions

Following additional mitigation measures laid out in 8.7, Significant Major and Moderate effects on receptors that were predicted during Construction, by sediment and other pollution of surface water, watercourse crossings, peat loss and disturbance and private water, have been reduced to either Minor or Negligible, and are summarised in Table 8.26. None of these are Significant in EIA terms.

A Moderate adverse effect remains predicted on direct and indirect loss of GWDTE. These remain Significant in EIA terms.

Table 8-26: Summary of Residual Predicted Effects Post Mitigation

Predicted Effect	Predicted Effects Pre Mitigation	Mitigation Measures (in addition to General – 8.7.2) from Table 8.25	Predicted Effects Post Mitigation
Sediment pollution of watercourses	Major	8.5, 8.6. 8.7, 8.8	Minor
Other pollution of surface water	Major	8.3, 8.5, 8.6, 8.8	Minor
Watercourse crossings –WC1.3.,5 and 6	Major	8.6, 8.7, 8.8	Minor
Watercourse crossings –WC2 and WC4	Major	8.6, 8.7, 8.8	Minor
Change in surface water flow	Negligible	n/a	Negligible
Change in groundwater flow	Minor	n/a	Minor
Change in groundwater quality	Minor	n/a	Minor
Peat Loss and Disturbance.	Major	8.9, 8.10, 8.11	Minor
Peat Stability	Minor	8.12	Negligible
Private Water supply – Muirpark PWS	Moderate	8.13, 8.14	Minor
Muirpark Agricultural pond	Moderate	8.115, 8.16	Minor
GWDTE (high dependency) – direct loss	Moderate	n/a	Moderate
GWDTE (high dependency) – indirect loss	Moderate	n/a	Moderate

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Chapter 9: Transport and Access

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1
Study Area	The public road network used for general construction traffic access to the Proposed Development as per Figure 9-1

List of Abbreviations

Abbreviation	Description
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
NTS	Non-Technical Summary
SC	Stirling Council
CTMP	Construction Traffic Management Plan
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
HGVs	Heavy Goods Vehicles
IEMA	Institute of Environmental Management and Assessment
IHT	Institute of Highways and Transportation
LGVs	Light Goods Vehicles
PoE	Port of Entry
NPF	National Planning Framework

9 Transport and Access

9.1 Introduction

This chapter assesses the potential effects of the Proposed Development on the existing transport network and on sensitive receptors as a result of the construction, operation and decommissioning phases of the Proposed Development.

The objectives of this chapter are to:

- Describe the assessment methodology and significance criteria used in completing the assessment;
- Describe the current access, traffic and transport conditions;
- Identify and assess the likely environmental effects associated with increased traffic;
- Identify and describe the mitigation measures proposed to address potential significant effects; and
- Assess residual effects post mitigation implementation.

This chapter has been prepared by SYSTRA Ltd and led by Alan DeVenny. Alan is a Projects Director and Chartered Engineer with SYSTRA. He has a BEng in Civil and Transportation Engineering as well as a PhD in Civil Engineering.

Alan has over 24 years' experience in the traffic and transportation industry and over 15 years' experience in the production of EIA transport chapters (and associated studies) for onshore wind farms in Scotland. He has also been responsible for assisting both Transport Scotland and National Highways in the preparation of guidelines for assessing the effects of wind farm developments. Alan is a Chartered Member of the Institution of Civil Engineers (CEng, MICE).

This chapter is supported by Figure 9-1: Study Area, Figure 9-2: Abnormal Loads Route and Figure 9-3: Traffic Counter Locations. Technical Appendix 9-1 Abnormal Loads Assessment is referenced in the text and can be found in full within Volume 3: Technical Appendices.

9.2 Methodology and Approach

9.2.1 Legislation, Planning Policy and Guidance

This assessment is informed by the following additional policy documents, data sources and guidelines:

- National Planning Framework 4 (NPF4);
- Planning Advice Notice (PAN) 75 – 'Planning for Transport';
- Institute of Highways and Transportation (IHT) publications - "Guidelines for Traffic Impact Assessment", 1998;
- Institute of Environmental Management and Assessment (IEMA) publication - "Environmental Assessment of Traffic and Movement", 2023 ("the IEMA Guidelines"); and
- Department for Transport (DfT) publication "Design Manual for Roads and Bridges" (DMRB).

9.2.2 Consultation

The assessment process has been informed by a consultation exercise coordinated through Stirling Council (SC) leading to the issue of a formal Scoping Opinion (October 2020). A summary of the key consultation responses is described in Table 9-1.

Table 9-1: Consultation

Consultee	Summary of Consultee Response	Where addressed within this Report
SC	In addition to the measures identified in the scoping report, a Transport Statement (possibly contained within a wider EIA) should be submitted covering, but not limited to:- i)traffic generation; ii) junction capacity issues, iii) Anticipated length of operations; iv) Assessment of suitable traffic routes; v) road network predicted impacts and impact mitigation, and iv) Traffic Management Plan to the satisfaction of Stirling Council.	Noted. Predicted traffic generation during the temporary construction period is detailed in Table 9-7. Anticipated traffic generation over the 12 month construction programme is detailed in Table 9-8. Junction capacity issues are discussed in section 9.2.4. Assessment of Effects is detailed in section 9-4. A CTMP is referenced in section 9.6 where a summary is provided of the measures which may be included. The CTMP will be developed during the detailed design phase of the Proposed Development and will be agreed with SC.

9.2.3 Scope of Assessment

Abnormal Loads

The most identifiable transport and access characteristic associated with wind farm developments is the need to transport the wind turbine components to the site. Turbine components will be delivered to an appropriate Port of Entry (PoE) and then transported as abnormal loads, given their size and weight, from the selected PoE via the public road network.

The Department for Transport (DfT) website defines an abnormal load as a vehicle that is;

> *"a weight of more than 44,000 kilograms; an axle load of more than 10,000 kg for a single non-driving axle and 11,500 kilograms for a single driving axle, a width of more than 2.9m; a length of more than 18.75m" (DfT, October 2012).*

Grangemouth has been identified as the most suitable PoE for shipping of the blade components which are the worst case in terms of the length and width combination. The route assessed is as follows:

- From the Port at Grangemouth the transporter vehicles will route onto the M9 and travel north for approximately 14km;
- At Junction 9, vehicles will leave the M9, turning north onto the A872. The abnormal loads will route north for approximately 350m before turning west onto Pirnhall Road then south onto New Line Road, continuing on minor roads to the Proposed Development Site.

General HGV's

There is also a need to bring general construction materials (concrete, aggregates, pipes, cabling, etc.) to the Proposed Development Site in standard heavy goods vehicles (HGVs). During the construction stage there is a temporary intensification of HGV traffic on the road network. This intensification varies depending on the scale of the development, the construction stage and operational requirements.

Staff Vehicles

A small amount of traffic will be generated by construction workers commuting to/from the site during the construction stage in private car or works minibus.

9.2.4 Potential Effects Scoped Out

On the basis of the modest scale of the Proposed Development, the professional judgement of the team and experience from other relevant projects and policy guidance, the following effects have been scoped out of the assessment.

Operational Stage

Once the Proposed Development is operational, the amount of traffic associated with a wind farm is minimal, relating to maintenance of the turbines only. It is estimated that on average there will be just single 4x4s accessing the Proposed Development Site from time to time.

Therefore, the effect of vehicle movements during the operational phase will be negligible. In respect of transport, the operational phase of the Proposed Development is therefore not assessed further.

Decommissioning Stage

Planning permission for the Proposed Development is sought for a 40-year period, after which time the Proposed Development will be decommissioned unless a further application is submitted for an operational extension. Traffic associated with the decommissioning stage is anticipated to be significantly less than that generated during construction.

Given the timescales involved and the likelihood for changes to the baseline situation during this period, the transport and access effects of wind farm decommissioning are not assessed further.

Peak Hour Congestion

It is the professional opinion of the transport consultant that the effect of construction related vehicles on the road network is considered unlikely to be significant in terms of peak hour congestion as deliveries will be spread out across the day. Therefore, detailed junction capacity assessments have not been undertaken.

Access Tracks & Beyond the Study Area

The effect of increased traffic associated with the Proposed Development on existing access tracks, such as those leading from the minor roads to the two potential site access points, is not anticipated to have a discernible environmental effect and is, therefore not appraised in this report. The effects of the Proposed Development on the local public road network are included.

It is anticipated that the volume of traffic associated with the construction of the Proposed Development will not have a discernible effect on roads and sensitive receptors outwith the study area (see below for definition of the study area) as the effects of traffic are diluted with increasing distance from the point of origin.

9.2.5 Assessment Methodology and Significance Criteria

Assessment of Effects

The assessment of effects is based on the project description as outlined in Chapter 3: Description of Development.

This assessment is structured around the consideration of potential environmental effects relating to traffic and transport, as identified by the IEMA Guidelines and including the following:

- Severance of communities;
- Road vehicle driver and passenger delay;
- Non-motorised user delay and amenity;
- Fear and intimidation on and by road users;
- Road user and pedestrian safety; and
- Hazardous and large loads.

There are no hazardous loads associated with the Proposed Development.

Guidance for the assessment of the environmental effects of generated traffic is provided in the IEMA document, "Environmental Assessment of Traffic and Movement". The document is the only guidance document currently available that sets out a methodology for assessing potentially significant environmental impacts where a Proposed Development is likely to give rise to changes in traffic flows.

The guidance suggests that in order to determine the scale and extent of the assessment and the level of impact the development will have on the surrounding road network, the following two 'rules' should be followed:

- Rule 1 – Include road links where traffic flows are predicted to increase by more than 30% or where the number of HGVs is predicted to increase by more than 30%; and
- Rule 2 – Include any other specifically sensitive area where traffic flows are predicted to increase by 10% or more.

These rules are used to identify the road links within the Study Area where a full assessment of environmental effects associated with an intensification in road traffic may be required. It is noted that further consideration should be given to road user and pedestrian safety as well as driver delay effects even if the above thresholds are not exceeded.

Paragraph 1.3 of the IEMA Guidelines identifies groups, locations and special interests which may be sensitive to changes in traffic conditions as follows:

- People at home;
- People at work;
- Sensitive and/or vulnerable groups (including young age; older age; income; health status; social disadvantage; and access and geographic factors);
- Locations with concentrations of vulnerable users (e.g. hospitals, places of worship, schools);
- Retail areas;
- Recreational areas;
- Tourist attractions;
- Collision clusters and routes with road safety concerns; and
- Junctions and highway links at (or over) capacity.

Assessment of Significance

The following section sets out the methodology used to assess the significance of effects at locations along the proposed routes within the Study Area where total traffic levels or the level of HGV traffic exceed the screening thresholds set out by the IEMA Guidelines.

Sensitivity

The sensitivity to change in traffic levels of any given road segment and the receptors located along that road segment are generally assessed by considering the residual capacity of the network under existing conditions.

Where there is a high degree of residual capacity, the network may readily accept and absorb an increase in traffic and therefore, the sensitivity may be said to be low. Conversely, where the existing traffic levels are high compared to the road capacity, there is little spare capacity, and the sensitivity to change in traffic levels will be considered to be high.

Consideration has been given to the composition of the traffic on the road network, under both existing and proposed conditions. For example, light goods vehicles (LGVs) have less effect on traffic and the road system than HGVs. Similarly, HGVs can have less effect than abnormal load vehicles, depending on the frequency of the abnormal loads.

The criteria that has been used to make judgements on the sensitivity of the receptor(s) are presented in Table 9-2.

Table 9-2: Framework for Determining Sensitivity of Receptors

Sensitivity	Description
High	The receptor/resource has little ability to absorb change without fundamentally altering its present character is of international or national importance. Local residents whose daily activities depend upon unrestricted movement within

Sensitivity	Description
	their environment. Receptors such as schools, colleges, hospitals and accident hotspots.
Medium	The receptor/resource has moderate capacity to absorb change without significantly altering its present character, or is of high importance.
Low	The receptor/resource is tolerant of change without detriment to its character; is of low/local importance. Areas such as trunk road or A class roads constructed to accommodate significant HGV volumes.
Negligible	Users not sensitive to transport effects. Includes very small settlements and roads with no significant settlements including new strategic trunk roads or motorways.

Magnitude

The magnitude of traffic effects is a function of the existing traffic volumes, the percentage increase and change due to the Proposed Development, changes in the type of traffic and the temporal distribution of traffic (day of week, time of day).

The determination of magnitude has been undertaken by reviewing the Proposed Development, establishing the parameters of the receptors that may be affected and quantifying these effects utilising the IEMA Guidelines and professional judgement.

Consideration is given to the composition of the traffic on the road network, under both existing and proposed conditions. For example, LGVs have less effect on traffic and the road system than HGVs. Similarly, HGVs can have less effect than abnormal load vehicles, depending on the frequency of the abnormal loads.

The criteria used to make judgement on the magnitude of the effect on the receptor(s) is presented in Table 9-3.

Table 9-3: Framework for Determining Magnitude of Effects

Magnitude	Description
Major	Total loss of, or major/substantial alteration to, key elements/features of the baseline (pre-development) conditions such that the post development character/composition/attributes will be fundamentally changed. Generally a rule of >90% (or >70% at sensitive receptors) change in traffic is considered to be a major magnitude.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of the baseline will be materially changed. Generally, a rule of 60% - 90% (or 40% - 70% at sensitive receptors) change in traffic is considered to be a moderate magnitude.
Minor	A minor shift away from baseline conditions. Change arising from the loss / alteration will be discernible/detectable but not material. The underlying character/composition/attributes of the baseline condition will be similar to the pre-development circumstances/situation. Generally, a rule of 30 – 60% (or 10% - 40% at sensitive receptors) change in traffic is considered to be a minor magnitude.
Negligible	Very little change from baseline conditions. Change barely distinguishable, approximating to a ‘no change’ situation. Generally, a rule of <30% (or <10% at sensitive receptors) change in traffic is considered to be a negligible magnitude.

Significance

As a guide to inform the assessment, but not as a substitute for professional judgement, criteria for determining the significance of traffic related effects are set out in Table 9-4. This is based on combining the magnitude of the effect with the receptor sensitivity.

Table 9-4: Significance Criteria Matrix

Sensitivity of Receptor	Magnitude of Change			
	Major	**Moderate**	**Minor**	**Negligible**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible
The effects recorded in grey highlighted cells are considered to be '**Significant**'				

9.2.6 Study Area

The study area for the assessment of transport and access has been identified using the thresholds within the IEMA Guidelines as an aide and is indicated by Figure 9-1.

The study area has been based on the location of the Proposed Development Site and the surrounding public road network which will be used for access. It is noted that there are currently two site access options (A and B), as indicated on Figure 9-1 Study Area.

The assessment considered in this chapter assumes both will be constructed, however in reality only one would be constructed. A comprehensive desk-based study has been undertaken to understand the surrounding road network.

Abnormal Loads

The turbine components will be brought into the Port at Grangemouth, which has significant experience in handling turbine components and affords good access to the strategic road network.

An Abnormal Loads Assessment complete with swept path plans for pinch points along the route from the Port at Grangemouth to the Proposed Development Site access point has been undertaken for an 85m long turbine blade. This provides a maximum worst case assessment. The Abnormal Loads Assessment can be found at Technical Appendix 9-1.

General Construction Traffic

All general construction traffic (HGVs, cars, and Light Goods Vehicles (LGVs)) will access the site from Junction 9 of the M80 and M9 (Pirnhall Interchange) by travelling north on the A872 for approximately 350m, then turning west onto Pirnhall Road, then south onto New Line Road, and continuing on minor roads for approximately 5km to the Proposed Development Site.

Access to the Proposed Development Site will then be taken via one of the two access options (only one of which would be constructed), Option A which is located on a minor road at the north eastern extent of the Proposed Development Site boundary, or Option B which routes via Muirpark Farm on the eastern boundary of the Proposed Development Site.

General construction HGVs, cars, and LGV traffic will use two main potential access routes to reach the Pirnhall Interchange. The first route is from the M80 south of Stirling (from Glasgow) which routes via Cumbernauld. The second route is from the M9 southeast of Stirling, from Grangemouth and the east.

It is expected that the M80 and M9 routes will be used for the delivery of various materials and machinery to the Proposed Development Site during the construction phase.

The A872 has been included in the Study Area as a potential route for delivery of supplies due to the location of Northfield Quarry, northeast of Denny. The specific routes will be determined following confirmation of the Principal Contractor for the site and will be based on a number of factors including supply locations and depot locations.

Study Area

The study area is therefore as follows:

- M80 approximately 15.5km south west of the Pirnhall Interchange to between Junction 5 and 6;
- M9 approximately 13.5km south east of the Pirnhall Interchange to Grangemouth;
- A872 south of the Pirnhall Interchange; and
- Minor roads from north of the Pirnhall Interchange to the two Proposed Development Site access points.

All road links within the study area are subject to IEMA Rule 1, whereby a 30% increase in HGV levels or total traffic will trigger the requirement for a detailed assessment of the potential environmental effects.

9.2.7 Desk Based Research and Data Sources

Traffic count information has been obtained to represent the baseline traffic flows for the road links within the Study Area. Data for the M80 and M9 has been sourced from 24-hour ATC surveys obtained from the Transport Scotland National Traffic Data System (NTDS) database for 2023. Traffic count information for the A872 and minor road from the A872 to the Proposed Development have been collected through ATC surveys carried out in November 2023.

The traffic flows have been factored up where necessary to represent the anticipated year of construction (2026) flows using the National Road Traffic Forecast (NRTF) "low growth" factors to represent the current and opening future year baseline flows respectively.

9.3 Baseline Conditions

The following paragraphs detail the baseline conditions of the road links identified as being within the study area.

9.3.1 M80

The M80 is a trunk road of approximately 40km in Scotland's Central, belt linking Glasgow to Stirling via Cumbernauld and Denny. The M80 is primarily a dual carriageway and is subject to the national speed limit.

Construction traffic from Glasgow and surrounding areas in the central belt may use the M80 to travel to the Proposed Development, exiting at Junction 9, the Pirnhall Interchange and continuing via the A872 and minor roads to the Proposed Development.

The M80 is a route well used by HGV traffic, providing a connection from the central belt to the A9. Therefore, for the purposes of this assessment, the impact of proposed Development traffic on the M80 will be considered against IEMA 'Rule 1' and the 30 % threshold of increase in total traffic or HGV levels (i.e. this road link is not considered specifically 'sensitive').

9.3.2 M9

The M9 is a 53km section of motorway which is part of the trunk road network and routes in a northwest direction from the M8 near Newbridge, to Dunblane north of Stirling where it becomes the A9. The road is primarily a dual carriageway and is subject to the national speed limit.

Construction traffic from eastern central Scotland including Edinburgh and Grangemouth may travel to the Proposed Development via the M9, exiting at Junction 9, the Pirnhall Interchange, and continuing via the A872 and minor roads to the site access.

The M9 is a route well used by HGV traffic, providing a connection from Edinburgh to Stirling via Grangemouth. Therefore, for the purposes of this assessment, the impact of Proposed Development traffic on the M9 will be considered against IEMA 'Rule 1' and the 30 % threshold of increase in total traffic or HGV levels (i.e. this road link is not considered specifically 'sensitive').

9.3.3 A872

The A872 routes approximately 12.5km in a north/south direction from Dennyloanhead in the south, to St. Ninians Roundabout in Stirling.

In the context of the Study Area, the A872 is a single carriageway road of approximately 6.5m width which is subject to the national speed limit.

It has been assumed that due to the proximity of Northfield Quarry to the Proposed Development Site that some construction traffic may use the A872 to travel from the quarry to the Pirnhall Interchange, then onwards to the Proposed Development. Few residential properties are located on this section of the A872, therefore, for the purposes of this assessment, the impact of Proposed Development traffic on the A872 will be considered against IEMA 'Rule 1' and the 30 % threshold of increase in total traffic or HGV levels (i.e. this road link is not considered specifically 'sensitive').

9.3.4 Minor Roads

Minor roads will be used by all construction traffic to route from the Pirnhall Interchange to one of the Proposed Development access points. From the Pirnhall Interchange traffic would route north on the A872 for approximately 350m before turning west onto Pirnhall Road.

Pirnhall Road is a rural single carriageway road of approximately 4m in width with frequent passing places and a 40mph speed limit. After 850m, traffic would turn south onto New Line Road.

South of Pirnhall Road, New Line Road is a two-way single carriageway road of approximately 5m in width. Construction traffic will travel approximately 1.9km in a southwest direction before turning west onto a minor road signposted for Carron Bridge.

This rural single track road is approximately 3.5m in width and bound by grass verges and agricultural land. Construction traffic will continue west for approximately 1.8km until reaching a fork in the road. At this point, Access point A is reached by taking the minor road to the right for approximately 1.2km. From access point A, new tracks would be constructed to lead to the Proposed Development. Access point B is reached by continuing southwest on the minor road for a further 950m to the access lane for Muirpark Farm. A new access track would then bypass Muirpark Farm and provide access to the Proposed Development.

A few farms and isolated properties are located on the minor roads within the Study Area. For the purposes of this assessment, the impact of Proposed Development traffic on the Minor Roads within the Study Area will be considered against IEMA 'Rule 1' and the 30 % threshold of increase in total traffic or HGV levels (i.e. not considered specifically 'sensitive').

9.3.5 Baseline Traffic Flows

Table 9-5 indicates the two-way Average Annual Daily Traffic Flow (AADF) in the study area and the percentage of traffic which is classified as HGVs. The source of the data is also stated. The table below indicates the capacity of each road link in a 12-hour period as per the guidance contained within the DMRB.

Counter location 4 on the Minor Road is used as a proxy for all the minor roads leading from the Pirnhall Interchange to the Proposed Development Access locations.

Table 9-5: Study Area Baseline Traffic Flows

Counter Location	DMRB Category	Source	DMRB Capacity (12 hr)	Base 2023 AADF	Base 2023 HGV	2026 AADF	2026 HGV	Percentage HGV
1. M80	Dual Carriageway 7.3m	NTDS (2023)	48,000	37477	4,835	38076	4912	13%
2. M9	Dual Carriageway 7.3m	NTDS (2023)	48,000	21516	1,743	21860	1771	8%
3. A872	Rural – typical single 6.75m	ATC survey Nov 23	15,120	5,795	833	5888	846	14%
4. Minor Road	Rural – single track	ATC survey Nov 23	1,680	392	46	398	47	12%

9.3.6 Road Safety

Accident data has been obtained from Transport Scotland for the trunk roads within the study area (M80 and M9) for the previous five years (November 2018 – November 2023). The Crashmap website has been utilised to determine the number of accidents that have occurred in the five year period from 2018-2022 (the most recent available data), along the remaining road links within the identified study area. The results of this investigation are indicated by Table 9-6 with additional commentary provided on serious and fatal accidents where applicable.

Table 9-6: Accident Statistics

Counter Location	Slight	Serious	Fatal	Comments
M80	48	13	1	Fatal accident approx. 1km north of Haggs Junction 7, involving 1 casualty and 1 vehicle in 2021.
M9	7	8	2	One fatal accident on the Pirnhall Interchange roundabout between the A872 on and off ramps involving one motorcycle casualty in 2020. One fatal accident approximately 1.6km south of M9 junction 7 in in 2023 involving one casualty and one vehicle.
A872	3	0	0	Three slight accidents on the section on A872 between the Pirnhall Interchange and just south of Auchenbowie. Two slight and two serious accidents on the A872 southbound approach to the Pirnhall Interchange.
Minor Roads	0	2	0	Two serious accidents east of Old Sauchie, one in 2018 and one in 2021.

Table 9-6 indicates there have been two serious accidents recorded in the last five years on the minor roads on route to the Proposed Development Site. On the A872 within the study area, a total of three slight accidents were recorded south of the Pirnhall Interchange and two slight and two serious were recorded on the southbound approach to the Pirnhall Interchange roundabout in the last five years.

While there are a number of recorded accidents along the M80 and M9 within the study area, the levels of accidents are typical of trunk roads of this rural nature carrying high volumes of traffic. There are no identified locations where it would be considered that special consideration would be required in relation to this application.

9.4 Assessment of Effects

The construction traffic associated with the Proposed Development will comprise construction workers, HGVs / LGVs carrying construction materials & plant and abnormal loads carrying the main wind turbine components.

Construction of the Proposed Development is estimated to take 12 months. General working hours are expected to be between 07:00 and 19:00 on weekdays and 07:00 and 13:00 on Saturdays (excluding Sundays and Scottish local and national holidays, unless specifically agreed otherwise with Stirling Council) which means that staff will predominantly arrive and depart outside the peak hours associated with the surrounding road network.

Turbine delivery, erection and commissioning activities may also take place outwith these hours depending on weather conditions.

The potential number of traffic movements that will result from the Proposed Development are set out in Table 9-7 whilst Table 9-8 indicates the distribution of traffic movements across the construction programme.

This assumes that 70% of stone will be imported to site for a robust and worst-case assessment, although it is anticipated that greater than 30% will be sourced from on-site borrow pits as indicated by the borrow pit assessment (Technical Appendix 3-1).

Estimated movements include HGV and abnormal loads. The movements are noted in line with an approximate 12 month construction programme and general assumptions around the composition and dimensions of associated infrastructure. Any required forestry removal is assumed to take place before commencement of the construction period and is not considered in this assessment.

Table 9-7: Construction HGV Movements

Construction Task	Vehicle Type	Approximate No. of Loads
Site Establishment	Low Loader and Dump Truck	50
General site deliveries	Low Loader and Dump Truck	50
Imported stone (access roads, crane hardstanding areas, other hardstanding areas)	Dump Truck	2,178*
Reinforcement	Low Loader	20
Foundations	Concrete Wagon	596
Cabling deliveries and sand	Low Loader	140
Geotextile separators	Low Loader	50
Delivery of HV electrical items	Dump Truck	15
Construction of Sub-station	Various	45
Cranes and related lifting equipment	Crane Vehicle	20
Erection of turbines	Abnormal Loads	44
Site reinstatement and restoration	Various	30
	Total (one-way trips)	**3,238**
	Total (two-way trips)	**6,476**

*Assuming that at a worst case, 70% of stone will be imported to site

Table 9-8: Construction HGV Movements per Month

Task	Month												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Site Establishment	16	17	17										50
General site deliveries	6	6	4	4	3	3	3	3	4	4	5	5	50
Imported stone*	457	457	457	457	350								2,178
Reinforcement				5	5	5	5						20
Foundations				149	149	149	149						596
Cabling deliveries and sand							28	28	42	42			140
Geotextile separators				13	13	12	12						50
Delivery of HV electrical items						8	7						15
Construction of Sub-station					15	15	15						45
Cranes and related lifting equipment					8	2					2	8	20
Erection of turbines							22	22					44
Site reinstatement and restoration											9	21	30
Total Inbound Trips	**479**	**480**	**478**	**628**	**543**	**194**	**241**	**53**	**46**	**46**	**16**	**34**	**3,238**
Total Inbound plus Outbound Trips	**958**	**960**	**956**	**1,256**	**1,086**	**388**	**482**	**106**	**92**	**92**	**32**	**68**	**6,476**

*Assuming 70% of stone imported

As Table 9-8 indicates, the predicted peak of HGV movements to and from the Proposed Development Site will be during month four of the construction programme, with a total of 1,256 two-way (inbound plus outbound) HGV movements.

If an average four-week month is considered, this will equate to 314 two-way weekly HGV movements. If a 5.5 working day week is considered, this will equate to a total of 57 two-way daily HGV movements during month four of the construction programme.

With regards to staff movements, it is estimated that there will be approximately 20 staff members on site on an average day. Assuming as a worst case that staff travel individually by vehicle to the Proposed Development Site, this will result in an average daily movement of 40 cars/LGVs (20 trips in, and 20 trips out daily) in addition to the daily average HGV movements derived from Table 9-8.

It is noted that the abnormal load movements have been spread across months 7 and 8 of the construction programme. The programming of these movements is indicative at this stage and the timing of such movements will be subject to the agreement of the relevant transport authorities and Police Scotland.

Table 9-9 indicates the daily percentage increases on the road links within the study area for the busiest month of the construction period (month four) in the assumed year of construction (2026).

At this stage, the source of the construction materials is unknown. In order to assess a robust scenario, 100% of construction traffic and staff trips has been applied to all routes to the Proposed Development Site.

It is important to note that this represents a worst-case scenario for each road link in isolation and this impact would not occur in reality as the total traffic distribution between all links could not exceed 100 %.

Table 9-9: Construction Traffic Effect on Routes within Study Area

Scenario	1.M80	2.M9	3.A872 South of Pirnhall	4.Minor Roads
2026 AADF	38076	21860	5888	398
2026 HGV Count	4912	1771	846	47
Month 4 worst-case daily total traffic (HGVs + staff vehicle movements)	97	97	97	97
Month 4 worst-case daily HGV traffic	57	57	57	57
Percentage increase in total traffic levels due to the Proposed Development	0.3%	0.4%	1.6%	24.4%
Percentage increase in HGVs due to the Proposed Development	1.2%	3.2%	6.7%	122.1%

As stated previously, IEMA Guidelines Rules 1 and 2 are used as thresholds to determine the requirement for a full assessment of effects in relation to an increase in traffic flows associated with the construction of the Proposed Development. Table 9-9 indicates that for Count Locations 1 to 3, the temporary increase in total traffic levels associated with the Proposed Development will increase both the total traffic and HGV traffic flow by a negligible amount (<10%).

Given that the increase in total traffic and HGV levels are both below the stricter IEMA Guideline 'Rule 2' threshold for roads considered as sensitive receptors, a full assessment of effects is not required for these road links in accordance with the IEMA Guidelines.

Table 9-9 indicates that for Count Location 4, the minor roads, temporary total traffic levels will increase by 24.4%, and HGV levels will increase by 122.1% during the worst-case month during the construction period. This level of increase is unsurprising, given that baseline total traffic and HGV levels are relatively low along this link. Notwithstanding this, the increase in total and HGV traffic exceeds the 30% increase in total and HGV traffic therefore triggering the need for a detailed assessment of effects on the minor roads.

9.4.1 Detailed Assessment of Minor Roads

Severance of Communities

The IEMA Guidelines advise that "Severance is the perceived division that can occur within a community when it becomes separated by major transport infrastructure".

The potential for traffic associated with the Proposed Development to cause severance is assessed on a case-by-case basis using professional judgement where traffic increases are predicted on roads through residential settlements.

Increased severance can result in the isolation of areas of a settlement or individual properties. Severance may result from the difficulty of crossing a heavily trafficked road or a physical barrier created by the road itself. Severance effects could equally be applied to residents, motorists or pedestrians.

With reference to Table 9-3, the magnitude of the change in HGV levels along the Minor Road is considered to be major given that the increase exceeds 90% of baseline levels. As discussed, this is undoubtedly due to the fact that baseline HGV levels are very low rather than there being high traffic volumes associated with the construction of the Proposed Development. To put the increase in traffic levels into perspective, 57 total (inbound plus outbound) HGV movements per day equates to only five additional HGVs per hour (essentially one every 12 minutes) over the course of a day.

The sensitivity of Link 4, the Minor Roads, to an increased severance effect is considered to be low in accordance with Table 9-2 due to the rural nature of the road and limited number of isolated dwellings along the route. Combining the major magnitude of the change with the low sensitivity of the receptor in accordance with Table 9-4 equates to a likely significance of effect which is classed as moderate and **Significant** as per the EIA Regulations, therefore mitigation is required.

Road Vehicle Driver and Passenger Delay

Some driver delay may be experienced when construction traffic is accessing the Site. The IEMA Guidelines advise "delays are only likely to be significant when the traffic on the network surrounding the Site is already at, or close to, the capacity of the system".

Traffic delay to non-development traffic may occur at several points on the network surrounding the Site including:

- At the Proposed Development Site entrance where there will be additional turning movements;
- At intersections along the local road network which might be affected by increased traffic; and
- At side roads where the ability to find gaps in traffic may be reduced, thereby lengthening delays.

It is noted that there are no significant areas of congestion on the Minor Roads at this point in time. With reference to Table 9-3, the magnitude of the change in HGV levels along the Minor Roads is considered to be major based on an increase in HGV levels of over 90%.

The sensitivity of the road link to an increased road vehicle driver and passenger delay effect is considered to be low in accordance with Table 9-2 as there are very few junctions and therefore potential areas for the delay of other road users by turning HGVs. Furthermore, the AADF of these road links is low, hence, there is sufficient available capacity to accommodate additional vehicle movements without causing delay to other road users.

Combining the major magnitude of the change with the low sensitivity of the receptor in accordance with Table 9-4 equates to an effect which is classed as moderate and **Significant** as per the EIA Regulations. Mitigation will be required.

Non-Motorised User Delay and Amenity

The IEMA Guidelines advise that "The assessment of pedestrian delay serves as a proxy for the delay that other modes of non-motorised users may experience when crossing roads".

Traffic volumes, traffic composition, traffic speed, the existence of pedestrian footways and the existence of pedestrian crossings all contribute to the level of general pleasantness experienced by pedestrians and other vulnerable road users.

With reference to Table 9-3, the magnitude of the change in HGV levels along the Minor Road is considered to be major.

The sensitivity of the Minor Roads to an increased pedestrian delay and reduced pedestrian amenity effect is considered to be negligible in accordance with Table 9-2 as there is likely to be low pedestrian activity along this road link due to the lack of footways present and no amenities within reasonable walking distance.

Combining the magnitude of the change with the sensitivity of the receptor in accordance with Table 9-4 equates to an effect which is classed as minor and **Not Significant** as per the EIA Regulations.

Fear and Intimidation on and by Road Users

IEMA guidelines state that "a further environmental impact that affects people is the fear and intimidation created by all moving objects", with the extent of fear and intimidation dependent upon:

- The total volume of traffic;
- The heavy vehicle composition;
- The speed these vehicles are passing; and
- The proximity of traffic to people.

The 2023 IEMA guidelines provide a weighting system to help quantify the likelihood and level of pedestrian fear and intimidation. Following this process, which is based on average traffic flows and vehicle speeds, the Minor Road is approximated to have a level of fear and intimidation classed as 'small', which is the lowest level, and the magnitude of change due to the increase in construction traffic during the worst case month of construction is deemed to be negligible. When the small sensitivity is combined with the negligible magnitude, the effect is assessed as negligible and **Not Significant**.

Road User and Pedestrian Safety

The most recently available accident data for the road links within the Study Area has been provided in Table 9-6 for the period between 2018 and 2022. The data indicates that during that time period a total of two serious accidents occurred on the Minor Roads leading to the Proposed Development Site.

An approximate calculation has been undertaken to quantify the level of accident risk that could be expected due to an increase in traffic associated with the Proposed Development. The likelihood of an accident occurring is commonly expressed in accidents per million vehicle-km. Accidents that are appraised in relation to transport are predominantly those in which personal injury is sustained by those involved (personal injury accidents (PIAs)).

For the purpose of this calculation, it has been assumed that the length of road is 8.4km, which includes both site access locations, and can be generally classified as 'rural typical single carriageway' in accordance with the criteria set out within DMRB.

Accident rates from the DMRB for this standard of road are:

- Rural typical single carriageway: 0.190 Personal Injury Accidents (PIA) per million vehicle-km.

Assuming a two-way trip on the 7.05km route for each of the 3,266 vehicles during the construction period (as set out in Table 9-7), a total distance of 45,482km is obtained. Based on the rate above; this suggests 0.0086 accidents during the construction period associated with the additional traffic.

It is considered that the magnitude of this effect is negligible but receptor sensitivity to this effect is always considered as high. When combined, the effect can be classified as minor and **Not Significant**.

Hazardous and Large Loads

There are no hazardous loads associated with the Proposed Development.

IEMA guidelines state that "The movement of large (abnormal) loads is regulated by National Highways and will be subject to separate agreement with the relevant highway authorities and police". The number and schedule of abnormal load trips associated with the Proposed Development is detailed in Table 9-8 and equates to approximately 5-6 abnormal loads per week over months 7 and 8 of the construction programme. This impact is considered to be negligible and **Not Significant**.

9.5 Cumulative Effects

Cumulative effects have been assessed for other developments which may utilise sections of the road network required for the Proposed Development. Operational wind farms have been discounted as they have negligible operational traffic and therefore have no cumulative traffic effect. The sites considered in terms of cumulative assessment are indicated by Figure 1-4.

The potential for cumulative effects has been assessed by reviewing traffic information available from the Traffic and Transport Chapters within the respective EIARs or Scoping Reports if still at planning stage. Where applicable, the effect of the combined increase in construction traffic generated by other wind farm developments and the Proposed Development is added to the baseline traffic to allow consideration of the cumulative effect.

Shelloch Windfarm - Consented

Shelloch Wind Farm gained consent from Stirling Council in 2022 for five wind turbines of up to 125m in height (to blade tip) on the Fintry Hills, 12km to the south-west of Stirling.

Whilst this development is in a similar area to the Proposed Development, access for the Shelloch development is taken via the A811 to the northwest of Stirling. With the access at this location, the only overlap of construction traffic routes with the Proposed Development are likely to be the M80 or M9. Both of these motorways are trunk roads of a good standard with sufficient capacity to accommodate the cumulative increases in traffic associated with both developments, however due to the two developments being at different stages of planning it is highly unlikely that the peak construction periods will coincide.

Earlsburn Windfarm Extension – Application Stage

The Earlsburn Windfarm extension proposes an 11 turbine extension to the existing Earlsburn Windfarm, located in the Touch Hills, around 2.2 km south of Gargunnock, 3.8km southeast of Kippen and 7 km to the west of Stirling.

Although situated approximately only 4km northwest of the Proposed Development (as the crow flies), the Earlsburn Extension will be accessed via the A811 to the west of Stirling, therefore the only overlap of construction traffic routes with the Proposed Development are likely to be the M80 or M9. Both of these motorways are trunk roads of a good standard with sufficient capacity to accommodate the cumulative increases in traffic associated with both developments, however due to the two developments being at different stages of planning it is highly unlikely that the peak construction periods will coincide.

Summary

In summary, it is unlikely that the peak construction period associated with another wind farm development in the area will overlap with the peak construction period of the Proposed Development as the applications are at different stages in the planning process and each development has varying lengths of construction period.

The high traffic generating activities, such as the importation of stone and concrete, only occur over a few months of the whole construction period for each development. It is unlikely that the local capacity for concrete and stone production could supply several developments at once, therefore, high traffic generating activities will naturally be staggered.

Furthermore, implementation of a CTMP for each development will ensure that there are open lines of communication with Stirling Council, Police Scotland, Transport Scotland, other stakeholders and wind farm developers to monitor the progress of the construction stages.

This process will flag whether construction HGV traffic is reaching unacceptable levels and will ensure that action is taken accordingly to minimise effects.

9.6 Mitigation Measures

The assessment predicts that, prior to mitigation measures, the effects of severance and road vehicle driver and passenger delay would be significant along the Minor Roads within the Study Area, as a result of increased levels of traffic and HGVs associated with the Proposed Development. In accordance with the EIA Regulations mitigation measures are required to address this potential effect. It is therefore proposed to prepare and implement a comprehensive CTMP which is intended to mitigate the identified effects by ensuring that they are minimised as far as possible within the Study Area to a level which is considered to be not significant.

The CTMP will identify measures to reduce the number of construction vehicles as well as considering ways to reduce or avoid the impact of vehicles through construction programming / routing and identification of an individual with responsibilities for managing transport and access effects.

The CTMP will also identify measures to reduce and manage construction staff travel by private car, particularly single occupancy trips. The CTMP will be developed during the detailed design phase of the Proposed Development. Potential measures could include (but are not limited to):

- Immediately upon commencement, all deliveries, operatives and visitors to The Proposed Development Site will report to the security gate. This will be communicated to all early works contractors at their pre-start meeting;
- The main contractor will develop a logistics plan highlighting the access point for the project, loading bay, pedestrian / vehicular segregation, welfare, storage, security and material handling that will be enforced following full site establishment;
- Approved haul routes will be identified to The Proposed Development Site and protocols put in place to ensure that HGVs adhere to these routes;

- All contractors will be provided with a site induction pack containing information on delivery routes and any restrictions on routes;
- Temporary construction site signage will be erected along the identified construction traffic routes to warn people of construction activities and associated construction vehicles;
- A construction traffic speed limit (for example, 20 mph) will be imposed through sensitive areas;
- The construction material 'lay down' areas will allow for a staggered delivery schedule throughout the day, avoiding peak and unsociable hours (i.e. before 6 am and after 10 pm);
- An integral part of the progress meetings held with all trade contractors is the delivery schedule pro-forma. All contractors will be required to give details of proposed timing of material deliveries to the Site. At this stage, they will be given a specific area for delivery;
- The CTMP and the control measures therein will be included within all trade contractor tender enquiries to ensure early understanding and acceptance / compliance with the rules that will be enforced on this project;
- Under no circumstances will HGVs be allowed to lay-up in surrounding roads. All personnel in the team will be in contact with each other and with Proposed Development Site management, who in turn will have mobile and telephone contact with the subcontractors;
- Roads will be maintained in a clean and safe condition; and
- A wheel cleaning facility will be installed on-site during the construction period in order to reduce mud and debris being deposited onto the local road network.

9.7 Residual Effects

The potential effects of the temporary increase in construction traffic on the study area roads was evaluated. The summary of this assessment is provided in Table 9-9. The percentage increase in total traffic levels due to the Proposed Development was deemed to be not significant on all road links in the study area, with the exception of the Minor Roads leading to the Proposed Development Site. No road capacity issues are predicted within the study area during the construction phase.

A full assessment of the Minor Roads has been carried out considering the peak month in construction traffic. Of the potential environmental effects of Severance, Driver Delay, Pedestrian Delay and Amenity, Accidents and Safety and Dust and Dirt, only Severance and Driver Delay were assessed as a significant effect, all other effects were deemed Not Significant on the Minor Roads.

Following implementation of the CTMP as a mitigation measure, the following paragraphs assess the likely residual effects of increased traffic levels within the Study Area during construction of the Proposed Development.

The CTMP will ensure that the volume of HGV trips is minimised as much as possible and will include measures such as the recycling/reuse of materials on-site where possible.

The CTMP will ensure that there is signage along the construction routes to make residents aware of the additional HGV traffic and to provide the opportunity to plan accordingly. The CTMP will ensure that construction HGVs do not travel during peak periods or at the start/end of the school day and that they adhere to a lowered speed limit. Each of these measures will contribute to minimising the level of effect experienced by residents of the isolated properties along the routes within the Study Area.

Furthermore, it is important to recognise that all effects associated with increased construction traffic will be temporary in nature and that this assessment has considered the worst-case possible effect at each location.

The residual effects of severance and road vehicle driver and passenger delay are therefore considered to be minor and **Not Significant** on the Minor Roads leading to the Proposed Development after implementation of a CTMP.

9.8 Summary and Statement of Significance

This chapter considers the potential traffic and transport effects associated with the construction of the Proposed Development on the surrounding public road network and sensitive receptors.

The construction programme associated with the Proposed Development is anticipated to cover a 12 month period. During this time, 3,226 HGVs are anticipated to access the Proposed Development Site, which would equate to 57 daily two-way (inbound and outbound) HGV trips during the peak construction month (Month 4).

A robust assessment has been undertaken using the worst case scenario for two-way traffic movements, including the assumption that 70% of stone will be imported to the Proposed Development Site. The effect of total construction traffic could increase traffic flows along the road links within the Study Area by the following percentages:

- M80– 0.3%;
- M9 – 0.4%;
- A872 – 1.6%; and
- Minor Roads – 24.4%.

The percentage increase in HGVs associated with the worst case month of the construction programme for the Proposed Development could increase HGV traffic flows by the following percentages;

- M80– 1.2%;
- M9 – 3.2%;
- A872 – 6.7%; and
- Minor Roads – 122.1%.

In this chapter, the increase in HGV traffic triggered a full assessment of the Minor Roads which is summarised in Table 9-10 below.

Table 9-10: Summary of Effects on Minor Roads in the Study Area

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
Construction Phase				
Minor Roads	Severance	Moderate – Significant	CTMP	Not Significant
	Driver Delay	Moderate – Significant	CTMP	Not Significant
	Pedestrian Delay and Amenity	Minor – Not Significant	Not required however, CTMP implemented as ‘good practice’.	Not Significant
	Fear and Intimidation	Minor – Not Significant	Not required however, CTMP implemented as ‘good practice’.	Not Significant
	Accidents and Safety	Minor – Not Significant	Not required however, CTMP implemented as ‘good practice’.	Not Significant
	Hazardous and Large Loads	Negligible – Not Significant	Not required however, CTMP implemented as ‘good practice’.	Not Significant

It is important to note that these increased traffic levels are temporary in nature and represent the expected traffic generation during the busiest month of construction. Traffic generated by the Proposed Development during other months of the construction programme will be considerably lower than those assessed in this chapter.

This chapter concludes that environmental effects of increased traffic as a result of the Proposed Development are Not Significant following implementation of a CTMP. This chapter also concludes that the traffic levels anticipated during the busiest month of construction can be accommodated by the existing road network within the Study Area, and further managed / minimised by the implementation of a CTMP.

9.9 References

Crashmap Website (www.crashmap.co.uk) (Accessed November 2023)

Department for Transport (DfT). (2013). Design Manual for Roads and Bridges (DMRB) Vol 15

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Scottish Government (2022). National Planning Framework 4 (NPF4)

Chapter 10: Cultural Heritage

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	Environmental Impact Assessment (EIA) is a means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 (EIA Regulations)
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1

List of Abbreviations

Abbreviation	Description
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
NTS	Non-Technical Summary
SC	Stirling Council
ACoW	Archaeological Clerk of Works
CIfA	Chartered Institute for Archaeologists
Discovery Excav. Scot.	Discovery Excavation Scotland
EIA	Environmental Impact Assessment
GDL	Garden and Designed Landscape
HEA	Historic Environment Assessment
HER	Historic Environment Record
HES	Historic Environment Scotland
OS	Ordinance Survey
OUV	Outstanding Universal Value
PCHIA	Principles of Cultural Heritage Impact Assessment
ICOMOS	International Council on Monuments and Sites
SNH	Scottish Natural Heritage
SCAS	Stirling Council Archaeology Service
UNESCO	The United Nations Educational, Scientific and Cultural Organization
ZTV	Zone of Theoretical Visibility
CIfA	Chartered Institute for Archaeologists

Abbreviation	Description
Discovery Excav. Scot.	Discovery Excavation Scotland
EIA	Environmental Impact Assessment
GDL	Garden and Designed Landscape

10 Historic Environment

10.1 Introduction

This Chapter of the EIA Report considers the potential effects of the Proposed Development on the historic environment.

The historic environment comprises; "…*the physical evidence for human activity that connects people with place, linked with the associations we can see, feel and understand.*" (Scottish Government 2014).

Its constituent parts are known as 'heritage assets'. These can be tangible features, buildings, or places or intangible stories, traditions and concepts that provide physical evidence of past human activity and hold of sufficient value (i.e. cultural significance) to this and future generations to merit consideration in the planning system (Historic Environment Scotland (HES) and Scottish Natural Heritage (SNH) 2018).

This assessment therefore focuses on if, and how, the Proposed Development will change the cultural significance of heritage assets within and around it.

Relevant heritage assets are also discussed in the Landscape and Visual Impact Assessment (LVIA) presented in Chapter 5: Landscape and Visual of this EIA Report.

The LVIA focuses on a development's visibility from a location, such as a heritage asset, and the effect that visibility has on visitors to that location, in other words on visual amenity.

In contrast, the cultural heritage assessment focuses on effects to the cultural significance of heritage assets. Each assessment therefore considers different types of receptors (people vs. cultural significance) and effects and can come to differing conclusions on levels of effect relating to the same receptor.

The historic environment assessment was undertaken by LUC. The chapter was prepared by David Bull BA (Hons) MCIfA. David is a Principal Historic Environment Consultant at LUC who is an experienced archaeologist with over 22 years' experience in the sector. Rachel Haworth MA (Hons) MA IHBC contributed to the assessment of Stirling Castle and city of Stirling assets.

Rachel is Associate Director of Historic Environment at LUC with over 22 years' experience in built heritage conservation, significance and impact assessment. The cultural heritage assessment was overseen by Steven Orr MA (Hons) MSc LRTPI FSA (Scot).

Steven is the Director of LUC's historic environment team and is a highly experienced town planner and landscape archaeologist with expertise in research, policy development and EIA.

This chapter is also supported by Appendix 10-1: Historic Environment Assessment (HEA) which is referred to throughout. This Appendix contains further details of the heritage assets referred to in this Chapter and the assessment of the potential effects on those assets.

This chapter is also supported by Appendix 10-2: NPF4 Addendum which provides additional expert analysis of the EIA findings and interprets its outcomes for the four designated heritage assets identified as experiencing likely effects, with regard to the relevant provisions of National Planning Framework 4.

10.2 Scope of Assessment

10.2.1 Effects Assessed in Full

The following effects were identified at the scoping stage for consideration in this assessment:

- Direct effects resulting from physical change to heritage assets within the Proposed Development Site. Heritage assets beyond the Proposed Development Site are not at risk of direct physical change as a result of the Proposed Development;
- Direct effects to designated and non-designated heritage assets that are identified as being sensitive to setting change. These effects are considered in relation to the Proposed Development Site and the different study areas as set out below; and
- Cumulative operational effects as a result of setting change.

10.2.2 Effects Scoped Out

On the basis of the desk based and field survey work undertaken, the professional judgement of the EIA team, experience from other relevant projects and policy guidance or standards, and feedback received from consultees, the following topic areas have been ‘scoped out’ of detailed assessment, as proposed in the Scoping Report:

- Direct physical effects to heritage assets outside of the Proposed Development Site where no construction works will take place;
- Direct effects to heritage assets as a result of setting change during construction as these will be temporary;
- Cumulative effects to the cultural significance of heritage assets during construction as a result of setting change as these will be temporary;
- Indirect physical effects on heritage assets as a consequence of vibration, dewatering or changes in hydrology (since such effects are unlikely, and will not be significant, given the scale and nature of the Proposed Development); and
- Cumulative physical effects (these are considered unlikely given the nature of the Proposed Development).

10.3 Methodology and Approach

10.3.1 Legislation, Planning Policy and Guidance

The following legislation, Planning policy and guidance were considered in carrying out this assessment.

Legislation

This assessment was carried out in accordance with the principles contained within the following legislation:

- Ancient Monuments and Archaeological Areas Act (1979);
- Planning (Listed Buildings and Conservation Areas) (Scotland) Act (1997); and
- Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations (2017). ('the EIA Regulations' / 'the Regulations').

Relevant planning policy is presented in Appendix 10-1: Historic Environment Assessment.

Guidance

This assessment is carried out in accordance with the principles contained within the following documents:

- Code of Conduct: professional ethics in archaeology (Chartered Institute for Archaeologists (CIfA), 2022);
- Standard and guidance for historic environment desk-based assessment CIfA (2020);
- Managing Change in the Historic Environment Guidance Notes – setting (hereafter referred to as the HES setting guidance) (Historic Environment Scotland (HES), 2020a);
- Managing Change in the Historic Environment Guidance Notes – gardens and designed landscapes (HES 2020b);
- Managing Change in the Historic Environment Guidance Notes – historic battlefields (HES 2020c);
- Managing Change in the Historic Environment Guidance Notes – World Heritage (HES 2020d);
- Designation Policy and Selection Guidance (HES 2020);
- Planning Advice Note 2/2011: Planning and Archaeology (Scottish Government 2011);
- Environmental Impact Assessment Handbook (particularly the framework for Cultural Heritage Impact Assessment provided in Appendix 1; hereafter this guidance is referred to as the EIA Handbook) (HES and SNH 2018); and
- Principles of Cultural Heritage Impact Assessment (PCHIA) in the UK (CIfA, Institute of Historic Building Conservation and Institute of Environmental Management and Assessment 2021).

10.3.2 Consultation

In undertaking the assessment, consideration has been given to the scoping responses and other consultation which has been carried out as detailed in Table 10-1.

Table 10-1: Consultation

Consultee	Summary of Consultee Response	Where addressed within this Report
HES (Formal Scoping Opinion - 23 October 2020)	Broadly content with the scope of assessment.	Noted with thanks.
	HES expressed significant concerns about the potential adverse impact on Scheduled Monuments in the vicinity of the development site boundary.	All designated heritage assets within 10km of the outermost turbines (the Inner and Outer Study Areas) have been include in the assessment. Impacts are reported in Appendix 10-1: The Historic Environment Assessment and Chapter 10 of the EIA Report.
	Potential cumulative impact of the proposed development should also be given particular attention in the assessment.	Cumulative effects are reported in Appendix 10-1: The Historic Environment Assessment and Chapter 10 of the EIA Report.
	Specific heritage assets are given in an annex this covering letter. These are: Stirling Castle (SM90291); Stirling, Royal Gardens including King's Knot (SM90288);King's Yett, cairn 300m W of (SM 2580); Dundaff Hill, mound 550m NE of summit (SM 6553); Dundaff Hill, enclosure 950m NNW of Carron Bridge (SM 7131); Bannockburn Inventory Historic Battlefield (BTL 4) and Sauchieburn Inventory Historic Battlefield (BTL 38).	The designated heritage assets identified by HES have been considered included in the baseline and impacts are reported in Appendix 10-1: The Historic Environment Assessment and Chapter 10 of the EIA Report.
	Impact on heritage assets located in the vicinity of the development site application boundary are assessed using our Managing Change guidance note on Setting and the EIA Handbook.	All direct effects due to setting change have been assessed with reference to the Managing Change guidance note on Setting, and the EIA Handbook has informed the assessment.
	Given concerns, it is important HES have further dialogue about the proposal in advance of any EIA Report and planning application.	Pre-application consultation has been undertaken with HES.
HES (post scoping	Stirling Castle was orientated with	The horizontal spread of the six

Consultee	Summary of Consultee Response	Where addressed within this Report
consultation meeting 16/12/2020)	the vista in mind and the ridge on which Craigengelt sits is already at capacity with the existing turbines. Principal concerns are the western views from the Castle Height of the turbines and their position closer makes them more prominent than the existing turbines. Turbines 2,3 and 6 give concern from Kings Yett	turbines was reduced in order to minimise the horizontal field of view from sensitive receptors (including Striling Castle) with the overall aim of producing a layout that lies within the horizontal field of view of the operational Craigengelt Wind Farm.
HES (post-scoping consultation cultural heritage visualisation review - 29 January 2024)	Proposals could raise issues of national interest for the settings of Stirling Castle SM90291 and King's Yett, cairn 300m W of (SM2580). CH3a demonstrates the potential impact on views looking from the monument. However, we note that a visualisation showing the potential impact when looking towards the monument, with turbines potentially appearing with the monument in the same view has not been produced. We therefore recommend that this should be included within any EIA Report.	Noted. Direct effects due to setting change have been assessed for Stirling Castle (SM90291) and King's Yett, cairn (SM2580), as well as Dundaff Hill mound and enclosure (SM6553; SM7131). Impacts are reported in Appendix 10-1 and Chapter 10 of the EIA Report. An additional in-combination visualisation (looking towards the Dundaff Hill mound enclosure (SM7131) has not been produced. This is due to the lack in-combination views of the enclosure and the Proposed Development due to the steep slope directly to the south-east of the asset. Please refer to Appendix 10-1.

10.3.3 Assessment Methodology

Study Areas

Physical effects to the cultural significance of heritage assets are assessed within the Proposed Development Site only.

Effects arising from setting change are assessed for those assets within the Proposed Development Site and using two study areas, which have been defined in response to the bare earth modelling of the Proposed Development's Zone of Theoretical Visibility (ZTV) and an understanding of the distance over which significant effects arising from setting change are considered likely. The two study areas are the:

- Inner Study Area: consisting of the land beyond the Proposed Development's outermost turbines to a distance of 5km from it. All heritage assets located within the Inner Study Area have been considered for the potential for effects arising from setting change; and

- Outer Study Area: consisting of land between 5km (Inner Study Area) and 10km. Designated heritage assets lying within this area have been considered for the potential for effects due to setting change.

Consideration has also been given to the potential for setting change to heritage assets within the ZTV, beyond 10km.

The Proposed Development Site boundary and the extent of the Inner and Outer Study areas are shown on Figures 10-1, 10-2 and 10-3.

Sources

The following data sources informed the assessment:

- HES spatial datasets and database for designated heritage assets comprising:
  - World heritage sites;
  - Scheduled monuments;
  - Listed buildings;
  - Conservation areas;
  - Inventory Gardens and Designed Landscapes; and
  - Inventory Historic Battlefields;
- SC Historic Environment Record (HER) data (received 6 February 2023);
- SC conservation area information, including conservation area appraisals where available;
- HES Canmore database (the National Record of the Historic Environment);
- Historic Land-use Assessment (HLA) data;
- Historic Ordnance Survey mapping (principally First and Second Edition 25 inch and 6 inch to a mile mapping where available for the Site) and other published historic mapping held in the National Library of Scotland (NLS) and available online;
- Aerial photographs (oblique and vertical) held by the National Collection of Aerial Photography (NCAP) available online;
- Available reports from recent archaeological work undertaken in the area ('grey literature');
- Relevant archive material held by SC, HES, NLS, registers of Scotland available online;
- Publicly accessible LiDAR data;
- Visualisations and 3-D turbines modelled and viewed in relevant software; and
- Findings of other relevant topics identified in Chapter 5: Landscape and Visual, Chapter 8: Hydrology, Geology and Hydrogeology and Chapter 11: Noise of this EIA Report.

In addition to the sources identified above, the Scottish Archaeological Research Framework (ScARF 2012), which provides a national overview by period, was used to inform the assessment of the cultural significance and importance of those heritage assets identified in the baseline.

Field Survey

A walkover survey of the construction footprint and selected heritage assets within the Proposed Development Site and site visits to selected heritage assets in the Inner and Outer Study Areas were undertaken in April and May 2023 to inform the assessment. Weather conditions during these surveys were good, with excellent visibility.

The walkover survey allowed for the verification of known heritage assets, confirming their interpretation, location, and likely sensitivity to change, and informed the assessment of potential effects on those assets. Selected heritage assets beyond the Proposed Development Site were also visited to confirm their setting and inform the assessment of change to that setting.

The selection of heritage assets beyond the Proposed Development Site was informed by the ZTV and professional judgement in relation to the likely sensitivity to setting change of heritage assets with theoretical visibility or the potential for in-combination views that contribute to their cultural significance.

Selected photographs which inform the baseline and assessment are included in Appendix 10-1.

Assessing Significance of Effect

The adopted assessment approach follows the six analytical steps set out in the PCHIA guidance for understanding heritage assets and evaluating change:

1. Understanding heritage assets:
    a. describe the heritage asset;
    b. ascribe cultural significance; and
    c. attribute importance;
2. Evaluating the consequences of change:
    a. understand change;
    b. assess impact; and
    c. weigh the effect.

The assessment methodology also draws on that set out in the EIA Handbook, as far as it is compatible with, or complements, the PCHIA guidance.

Understanding Heritage Assets

Heritage Asset Description

All heritage assets are described factually and in a manner proportionate to their importance and susceptibility to change.

The description includes sufficient detail to understand the potential effect of the Proposed Development on their cultural significance and, consequently, only information that is relevant to understanding how cultural significance might be affected by the Proposed Development has been included. Further information on heritage assets identified in this chapter is presented in Appendix 10-1.

Heritage Asset Value (Cultural Significance)

Heritage assets are important due to their cultural significance, which can be articulated in various ways. This assessment draws upon the heritage values referenced by HES' Historic Environment Policy for Scotland (2020e), which in turn are drawn from The Burra Charter (Australia ICOMOS 2013a) and detailed in Understanding and Assessing Cultural Significance Practice Note (Australia ICOMOS 2013b). These values comprise:

- Evidential value: This refers to the information content of a place and its ability to reveal more about an aspect of the past through examination or investigation of the place, including the use of archaeological techniques. The relative scientific value of a place is likely to depend on the importance of the information or data involved, on its rarity, quality or representativeness, and its potential to contribute further important information about the place itself or a type or class of place or to address important research questions;
- Historic value: This is typically either illustrative or associative. It is intended to encompass all aspects of history; for example, the history of aesthetics, art and architecture, science, spirituality, and society. It therefore often underlies other values. A place may have historic value because it has influenced, or has been influenced by, an historic event, phase, movement or activity, person or group of people. It may be the site of an important event. For any place, the significance will be greater where the evidence of the association or event survives at the place, or where the setting is substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of such change or absence of evidence;
- Aesthetic value: This refers to the sensory and perceptual experience of a place; that is, how we respond to visual and non-visual aspects such as sounds, smells and other factors having a strong impact on human thoughts, feelings and attitudes. Aesthetic qualities may include the concept of beauty and formal aesthetic ideals. Expressions of aesthetics are culturally influenced; and
- Social / Spiritual value: This refers to the associations that a place has for a particular community or cultural group and the social or cultural meanings that it holds for them. Spiritual value refers to the intangible values and meanings embodied in or evoked by a place which give it importance in the spiritual identity, or the traditional knowledge, art and practices of a cultural group. Spiritual value may also be reflected in the intensity of aesthetic and emotional responses or community associations and be expressed through cultural practices and related places.

The ICOMOS values are a more consistent and easily understandable way of framing the values encapsulated by the HES designation criteria (Historic Environment Scotland 2019), which offer an alternative framework for understanding cultural significance.

The Contribution of Setting to Cultural Significance

The ICOMOS heritage values are a way of transparently and consistently articulating the cultural significance of a heritage asset, including any contribution made by setting to it. The HES setting guidance explains that setting is the way the current surroundings of a heritage asset or place contribute to how it is understood, appreciated, and experienced in the present landscape.

All heritage assets have a setting, but the contribution that this makes to their cultural significance varies in line with the location, form, function and preservation of the asset and its surroundings. In this assessment, the contribution made by setting to a heritage asset's cultural significance is set out discursively.

Setting can be integral to the cultural significance of a heritage asset contributing to one of more of its heritage values or their appreciation. Therefore, a change in an important element of a heritage asset's setting can equate to a direct impact to its cultural significance.

Equally, where setting does not contribute to a heritage asset's cultural significance or is not sensitive to change resulting from a proposed development, no effect can result from setting change. For this reason, not all heritage assets in the study area need to be subject to detailed assessment.

An explanation of how heritage assets are identified as being sensitive to the Proposed Development is discussed below in the sensitivity section.

Heritage Asset Importance

The ICOMOS heritage values (discussed above) can help explain a heritage asset's cultural significance, but they do not explain how important (e.g. high, medium, low) the cultural significance of the asset is.

Establishing the importance of a heritage asset is a key stage of the assessment process as it influences the way in which decisions are made during the development of a proposal as well as the weight to be given to it by the decision-maker.

Importance is determined using professional judgement alongside an understanding of local, regional, and national historic environment research objectives and, where appropriate, the use of the designation criteria for heritage assets. The criteria used to inform the assessment of importance of heritage assets are identified in Table 10-2.

Table 10-2: Heritage Asset Importance

Importance	Criteria
High	Designated heritage assets. Non-designated heritage assets that meet the criteria for statutory designation, or an equivalent level of cultural significance.

Importance	Criteria
Medium	Non-designated heritage assets of regional or regional/local value.
Low	Non-designated heritage assets of local value.
Very Low	Non-designated heritage assets of less than local or other value.
Uncertain	The heritage value of the heritage asset could not be fully ascertained.

Evaluating the Consequences of Change (Sensitivity)

A heritage asset's importance is not an automatic indication of how sensitive it is to a development. Sensitivity varies depending on the nature of a heritage asset's cultural significance, the contribution that setting makes to that cultural significance, and the character of the development and the way in which it interacts with that cultural significance.

Hence, understanding if a heritage asset is sensitive to a particular development proposal determines which assets need to be subject to detailed assessment (HES and SNH 2018).

Unless otherwise stated, all heritage assets within the Proposed Development Site have been assumed to be of high sensitivity to physical change. This is because their cultural significance is likely to be derived primarily from their evidential and historic value (form and fabric); and being located within the Site, these factors are at risk of being diminished or lost through physical change.

Any heritage assets that the Proposed Development could physically interact with have been assessed in detail.

In terms of the operation of the Proposed Development, the risk to the cultural significance of heritage assets is one of setting change.

Visibility is typically a key factor in setting change and the most far-reaching experiential quality. Therefore, heritage assets sensitive to setting change have been identified via the creation of study areas informed by review of a bare earth ZTV and an understanding of the distance over which significant visual effects are considered likely.

Heritage assets within the Inner and Wider Study Areas that were identified as having theoretical visibility of the Proposed Development have been subject to a desk-based appraisal of their cultural significance (including the contribution made by setting) and their potential interaction with the Proposed Development (see Appendix 10-1).

Designated heritage assets lying outside the ZTV were also subject to review to see if they had the potential for change to their cultural significance because of potential in-combination views. Heritage assets deriving cultural significance from elements of their setting that could be changed by the Proposed Development have been assessed in detail.

All heritage assets identified as being sensitive to the Proposed Development have been assessed in Appendix 10-1.

This chapter focuses on presenting the findings of the assessment of effects of the Proposed Development on those heritage assets considered to have the potential to experience significant effects for the purposes of the EIA Regulations.

Understanding Change

In line with the PCHIA guidance and EIA Handbook, the way in which the Proposed Development may change the cultural significance of a heritage asset, and whether that change is temporary or permanent, has been clearly articulated with explicit reference to the heritage value(s) affected.

Assessing Impact (Magnitude of Change)

Assessment of the impact to a heritage asset's cultural significance as a result of the Proposed Development has been undertaken using professional judgement and an understanding of how the heritage values of that asset that contribute to its cultural significance will be affected.

It is not a measure of the reach or extent of the proposal or the importance of the heritage asset. As per the PCHIA guidance a simple scale is used for assessing an impact (or magnitude of change) and, for transparency, the criteria for this are set out below in Table 10-3.

Table 10-3: Level of Impact / Magnitude of Change Criteria

Magnitude of Change	Description
Large	Substantial, near total, or total loss of a heritage asset's cultural significance either through physical and/or setting change. Substantial level of change to how that significance is understood, appreciated, or experienced.
Medium	Medium loss or alteration of a heritage asset's cultural significance either through physical and/or setting change. Medium level of change to how that significance is understood, appreciated, or experienced.
Small	Slight loss or alteration of a heritage asset's cultural significance either through physical and/or setting change. Small changes to how that significance is understood, appreciated, or experienced.
None	No change to the cultural significance of the heritage asset, or how that significance is understood, appreciated, or experienced

Level of Effect (Significance of Effect)

In EIA terms the level of effect is typically referred to as the significance of effect. This terminology has deliberately been avoided to prevent confusion with the discussion of cultural significance. Similarly, the PCHIA term of 'weighting the effect' has been avoided to remove any sense of conflation with weighing of effects in the planning balance – a matter solely for the decision-maker.

The level (significance) of the effect has been determined using professional judgement to reflect the importance of the heritage asset, the magnitude of change and sensitivity using the scaled criteria in Table 10-4. The justification for the significance of effect has been reported clearly.

This approach accords with the guidelines for assessment set out in the PCHIA guidance (termed 'weighting the effect') and EIA Handbook.

A clear statement has been made as to whether an effect is a significant effect in terms of the EIA Regulations based on professional judgement of the available evidence and guided by the description of significance of effect identified in Table 10-4. **Major** and **Moderate** effects are considered significant in the context of the EIA Regulations.

Table 10-4: Significance of Effect Criteria

Significance of Effect	Description
Major	A large magnitude of change (e.g. total or near total loss) to the cultural significance of a heritage asset of medium or high importance.
Moderate	A medium magnitude of change (e.g. substantial loss or alteration) to the cultural significance of a heritage asset of medium or high importance; or a large magnitude of change (total or near total loss) to a heritage asset of low importance.
Minor	A small magnitude of change (slight loss or alteration) to the cultural significance of a heritage asset of medium or high importance; a medium or small (slight to substantial loss or alteration) to the cultural significance of a heritage asset of low importance; or any change to a heritage asset of very low importance.
None	No change to the cultural significance of a heritage asset.

Cumulative Effects

Impacts of a cumulative nature can relate to the physical fabric or setting of heritage assets. This can be a result of impact interactions between different impacts of a development or in-combination with impacts of other schemes. Alternatively, they may be additive impacts from incremental changes caused by a development together with other extant schemes or those already in the planning system.

This assessment considers the potential effects to the cultural significance of heritage assets against a baseline that includes existing or consented wind farms, in line with the schemes agreed for inclusion in the cumulative assessment. A full list of operational and consented developments considered in the cumulative effects assessment is provided in Chapter 5 of the EIA Report and their locations are shown on Figures 5.1.5a and 5.1.5b.

Seven developments fall within the Inner and Wider Study Areas. The nearest operational or consented developments beyond the Wider Study Area are approximately 12km from the Proposed Development. Given that the potential for setting change to result in a significant effect to a heritage asset's cultural significance diminishes with distance, significant cumulative effects, including those resulting from in-combination views, beyond the Wider Study Area are not predicted.

10.3.4 Assessment Assumptions and Limitations

The assessment has utilised a range of sources on the area's historic environment. Much of this is necessarily secondary information compiled from a variety of sources (e.g. HER data and grey literature reports). It has been assumed that this information is reasonably accurate unless otherwise stated.

Given their locations, some heritage assets with intervisibility with the Proposed Development were not the subject of a site visit due to limited access or ground conditions, however, desk-based sources and visualisations were sufficient to identify potential effects due to setting change.

The potential for previously unrecorded heritage assets, including buried archaeological remains, has been considered in relation to the pattern and significance of known heritage assets (drawn from the SC HER and Canmore data and a review of historic mapping and available digital aerial imagery) within the vicinity of the Site, and land use history within it, to understand the archaeological potential.

While non-intrusive or intrusive archaeological investigations, such as geophysical survey and archaeological trial trenching, have not been undertaken to inform the historic environment baseline, the sources identified above are sufficient to identify the potential for previously unrecorded buried archaeological remains, within the Site and the assessment of any likely significant effects.

Whilst some information gaps are inevitable, given the buried nature of archaeological remains, it is considered that there is sufficient information to enable an informed decision to be taken in relation to the identification and assessment of likely significant environmental effects on cultural heritage.

A precautionary approach has been applied, based on the available information and the professional experience and judgment of the project team, to ensure that all likely significant effects have been assessed and reported.

For the avoidance of doubt, when any asset is identified as being of 'uncertain' importance, a precautionary approach would be applied, and the effect reported as potentially significant. However, this has not been necessary in this instance.

10.4 Baseline Conditions

A summary of the existing conditions is presented below. Further information on the archaeological and historical context for the assessment and individual heritage assets forming the baseline is presented in Appendix 10-1.

10.4.1 Proposed Development Site

The location of heritage assets identified within the Proposed Development Site are depicted on Figure 10-1.

Designated Heritage Assets

No designated heritage assets have been identified within the Site.

Non-designated Heritage Assets

Twenty-nine non-designated heritage assets are located within the Proposed Development Site. The majority are located on the lower slopes of Drummarnock Hill and at Muirpark and along the southern bank of the Bannock Burn. They are characterised by the remains of pre-Improvement Era farmsteads, rig and furrow cultivation and evidence limestone quarrying and processing.

Evidence of arable cultivation in the form of rig and furrow cultivation is confined to the lower northeast and east facing slopes of Drummarnock Hill (SC HER Ref: 2727; Canmore Ref: 120246; SC HER Ref: 2726; Canmore Ref: 120245) where growing conditions were sufficient to sustain crops on marginal land.

A common feature in productive areas of the upland fringes in Scotland, the cultural significance of these areas of rig and furrow is increased when they are identified as being contemporary with the remains of former farmsteads.

Given the contribution of their evidential (physical remains) and historical value in understanding the exploitation of marginal areas and past agricultural practices at a local level, the importance of these heritage assets has been assessed to be **low**.

A pre-Improvement Era farmstead to the northeast of Muirpark survives as two low turf covered building platforms (SC HER Ref: 2730.01; 2730.03 Canmore Ref: 12047), associated with an enclosure (SC HER Ref: 2730.02).

The current setting of these heritage assets comprised a level terrace to the south of a natural ridge of slightly higher ground to the north, within an area of later Improvement Era field enclosures. An area of rig and furrow (SC HER Ref: 2727) is recorded on the northeast facing slope to the south an un-named watercourse.

These elements of this farmstead's setting contribute most to the understanding and appreciation of the likely choice of location, designed to take advantage of shelter provided by the ridge of higher ground to the north, provided access to running water and to areas of more fertile and easily workable soils.

The probable functional relationship between the farmstead and the rig and furrow cultivation to the south, also contributes to the cultural significance of the heritage asset.

Located to the south of the Proposed Development Site in an area of enclosed moorland is a pre-Improvement Era farmstead or shieling which survives as two buildings defined as low dry-stone walls, linked by a short length of wall (SC HER Ref: 3397).

To the north, beyond an un-named watercourse is a small oval enclosure. Defined by the poorly preserved remains of a drystone wall, this may have been a sheepfold or a garden enclosure designed to exclude livestock.

The setting of this heritage asset comprises the higher rocky ground immediately to the southwest, the enclosed moorland that surrounds it and the watercourse and Craigengelt Wind Farm.

While there are long views towards Stirling to the north-east these are not intended, and do not contribute to the asset's cultural heritage. A number of existing turbines are visible to the south-west, as are the masts on Earl's Hill to the northwest.

Similarly positioned in a sheltered location near a watercourse, a further farmstead or shieling is located c. 500m to the south-southeast (SC HER Ref: 3380). A single three bay building defined by low turf covered wall footings, other earthworks to the south and east may be associated with accompanying enclosures.

The setting of this heritage asset includes the existing wind farm access track to the south and Craigengelt Wind Farm to the south-west.

These heritage assets' sheltered locations, access to fresh water, surrounding enclosed moorland and in the case of SC HER Ref: 3397, the functional relationship with the enclosure, are the key elements of these assets' setting which contribute most to how they are understood, appreciated and experienced as pre-Improvement Era shielings or farmsteads.

They illustrate the choice of location with ready access to fresh water and the open moorland which would have provided pasture and grazing for livestock. The sheltered positions would have protected the occupants and their animals and crops from the worst of the prevailing wind.

The cultural significance of these assets is derived from the evidential value of any surviving physical remains, which have the potential to contribute to the understanding of pre-Improvement Era agricultural settlements, practices, and land use. Given that these heritage assets are a common and well-understood type found throughout the Scottish uplands, they have been assessed to be of **low** importance.

Located on the northern boundary of the Proposed Development Site and forming a wider extensive complex of limestone extraction and processing located on both banks of the Bannock Burn within Swallowhaugh over a distance of approximately 1.5km, are a series of limestone quarries and lime kilns (SC HER Ref: 2725).

Thought to date to the 18th century (Carter 1997, p.79) it is likely that the limestone exposures along the Bannock Burn have been exploited for lime production from as early as the mid- 14th century (Harrison 1993, p.83).

The elements of their setting which contribute most to how they are understood, appreciated and experienced as 18th century mineral extraction and processing is the association with the limestone deposits along the Bannock Burn, the functional relationship between the quarries and the kilns, and the agricultural land which surrounds it that likely used the product to improve soils.

Their cultural significance is derived from the evidential value and historical (illustrative) value of their physical remains which have the potential to contribute to the understanding of the technologies and processes employed, early industrial activities and the rural economy.

While not uncommon, there is potential for evidence of the exploitation and processing of lime from the medieval period and at a regional level, and as such they have been assessed to be of **medium** importance.

Four heritage assets comprise a modern rectangular sheepfold no longer in use, a well-defined trackway aligned south-west / north-east partly in use as a farm track, a quarry and a undated D shaped enclosure defined by a drystone wall.

These heritage assets are typical of upland agricultural areas and evidence farming practices and land use from the post-medieval period to the 20th century and have been assessed to be of low to **very low** importance.

Potential for Previously Unrecorded Heritage Assets Including Buried Archaeological Remains

While there are upstanding prehistoric funerary monuments near the Proposed Development Site, including King's Yett cairn (SM2580), there is no evidence of prehistoric activity within the Proposed Development Site. Later medieval and post-medieval activity associated with upland animal husbandry and cultivation is largely restricted to the lower slopes and sheltered locations below 260 m AOD.

Evidence of historic land use of the enclosed moorland within the Proposed Development Site and its surrounding environs appears to have been confined to seasonal occupation and grazing. This, in-combination with the exposed and unproductive environment suggests that in these is a **low** to **negligible** potential for previously unrecorded heritage assets, including buried archaeological remains.

There are areas of peat with depths measuring between <0.5m to 2.58m within the Proposed Development Site (please refer to Chapter 8 for details). It can take over 1,000 years for a metre of peat to form, with the varying depths having the potential to preserve any archaeological remains which predate, or coincide with, the peat formation. As peat is formed in anaerobic conditions, which prevent the micro-biological activity needed for the chemical breakdown of organic materials there is potential for organic archaeological remains, and **low** to **medium** potential for paleoenvironmental evidence.

10.4.2 Inner Study Area

The location of heritage assets identified within the Inner Study Area are depicted on Figure 10-2.

Designated Heritage Assets

Twenty-six designated heritage assets of **high** importance have been identified within the Inner Study Area. These comprise:

- 14 Scheduled Monuments:
  - three prehistoric funerary and ritual monuments (SM6553; SM7131; SM2580);
  - evidence of a roundhouse (Castlehill, hut circle; SM7017);
  - Sauchie Craig hillfort (SM2120);

  - five late prehistoric duns (SM7016; SM177; SM2110; SM2121; SM2243) and one homestead (SM4599);
  - cultivation terraces (SM3395);
  - Sir John de Graham's Castle, a 13th century motte (SM4278); and
  - a 19th century lime kiln (SM36802).
- 21 listed buildings:
  - two category A listed buildings associated with a fish hatchery and fish farm (LB15275; LB15306);
  - 19 category B listed buildings, including those associated with Old Sauchie (LB15299; LB15300), three bridges (LB1964; LB1965; LB11749), two sundials (LBLB15301; LBLB15301) and Buckieburn Church (LB15272); and
  - two category C listed buildings comprising Millnholm bridge (LB15276) and Lochend Farm (LB15288).
- the Inventory Garden and Designed Landscape at Touch (GDL00377).

Non-designated Heritage Assets

Two hundred and ninety-four non-designated heritage assets have been identified within the Inner Study Area from data held by the SC HER and Canmore.

These are characterised by poorly preserved prehistoric funerary and ritual monuments, prehistoric rock art, the remains of late prehistoric settlements, including duns and groups of hut circles, pre-Improvement and Improvement Era buildings, farmsteads and their associated enclosures, areas of rig and furrow cultivation, shielings, sheepfolds, chapels, churches and their associated burial grounds, post-medieval bridges, quarries, lime kilns and the site of a World War Two searchlight battery.

These have been assessed to be of **very low** to **medium** importance. Given their locations, type and form, changes to the setting of these heritage assets are not predicted to result in significant effects.

10.4.3 Outer Study Area

The following designated heritage assets of **high** importance are located within the Outer Study Area:

- The Antonine Wall world heritage site;
- 40 Scheduled Monuments, including Stirling Castle (SM90291);
- 757 listed buildings;
- 14 conservation areas, the majority of which are within the City of Stirling, including Stirling Town & Royal Park;
- four Inventory-listed Garden and Designed Landscapes at Gargunnock House (GDL00188), Colzium Lennox Estate (GDL0041), Cowane’s Hospital (GDL00400) and the Kings Knot (GDL00241); and

- four Inventory-listed historic battlefields at Bannockburn, Kilsyth, Stirling Bridge and Sauchieburn (BTL4; BTL13; BTL28; BTL38).

The locations of these heritage assets are shown on Figure 10-3.

10.4.4 Designated Heritage Assets Scoped in for Detailed Assessment

Information as to why designated heritage assets within the Inner and Outer Study Areas have been scoped in or out of the assessment of effects is presented in Appendix 10-1.

The following eight designated heritage assets of **high** importance have been identified as having theoretical visibility with the Proposed Development, the presence of which during operation has the potential to change their setting and have been included for further assessment.

King's Yett, Cairn (SM2580) and **Dundaff Hill, Mound (SM6553)** comprise the remains of a Neolithic or Bronze Age burial cairn and mound respectively.

The King's Yett, Cairn is located in an area of heather moorland with young naturally regenerating birch scrub. The asset's setting includes extensive areas of rotational commercial forest to the west and north and enclosed semi-improved moorland to the east.

A purpose-built wide pedestrian gravel path 30m to the west of the asset, enables recreational access to the coniferous forestry. The path begins at a small frequently used car park approximately 170m south of the asset. A minor hill road crosses the heather moorland and provides access to the car park. The noise and movement of vehicles using the car park and minor road forms part of the setting of the cairn.

A small watercourse called the King's Yett Burn aligned approximately north-west and south-east, flows past the cairn c.30m to the north. The cairn is sited on a wide terrace sloping gently to the east.

Unlike other prehistoric funerary monuments in the area (such as Dundaff Hill, Mound (SM6553)), the position of the cairn in the landscape appears to be related to the watercourse, rather than having been deliberately sited in a prominent (hilltop) location.

Despite this, its location on the gently sloping east-facing terrace enables uninterrupted views over the heather moorland towards Lewis Hill. While present in glimpsed views, the Lewis Hill limits intervisibility over the Forth floodplain beyond.

Views from the asset to the south are limited by the rising landform between the cairn and the Bannock Burn. Coniferous trees currently forming a windbreak to the south-east of the minor road, overhead utilities on wooden poles and turbines forming part of the existing Craigengelt Hill Wind Farm seen from the cairn on the skyline and form part of the setting of the asset.

When occupied, parked vehicles belonging to people using the small frequently used car park to access the forestry paths, and vehicles using the minor road are present in the asset's setting (refer Figure 10-5).

There is very limited intervisibility with Dundaff Hill, which is just apparent on the skyline some 4.8km to the south of the cairn, behind the current windbreaks. The intervening rising landform suggests that the King's Yett cairn was not positioned to exploit views between it and Dundaff Hill, or that of Dundaff Hill, Mound (SM6553; see Figure 10-5).

Given the distance between the two assets (nearly 5km), the low-lying position of the King's Yett cain, and the scale of the visible (above ground) physical remains of Dundaff Hill, Mound, while the landform on which the mound is positioned (Dundaff Hill) is present in the asset's setting, the mound itself is not discernible.

There is no intervisibility with any other known contemporary prehistoric ritual and funerary monuments. Given their landscape separation and lack of intervisibility, these putatively contemporary assets do not share any further relationship beyond their obvious spatial relationship.

Dundaff Hill, Mound (SM6553) is located on the western end of a low north-facing ridge below Dundaff Hill, in open ground within rotational commercial forest. Below Dundaff Hill, but not visible from the mound is Buckieburn Reservoir, beyond which enclosed moorland rises to a height of 358m ASL at Craigengelt Hill, which forms part of the gently rolling landform of Touchadam Muir and the Touch Hills (refer to Figure 10-7).

While the current surroundings of the mound are dominated by rotational commercial forest, the asset's setting includes the existing Craigengelt Hill Wind Farm the nearest turbine of which is approximately 1.6km to the north-west.

While turbines belonging to this wind farm are prominent in views to the north-west of Craigengelt Hill, the distinct landscape form of rolling hills - Craigengelt Hill, Touchadam Muir and the Touch Hills - remain well-defined, recognisable and easily readable in the landscape.

It is likely that the site of the mound was chosen to take advantage of its prominent location within the landscape. Putative intervisibility and spatial relationships with other contemporary funerary monuments may also have been an important factor in the choice of location, including King's Yett, cairn (SM2580) 4.3km to the north.

There is no intervisibility between the mound and Dundaff Hill, Enclosure (SM7131) approximately 530m to the south (refer to Figure 10-9). Had intervisibility with contemporary monuments been important, then the summit of Dundaff Hill 500m to the south would have provided wider views of the surround landscape and greater theoretical visibility with other possibly contemporary assets.

There is a clear line of sight between the mound and the King's Yett cairn.

However, given the distance between the two assets (c.4.3km), the low-lying position of the King's Yett cairn, combined with the scale of the visible (above-ground) physical remains of the cairn, the colour palette of the vegetation covering and surrounding it, and its current coniferous forest backdrop, the King's Yett cain itself is not discernible in views from Dundaff Hill mound.

Given their landscape separation and lack of intervisibility, these putatively contemporary assets do not share any further relationship beyond their obvious spatial relationship.

As a places of burial and ritual during the Neolithic and Bronze Age, it is likely that these assets had a prominent place within a social group's territory and may have acted as a focal point for communal activity in the landscape, as well as serving as a physical and symbolic marker of its builders' place in space and time.

The key elements of the setting of the King's Yett cairn which contribute most to how this is appreciated and understood, and the way it is experienced comprise its positioning next to the watercourse to the north, the gently sloping terrace which enables views to the east over the heath moorland towards Lewis Hill and glimpsed views over the Forth floodplain.

While the key elements of the setting of the Dundaff Hill mound which contribute most to how it is appreciated and understood as a prehistoric funerary monument, and the way it is experienced comprise its prominent position on the north-facing slope of Dundaff Hill, that enabled views to and from Craigengelt Hill, Touchadam Muir and the Touch Hills.

Dundaff Hill, Enclosure (SM7131) comprises a prehistoric ceremonial enclosure or cairn. Such an asset would typically be considered a bell or bowl cairn of Neolithic or Bronze Age date, however, the presence of a natural bedrock outcrop instead of a man-made cairn in the centre suggests the asset may have been associated with other, non-funerary ritual activities.

Located in an area of enclosed rough pasture defined by dry-stone walls approximately 300m to the south-south-east of the summit of Dundaff Hill. The enclosure has been positioned on the edge of a terrace, just above the break of the steep southeast facing slope.

Its setting includes the Carron Valley Forest and Kilsyth Hills to the south-west and south, the Carron Valley to the southeast, Loch Coulter Reservoir to the north-east and to the north the rotational commercial forest covering the north-facing slope of Dundaff Hill (see Figure 10-9).

Three turbines associated with the existing Craigengelt Wind Farm form part of this asset's setting. These are located approximately 2km to the north-east, are set back beyond and behind Dundaff Hill. There is no intervisibility with Dundaff Hill, Mound (SM6553).

Despite not having been constructed on the highest point of Dundaff Hill, which limits views from the asset to the north and west, the prominent location of the enclosure on the edge of the break of slope, enables open views over the landscape to the south and east.

Due to its position the asset does not become apparent when approached from the south-east, until the steep slope has been breached. This, along with the natural bedrock outcrop may have influenced the siting of the enclosure, to enable a sense of expectation and surprise and to incorporate the outcrop into its form. This assumes that the enclosure was intended to be approached from the southeast.

It is just as valid to suggest that the asset was intended to be approached from the north-west, providing a similar sense of anticipation and surprise when toping Dundaff Hill, and encountering the enclosure in the context of the open views over the landscape to the south-east and east. Approaching from Dundaff Hill, Mound (SM6553) would have had a similar affect.

The spatial and functional relationship with other possibly contemporary monuments, including the burial mound (SM6553), may have influenced its siting in the landscape.

The spatial relationship to another prehistoric funerary and ritual monuments, and the landforms to the south-east and east, and long views over the landscape, makes a positive contribution to how this asset is understood and appreciated as a possible prehistoric ritual or funerary monument.

The cultural significance of these three heritage assets (SM2580; SM6553; SM7131) is largely derived from the evidential (scientific) value of their physical remains, including any buried archaeological remains that have the potential to contribute to the understanding of prehistoric burial and ritual practices.

For the enclosure this includes an understanding of the form and function of the asset, and its relationship with the natural rock outcrop. There is also the potential for environmental evidence preserved in the soils beneath the burial mound that may inform the understanding of climate, local conditions and land cover when the asset was constructed.

While these assets belong to a numerous and widespread group of prehistoric funerary and ritual monuments, they have historical (illustrative) value as good representative examples of these asset's type and form, with the potential contribution to the understanding of the diversity of these monument types in Scotland, and the practice of burial and design of funerary and ritual monuments.

Located approximately 1.5km to the north-east of the Proposed Development Site, **Sauchie Craig, Fort (SM2120)** heritage asset is a roughly oval late prehistoric defended enclosure occupying a rocky knoll above the cliff edge forming Sauchie Craig on Lewis Hill.

The defended enclosure has been positioned to take advantage of the natural defences provided by the precipitous cliff edge forming Sauchie Craig to the north-west above the entrance to Windy Yet Glen.

The enclosure is set back into the entrance to the glen and not on the more exposed or inwardly visible section of Sauchie Craig to the southwest, or at the highest point on Lewis Hill. This suggests that views to the west were not as important as the shelter provided by the enclosure's position, or views north, north-west and east towards the Forth floodplain.

The position of the enclosure may have been designed to enable the occupants to control and monitor the movement of people through the landscape, including Windy Yet Glen.

The setting of the enclosure includes the North Third Reservoir and dam to the west and rotational commercial forest, as well as natural mature woodland along Lewis Hill.

The key elements of this asset's setting which contribute most to how it is appreciated, understood and experienced as a defended enclosure are its dramatic cliff top position which takes advantage of the natural defensive position of Sauchie Craig, views down and into Windy Yet Glen.

Wider views over the surrounding landscape to the north-west, and to a lesser extent towards the lowlands of the Forth floodplain to the north and northeast also contribute to the asset's setting.

The cultural significance of this asset is predominantly derived from the evidential (scientific) value of its physical remains, including any buried archaeological remains that may be present, that have the potential to inform the understanding of late prehistoric to early medieval activity and settlement in the area.

The fort also has some historical (illustrative) value given its potential to contribute to the understanding of defended enclosures as well as settlement, economy and the development of the landscape at the time.

Touch Muir and Wallstale duns (SM2243; SM2110) comprise circular stone walled structures, and **Castlehill Wood, Dun (SM177)**. All three have entrances to the east. Excavations noted paving in the entrance passageway for both Wallstale and Castlehill Wood duns. Artefacts recovered from Castlehill Wood suggested 1st or 2nd century occupation.

Touch Muir dun is in an area of enclosed moorland approximately 4km north of the Proposed Development Site. The setting of the dun comprises the enclosed moorland, Craigbrock Burn to the north and an unnamed watercourse to the south, and to the south, the two Touch reservoirs.

Wallstale dun is located c. 3.3km northeast of the Proposed Development Site on the wooded southern slope of Gillies Hill by Gateside Road, north of the Bannock Burn. The dun's setting includes the scheduled lime kilns (SM3680; see below) just below it and Murrayshall Quarry to the northwest.

The setting of Castlehill Wood dun includes its elevated position on a natural ridge of high ground approximately 3km to the north-east of the Proposed Development Site. Its chosen location provides open views to the southwest towards the Proposed Development.

Views to the west, north and east are currently limited by rotational commercial forest. The dun is located on the edge of an area formerly used as a vehicle testing and training ground by the Ministry of Defence, and deeply rutted vehicle tracks and manmade obstacles form part of its setting. It now forms part of a clay pigeon shooting range.

The positioning of these heritage assets in the landscape appears to have been an important design consideration, their elevated locations providing views over the landscape around them.

Touch Muir dun's positioning on a raised area of land may have been designed to provide a solid foundation for its constructions compared to the waterlogged ground that surrounds it. Wallstale dun was constructed on an 8m scarp over 1.5m high, which may have assisted in making the structure appear larger in the landscape.

The positioning of Castlehill Wood afforded it open views to the north, east and south, and was likely a prominent feature in the landscape. This prominence has been significantly reduced, and its visible physical remains are no longer evident unless in close proximity to the asset.

The cultural significance of these heritage assets is largely derived from the evidential value of their surviving physical remains, including any associated archaeological remains, which have the potential to contribute to the understanding of late prehistoric to early medieval domestic, social and economic activity.

While these duns have been subject to stone robbing and are generally in poor condition, they also have some historical (illustrative) value derived from the potential of their physical remains to contribute to the understanding of the development of domestic architecture and dun design.

Stirling Castle (SM90291)

Stirling Castle is located approximately 8.5km north-east of the Proposed Development Site. It is an outstanding example of a medieval royal castle with later alterations and additions, one of the most important royal sites of medieval and early modern Scotland.

It occupies a spectacular location on a volcanic outcrop commanding the lower Forth valley. The castle comprises three main enclosures: the outer defences, the main enclosure encircled by a curtain wall, and the Nether Bailey.

The castle embodies a complex series of built phases, demonstrating the development of fortified and domestic architecture from the 12th to 17th centuries, culminating in the superb 16th-century Stewart royal lodgings ranged around the Inner Close, comprising the King's Old Building, the Great Hall, the Chapel Royal and the Royal Palace.

The cultural significance of this heritage asset is derived from the evidential value of its built fabric and buried archaeological remains, which inform the understanding of medieval castles and the activities associated with them.

The castle's historical and architectural values derive from its strategic military and political functions, its role as one of the favoured palaces of the Stewart monarchs and the outstanding Renaissance architectural accomplishments of the palace range.

It has aesthetic value as a landmark, exploiting its defensive site within scenic terrain, to picturesque effect. It also embodies social value as a popular visitor attraction in public care, retaining strong communal links to the communities of Stirling and to the British Army.

10.4.5 Future Baseline

It is assumed that the natural baseline will remain unaltered through the lifetime of the Proposed Development.

10.5 Assessment of Effects and Mitigation

The assessment of effects is based on the project description as presented in Chapter 3: Description of Development of this EIA Report. Unless otherwise stated, potential effects identified are considered to be adverse.

Technical Appendix 10-1 (Historic Environment Assessment) identifies the baseline conditions for the historic environment and assesses the potential effects of the Proposed Development on the historic environment.

10.5.1 Design Considerations (Embedded Mitigation)

The design of the Proposed Development has sought to avoid or minimise (as far as reasonably possible) effects to heritage assets (in consultation with key stakeholders). The design has been influenced by the reasons for refusal for a previous planning application within the Proposed Development Site. This included avoiding and minimising direct effects due to setting change to Stirling Castle and Kings Yett Cairn.

Each iteration of the design has been reviewed to ensure that direct physical effects to known heritage assets are avoided. Similarly, how turbines will appear within the setting of heritage assets has been a key consideration in design refinements, including the number and location of turbines.

Further detailed information on the evolution of the design of the Proposed Development is presented in Chapter 3: Description of Development of this EIA Report.

10.5.2 Construction Effects (Direct Physical Effects)

No significant effects on designated and non-designated heritage assets have been identified as a result of the construction of the Proposed Development.

Following restriction to the micrositing allowance (as detailed in section 10.6.1) (embedded mitigation) and adoption of construction best practice presented in the Construction Environment Management Plan (CEMP; Appendix 15-1 Volume 3), including the clear demarcation of known heritage assets, it is anticipated that potential direct physical effects due to accidental damage or micrositing during construction can be avoided.

The potential for previously unrecorded heritage assets, including buried archaeological remains, within the Proposed Development Site has been assessed to be **negligible** to **low**. There is some potential for previously unrecorded heritage assets within the construction footprint to be removed or truncated during construction.

There are areas of peat with depths measuring between <0.5m to 2.58m within the Proposed Development Site. The design process for the Proposed Development has sought to avoid interacting with areas of deep peat and changes to the hydrology of the Proposed Development Site (refer to Chapter 8: Hydrology, Geology and Hydrogeology of this EIA Report).

While there is potential for areas of peat to retain paleoenvironmental information, the potential for the construction of the Proposed Development to negatively affect the preservation of this record has been assessed to be **negligible**.

10.5.3 Operational Effects (Direct Effects Due to Setting Change)

No significant effects in EIA terms have been identified for heritage assets as a result potential direct effects resulting from setting change.

The following potential non-significant direct effects resulting from setting change for four designated heritage assets of **high** importance have been identified.

The presence of the Proposed Development during operation will slightly change the way the following designated heritage assets are experienced:

- King's Yett, Cairn (SM2580) - changes to the setting of the King's Yett, Cairn as a result of the presence of the turbines to the south will affect the way the cairn is experienced but will not affect its overall cultural significance. This will lead to a level of impact judged to be **small** resulting in a **minor** potential level of effect in EIA terms.
- Dundaff Hill, Mound (SM6553) - changes to the setting of this heritage asset during operation of the Proposed Development will slightly alter the way the asset is experienced within the landscape. This will lead to a level of impact judged to be **small** resulting in a **minor** potential level of effect in EIA terms.
- Dundaff Hill, Enclosure (SM7131) - changes to the setting of this prehistoric ritual or funerary monument during operation of the Proposed Development will slightly alter the way the asset is experienced within the landscape. This will lead to a level of impact judged to be **small** resulting in a **minor** potential level of effect in EIA terms.
- Stirling Castle (SM90291) - The presence of the Proposed Development during operation will be a slight change to the setting of the Stirling Castle, affecting how it is experienced, however this will not affect the asset's overall cultural significance. This will lead to a level of impact judged to be **small** resulting in a **minor** potential level of effect in EIA terms.

One non-designated heritage asset, Buckie Burn Sheiling-Hut (SC HER Ref: 3379; **low** importance), has been identified as experiencing setting change.

While this has the potential to affect the contribution its setting makes to how they are experienced, the elements of this asset's setting which contributes most to its cultural significance, and the evidential and historical value of this asset's physical remains will not be affected. This **small** change to the way the setting of the asset contributes to how it is experienced will lead to a **minor** potential level of effect in EIA terms.

All direct effects due to setting change will last for the life of the Proposed Development and will be reversible upon decommissioning.

10.5.4 Decommissioning Effects

At the end of the Proposed Development's operational life (40 years), an application could be submitted to retain or replace the turbines, or they could be decommissioned.

Decommissioning of the Proposed Development will be carried out in line with the legislation and guidance current at the time of decommissioning. Decommissioning effects are assumed to be no worse than construction effects (temporary) and that the CEMP will be updated to ensure best practice is adopted during decommissioning.

10.5.5 Cumulative Effects

No significant cumulative effects to heritage assets have been identified resulting from the operation of the Proposed Development. Further information on cumulative effects is presented in Appendix 10-1.

10.6 Residual Effects and Conclusions

10.6.1 Proposed Mitigation/Monitoring

Micrositing

Prior to construction, micrositing may take place to allow adjustment within a defined radius of the proposed turbine locations, and a similar tolerance either side of the access track locations. The micrositing allowance for turbines and associated infrastructure is proposed as 50m, as set out in Chapter 3: Description of Development.

A review of these areas has identified that one non-designated heritage asset, Muirpark, farmstead (SC HER Ref. 2730; low importance) could be physically affected as a result of the micrositing, from the operation of machinery and plant during the upgrading of the access track to the south of the heritage asset. Micrositing will be restricted so that movement of the access track is limited to the north.

It is considered that any changes to the location of turbines as a result of micrositing will not increase the significance of effect resulting from setting change identified in Appendix 10-1.

Good Practice Measures

Good practice measures to prevent, reduce, and/or where possible offset potential physical effects to previously unrecorded heritage assets, including buried archaeological remains are proposed. Measures which may be adopted include:

- The fencing off or marking out the elements of Muirpark, farmstead (SC HER Ref. 2730; low importance) refer to Appendix 10-1);
- Implementation of a working protocol should previously unrecorded heritage assets, including buried archaeological remains (e.g. archaeological deposits and features) be discovered;
- The use of a Construction Environmental Management Plan (CEMP), supplemented by toolbox talks as appropriate, to highlight the historic environment sensitivities of areas of the Proposed Development Site to those working on the Proposed Development. An outline CEMP is provided as Appendix 15-1; and
- Appointment of an Archaeological Clerk of Works (ACoW) to supervise targeted ground-breaking operations and provide onsite advice on avoidance of effects (e.g. providing onsite identification and recording of previously unrecorded heritage assets and liaising with the local authority archaeological adviser as necessary).

The Stirling Council Archaeology Service (SCAS) will be consulted to provide guidance on appropriate conditions to be applied to any prospective consent.

10.6.2 Residual Effects

Appropriate provision of archaeological monitoring and recording during ground-breaking works will ensure that heritage assets, including previously unrecorded heritage assets identified during construction of the Proposed Development can be effectively understood, characterised and recorded.

Should assets of regional or national importance be identified, the ACoW will liaise with SCAS to agree an appropriate conservation strategy and, where necessary, microsite infrastructure to avoid/reduce effects.

No specific mitigation to reduce the potential significant effects to the four designated heritage assets identified above, due to setting change resulting from the operation of the Proposed Development.

10.6.3 Cumulative Effects

No residual cumulative effects to heritage assets have been identified resulting from the operation of the Proposed Development.

10.7 Summary and Statement of Significant effects

No significant effects on cultural heritage have been identified as a result of the construction or operation of the Proposed Development.

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Chapter 11: Noise

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site or 'Site'	The land enclosed by the red line shown on Figure 1-1
The Planning Act	The Town and Country Planning (Scotland) Act 1997 (as amended)
dB or dB(A)	A measure of sound level using a logarithmic scale. The 'A' suffix denotes a filtering or 'weighting' of frequencies such that the defined decibel level provides a representative level relating to the sensitivity of human hearing.
dB L_{A90}	The level of noise, in dB, exceeded for 90 percent of the specified time, usually used to define the A-weighted sound pressure level background level, but also used for wind turbine measurement and prediction.
L_{WA} - Sound Power Level	The fundamental measure of sound power. Sound power is the total sound energy radiated by a source per unit time. The subscript 'A' refers to an A-weighted sound power level.
Hertz (Hz)	The unit of frequency representing cycles per second

List of Abbreviations

Abbreviation	Description
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
DECC	Department for Energy and Climate Change
DTI	Department of Trade and Industry
NTS	Non-Technical Summary
SC	Striling Council
GPG	Good Practice Guide
IOA	Institute of Acoustics
CEMP	Construction Environmental Management Plan
CTMP	Construction Traffic Management Plan
RNB	Remaining Noise Budget

11 Noise

11.1 Introduction

This Chapter assesses the potential noise effects associated with the construction and operation of the Proposed Development. The specific objectives of the chapter are to:

- Describe the assessment methodology and significance criteria used in completing the impact assessment;
- Describe the potential effects and cumulative effects;
- Describe the mitigation measures proposed to address likely significant effects; and
- Assess the residual effects remaining following the implementation of mitigation.

This Chapter has been produced by the Hayes McKenzie Partnership Ltd, who have worked on over 1000 proposed, consented or existing wind farm sites, particularly in the UK and the Irish Republic but also in the rest of Europe, Australia, New Zealand, Canada and the USA, and have provided evidence for around 100 UK public inquiries together with other hearings and in court.

All consultants are associate or corporate members of the UK Institute of Acoustics (IOA). The company is a member of the UK Association of Noise Consultants (ANC) and a Sponsor Member of the UK Institute of Acoustics. All work is carried out in line with recognised industry standards, and best practice recommendations of the IOA and ANC.

11.2 Methodology and Approach

11.2.1 Legislation, planning policy and guidance

The scope of the assessment has been informed by consultation responses summarised below and the guidelines and policies set out below. The relevant overarching policies are explained in more detail in Chapter 4 Planning Policy.

National Planning Framework 4

The National Planning Framework 4 adopted in 2023 (Scottish Government, 2023) sets out the Scottish Government's overarching ambitions with regards to national planning. Policy 11 states that development proposals for all forms of renewable, low-carbon and zero emissions technologies will be supported, but that noise effects on communities and individual dwellings should be assessed. Policy 23 states that development proposals that are likely to raise unacceptable noise issues will not be supported.

Onshore Wind Policy Statement 2022

The Onshore Wind Policy Statement (OWPS) 2022 (Scottish Government, 2022) references ETSU-R-97, *The Assessment and Rating of Noise from Wind Farms* (DTI, 1997) and the Institute of Acoustics (IOA) document, *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (GPG) (IOA, 2013) as the framework by which noise from wind energy developments is measured and assessed.

It is considered that adherence with the noise limits set out in ETSU-R-97 and referred to in the OWPS ensures that the Proposed Development will not give rise to unacceptable noise impacts in terms of the relevant policy of NPF4. Further information on these guidance documents is detailed in Section 2 of Technical Appendix 11-2.

Planning Advice Note PAN1/2011: Planning and Noise

PAN1/2011 (Scottish Government, 2011) identifies two sources of noise from wind turbines: mechanical noise and aerodynamic noise. It states that; "*…good acoustical design and siting of turbines is essential to minimise the potential to generate noise*". It refers to the Scottish Government's 'web-based planning advice' on renewables technologies for onshore wind turbines, as discussed below.

Technical Advice Noise

The Technical Advice Noise (TAN) to PAN1/2011 *Assessment of Noise* (Scottish Government, 2011) refers to the Control of Pollution Act (Control of Pollution Act 1974) as the mechanism whereby local authorities can control noise from construction activities.

It lists several documents that contain advice on how to minimise such noise and includes British Standard BS 5228:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites* (BSI, 2014).

Scottish Government 2014: Web Based Planning Advice, Onshore Wind Turbines

The web-based planning advice for onshore wind turbines (Scottish Government, 2014) states that the sources of noise are; "*…the mechanical noise produced by the gearbox, generator and other parts of the drive train; and the aerodynamic noise produced by the passage of the blades through the air…*" and that; "*there has been significant reduction in the mechanical noise generated by wind turbines through improved turbine design*".

It states that:

> "*…the Report, 'The Assessment and Rating of Noise from Wind Farms' (Final Report, Sept 1996, DTI), (ETSU-R97), describes a framework for the measurement of wind farm noise, which should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments, until such time as an update is available*".

It further states that;

> "*this gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable burdens on wind farm developers, and suggests appropriate noise conditions*".

The document goes on to reference the IOA GPG document discussed below in terms of assessing noise associated with wind turbine developments.

Planning Advice Note PAN 50

Planning Advice Note (PAN) 50 *Controlling the Environmental Effects of Surface Mineral Workings* (Scottish Government, 1996) provides advice on environmental effects arising from mineral working operations.

The advice is said to be relevant in considering planning applications, among other things, and is applicable to the construction of borrow pits which are frequently used during wind turbine construction and is relevant to blasting activities in particular.

PAN 50 Annex D *The Control of Blasting at Surface Mineral Workings* provides advice to planning authorities and the minerals industry on how to keep the effects of blasting from surface mineral workings within environmentally acceptable limits.

PAN 50 Annex D advocates primarily for the use of BS 5228 for the assessment of mineral workings noise, and for the minimisation of the need for blasting, as well as for engagement with the public, stating that:

> *"The response of an individual to any such event is dependent upon the same factors as that of groundborne vibration with the understanding of the phenomenon through public relations and the attitude of the operators being of utmost importance".*

The Stirling Development Plan

The Statutory Development Plan for the Stirling Council Planning Authority Area comprises the adopted *NPF4*, and the *Stirling Local Development Plan* (Stirling Council, 2018) and its supplementary guidance.

Supplementary guidance *Wind Energy Developments* (Stirling Council, 2019) addresses noise in paragraph 5.34 by further referring the reader to *The Scottish Government's Planning Advice Sheet – Onshore Wind Turbines* (Scottish Government, 2014) for assessing noise from wind energy developments.

This contains a summary of industry good practice for the assessment of wind farm noise, primarily advocating for the use of ETSU-R-97 and the IOA GPG, which are detailed below.

ETSU-R-97: The Assessment and Rating of Noise from Wind Farms

ETSU-R-97 presents the recommendations of the Working Group on Noise from Wind Turbines, set up in 1993 by the Department of Trade and Industry (DTI) as a result of difficulties experienced in applying the noise guidelines existing at the time to wind farm noise assessments.

The group comprised independent experts on wind turbine noise, wind farm developers, DTI personnel and local authority Environmental Health Officers. In September 1996 the Working Group published its findings by way of report ETSU-R-97.

This document describes a framework for the measurement of wind farm noise and contains suggested noise limits, which were derived with reference to existing standards and guidance relating to noise emission from various sources.

ETSU-R-97 recommends that, although noise limits should be set relative to existing background and should reflect the variation of both turbine and background noise with wind speed, this can imply very low noise limits in particularly quiet areas, in which case "it is not necessary to use a margin above background in such low-noise environments.

This would be unduly restrictive on developments which are recognised as having wider global benefits. Such low limits are, in any event, not necessary in order to offer a reasonable degree of protection to the wind farm neighbour."

For daytime periods, the noise limit specified by ETSU-R-97 is 35-40 dB L_{A90} or 5 dB(A) above the 'quiet daytime hours' prevailing background noise, whichever is the greater. The actual value within the 35-40 dB L_{A90} range (the lower limiting value) depends on the number of dwellings in the vicinity; the effect of the limit on the number of kWh generated; and the duration of the level of exposure.

For night-time periods the noise limit specified by ETSU-R-97 is 43 dB L_{A90} or 5 dB(A) above the prevailing night-time hours background noise, whichever is the greater. The 43 dB(A) lower limit is based on a sleep disturbance criterion of 35 dB(A) with an allowance of 10 dB(A) for attenuation through an open window and 2 dB(A) subtracted to account for the use of L_{A90} rather the L_{Aeq}.

Where the occupier of a property has some financial involvement with the proposal, the day and night-time lower limiting values are both increased to 45 dB L_{A90} and consideration can be given to increasing the permissible margin above background. These limits are applicable up to a wind speed of 12 m/s measured at 10 m height on the site.

Quiet daytime periods are defined as: evenings from 18:00-23:00 plus Saturday afternoons from 13:00-18:00 and Sundays from 07:00-18:00. Night-time is defined as 23:00-07:00.

The prevailing background noise level is set by calculation of a best fit curve through values of background noise plotted against wind speed as measured during the appropriate time period with background noise measured in terms of $L_{A90,t}$. The $L_{A90,t}$ is the noise level which is exceeded for 90% of the measurement period 't'. It is recommended that at least 1 weeks' worth of measurements is required.

Where predicted noise levels are low at the nearest residential dwellings a simplified noise limit can be applied, such that daytime and night-time noise is restricted to the minimum ETSU-R-97 level of 35 dB L_{A90} for wind speeds up to 10 m/s at 10 m height. This removes the need for extensive background noise measurements for smaller or more remote schemes.

It is stated that the $L_{A90,10min}$ noise descriptor should be adopted for both background and wind farm noise levels and that, for the wind farm noise, this is likely to be between 1.5 and 2.5 dB less than the L_{Aeq} measured over the same period.

The $L_{Aeq,t}$ is the equivalent continuous 'A' weighted sound pressure level occurring over the measurement period 't'. It is often used as a description of the average noise level. Use of the L_{A90} descriptor for wind farm noise allows reliable measurements to be made without corruption from relatively loud, transitory noise events from other sources.

ETSU-R-97 also specifies that a penalty should be added to the predicted noise levels, where any tonal component is present. The level of this penalty is described and is related to the level by which any tonal components exceed audibility.

With regard to multiple wind farms in a given area, ETSU-R-97 specifies that the absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area contributing to the noise received at the dwellings in question.

Existing wind farms should therefore be included in cumulative predictions of noise level for proposed wind turbines and not considered as part of the prevailing background noise.

A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise

IOA published the GPG in May 2013, which was subsequently endorsed in all parts of the UK. The publication of the GPG followed a review for the Department of Energy and Climate Change (DECC) of current practice carried out (DECC, 2011) and an IOA discussion document (IOA, 2012) which preceded the GPG.

The GPG includes sections on Context; Background Data Collection; Data Analysis and Noise Limit Derivation; Noise Predictions; Cumulative Issues; Reporting; and Other Matters including Planning Conditions; Amplitude Modulation; Post Completion Measurements; and Supplementary Guidance Notes.

The Context section states that the guide;

> *"…presents current good practice in the application of the ETSU-R-97 assessment methodology for all wind turbine development above 50 kW, reflecting the original principles within ETSU-R-97, and the results of research carried out and experience gained since ETSU-R-97 was published"*.

As well as expanding on and, in some areas, clarifying issues which are already referred to in ETSU-R-97, additional guidance is provided on noise prediction and a preferred methodology for dealing with wind shear.

BS 5228: 2009+A1: 2014

BS 5228: Code of practice for noise and vibration control on construction and open sites – Part 1: Noise (BS 5228-1) provides example criteria for the assessment of the significance of construction noise effects, a method for the prediction of noise levels from construction activities, and practical information on construction noise and vibration reduction measures, promoting a 'Best Practicable Means' (BPM) approach to noise and vibration control.

The potential influence of construction traffic will be reviewed and assessed as necessary in terms of the increase in traffic noise at roadside locations, except where there is little or very little traffic movement in which case it will be assessed against the criteria in BS 5228-1.

11.2.2 Consultation

Consultation was held through the scoping report and subsequent consultations arising from the scoping responses. A summary of the consultation responses is included in **Table 11-1** below.

Table 11-1: Consultation

Consultee	Summary of Consultee Response	Where addressed within this Report
Stirling Council	Effects should be classified as either 'significant' or 'not significant'. Clear methodologies should be presented within the Environmental Statement.	11.2.5 Significance Criteria
Stirling Council	Other wind turbine / windfarm developments in the vicinity of the Proposed Development should be considered if they are either 'proposed' (i.e. subject to a live planning application, or subject to appeal), 'consented' (but yet to be progressed), 'under construction', or 'operational'. A search radius of 5 km is recommended.	11.4.3 Cumulative Effects Appendix 11-3 Details of Cumulative Wind Farms
Stirling Council	The cumulative noise assessment should be undertaken in accordance with the guidance presented in section 5.4 of the IoA GPG.	11.2.3 Assessment Methodology 11.4.3 Cumulative Effects
Stirling Council	All turbine noise level predictions should be undertaken by application of the ISO 9613 2 prediction method (reflective of downwind propagation) but also in accordance with the IoA GPG	11.2.3 Assessment Methodology Appendix 11-1 Noise Prediction Methodology
Stirling Council	The assessment will need to take due account of the content of Planning Advice Note 1/2011: Planning and noise (PAN 1/2011), as referenced within Chapter 5, but also the associated Technical Advice Note (TAN) to that PAN1/2011 entitled: Assessment of noise.	11.2.1 Legislation, planning policy and guidance
Stirling Council	Where on-site borrow pits and/or blasting works are identified to be required, the content of Planning Advisory Note 50: Controlling the effects of surface mineral workings (PAN 50) and the associated Annex D: The control of blasting at surface mineral workings should also be accounted for.	11.2.3 Assessment Methodology 11.4.1 Construction Noise Effects
WSP (acting on behalf of Stirling Council)	The applicant proposes a fixed limit of 40 dB(A) for the daytime period. That limit is at the upper bound of the 35 to 40 dB(A) range specified in ETSU-R-97. That limit will therefore need to be appropriately supported with due consideration to the factors outlined in ETSU-R-97 and the IOA GPG.	11.2.3 Assessment Methodology 11.2.5 Significance Criteria

Consultee	Summary of Consultee Response	Where addressed within this Report
Stirling Council	The Scoping Report suggests that construction noise calculations will not be undertaken except for any track works that could give rise to short term impacts at receptors. We suggest that the application of a 300 m distance buffer would be appropriate, with sample calculations undertaken for all works anticipated within this distance of sensitive receptors and based on the final scheme layout being assessed.	11.2.3 Assessment Methodology 11.4.1 Construction Noise Effects
WSP (acting on behalf of Stirling Council)	With respect to cumulative development, in the case where the -10 dB rule is not proven, and there is therefore reliance upon noise budget, that budget must be carefully determined. That budget will need to be determined including appropriate account that higher noise levels could be generated by the cumulative developments in the future (e.g. than those which currently prevail) whilst still operating within their extant consents.	11.2.3 Assessment Methodology When calculating the remaining noise budget noise limits applicable to the Proposed Development acting alone, an additional uncertainty margin has been added to the predicted operational noise levels from the other wind farms included in the cumulative assessment.
WSP (acting on behalf of Stirling Council)	It is noted that agreement is provided on the previously made recommendation that any assessment of construction noise should be made in accordance with BS 5228-1. If such an assessment is to be scoped-out, it will need to be appropriately supported with associated reporting in the ES.	11.4.1 Construction Noise Effects

11.2.3 Assessment Methodology

Construction Noise

Annex E of BS 5228-1 details a method for the assessment of significance of construction noise effects in relation to ambient noise levels, the 'ABC method' set out in **Table 11-2**, which sets a series of noise thresholds depending on the existing ambient sound levels and the applicable time period.

It is assumed as a worst-case that all receptors experience the lowest ambient sound levels, and therefore the Category A thresholds set out in **Table 11-2** are set as the threshold of significant effects.

Table 11-2: BS 5228-1 Threshold of Potential Significant Effect at Dwellings

Assessment category and threshold value period	Threshold value, in decibels (dB) ($L_{Aeq,T}$)		
	Category A	Category B	Category C
Night-time (23:00-07:00)	45	50	55
Evenings and weekends D)	55	60	65
Daytime (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

D) 19:00-23:00 weekdays, 13:00-23:00 Saturdays, and 07:00-23:00 Sundays

Additional contextual considerations for construction noise may also apply, including:

1. The duration of the effect. BS 5228 sets out that noise levels above the threshold values lasting for less than 10 days (or 10-evening/night periods) in any 15 consecutive days, or 40 days (or evening/night periods) in any 6-month consecutive period would not normally be considered significant.
2. The time of effect. Where marginal, night-time effects are more likely to be considered significant than daytime impacts.
3. The location of the effect. A receptor may contain areas which are more or less significant than others, such as kitchens and bathrooms which are considered to be less sensitive than living rooms and bedrooms.
4. The nature, time of use, and design of the receptor. A receptor which is not used at night would not be considered sensitive to night-time construction works.

Where separation distances are large (around 500 m or more from major construction activities) typical wind farm construction noise levels are likely to be well below the Category A thresholds and do not require detailed calculation and quantitative assessment.

As the separation distance between receptors and the closest proposed turbine hardstanding is over 600 m and construction activities are likely to be short-term, the detailed assessment of turbine construction noise is scoped out.

A qualitative assessment is provided, setting out the best practice and control measures to ensure that construction noise is adequately controlled.

Noise associated with construction traffic movements along local roads during the construction of the development will cause a short-term increase in noise levels, particularly for dwellings located along the proposed routes to the Proposed Development and given the rural nature of the area.

Where construction traffic movements will occur along access tracks away from the public road network, a buffer of 300 m will be applied and indicative calculations will be conducted for receptors within this distance from access tracks using the method set out in BS 5228 Annex F *Estimating noise from sites*, sub-clause F.2.5 *Method for mobile plant using regular well-defined route (e.g. haul roads)* using the formula:

$$L_{Aeq,T} = L_{WA} - 33 + 10\log_{10}Q - 10\log_{10}V - 10\log_{10}d$$

where:

L_{WA} is the sound power level of the plant, in decibels (dB);

Q is the number of vehicles per hour;

V is the average vehicle speed, in kilometres per hour (km/h);

d is the distance of receiving position from the centre of haul road, in metres (m).

Such noise can be assessed against the criteria in **Table 11-2** or by assessing the predicted increase in noise level along the access route relative to the existing baseline road traffic noise levels. Where the increase in noise due to construction vehicles on the road network is less than 3 dB (equivalent to a doubling of the road traffic) the impact is considered to be not significant.

Even during the most intensive periods of deliveries to the construction site, and at receptors relatively close to the access tracks, it is unlikely that noise thresholds in **Table 11-2** would be exceeded, particularly for typical daytime periods, due to the sporadic and intermittent nature of the noise from vehicles passing the neighbouring dwellings and the slow speeds at which construction vehicles will pass the dwellings.

Any deliveries which are necessary to undertake during night-time and/or other sensitive hours, and therefore have the potential to disturb the residents of neighbouring dwellings, will be agreed with the Environmental Health Officer dealing with the development and residents will be kept informed of these activities prior to any night-time deliveries taking place. These arrangements will be secured within the Construction Environment Management Plan (CEMP).

Blasting activities may be required in the process of creating borrow pits for the construction activities. Blasting for borrow pits is subject to the PAN 50 guidance which require an environmental assessment where the surface of mineral extraction proposals exceed 25 hectares.

The total surface area of all borrow pits for the Proposed Development is well below this value. Blasting is therefore included as part of the overall construction noise assessment.

Operational Noise – Wind Turbine Noise

Noise Predictions

Noise predictions have been carried out using ISO 9613 (ISO, 1993) (ISO, 1996) as referred to within the IOA GPG. The propagation model described in Part 2 of this standard provides for the prediction of sound pressure levels based short-term downwind (i.e., worst case) conditions. A supplementary term has been added to the methodology to allow for the effects of wind direction as discussed in the IOA GPG.

The propagation model calculates the predicted sound pressure level by taking the source sound power level for each turbine in separate octave bands and subtracting a number of attenuation factors. The details of the prediction methodology are set out in Appendix 11-1: Noise Prediction Methodology.

The turbine locations used for the Proposed Development noise predictions are shown in **Table 11-3**.

Table 11-3: Proposed Turbine Locations

Turbine	Easting	Northing
T1	272767	687404
T2	273702	687071
T3	272913	687021
T4	273610	687517

For the purposes of the noise assessment, a candidate turbine has been selected based on the respective overall noise emissions of available options. The turbine option with the highest overall noise emissions, the Nordex N163 STE 6.8 MW, was selected as a worst-case assumption. The turbine tip height will not exceed 180 m, and a hub height of 98.5 m has therefore been assumed, based on a 163 m rotor diameter for this turbine model, in order to reach this maximum tip height.

Table 11-4 shows octave band sound power levels at various standardised 10 m height integer wind speeds (corrected from hub height using the reference ground roughness length of 0.05 m) at a hub height of 98.5 m for the Nordex N163 STE 6.8 MW turbine with +2 dB uncertainty added. Octave band data is based on manufacturer supplied data for Mode 1 with 138 m hub height (lowest available).

Table 11-4: Nordex N163 STE 6.8 MW, Mode 1 Sound Power Levels (dB L_{WA})

Standardised 10 m height wind speed, m/s	Octave band centre frequency (Hz)								
	63	125	250	500	1000	2000	4000	8000	Overall
3	83.5	87.3	90.2	91.3	91.2	87.2	77.1	55.5	97.0
4	85.5	89.3	92.2	93.3	93.2	89.2	79.1	57.5	99.0
5	90.3	94.1	97.0	98.1	98.0	94.0	83.9	62.3	103.8
6	94.7	98.5	101.4	102.5	102.4	98.4	88.3	66.7	108.2
7	94.9	98.7	101.5	102.6	102.5	98.5	88.5	66.8	108.4
8	94.9	98.7	101.6	102.7	102.6	98.6	88.5	66.9	108.4
9	94.9	98.7	101.6	102.7	102.6	98.6	88.5	66.9	108.4
10	94.9	98.7	101.6	102.7	102.6	98.6	88.5	66.9	108.4
11	94.9	98.7	101.6	102.7	102.6	98.6	88.5	66.9	108.4
12	94.9	98.7	101.6	102.7	102.6	98.6	88.5	66.9	108.4

The ETSU-R-97 noise limits assume that the wind turbine noise contains no audible tones. Where tones are present, a correction should be added to the measured or predicted noise level before comparison with the recommended limits.

Where topographical features are present between source and receiver, there is the potential for barrier effects, whereby the line-of-sight between source and receiver is obscured resulting in reduced sound propagation, and for ‘concave ground profile’ effects, for example across a valley, resulting in higher levels of sound propagation. These effects are further explained in Appendix 11-1.

An analysis of the ground profiles between the proposed turbines and the neighbouring dwellings has been carried out and are set out in Appendix 11-2: Corrections for Ground Profile & Barriers.

Assessment Approach

The assessment of noise at this site has been carried out in consultation with WSP (acting on behalf of Stirling Council) and Stirling Council.

Background noise measurement would usually inform the ETSU-R-97 noise limits, but since there are operational wind farms in the area, it would be very difficult to correct the background noise for the presence of these.

In such cases its often possible to re-use previous baseline noise monitoring, providing the noise environment is unlikely to have changed since the noise monitoring campaign.

The use of existing noise data would require a correction factor to be calculated and applied to the wind data associated with such measurements, in order to derive the equivalent baseline noise levels for standardised 10 m height wind speeds based on the Proposed Development hub height. However, calculations for such correction factors require wind data for at least two different heights. Since the available associated wind data comprises wind measurements at 10 m height only, such corrections are not possible. As such, fixed cumulative noise limits are adopted for the purposes of this assessment. This approach results in a worst-case assessment.

The proposed approach to determine significance is to adopt fixed 40 dB L_{A90} daytime, 43 dB L_{A90} night-time and 45 dB L_{A90} financially involved limits for cumulative noise at all wind speeds.

This approach has been undertaken in the absence of baseline data for all receptors, and in the context of the noise limits (or lack thereof) at existing wind farms in the vicinity, which is discussed further for the cumulative effects assessment methodology.

The receptors considered in the assessment were identified and agreed with WSP (on behalf of Stirling Council) during the scoping process. Receptors are set out in **Table 11-5**, including the co-ordinates of the receptors, and are shown in Figure 11-1.

At all other identified noise-sensitive receptor locations, either the simplified ETSU cumulative noise limit of 35 dB(A) is met, or the Proposed Development is predicted to contribute noise levels at that location which are negligible and a detailed assessment is scoped out.

Table 11-5: Noise-Sensitive Receptor Locations

Receptor	Easting	Northing
Easter Cringate Cottage	271743	687544
Ryecroft	272529	688125
Craigengelt	274454	685851
Craigengelt Bungalow	275036	685572
Muirpark	275554	687121
Todholes Farm Cottage	275254	688031
Shankhead	275011	685908
Shankhead Farm	275136	685878
Townhead Farm	274854	689058
Greathill House	275232	688921

With regard to the daytime noise limit, the IOA GPG states (paragraph 3.2.2):

> *"The day amenity noise limits have been set in ETSU-R-97 on the basis of protecting the amenity of residents whilst outside their dwellings in garden areas. The daytime amenity noise limits are formed in two parts: Part 1 is a simple relationship between the prevailing background noise level (with wind speed) with an allowance of +5 dB; Part 2 is a fixed limit during periods of quiet. ETSU-R-97 describes three criteria to consider when determining the fixed part of the limit in the range of 35 dB to 40 dB L_{A90}, all of which should be considered. They are:*
> 1) *The number of noise-affected properties;*
> 2) *The potential impact on the power output of the wind farm; and*
> 3) *The likely duration and level of exposure"*

In this instance there are relatively few properties affected but there is the potential for substantial implications for the power output if lower noise limits were applied. The Proposed Development is to the east and southeast of the nearest receptors, Easter Cringate Cottage and Ryecroft. Given that the UK lies in the latitude of predominantly westerly winds (Met Office, 2023), it would typically be uncommon for downwind conditions to occur between the Proposed Development and these receptors. It would be anticipated that lower noise levels than predicted would occur for much of the time.

In addition, the nearby Earlsburn Wind Farm operates with noise limits derived using 40 dB lower limiting values. On this basis, a 40 dB L_{A90} lower limiting value is considered to be appropriately justified.

Cumulative Effects

There are a number of proposed and operational wind farms in the vicinity of the Proposed Development which have been considered in the cumulative operational noise assessment. These comprise:

- Craigannet Wind Turbine;
- Craigengelt Wind Farm;
- Earlsburn Wind Farm;
- Earlsburn Extension Wind Farm;
- Kingsburn Wind Farm; and
- Shelloch Wind Farm.

Further details of the cumulative wind farms, including details of turbine locations, models, and assumed noise data, are set out in Appendix 11-3: Details of Cumulative Wind Farms.

The noise from the above turbines is predicted using the same method as for the Proposed Development, set out in Appendix 11-1 and Appendix 11-2.

It is noted that multiple nearby wind farms do not have existing noise limits, and noise was instead controlled via agreement of the turbine design with Stirling Council prior to installation (Craigengelt, which is the closest cumulative wind farm to the Proposed Development, and Kingsburn).

Where wind farms are remote from receptors (Shelloch) or contain a small number of turbines (Craigannet, one turbine), noise limits were set for the daytime at the greater of 35 dB L_{A90} or 5 dB above background noise.

The Earlsburn wind farm adopts noise limits of the greater of 40 dB L_{A90} or 5 dB above background noise levels, which the recently proposed Earlsburn Extension EIA chapter similarly adopts following consultation with Stirling Council.

Adopting fixed cumulative noise limits identical to the noise limits from the Proposed Development acting alone is a worst-case assessment and further justifies the assessment approach as set out in **Table 11-6**.

Table 11-6: Cumulative Noise Limits

Time Period	Cumulative Noise Limit (dB L_{A90})
At all times if predicted operational noise levels are below this level, noise effects are negligible detailed cumulative assessment is not required	30 dB L_{A90}
At all times if predicted operational noise levels at properties that are financially involved with neighbouring wind farm developments are below this level, noise effects are predicted to be negligible and detailed cumulative assessment is not required	35 dB L_{A90}
Daytime noise limit applicable to cumulative noise from all wind turbine developments	40 dB L_{A90}
Night-time noise limit applicable to cumulative noise from all wind turbine developments	43 dB L_{A90}
Night-time and Daytime noise limit applicable to cumulative noise from all wind turbine developments where the receptor has a financial involvement with the Proposed Development	45 dB L_{A90}

Noise levels from all wind farms including the Proposed Development are calculated and compared against the noise limits in **Table 11-6**.

Where these limits are exceeded, mitigation would be applied in the form of a curtailment strategy. The predicted noise levels from all wind farms other than the Proposed Development are then calculated.

For each receptor, where the reasonable worst-case noise levels from other developments are below the cumulative noise limits, the reasonable worst-case noise level from other developments is subtracted from the cumulative noise limits to derive a 'Remaining Noise Budget' (RNB).

The reasonable worst-case noise levels assumed for other developments for the purposes of this calculation are determined by applying a further uncertainty uplift, in addition to the normal uncertainty value of +2 dB. This additional uncertainty is applied in order to account for the potential that other wind farm developments may emit a greater level of noise than predicted while remaining within their consented noise limits. An additional increase of +2 dB is applied to existing wind farm developments where the turbine type is known, while an additional increase of +4 dB is applied to developments that have not yet been built and as such the installed turbine type could differ from that assumed in this assessment.

In some instances, the reasonable worst-case noise levels are already above the cumulative noise limits, or the calculated RNB is more than 10 dB below either the noise levels from other developments or the cumulative noise limits. In these cases, the RNB is set at a level 10 dB below the cumulative noise limit, or 10 dB below the anticipated noise level from other developments (i.e. the predicted noise level without applying the additional uncertainty uplift), whichever is higher.

On the basis of the above, where the noise levels from the Proposed Development acting alone meets the RNB, either the cumulative noise limit is predicted to be met or the Proposed Development is predicted to have a negligible contribution to cumulative noise levels.

11.2.4 Potential Effects Scoped Out

Construction Vibration

The construction phase of the development will involve vibration-generating activities. However, these effects will be short-term and negligible due to the large separation distances between receptors and the closest areas of works.

Construction of Access Tracks

Construction works associated with constructing the access tracks has the potential to result in relatively high levels of noise at receptors close to access tracks. However, the noise from these activities will be very short duration due to the works moving along the length of the access tracks. Therefore, any potential exposure to high levels of noise will occur for sufficiently short duration that an assessment is not required.

Decommissioning Noise

Decommissioning activities will meet the relevant noise limits that apply to noise from construction. Decommissioning operations will be undertaken in line with the relevant standards and limits that apply at the time. Decommissioning activities typically result in the same or lower noise levels compared to those for construction, and therefore an assessment of decommissioning noise is not required.

Operational Vibration

The operational phase of the development will generate vibration. However, these effects will be negligible at the large separation distances between receptors and the closest areas of works.

Operational Noise – Road Traffic

The operation of the Proposed Development will result in minimal additional road traffic, primarily comprising occasional maintenance visits. As such, road traffic noise effects from operational phase of the Proposed Development will be negligible.

Operational Noise – Substation

Further operational noise may occur due to the substation proposed to be built as auxiliary infrastructure to the site. The noise from the substation is anticipated to be lower in level than that from the wind turbine noise at all locations except very close to the substation. The substation is located at large distances (>700 m) to all receptors except for Muirpark, which is approximately 240 m from the substation.

The layout and sound source information related to the substation are not available at this stage, and therefore a detailed assessment of noise from the substation is not able to be conducted.

Such an assessment will be undertaken as part of the detailed design stage. It is anticipated that noise from the substation will be able to be adequately mitigated through embedded mitigation, such as equipment selection, positioning of equipment, or enclosing the equipment within a building or structure.

Muirpark is financially involved as the landowner for the project, providing context that the noise impacts would be lower at this receptor due to reduced sensitivity.

This context makes it likely that the separation distances, in addition to the presence of multiple large farm buildings between the receptor and substation, and the embedded mitigation described above, will result in sufficiently low noise levels at Muirpark that there will be no significant noise effects.

Tonal Noise

ETSU-R-97 specifies that, in line with other noise guidance, a penalty should be added to measured or predicted wind turbine noise levels if there is tonal noise above a certain level which is audible at residential properties.

In this assessment, it has been assumed that there would be no tonal noise associated with the operation of the Proposed Development which would give rise to such a penalty as most modern turbines operate without significant tonal noise.

It is anticipated that a penalty would be included in an appropriately worded planning condition such that a tonal penalty would need to be added to measured noise levels, where required, before comparing them with the noise limits. Warranty agreements with turbine suppliers seek to ensure that any such penalties will not occur in practice.

Low Frequency and Infrasound

Low frequency sound is typically defined as sound in the audible hearing frequency range of 20 Hz up to about 200 Hz. Noise from wind turbines is not inherently low-frequency and it is typically broad-band in nature, and close to a wind turbine the dominant frequencies are usually in the 250 to 2000 Hz range.

At increasing distance from a wind farm site, the noise level decreases due to the spreading out of the sound energy and due to air absorption, which increases with increasing frequency.

This means that, although the energy across the whole frequency range is reduced, higher frequencies are reduced more than lower frequencies with the effect that as distance from the site increases the ratio of low to high frequencies also increases.

This effect may be observed with road traffic noise or natural sources, such as the sea, where higher frequency components are diminished relative to lower frequency components at long distances. At such distances, however, the overall noise level is so low, such that any bias in the frequency spectrum is insignificant.

Work carried out in 2006 by Hayes McKenzie for the UK Department of Trade and Industry (DTI, 2006) to investigate the extent of low frequency and infrasonic noise from three UK wind farms concluded that there is no evidence of health effects arising from infrasound or low frequency sound, stating that; "*the common cause of complaints associated with noise at all three wind farms is not associated with low frequency noise, but is the audible modulation of the aerodynamic noise, especially at night*".

The findings that there is no evidence of health effects arising from infrasound or low frequency noise are endorsed by the Scottish Government and are included in their planning advice on wind farm noise (Scottish Government, 2014).

Infra-sound is noise occurring at frequencies below that at which sound is normally audible, i.e. at less than about 20 Hz, due to the significantly reduced sensitivity of the ear at such frequencies. In this frequency range, for sound to be perceptible, it has to be at very high amplitude, which is not the case for wind turbine noise.

In November 2016, a study into low frequency and infrasound was published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Wuerttemberg (Landesanstalt für Umwelt, Messungen und Naturschutz Baden-Württemberg, 2016).

This contained a comprehensive review of low frequency and infrasound from wind turbines and evaluated such noise in relation to other sources.

The results found that;

> *"…the infrasound level in the vicinity of wind turbines is – at distances between 120m and 300m – well below the threshold of what humans perceive…"*

and that

> *"…at a distance of 700m from the wind turbines, it was observed by means of measurements that when the turbine is switched on, the measured infrasound level did not increase or only increased to a limited extent. The infrasound was generated mainly by the wind and not by the turbines."*

The report concludes that:

> *"Infrasound is caused by a large number of different natural and technical sources. It is an everyday part of our environment that can be found everywhere. Wind turbines make no considerable contribution to it. The infrasound level generated by them lie clearly below the limits of human perception. There is no scientifically proven evidence of adverse effects in this level range."*

It is therefore considered that infrasound can be scoped out of the assessment.

A WSP report for the Department for Business, Energy & Industrial Strategy (WSP, 2022) states that;

> *"…the weight of evidence appears to indicate that wind turbine infrasound has no adverse effects on human health at typical exposure levels…"*

and that;

> *"…due to the inherent characteristics of wind turbine sound, suitable controls on A-weighted sound levels are expected to also provide sufficient control for the potential impact of low frequency noise".*

It is therefore considered that low frequency noise can be scoped out of the assessment.

Amplitude Modulation

The variation in noise level associated with wind turbine operation, at the rate at which turbine blades pass any fixed point of their rotation (the blade passing frequency), is often referred to as blade swish or Amplitude/ Aerodynamic Modulation (AM).

This effect is identified within ETSU-R-97 where it is considered that;

> "*... modulation of blade noise may result in variation of the overall A-Weighted noise level by as much as 3 dB(A) (peak to trough) when measured close to a wind turbine...* "

and that at distances further from the turbine where there are;

> "*... more than two hard, reflective surfaces, then the increase in modulation depth may be as much as 6 dB(A) (peak to trough)*".

There have been instances where level of AM rates are higher than this, which results in the noise being perceived as more intrusive (in the same way as tonal content makes the noise more intrusive).

DECC commissioned a Wind Turbine AM Review report that was published in two phases: Phase 1 in September 2015 and Phase 2 in October 2016 (although the Phase 2 report is dated August 2016) (DECC, 2016).

Phase 1 of the report sets out the approach and methodology to the review and research, and the Phase 2 report includes a literature review, research into human response to AM. This recommends how excessive AM might be controlled through the use of a planning condition.

The report includes recommendations on how AM should be addressed when quantified according to the recommendations of a separate Institute of Acoustics (IOA) working group document, A Method for Rating Amplitude Modulation in Wind Turbine Noise (IOA, 2016).

The AM Review reports recommend a two-tier approach whereby the first tier seeks a reduction in the depth and/or occurrence of AM with a rating level (according to the IOA Amplitude Modulation Working Group method) ≥3 dB.

Whether remedial action is required depends on the prevalence of any complaints, and how often AM rating levels ≥3 dB occur.

The second tier is that if AM is deemed to be a significant issue, and if nothing can be done to reduce the level of AM, then a penalty scheme is proposed whereby a penalty ranging from 3 dB (for a rating level of 3 dB) up to a maximum of 5 dB (for a rating level of 10 dB and above) could be added to the measured level before measured levels are compared with the relevant noise limits.

It should be noted that most wind farms operate without significant AM, and that it is not possible to predict the likely occurrence of AM. At the time of writing (December 2023) there has been no official response to those recommendations from the IOA Noise Working group or endorsement from any Scottish Government Minister or Department.

The IOA GPG (IOA, 2013), states that; "*...the evidence in relation to "Excess" or "other" Amplitude Modulation (AM) is still developing. At the time of writing, current practice is not to assign a planning condition to deal with AM*".

11.2.5 Significance Criteria

The criteria for significance are based upon threshold values taken from ETSU-R-97 and BS 5228 for operational noise and construction noise respectively. These thresholds are detailed in **Table 11-2** and **Table 11-6**.

Where cumulative noise limits are exceeded, the RNB limit is calculated for each receptor as an 'effective noise limit'. The RNB values are ultimately derived from the requirement for cumulative noise to meet the limits set out in **Table 11-6**.

Where noise levels exceed the applicable thresholds, significant effects are predicted to occur. Similarly, noise effects are predicted to be not significant where noise levels remain below the applicable thresholds.

11.3 Baseline Conditions

The baseline noise environment in rural areas usually consists of a combination of natural sources and those of human origin which, in most cases, vary in line with a standard diurnal cycle, with higher level of noise occurring during the day and lower levels occurring at night. Overlaid on this is the variation of noise from wind-blown trees and foliage, which varies with wind speed and, sometimes, direction.

In addition, the presence of multiple wind farms in the vicinity of the Proposed Development is also likely to result in contributions of wind farm noise to the existing baseline conditions.

Background noise measurement would usually inform the ETSU-R-97 noise limits, but since there are now operational wind farms in the area, it would be very difficult to correct the background noise for the presence of these. In such cases its often possible to re-use previous baseline noise monitoring, providing the noise environment is unlikely to have changed since the noise monitoring campaign. The use of existing noise data would require a correction factor to be calculated and applied to the wind data associated with such measurements. The equivalent baseline noise levels for standardised 10 m height wind speeds based on the Proposed Development hub height could then be derived. However, calculations for such correction factors require wind data for at least two different heights. Since the available associated wind data comprises wind measurements at 10 m height only, such corrections are not possible. As such, no baseline data has been adopted for the purposes of this assessment, with fixed-limit criteria used instead.

It is assumed that the natural baseline will remain unaltered through the lifetime of the Proposed Development.

11.4 Assessment of Effects and Mitigation

11.4.1 Construction Noise Effects

Turbine Construction

The construction of the proposed turbines will occur at distances that are unlikely to breach typical construction noise limits prescribed within BS 5228 at the nearest noise sensitive receptors. This, combined with the short-term nature of the works, means that a detailed assessment of the construction noise impacts is not considered necessary.

The closest residential location (Ryecroft) is approximately 650 m to the nearest turbine hardstanding area and the nearest borrow pit, and 600 m to the nearest access track. The second closest residential location (Easter Cringate Cottage) is 1 km from the nearest turbine and access track and 1.3 km to the nearest borrow pit.

Nonetheless, construction noise has the potential to be audible, and is subject to BPM, which will be detailed and secured within the CEMP. Some examples of BPM include switching off vehicles when not in use, placing materials on the ground instead of dropping them, and maximising separation distances between noise sources and noise-sensitive receptors.

Construction Compound and Substation

The main construction compound and proposed substation are adjacent to each other and situated at relatively large distances from most receptors. The nearest receptor is Muirpark (approximately 180 m), while the second closest receptor to the construction compound and substation is Todholes Farm Cottage (approximately 650 m).

Muirpark is financially involved in the project and would therefore have reduced sensitivity to noise effects from the Proposed Development. Additionally, the substation and construction compound are to the northwest of Muirpark, with several large farm buildings located in between the receptor and potential construction activities.

It is therefore considered that, on the basis of the above considerations and the separation distances involved, in addition to the adoption of BPM for such construction activities, noise from construction activities at the construction compound and construction of the substation will be not significant.

Blasting

There may be a need for blasting in the process of creating borrow pits for the construction activities. BS 5228 states regarding blasting and its potential effect on neighbours to site that:

> *"Vibration and air overpressure from blasting operations is a special case and can under some circumstances give rise to concern or even alarm to persons unaccustomed to it. The adoption of good blasting practices will reduce the inherent and associated impulsive noise: prior warning to members of the public, individually, if necessary, is important".*
>
> *to it. The adoption of good blasting practices will reduce the inherent and associated impulsive noise: prior warning to members of the public, individually, if necessary, is important".*

It is unlikely that noise from blasting will exceed the thresholds in **Table 11-2** for more than 10 days in any 15 consecutive days, or 40 days in any 6-month consecutive period, and as such is considered to be not significant, subject to the adoption of appropriate BPM mitigation measures.

Construction Traffic Noise

The predicted changes in road traffic on public roads during the construction phase are assessed in Chapter 9: Transport and Access, which shows that the maximum increase in traffic (during the peak month of construction) is significantly less than a doubling in road traffic.

Therefore, due to relatively infrequent abnormal load deliveries and the relatively small increase in light and heavy vehicles on the local road network, the change in road traffic noise is anticipated to be less than 3 dB and would not be significant.

Some night-time transportation of turbine blades may be required in order to minimise the impact of slow-moving vehicles on road traffic flows. Such activities will be infrequent and are not anticipated to result in significant noise effects. No significant construction traffic noise effects are anticipated.

Where construction traffic uses access tracks to reach construction areas, the access tracks are beyond the 300 m exclusion buffer identified in 11.2.3 for all receptors except for Muirpark, approximately 100 m from the nearest access track.

An indicative calculation is conducted for Muirpark below, based on the formula in BS 5228 Annex F, F.2.5, described in 11.2.3.

$$L_{Aeq,T} = L_{WA} - 33 + 10\log_{10}Q - 10\log_{10}V - 10\log_{10}d$$

The construction vehicle L_{WA} can be assumed to be 109 dB based on BS 5228 Annex C Table C.4 item 1 Articulated dump truck. The number of vehicles per hour Q is assumed as a worst-case estimate, to be 10 vehicles (one vehicle passing every six minutes).

The average construction vehicle speed along the access track is assumed as a worst-case estimate to be 10 km/h. The distance from the access track, d, is 100 m, as described above.

The resulting $L_{Aeq,T}$ for this scenario is 56 dB which is well below the daytime construction noise limit of 65 dB given in **Table 11-2**. Construction traffic noise effects are therefore negligible and not significant.

11.4.2 Operational Noise Effects

Operational noise predictions have been carried out for the candidate wind turbine under consideration for the Proposed Development in line with the methodology set out in the IOA GPG. Full details of the prediction methodology are set out in Technical Appendix 11-1: Noise Prediction Methodology, but the main assumptions are described below:

- Receiver height of 4 m;
- Ground effect ground coefficient G = 0.5;
- Atmospheric attenuation corresponding to a temperature of 10 °C and a relative humidity of 70 %;
- Topographical barriers and concave ground profile corrections have been applied according to the IOA GPG;
- Downwind propagation is assumed for all receptors; and
- A margin of plus 2 dB has been added to manufacturer’s sound power level data to account for uncertainty.

Only noise sensitive properties where the predicted operational noise level from the Proposed Development is above 30 dB L_{A90} have been considered since this is 10 dB below the upper daytime noise limit. These properties have been identified using OS AddressBase Plus data and are given in **Table 11-5** and shown in Figure 11-1.

The results of the operational noise predictions at the noise-sensitive properties within the study are shown at **Table 11-7**. The results are also presented as a noise contour plot valid for standardised 10 m height wind speeds of 7 – 12 m/s at Figure 11-1.

Table 11-7: Predicted Downwind Operational Noise Levels for Proposed Development (dB L_{A90})

Location	Standardised 10m height wind speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
Easter Cringate Cottage	25	27	31	36	37	37	37	37	37	37
Ryecroft	28	30	34	38	40	40	40	40	40	40
Craigengelt	22	24	28	33	34	34	34	34	34	34
Craigengelt Bungalow	19	21	25	29	31	31	31	31	31	31
Muirpark	20	22	26	30	32	32	32	32	32	32
Todholes Farm Cottage	21	23	27	31	32	32	32	32	32	32
Shankhead	20	22	26	31	32	32	32	32	32	32
Shankhead Farm	20	21	26	30	31	31	31	31	31	31
Townhead Farm	19	21	25	29	31	31	31	31	31	31
Greathill House	18	20	24	29	30	30	30	30	30	30

Predicted noise levels are the same for both night-time and daytime. The highest predicted noise level for each receptor is compared against the applicable daytime and night-time noise limits, alongside a description of the outcome of the assessment.

The receptor Muirpark is financially involved with the Proposed Development and is therefore subject to a noise limit of 45 dB L_{A90}. At all other receptors, for the purposes of assessing direct operational noise effects from the Proposed Development, the daytime noise limit of 40 dB L_{A90} and the night-time noise limit of 43 dB L_{A90} apply. The receptors Craigengelt and Easter Cringate Cottage are financially involved with Craigengelt Wind Farm and are therefore subject to a cumulative noise limit of 45 dB LA90, where applicable.

It should be noted that ongoing discussions are being held with receptors Easter Cringate Cottage and Ryecroft, with respect to agreeing financial involvement of these properties. While discussions have been positive, agreements have not yet been confirmed and therefore the financial involvement of these receptors cannot be assumed for the purposes of the assessment. Noise limits for these receptors may therefore ultimately be higher than those assumed.

Table 11-8: Predicted Operational Noise Levels

Receptor	Time Period	Predicted maximum Downwind Noise Level, dB L_{A90}	Noise Limit, dB L_{A90}	Assessment Outcome
Easter Cringate Cottage	Daytime	37	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met
Ryecroft	Daytime	40	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met
Craigengelt	Daytime	34	45	The daytime noise limit is

Receptor	Time Period	Predicted maximum Downwind Noise Level, dB L_{A90}	Noise Limit, dB L_{A90}	Assessment Outcome
				met
	Night-time		45	The night-time noise limit is met
Craigengelt Bungalow	Daytime	31	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met
Muirpark	Daytime	33	45	The daytime noise limit is met
	Night-time		45	The night-time noise limit is met
Todholes Farm Cottage	Daytime	33	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met
Shankhead	Daytime	32	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met
Shankhead Farm	Daytime	31	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met
Townhead Farm	Daytime	31	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met
Greathill House	Daytime	30	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met

At all identified receptors, the direct operational noise impact from the Proposed Development meets the applicable noise limits and is therefore not significant.

11.4.3 Cumulative Effects

Cumulative Construction Noise

The Earlsburn Extension development is not currently built, and there is the potential for this, or other developments, to be constructed at a similar or overlapping time period. However, due to remote nature of the area and the large separation distances involved, the combined effect of noise from simultaneous construction activities is considered likely to be negligible.

Even during the most intensive periods of deliveries to multiple development construction sites, and at receptors relatively close to the access tracks, it is unlikely that noise thresholds in **Table 11-2** would be exceeded, particularly for typical daytime periods, due to the sporadic and intermittent nature of the noise from vehicles passing the neighbouring dwellings and the slow speeds at which construction vehicles will pass the dwellings.

Noise associated with construction traffic movements along local roads during the construction of multiple development will cause short-term increases in noise levels, particularly for dwellings located along the proposed routes to multiple developments and given the rural nature of the area.

However, the noise increase is likely to remain less than 3 dB. For this reason, as well as due to the limited duration of these potential noise increases, the cumulative increase in road traffic during the construction phase is considered to be not significant.

Cumulative Operational Noise

The predicted noise level from the Proposed Development is up to 34 dB at Craigengelt, 32 dB at Muirpark, and 30 dB at Greathill House which are all at least 10 dB below all applicable cumulative noise limits, and therefore the contribution of the Proposed Development is considered negligible for those properties. Cumulative effects for these receptors are therefore not significant, and not considered further.

There are a number of proposed and operational wind farms in the vicinity of the Proposed Development Site which have been considered in the cumulative operational noise impact assessment. Cumulative assessments have been carried out for each of the receptors identified for the operational noise assessment, except for Craigengelt, Muirpark, and Greathill House as outlined above.

The prediction method for the cumulative noise assessment is the same as that for the operational noise assessment, as set out in Appendix 11-1 and Appendix 11-2. Details of the assumptions adopted for the cumulative wind farms are set out in Appendix 11-3. In addition, due to the spread-out arrangement of the cumulative noise sources, receptors often cannot be both upwind and downwind of the Proposed development and other wind farms at the same time. As a result, separate noise levels are calculated for each wind direction in directional bands of 30° width, from 0° to 330°.

The cumulative predicted noise levels from all wind farms, including the Proposed Development, are set out in **Table 11-9**. It should be noted that the predicted noise levels from other wind farm developments includes the normal uncertainty of +2 dB.

Table 11-9: Predicted Cumulative Noise Levels (dB L_{A90})

Location	Wind Direction, °	Standardised 10m height wind speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
Easter Cringate Cottage	0	30	31	33	36	37	37	37	37	37	37
	30	32	33	35	37	38	39	39	39	39	39
	60	36	36	37	39	40	40	41	41	41	41
	90	39	39	39	40	41	42	43	43	43	43
	120	39	39	39	40	41	42	43	43	43	43
	150	39	39	39	40	41	42	43	43	43	43
	180	39	39	39	40	41	42	42	43	42	42
	210	39	39	39	40	40	42	42	42	42	42
	240	38	38	39	39	39	41	42	42	42	42
	270	35	35	36	37	37	38	39	39	39	39
	300	31	32	33	35	35	36	36	36	36	36
	330	29	30	32	34	35	36	36	36	36	36
Ryecroft	0	26	28	31	35	36	36	36	36	36	36
	30	27	29	32	36	37	37	37	37	37	37
	60	29	30	34	38	39	39	39	39	39	39
	90	33	33	36	39	40	41	41	41	41	41
	120	35	35	37	40	41	41	41	41	41	41
	150	35	35	37	40	41	41	41	42	41	41
	180	35	36	37	40	41	41	42	42	42	42
	210	35	36	37	40	41	41	42	42	42	42
	240	35	36	37	40	40	41	41	41	41	41
	270	34	34	36	38	39	40	40	40	40	40
	300	30	31	33	36	37	37	37	38	37	37
	330	27	29	31	35	36	36	36	36	36	36
Craigengelt Bungalow	0	29	29	30	32	33	34	34	34	34	34
	30	26	26	28	31	32	32	32	33	32	32
	60	20	21	24	27	28	28	29	29	29	29
	90	17	17	19	22	23	24	24	24	24	24
	120	16	17	18	20	21	22	22	22	22	22
	150	18	19	20	21	22	23	23	23	23	23
	180	25	25	25	26	27	28	28	28	28	28
	210	28	28	29	30	31	32	32	33	32	32
	240	29	29	30	32	33	34	34	34	34	34
	270	29	29	31	32	33	34	34	34	34	34
	300	29	29	31	32	33	34	34	34	34	34
	330	29	29	31	32	33	34	34	34	34	34

Location	Wind Direction, °	Standardised 10m height wind speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
Todholes Farm Cottage	0	22	23	26	29	30	30	30	30	30	30
	30	18	20	22	25	26	26	26	27	27	27
	60	16	17	19	22	23	23	24	24	24	24
	90	16	17	19	22	23	23	23	23	23	23
	120	20	20	22	25	25	26	26	26	26	26
	150	25	26	27	30	31	31	32	32	32	32
	180	28	28	30	33	34	34	34	34	34	34
	210	28	28	30	33	34	34	35	35	35	35
	240	28	28	30	33	34	34	35	35	35	35
	270	28	28	30	33	34	34	35	35	35	35
	300	28	28	30	33	34	34	35	35	35	35
	330	26	27	29	32	33	34	34	34	34	34
Shankhead	0	29	29	31	33	34	34	35	35	35	35
	30	25	26	28	31	32	33	33	33	33	33
	60	20	21	24	27	28	28	28	28	28	28
	90	17	18	20	23	23	24	24	24	24	24
	120	17	17	19	21	22	23	23	23	23	23
	150	20	20	21	23	23	24	25	25	25	25
	180	26	26	27	28	28	29	30	30	30	30
	210	29	30	30	32	32	33	34	34	34	34
	240	30	30	31	33	34	35	35	35	35	35
	270	30	30	31	33	34	35	35	35	35	35
	300	30	30	31	33	34	35	35	35	35	35
	330	30	30	31	33	34	35	35	35	35	35
Shankhead Farm	0	29	29	30	33	33	34	34	34	34	34
	30	24	25	27	30	31	32	32	32	32	32
	60	19	20	23	26	27	28	28	28	28	28
	90	16	17	19	22	23	23	24	24	24	24
	120	16	17	18	21	22	22	22	23	23	23
	150	19	20	21	22	23	24	24	24	24	24
	180	25	26	26	27	28	29	29	30	29	29
	210	29	29	30	31	32	33	33	34	33	33
	240	29	30	31	33	34	34	35	35	35	35
	270	29	30	31	33	34	34	35	35	35	35
	300	29	30	31	33	34	34	35	35	35	35
	330	29	30	31	33	34	34	35	35	35	35

Location	Wind Direction, °	Standardised 10m height wind speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
Townhead Farm	0	20	22	24	28	28	28	29	29	29	29
	30	17	19	22	25	25	26	26	26	26	26
	60	15	16	19	22	23	23	23	23	23	23
	90	17	18	20	23	24	24	24	24	24	24
	120	22	23	25	28	29	29	30	30	30	30
	150	26	26	28	31	32	32	32	32	32	32
	180	26	27	29	31	32	33	33	33	33	33
	210	26	27	29	32	33	33	34	34	34	34
	240	26	27	29	32	33	33	34	34	34	34
	270	26	27	29	32	33	33	34	34	34	34
	300	26	27	29	32	32	33	33	33	33	33
	330	23	24	27	30	30	31	31	31	31	31

The highest predicted cumulative noise level for each receptor is compared against the applicable daytime and night-time cumulative noise limits, alongside a description of the outcome of the cumulative assessment.

Table 11-10: Predicted Cumulative Noise Levels

Receptor	Time Period	Highest Predicted Cumulative Noise Level, dB L_{A90}	Noise Limit, dB L_{A90}	Assessment Outcome
Easter Cringate Cottage	Daytime	43	45	The daytime noise limit is met
	Night-time		45	The night-time noise limit is met
Ryecroft	Daytime	42	40	The daytime noise limit is not met*
	Night-time		43	The night-time noise limit is met
Craigengelt Bungalow	Daytime	34	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met
Todholes Farm Cottage	Daytime	35	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met
Shankhead	Daytime	35	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met
Shankhead Farm	Daytime	35	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit is met
Townhead Farm	Daytime	34	40	The daytime noise limit is met
	Night-time		43	The night-time noise limit

Receptor	Time Period	Highest Predicted Cumulative Noise Level, dB L_{A90}	Noise Limit, dB L_{A90}	Assessment Outcome
				is met

* Noise limits would be met if this receptor were to be financially involved.

The cumulative assessment identifies that the noise limits are met for all receptors except at Ryecroft for some wind directions at wind speeds of 7 m/s or higher during the daytime. All noise limits are met at night.

Mitigation is therefore required in the daytime in the form of a curtailment strategy in order to avoid significant effects at Ryecroft. If this receptor is financially involved, no mitigation would be required. No significant cumulative noise effects are identified for all other receptor locations during either the daytime or night-time.

11.4.4 Embedded Mitigation

Predicted operational noise levels were reviewed as the project layout evolved such that operational noise was considered during the design phase of the Proposed Development.

Furthermore, the candidate turbine model (worst case scenario) selected for the Proposed Development (Nordex N163 STE 6.8 MW) has a serrated trailing edge (STE) design which has an inherent reduction effect on noise emissions compared to equivalent turbines without STE. This is incorporated into the sound power specification provided by the manufacturer.

11.4.5 Proposed Mitigation/Monitoring

Proposed Mitigation During Construction

Noise during the construction phase, including noise from construction traffic on access tracks, will be minimised through the adoption of Best Practicable Means (BPM). Methods for mitigating and minimising noise will be set out in the detailed Construction and Environmental Management Plan (CEMP) that will be prepared before construction commences.

An outline CEMP has been produced as part of this EIA Report, and presented in Technical Appendix 15-1.

The relevant BS 5228 noise limits that would apply to construction activities with a duration of greater than one month are set out at **Table 11-2**.

Noise during construction works will be controlled by generally restricting works to standard working hours (07:00 to 19:00 Monday to Friday and 07:00 to 13:00 on Saturdays) and excluding Sundays and Scottish local and national holidays, unless specifically agreed otherwise with Stirling Council.

Outside these hours, construction activities on-site will be limited to turbine erection, maintenance, emergency works, dust suppression, and the testing of plant and equipment, unless otherwise approved in advance in writing by Stirling Council. It is therefore expected that only the weekday daytime noise limit will be applicable, but this is dependent on the working hours required at the time of construction.

It is not yet known whether blasting activities will be required. With regards to potential blasting activities, BS 5228 states that practical measures, including good blast design, that have been found to reduce air overpressure and/or vibration are:

- Ensuring appropriate burden to avoid over or under confinement of the charge;
- Accurate setting out and drilling;
- Appropriate charging;
- Appropriate stemming with appropriate material such as sized gravel or stone chippings;
- Using delay detonation to ensure smaller maximum instantaneous charges;
- Using decked charges and in-hole delays;
- Blast monitoring to enable adjustment of subsequent charges;
- Designing each blast to maximize its efficiency and reduce the transmission of vibration; and
- Avoiding the use of exposed detonating cord on the surface to minimize air overpressure – if detonating cord is to be used in those cases where down-the-hole initiation techniques are not possible, it should be covered with a reasonable thickness of selected overburden.

If blasting is required, the above factors will be considered as part of the CEMP, and a combination of minimising blasting activities and ensuring nearby residents are fully warned will mitigate adverse effects from these activities which are high in sound and vibration energy but of very short duration.

With regard to noise from construction traffic, a site management regime will be developed to control the movement of vehicles to and from the site. This will be implemented through a Construction Traffic Management Plan (CTMP), as discussed further in Chapter 9: Transport and Access of this EIAR.

Turbine Noise Curtailment – Remaining Noise Budget

Noise mitigation in the form of a curtailment strategy is anticipated to be required due to predicted cumulative noise levels greater than the applicable cumulative noise limits at Ryecroft. This would only be required in the scenario that this receptor is not financially involved in the Proposed Development. In order to design such a mitigation strategy, RNB limits must be identified.

The predicted reasonable worst-case noise levels from all wind farms excluding the Proposed Development are used to calculate the RNB for the Proposed Development for Ryecroft. These include an additional uncertainty uplift of +2 dB where the development is installed and the turbine type is known, or an additional +4 dB where the development is not yet installed and the turbine type may differ to the models assumed for these calculations. Reasonable worst-case noise levels from other developments are set out in Table 11-11 below. The full RNB calculation methodology is set out in Section 11.2.3.

Note that for all RNB and curtailment calculations, the calculations are performed without rounding, with input values using a minimum precision of one decimal place, whereas calculation results are presented to the nearest integer value.

Table 11-11: Predicted Reasonable Worst-case Noise Levels from Wind Farms Except the Proposed Development (dB L_{A90})

Location	Wind Direction, °	Standardised 10m height wind speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
Ryecroft	0	27	28	31	34	34	34	35	35	35	35
	30	26	27	30	33	33	34	34	34	34	34
	60	27	27	29	31	31	32	32	32	32	32
	90	33	33	33	33	33	35	36	36	36	36
	120	36	36	36	36	36	37	38	38	38	38
	150	36	36	36	36	36	38	39	39	39	39
	180	36	36	36	36	37	38	39	39	39	39
	210	36	36	37	37	37	39	39	40	39	39
	240	36	36	37	38	38	39	40	40	40	40
	270	35	36	36	37	38	39	39	39	39	39
	300	32	32	34	35	36	36	37	37	37	37
	330	28	29	31	34	35	35	35	35	35	35

The levels in Table 11-11 can then be used to determine the RNB. The RNB values are set out below in Table 11-12.

Table 11-12: Daytime RNB values (dB L_{A90})

Location	Wind Direction, °	Standardised 10m height wind speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
Ryecroft	0	40	40	39	39	39	39	38	38	38	38
	30	40	40	40	39	39	39	39	39	39	39
	60	40	40	40	39	39	39	39	39	39	39
	90	39	39	39	39	39	38	38	38	38	38
	120	38	38	38	38	38	36	35	35	35	35
	150	38	38	38	38	38	36	34	34	34	34
	180	38	38	38	38	37	35	33	33	33	33
	210	38	38	37	37	37	34	31	30	31	31
	240	38	38	37	36	36	32	30	30	30	30
	270	38	38	38	37	36	34	32	31	32	32
	300	39	39	39	38	38	37	37	37	37	37
	330	40	40	39	39	38	38	38	38	38	38

Turbine Noise Curtailment – Curtailment Strategy

Based on the RNB values in Table 11-12, noise reductions of up to 9 dB at Ryecroft would be required in order to meet the cumulative noise limits.

The candidate turbine model Nordex N163 can operate in several noise-reduced modes, depending on the extent of the noise reduction required. This range of modes of operation have been used to form a curtailment strategy for the Proposed Development.

The curtailment strategy comprises a matrix for each of the four turbines of the Proposed Development whereby the turbine operational mode is specified for each wind speed (4 to 12 m/s) and wind direction (30° segments). When no noise mitigation is required, turbines will operate in a power-optimised mode. When the required mitigation cannot be achieved with all turbines operating at the quietest noise-reduced mode, one or more turbines will be shut down.

Further details of the curtailment strategy and the method used to determine the strategy are set out in Appendix 11-4 Noise Mitigation Strategy.

The predicted directional noise levels after the adoption of the curtailment strategy are shown in Table 11-13. The difference between these values and the RNB is shown in Table 11-14. Note that zeros and negative values indicate that the limit is met.

Table 11-13: Predicted directional noise levels with mitigation (dB L_{A90})

Location	Wind Direction, °	Standardised 10m height wind speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
Ryecroft	0	22	24	28	33	34	34	34	34	34	34
	30	25	27	31	35	36	36	36	36	36	36
	60	27	29	33	37	39	39	39	39	39	39
	90	28	30	34	38	39	38	38	38	38	38
	120	28	30	34	38	38	36	35	35	35	35
	150	28	30	34	38	38	36	35	34	34	34
	180	28	30	34	37	38	35	34	33	34	34
	210	28	30	34	36	37	35	31	30	31	31
	240	27	29	33	35	36	33	30	30	30	30
	270	25	27	31	35	37	33	32	30	32	32
	300	23	25	29	33	34	34	34	34	34	34
	330	22	24	28	32	33	34	34	34	34	34

Table 11-14: Difference between mitigated noise levels and daytime RNB values (dB L_{A90})

Location	Wind Direction, °	Standardised 10m height wind speed (m/s)									
		3	4	5	6	7	8	9	10	11	12
Ryecroft	0	-17	-15	-11	-6	-5	-5	-4	-4	-4	-4
	30	-15	-13	-9	-4	-3	-3	-3	-3	-3	-3
	60	-13	-11	-7	-2	-1	-1	0	0	0	0
	90	-11	-9	-5	-1	0	-1	-1	0	-1	-1
	120	-10	-8	-4	0	0	0	0	0	0	0
	150	-10	-8	-4	0	0	0	0	0	0	0
	180	-10	-8	-4	-1	0	-1	0	0	0	0
	210	-10	-8	-4	-1	0	0	0	0	0	0
	240	-11	-9	-4	-1	0	0	0	0	0	0
	270	-13	-11	-7	-1	0	-1	0	-1	0	0
	300	-17	-15	-10	-5	-4	-3	-3	-3	-3	-3
	330	-18	-16	-12	-7	-5	-5	-5	-5	-5	-5

The purpose of this curtailment strategy is to demonstrate the feasibility of achieving the RNB noise limits based on the development design.

The mitigation strategy used in practice will depend upon the specific noise conditions for the Proposed Development and the turbine model(s) installed on site, which may be quieter than the candidate turbine model used for the noise predictions.

It should be noted that the calculated RNB limits would need to be updated should assumptions change regarding noise levels from other developments, for example if the Earlsburn Extension application is refused or a different turbine type is installed.

In addition, the +2 dB uncertainty value assumed as part of the predicted noise level calculations (see Appendix 11-1) may in practice result in lower noise levels than predicted, particularly where warranted sound emissions are provided by a turbine manufacturer, in which case the Proposed Development would require less stringent curtailment.

11.4.6 Residual Effects

Residual Construction Effects

No significant construction residual effects are predicted as the relevant noise limits are predicted to be met other than for short duration activities. No specific mitigation is proposed, although noise will be required to be minimised during the construction phase through the adoption of BPM.

Residual Operational Effects

No significant residual operational noise effects are predicted, with both night and daytime noise limits being met at all noise-sensitive properties in the vicinity of the Proposed Development.

No significant residual operational noise effects from the substation are anticipated.

Cumulative Construction Residual Effects

Cumulative construction residual effects are considered to be not significant as it is unlikely that relevant construction noise limits would be exceeded even if the Proposed Development was constructed at a similar time to other proposed developments in the vicinity.

Cumulative Operational Residual Effects

No significant cumulative operational residual noise effects are predicted with both night and daytime noise limits being able to be met at all noise-sensitive properties in the vicinity of the Proposed Development.

At noise-sensitive receptors that are further from the Proposed Development, and that may be closer to other consented or proposed wind farm developments, the predicted contribution to overall noise levels from the Proposed Development is negligible and therefore no significant effects are predicted as a result of the Proposed Development.

11.5 Summary and Statement of Significance

The construction noise effects associated with the Proposed Development in isolation and cumulatively with other potential development in the area are considered not significant. No specific mitigation is required, although noise is to be minimised as much as possible through BPM and will be secured through the CEMP.

The operational noise effects associated with the Proposed Development operating in isolation area are considered not significant.

Potential significant cumulative operational noise effects associated with wind turbine noise from the Proposed Development and other potential development in the area have been identified at Ryecroft. These effects would be not significant if this receptor was financially involved in the Proposed Development or another nearby wind farm resulting in financially involved cumulative noise limits being applicable.

Mitigation in the form of a curtailment strategy is provided to demonstrate that these effects can be reduced such that the residual effect is not significant.

The cumulative operational noise effects associated with wind turbine noise from the Proposed Development and other potential development in the area are considered to be not significant at all other receptors.

11.6 References

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Chapter 12: Socio-economics, Tourism and Recreation

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (EIA Regulations)
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1
The Planning Act	The Town and Country Planning (Scotland) Act 1997 (as amended)

List of Abbreviations

Abbreviation	Description
AGER	Advisory Group on Economic Recovery
BRES	Business Register and Employment Survey
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPG	Energy Price Guarantee
ESJTP	Energy Strategy and Just Transition Plan
GIS	Geographic Information Systems
GVA	Gross Value Added
IEMA	Institute of Environmental Management and Assessment
MW	Mega Watt
NPF4	National Planning Framework 4
NRS	National Records for Scotland
ONS	Office for National Statistics
OnWPS	Onshore Wind Policy Statement
SIMD	Scottish Index of Multiple Deprivation

12 Socio-economics, Tourism and Recreation

12.1 Introduction

This Chapter of the EIA Report assesses the potential socio-economic, tourism and recreation effects, both positive and negative, of the Proposed Development on the surrounding area.

The relevant policy context and methods used to assess the potential effects are described together with the baseline conditions that exist in the area in the absence of the Proposed Development. Potential effects of the Proposed Development are discussed, together with possible cumulative effects in combination with other developments.

12.2 Methodology and Approach

12.2.1 Legislation, Planning Policy and Guidance

There is no relevant legislation or guidance available on the methods that should be used to assess the socio-economic effects of a proposed onshore wind farm within an EIA.

Similarly, there is no formal guidance on the methods that should be used to assess the effects that wind farm developments may have on tourism and recreation/leisure interests. The assessment is based on best practice and draws on experience in assessing the socio-economic, tourism and recreation impacts of onshore wind developments across Scotland.

The following paragraphs summarise relevant policy in relation to socio-economic, tourism and recreation effects. Further detail on planning, energy and climate change policy can also be found referenced in Chapter 4: Planning and Energy Policy.

National Policy

Fourth National Planning Framework (NPF4)

NPF4 was adopted and published by the Scottish Government (2023) on 13th February 2023. NPF4 is the long-term plan that guides spatial development; specifies national planning policies; designates national developments; and highlights regional spatial priorities.

In addition to setting out an increased emphasis on the 'net zero agenda', the Minister in his foreword to NPF4 states that:

> *"Planning will also play a critical role in delivering the National Strategy for Economic Transformation and in community wealth building."*

Policy 11 (c) notes that:

> *"Development proposals will only be supported where they maximise net economic impact, including local and community socio-economic benefits such as employment, associated business and supply chain opportunities."*

Project design and mitigation for developments in these sectors should address:

> *"public access, including impact on long distance walking and cycling routes and scenic routes".*

The Proposed Development lies within the "Central" area as defined by NPF4 and is described as densely populated and containing many of the largest emitters of greenhouse gases.

NPF4 states:

> *"We need to work together to decarbonise buildings and transport and tackle congestion, make more efficient use of existing land and buildings, generate renewable energy and establish supporting electricity and heat networks and create more inclusive, greener and sustainable places that will stand the test of time."*

The priorities outlined for this area include:

> *"Provide net zero energy solutions including extended heat networks and improved energy efficiency, together with urban greening and improved low carbon transport."*
>
> *and*
>
> *"Target economic investment and build community wealth to overcome disadvantage and support a greener wellbeing economy."*

Development proposals which contribute to local employment will be supported in line with Policy 29 (Rural Development), which states:

> *"… c) Development proposals in remote rural areas, where new development can often help to sustain fragile communities, will be supported where the proposal:*
>
> i) *will support local employment*"

Policy 25 (Community Wealth Building) encourages, promotes and facilitates a new strategic approach to economic development that also provides a practical model for building a wellbeing economy at local, regional and national levels.

The policy states:

> *"a) Development proposals which contribute to local or regional community wealth building strategies and are consistent with local economic priorities will be supported. This could include for example improving community resilience and reducing inequalities; increasing spending within communities; ensuring the use of local supply chains and services; local job creation; supporting community led proposals, including creation of new local firms and enabling community led ownership of buildings and assets.*

b) Development proposals linked to community ownership and management of land will be supported."

Onshore Wind Policy Statement 2022

The Onshore Wind Policy Statement (OnWPS) 2022 (Scottish Government, 2022) was published on 21st December 2022 and outlines the Scottish Government's ambitions for the Onshore Wind Sector, highlighting how these can be delivered.

The commitment of the Scottish Government to meeting Net Zero targets whilst realising the benefits to local and regional communities is emphasised through the statement that;

> *"The Scottish Government is committed to achieving our climate change targets in a way that maximises the economic and social benefits of a just transition to a net-zero economy."*

The OnWPS details the criteria through which proposals will be evaluated, with a stronger emphasis on the role which wind energy developments can play both in the response to the climate emergency as well as the resulting socio-economic and community benefits, stating that;

> *"The socio-economic benefits of the onshore wind sector in Scotland are widespread, from investment and innovation to skills development and jobs. The latest statistics from the UK Government show that onshore wind in the UK generated £2.4 billion in turnover in 2020 alone."*

The OnWPS notes that;

> *"...Scotland's available land has a variety of demands that we need to balance if we are to meet our net zero targets. We consider the effect that onshore wind farms can have on local and national tourism as a significant opportunity to cultivate a 'people and place' approach and provide economic opportunities in areas that may otherwise be overlooked. The Scottish Government is keen to see more developments in Scotland with similar recreational or community-based provisions.*
>
> *There are already many examples of renewable energy schemes boosting tourism across Scotland, be it Whitelee Wind Farm on the outskirts of Glasgow, providing additional outdoor recreational activities on over 130km of tracks; or the Soirbheas Community Group who reinvest revenue from renewable energy schemes into a range of projects to benefit their communities."*

Chapter 4 of the OnWPS (Benefits to Local Communities and Financial Mechanisms) notes that;

> *"The Scottish Government remains committed to the principles of a just transition to a net zero economy, and that means ensuring that communities across Scotland feel the benefits of this transition. Community benefit and shared ownership can be transformational for the communities who host renewable developments, and we must ensure that industry continue to deliver on these expectations."*

Draft Energy Strategy and Just Transition Plan

The Draft Energy Strategy and Just Transition Plan (ESJTP) was published on 10th January 2023 (Scottish Government, 2023a). The Scottish Government's key ambitions for Scotland's energy future are detailed, as well as "*proposing a vision for a just energy transition*" which provides socioeconomic benefits whilst protecting the environment and providing energy security.

Expanding on the communities and places which can benefit from the net zero energy transition is identified as a key action, with the Scottish Government stating that they are:

> "*…taking forward research into how to accrue maximum economic benefits to Scotland's households, communities and our economy at regional/local and national levels from Scotland's anticipated surplus low carbon energy.*"

The draft ESJPT emphasises the Scottish Government's focus on "*collaboration between people from all parts of Scotland and all walks of life*", ensuring that workers, businesses, communities and consumers have all played a key part in forming the draft through early codesign.

The draft ESJPT also states that;

> "*Community and shared ownership of energy provides revenue that can be directly invested back into the local community, and community benefit from renewables projects can make a real and lasting difference to local communities.*"

Draft Advice on Net Economic Benefit and Planning

The Draft Advice on Net Economic Benefit and Planning (Scottish Government, 2016) states the importance of demonstrating the net economic benefit of a proposed scheme, highlighting the importance of taking economic benefits into account when determining a planning decision.

The meaning of 'net economic benefit' is described as the difference between the estimated economic position where the development proceeds and the position if the proposal does not go ahead.

Advice is provided on the methodology to be used when modelling economic benefits and acknowledges that;

> "*…assessing the additional benefit from a proposal will usually involve making some assumptions and is therefore not an exact science. It is important that the level of detail of any assessment is kept proportionate to the likely scale of the net economic benefit, and that assumptions made are completely transparent, evidence-based and as accurate as possible*".

National Performance Framework

Scotland's National Performance Framework first published in 2018, sets out the ambitions of the Scottish Government to provide a vision for national wellbeing across a range of economic, social and environmental factors (Scottish Government, 2018).

The framework includes 'increased well-being' as part of its purpose and combines measurement of how well Scotland is doing in economic terms with a broader range of well-being measures.

The National Performance Framework is designed to give a more rounded view of economic performance and progress towards achieving sustainable and inclusive economic growth and well-being across Scotland. The stated aims for Scotland are to:

- Create a more successful country;
- Give opportunities to all people living in Scotland;
- Increase the well-being of people living in Scotland;
- Create sustainable and inclusive growth; and
- Reduce inequalities and give equal importance to economic, environmental and social progress.

The National Performance Framework sets out and reports against outcomes and indicators which illustrate the progress Scotland is making in achieving these aims. The Proposed Development has potential to support the achievement of the national outcomes, making a contribution to advancing the development of a competitive, inclusive and sustainable economy in Scotland.

Scotland's National Strategy for Economic Transformation 2022

This is the Scottish Government (2022b) statement of ambition for economic recovery following the COVID-19 pandemic.

It identifies the next ten years as a time of; "*...extraordinary opportunity...*" and promotes Scotland as a nation with competitive advantages in the new industries generated by technological change, scientific advance and our response to the climate and nature crises.

The strategy focuses on five policy programmes with the greatest potential benefit, including to; "*...strengthen Scotland's position in new markets and industries, generating new, well-paid jobs from a just transition to net zero.*"

The transition to net zero is seen not just an environmental imperative but an economic opportunity, one where Scotland will become world leading. The identified opportunities for this competitive advantage include the construction and development of on- and off-shore energy generating technologies.

Fuel Poverty and Cost of Living Crisis

The 2019 Scottish House Condition Survey (Scottish Government, 2019b) identified that in 2019, 24.6% of all households in Scotland were in fuel poverty which is defined as at least 10% of income is spent on heating. In the same year, 12.4% were in extreme fuel poverty. Between 2018 and 2019, fuel poverty increased in remote rural areas from 33% up to 43%.

Since 2019, there have been considerable surges in the costs associated with heating and power, which is expected to increase the proportion of the population in fuel poverty.

A recent Scottish Parliament statement provided an estimate of the increased number of households in fuel poverty:

> *"This modelling estimates that from October 2022 there are around 860,000 households (35%) in fuel poverty in Scotland. This is an increase of 247,000 households or around 10 percentage points from the latest available 2019 SHCS statistics, which showed 613,000 households in fuel poverty (25%). With the increase in the Energy Price Guarantee to £3,000 in April 2023 we estimate that*

> *around 980,000 households (39%) in Scotland will be in fuel poverty. While these modelled estimates are not available at Local Authority level, the large increases in the fuel poverty rate will be reflected across each Local Authority in Scotland."(Scottish Parliament, 2023)*

There is a drive to reduce UK dependence on fossil fuels and boost the sources of green energy for better energy security in the long-term which is set out within the British Energy Security Strategy (Department for Energy Security and Net Zero, 2022).

Regional Policy

Stirling Local Development Plan

Stirling Local Development Plan (LDP) was adopted in 2018 and seeks to deliver a positive approach to appropriate development and supports sustainable economic growth and sustainable development, whist recognising the importance of 'placemaking' and safeguarding the area's important environmental and historic assets.

Stirling Council 10 Year Strategy

In December 2020, Stirling Council approved the 10-year strategy: Thriving Stirling. The strategic goals outlined within the plan are:

- Thriving Communities;
- Thriving Partnerships;
- Thriving Workforce; and
- Thriving Organisation.

The targeted relevant outcomes of the strategy include social and economic equality, financial sustainability, carbon net zero.

Stirling and Clackmannanshire City Region Deal

The deal was signed in May 2018, with four strategic outcomes:

- Inclusive economic growth;
- Creating higher value jobs;
- Sharing prosperity; and
- Inclusive skills ecosystems.

The UK Government, Scottish Government, and regional partners are investing over £214 million collectively into the region, comprising of Stirling and Clackmannanshire.

As part of this Deal, Stirling Council is producing a Regional Energy Masterplan a draft of which was published in the Autumn of 2023 with the ambition for Stirling and Clackmannanshire to lead the just transition to a fossil fuel free climate ready area by 2045 (Stirling Council, 2023). This document maps out energy demands and sources, and identify low-carbon projects, match local demand with local supply, improve energy efficiency, reduce energy waste and reduce fuel poverty. The City Region Deal states that:

> *"A Regional Energy Masterplan (REM) will support activity to tackle the climate emergency while meeting the energy needs of our local communities and businesses in both Council areas.".*

One of the four work streams is to generate new renewable electricity to support the development of decarbonised heat and local energy security.

There is a focus within the document on community owned energy assets to create and sustain local jobs increasing energy security and affordability.

The draft document also identifies that:

> *"Planning authorities will support 1,3,5 renewable proposals that make a positive contribution to the climate and nature crises in appropriate situations, having regard to the facts and circumstances of each case in line with the adopted NPF4 and any Local Development Plan for the area."*

And that in relation Energy Efficiency the Councils will:

> *"Investigate the potential to use proceeds from renewable energy generation projects to help fund energy efficiency improvements for homeowners who cannot afford the work themselves."*

Tourism Policy Context

In terms of relevant tourism policy, the Scottish Tourism Alliance developed The National Tourism Strategy 2030 'Scotland Outlook 2030' (Scottish Tourism Alliance, 2020) which confirms the importance of tourism to Scotland's economy and emphasises the resilience of the tourism industry since the start of the Covid-19 pandemic in 2020.

Scotland Outlook 2030 has been developed by Scottish Tourism Alliance, the Scottish Government, VisitScotland, Scottish Enterprise, Highlands and Islands Enterprise, and Skills Development Scotland. Over 2,500 tourism leaders and stakeholders from the Scottish tourism industry have contributed to its development.

The four key priorities of Scotland Outlook 2030 are:

> *"Our Passionate People - We will attract, develop and retain a skilled, committed, diverse and valued workforce;*
>
> *Our Thriving Places - We will create and develop a sustainable destination together;*
>
> *Our Memorable Experiences – We will provide the very best, authentic and memorable experiences; and*
>
> *Our Diverse Businesses – We will build business resilience, sustainability and profitability."*

12.2.2 Consultation

The assessment process has been informed by pre-application consultation as part of the Major Applications process run by Stirling Council and the Scoping Opinion. A summary of the key consultation responses in relation to socio-economic issues is presented in Table 12-1.

Table 12-1: Relevant Consultation

Consultee	Pre-application Comment	Scoping Comment	Where addressed within this Report
Stirling Council - Access and	There are no core paths or countryside	Although there are no core paths or rights of	Noted - there are no core paths within the

Consultee	Pre-application Comment	Scoping Comment	Where addressed within this Report
Sustainable Travel (Pre-Application)	right of ways within the site boundary. There is therefore no concern regarding the continuity of public access to the core path network.	way in the immediate area, if there is an opportunity to improve access for all for the public as part of the development that would be most welcome.	footprint of the Proposed Development. No core paths in the vicinity of the Proposed Development are expected to be affected by the Proposed Development. Details included in Section 12.4 below, including consideration of improvements to access.

12.2.3 Assessment Methodology

The methods applied within this assessment are based on established best practice, including methods from UK Government and industry reports.

The assessment has employed appraisal techniques consistent with environmental impact guidance published by the Institute of Environmental Management and Assessment (IEMA, 2014) and draws on analysis and assumptions in research published by Renewable UK in 2015, Onshore Wind: Economic Impacts in 2014 (RenewableUK, 2015).

Consideration has been given to the 2019 RenewableUK Report 'Quantifying the benefits of onshore wind to the UK (RenewableUK, 2019) in consideration of the wider economic benefit.

The methodology adopted in this assessment has involved the following key stages:

- Consideration of the relevant baseline;
- Review of the Proposed Development for potential impacts;
- Evaluation of significance;
- Identification of mitigation measures, where required; and
- Assessment of residual impacts.

The scale of significance described below has been used to assess the potential and residual impacts of the Proposed Development against baseline conditions. The assessment process aims to be objective and quantifies impact as far as possible; however, some impacts can only be evaluated on a qualitative basis:

- **Negligible or No effect**: Either no change or no detectable change to a location, environment or sensitive receptor;
- **Minor**: A detectable but non-material change to a location, environment or sensitive receptor;
- **Moderate**: A material, but non-fundamental change to a location, environment or sensitive receptor; and
- **Major**: A fundamental change to a location, environment or sensitive receptor or in breach of recognised legislation, policy or standards.

In assessing significance, consideration is given to the national, regional and local baseline situation. The magnitude of the effect is determined in proportion to the area of effect relevant to each receptor. For the purpose of the assessment, a moderate or major effect is deemed to be 'significant' in terms of the EIA Regulations.

In terms of socio-economic factors, potential effects would be significant if the Proposed Development resulted in fundamental or material changes in population, structure of the local community or local economic activity.

The effect of the Proposed Development on tourism and recreation is closely related to public attitudes to wind farms, however, a negative opinion does not necessarily result in a material change in recreational patterns. The relevant conclusions from the most recent studies are discussed later in this Chapter.

The research analysis used in the methodology (Renewable UK, 2015) considers economic effects of onshore wind development only, therefore the assessment has been undertaken based on the indicative generating capacity of the wind turbines on the Proposed Development.

Spatial Scope

The spatial scope of the assessment of socio-economic effects is represented by the study areas of Stirling Council and Scotland. Effects on tourism and recreation extend to the area in the vicinity of the Proposed Development Site.

Temporal Scope

The temporal scope of the socio-economic assessment is during the following phases:

- Development, including project development, legal and financial, planning and Environmental Impact Assessment costs;
- Construction; and
- Operational and maintenance.

Effects associated with the construction phase of the Proposed Development are considered to be temporary and short-term. Effects associated with the operational phase of the Proposed Development are considered as long-term.

Accordingly, tourism and recreation effects are considered based on the operational phase of the Proposed Development. Development and construction effects are scoped out of the assessment.

Very few onshore wind projects to date have been fully decommissioned in the UK and, as a result, there is minimal data regarding the economic costs and impacts associated with this phase, however, any potential effects are considered likely to be similar to the construction phase.

12.3 Baseline Conditions

A review of publicly available information has been undertaken to identify the key characteristics of the local economy, existing land use and tourism and recreational facilities in the Stirling Council area. Sources include:

- Office for National Statistics (ONS), 2022, 2023;
- National Records of Scotland (NRS), (2022);

- Scottish Index of Multiple Deprivation (SIMD) (2020); and
- VisitScotland, (2021).

The baseline socio-economic profile of the study area covers the aspects of:

- Population;
- Economic activity and employment;
- Deprivation; and
- Tourism and recreation.

12.3.1 Population

In 2021, the Stirling Council area had a population of 93,470, accounting for 1.7% of Scotland's total 2021 population (NRS, 2022).

Table 12-2, Population Structure, illustrates that the population of Stirling Council has a similar structure to that of the national population.

The region has a similar average share of the population younger than 16 (16% compared to 16.6%) and of working age (63.9% compared to 63.8%) to that of the national population.

Table 12-2: Population Structure

	Stirling	Scotland
Total Population	93,470	5,479,900
% under 16	16%	16.6 %
% of working age (16 to 64)	63.9%	63.8%
% of pensionable age (65 and over)	20.1%	19.6%

Source: National Records of Scotland (2022). Population percentages were rounded to one decimal point.

Future Baseline

During the construction and operation period of the Proposed Development the population of the study areas is expected to change.

Population projections produced by National Records of Scotland (2022) anticipate that the population of the Stirling Council area will total 98,836 by 2028. This is a projected increase of 4.8%, compared to a projected increase of 1.8% of Scotland for the same time period.

The proportion of the projected population in 2028 expected to be of working and of pensionable ages in the Stirling Council area are 63% and 21.6% compared to Scotland as a whole at 62.2% and 22.1% respectively.

Table 12-3: Population Projections – 2028

	Stirling	Scotland
Total Population	98,836	5,537,116
% under 16	15.4%	15.6%
% of working age(16 to 64)	63%	62.2%
% of pensionable age(65	21.6%	e%

	Stirling	Scotland
and over)		

Source: National Records of Scotland (2022).

12.3.2 Economic Activity and Employment

As shown in Table 12-4, the economic activity rate for the Stirling Council area is higher than that of the national average (at 81.2% compared to the Scottish average of 77.4%).

Stirling has a similar unemployment rate to Scotland as a whole, at 3.2% compared to 3.5% (ONS, 2023).

Wages in the region are higher, with full-time working residents of Stirling typically making a median weekly gross wage of £653, compared to the Scottish average of £622(ONS, 2021).

Table 12-4: Employment and Unemployment (April 2022 – March 2023)

	Stirling	Scotland
Economically Active	81.2%	77.4%
Employed	77.6%	74.7%
Unemployed (model-based)	3.2%	3.5%
Median Weekly Gross Income (£)*	653	622

*Source: Annual Population Survey, ONS (2023), *Annual Survey of Hours and Earnings, ONS (2021)- full time workers*

Employment by Occupation

In terms of the nature of employment in the Stirling Council area, Table 12-5 shows that the region has an above average proportion of the workforce employed in the Wholesale and Retail Trade at 15.2% compared to 14.4% in Scotland and the Accommodation and Food Services industry at 10.9% of the work force compared to 7.6% in Scotland.

The region also has a slightly above average share of employees working in the construction sector, accounting for approximately 6.5% of the workforce. This is equivalent to approximately 3,000 jobs. The construction sector is an area of employment that would be positively impacted by the Proposed Development should local workers and suppliers be utilised in the construction phase.

Employment in the Transportation and Storage sector accounts for a lesser share of the workforce than for Scotland as a whole, with 2.2% of the population employed in Stirling in contrast to the 4.2% of the population of Scotland.

Table 12-5: Jobs by Industry

	Stirling	Scotland
Wholesale and Retail Trade; repair of Motor Vehicles and Motorcycles	15.2%	14.4%
Accommodation And Food Services	10.9%	7.6%
Education	10.9%	8.7%
Human Health and Social Work Activities	10.9%	15.9%

	Stirling	Scotland
Administrative and Support Service Activities	8.7%	8%
Construction	6.5%	6.1%
Professional, Scientific and Technical Activities	6.5%	6.5%
Public Administration and Defence; Compulsory Social Security	6.5%	6.6%
Manufacturing	5.4%	7.1%
Information and Communication	5.4%	3.1%
Arts, Entertainment and Recreation	3.3%	2.5%
Financial and Insurance Activities	2.7%	3.1%
Transportation and Storage	2.2%	4.2%
Real Estate Activities	1.7%	1.5%
Other Service Activities	1.5%	1.8%
Water Supply; Sewerage, Waste Management and Remediation Activities	0.5%	0.8%
Mining and Quarrying	0.1%	1%
Electricity, Gas, Steam and Air Conditioning Supply	0.1%	0.7%

Source: ONS (2022).

12.3.3 Deprivation

The Scottish Index of Multiple Deprivation (SIMD) is a relative measure of deprivation which ranks each small area of Scotland in terms of deprivation across the domains of income, employment, education, health, access to services, crime and housing.

These areas can be ranked by quintiles (one fifth shares), with a small area in the first quintile being in the 20% most deprived areas in Scotland.

There are 121 small areas in the Stirling Council Area, of which 12.4 % are ranked in the most deprived quintile and 27.3% of are ranked in the country's least deprived (Scottish Government, 2020b). As shown in Table 12-6, the majority of households in Stirling are ranked in the 4thquintile, accounting for 31.4% of small areas in the region.

This suggests that the region, as a whole, may be more affluent than it is deprived when considering the domains in the analysis.

Table 12-6: Scottish Index of Multiple Deprivation by Quintile, 2020

	Stirling
1 (Most Deprived Quintile)	12.4%
2	14%
3	14.9%
4	31.4%
5 (Least Deprived Quintile)	27.3%

Source: Scottish Government (2020b).

Fuel poverty represents household deprivation in terms of the proportion of income a household spends on fuel; when this is more than 10% a household is said to be in fuel poverty.

The Stirling Council area has a fuel poverty rate of 21% compared to 24% of Scottish households according to the House Condition Survey 2017-2019 (Scottish Government 2019b).

Extreme fuel poverty is defined as a household that would have to spend more than 20% of its adjusted net income on total fuel costs to maintain a satisfactory heating regime. Extreme fuel poverty in Stirling is 9% compared to the Scottish rate of 12%. These figures may have increased since the 2019 data was published given the cost of living crisis.

12.3.4 Tourism and Recreation Indicators

Tourism and recreation are substantial contributors to the economy of Scotland. Benefits include cash flows into a range of businesses, extending beyond accommodation, restaurants and visitor attractions.

Taxis and public transport, village shops, craft workers and country estates are among the list of those receiving direct business. Local trades are also boosted through purchases by businesses and improvements to premises stimulated by tourism.

In 2021, the sustainable tourism sector in the Stirling Council area accounted for 5,700 jobs and accounted for £77.3 million GVA as shown in Table 12-7 (Scottish Government (2021b). This represented 2.83% of Scotland's total employment in the sector and 2.29% of the country's total GVA generated by the sector.

Table 12-7: GVA and Employment in the Sustainable Tourism Sector

	Stirling	Scotland
GVA (£ million)	77.3	3,365.8
Employment (jobs)	5,700	201,100

Source: Scottish Government: Scottish Annual Business Statistics (2021b)

Local Attractions

The Stirling Council area has a rich and diverse range of attractions, famous for its history and scenery. Stirling, along with Clackmannanshire and Falkirk, is part of the Forth Valley, and is proverbially known as the "Gateway to the Highlands".

In 2019 the Forth Valley area accounted for 4.42% of international visits to Scotland and 2% of the overall spend for international tourism in Scotland (VisitScotland, 2021) In 2017-2019 British residents accounted for three quarters of all overnight trips to Forth Valley, of which most were Scottish.

Table 12-8: International Tourism Performance 2019

	Forth Valley	Scotland
Visits	153,000	3,460,000
Spend (£M)	51	2,538
Nights	798,000	27,385,000

Source: VisitScotland 2021

The most visited tourist attractions in the Stirling Council area are displayed in Table 12-9, alongside the approximate distance from the Proposed Development. Please note that these figures are from the pre-pandemic year of 2019.

Table 12-9: Most visited tourist attractions

Attraction	Number of Visitors (2019)	Approx. driving distance from the Proposed Development
Stirling Castle	609,698	6 miles
Doune Castle	152,987	15.5 miles
National Wallace Monument	127,692	8 miles
Bannockburn Heritage Centre	43,427	2 miles

Source: Association of Leading Visitor Attractions 2019

There are a number of facilities within the vicinity of the Proposed Development, with the majority located in the City of Stirling.

Local Recreational Paths and Trails

There are no core paths within the footprint of the Proposed Development. The closest core path touches the north east boundary of the Proposed Development, surrounding the North Third Reservoir, which juts out to the Proposed Development Site boundary to the south of the reservoir.

12.4 Assessment of Effects

Capital and Operational Expenditure (Spend)

The assessment of the generation of employment opportunities, and Gross Value Added (GVA) has been undertaken based on the Renewable UK research, (RenewableUK, 2015). The capital and operational expenditure (spend) for the Proposed Development have been estimated using the methodology in this research (RenewableUK, 2015).

It is acknowledged that a number of factors both economic and technical may have changed since this research was completed, accordingly the figures produced through this assessment should be treated as indicative.

Table 12-10 provides a summary of average spend per MW installed for each of the development, construction and operational phases of UK wind farms, drawn from the research study.

Table 12-10: Weighted Average Spend per MW on Windfarms in the UK

Project phase	Weighted Spend per MW
Development	£150,216
Construction	£1,318,875
Operation	£59,867

Source: Renewable UK (2015)

Predicted Development Phase Effects

The average weighted spend in the UK during the development phase of a wind farm is £150,216 per MW (RenewableUK, 2015).

Applying these assumptions to the Proposed Development with an indicative maximum generating capacity of 30MW, results in an estimated total spend of £4,506,480 during the development phase (the stage, prior to construction, during which proposals are developed and environmental assessments undertaken).

On average 13% of this is generally spent in the local area, with 59% spent within Scotland and, overall, the majority (98%) of spend retained within the UK.

Table 12-11 summarises the estimated spend during the development phase for the Proposed Development across each area.

Table 12-11: Weighted Average Development Spend by the Proposed Development

Area	Weighted Spend (£)	Percentage (%) of Spend
Stirling	£585,842	13%
Scotland	£2,658,826	59%
UK	£4,416,350	98%
Outside UK	£90,139	2%
Total	**£4,506,480**	**100%**

Source: Renewable UK, 2015

The RenewableUK research indicates that there is one employee for every £103,036 and a GVA rate of 0.666. On this basis, it is estimated that up to 42 FTE jobs are to be generated during the development phase (with a total GVA of over £3million).

Within Stirling, up to 5 jobs are estimated to be generated as a result of the Proposed Development and a GVA of over £390,000.

Within Scotland, the Proposed Development is expected to generate up to 25 jobs during this phase and a GVA of over £1,770,000.

Table 12-12 summarises the estimated jobs and GVA likely to be generated by the Proposed Development during the development phase.

Table 12-12: Turnover and GVA - Development Phase

Area	Estimated spend (£)	Estimated Jobs Generated (Rounded Down)	GVA (£)
Stirling	£585,842	Up to 5	£390,170
Scotland	£2,658,826	Up to 25	£1,770,778
UK	£4,416,350	Up to 42	£2,941,289
Outside UK	£90,139	Less than 1	£60,032
Total	**£4,506,480**	**Up to 42**	**£3,001,315**

Source: Renewable UK, 2015

The predicted level of effect from the development phase, in spend, employment and GVA terms, is considered to be negligible to minor beneficial in the context of the local economy and negligible but positive nevertheless on the national economy.

Predicated Construction Phase Effects

The average weighted spend during the construction phase of a UK wind farm is £1,318,875 per MW (RenewableUK, 2015).

Applying this assumption to the Proposed Development with a potential maximum generating capacity of 30MW, results in a total spend of £39,566,250 during the construction phase. As shown in Table 12-13, over £14million is estimated to be spent in Scotland and over £4.7million in Stirling.

Table 12-13: Weighted Average Construction Spend by the Proposed Development

Area	Weighted Spend (£)	Percentage (%) of Spend
Stirling	£4,747,950	12%
Scotland	£14,243,850	36%
UK	£18,596,137	47%
Outside UK	£20,970,112	53%
Total	**£39,566,250**	**100%**

Source: Renewable UK, 2015

Research undertaken by RenewableUK indicates that there is one employee for every £137,942 of spend and a GVA rate of 0.432 during the construction phase. On this basis, it is estimated that up to 286 FTE jobs will be generated as a result of the construction phase with a total GVA of over £17million.

Within Stirling, up to 34 jobs are estimated to be generated as a result of the Proposed Development and a GVA of over £2 million.

Within Scotland, the Proposed Development is expected to generate up to 103 jobs and a GVA of over £6 million.

Table 12-14 summarises the estimated jobs and GVA likely to be generated by the Proposed Development during the construction phase.

Table 12-14: Turnover and GVA - Construction Phase

Area	Estimated Turnover (£)	Estimated Jobs Generated (Rounded Down)	GVA (£)
Stirling	£4,747,950	Up to 34	£2,051,114
Scotland	£14,243,850	Up to 103	£6,153,343
UK	£18,596,137	Up to 134	£8,033,531
Outside UK	£20,970,112	Up to 152	£9,059,088
Total	**£39,566,250**	**Up to 286**	**£17,092,620**

Source: Renewable UK, 2015

It is important to note that although construction impacts are temporary in nature, they will last for the duration of the project thereby ensuring meaningful benefit to the local economy.

The expected scale of employment and GVA effect during construction are judged as being minor beneficial on both the regional and national economies. With local (Stirling) economic activity appearing to be in line with the Scottish averages, the local effects of the Proposed Development could be as much as minor beneficial.

Predicted Operational Phase Effects

The average weighted cost in the UK during the operational phase of a wind farm is £59,867 per MW per annum (RenewableUK, 2015).

Applying this assumption to the Proposed Development with an output capacity of 30MW, results in an estimated total spend of £1,796,010 per annum. As shown on Table 12-15, over £750,000 is estimated to be spent in Stirling and over £1million in Scotland.

Table 12-15: Annual Weighted Average Operational Spend by the Proposed Development

Area	Weighted Spend (£)	Percentage (%) of Spend
Stirling	£754,324	42%
Scotland	£1,041,685	58%
UK	£1,562,528	87%
Outside UK	£233,481	13%
Total,	**£1,796,010**	**100%**

Source: Renewable UK, 2015

Research undertaken by Renewable UK indicates that there is one employee for every £121,935 of spend and a GVA rate of 0.43 per year during the operational phase. On this basis, it is estimated that at least 14 jobs will be generated as a result of the operational phase with a total GVA of over £750,000.

Within Stirling, at least 6 jobs are estimated to be generated as a result of the Proposed Development and a GVA of over £320,000. Within Scotland, the Proposed Development is expected to generate up to 8 jobs and a GVA of over £440,000.

Table 12-16 summarises the estimated jobs and GVA likely to be generated by the Proposed Development during the operational phase. The Proposed Development is therefore expected to have a negligible to minor beneficial impact which is not regarded in EIA terms as significant.

Table 12-16: Annual Turnover and GVA - Operational Phase

Area	Estimated Turnover (£)	Estimated Jobs Generated (Rounded Down)	GVA (£)
Stirling	£754,324	Up to 6	£324,359
Scotland	£1,041,685	Up to 8	£447,924
UK	£1,562,528	Up to 12	£671,887
Outside UK	£233,481	1	£100,396
Total	**£1,796,010**	**Up to 14**	**£772,284**

Source: Renewable UK, 2015

Community Benefit Fund Expenditure and Community Shared Ownership

Renewable energy in Scotland presents an unprecedented opportunity for communities to share in the benefits of their local energy resources.

In relation to the Proposed Development the relevant policy is contained in the Good Practice Principles for Community Benefits from Onshore Renewable Energy Developments (Scottish Government, 2019a) and the Onshore Wind Policy Statement (OnWPS) (Scottish Government, 2022a).

One of the key principles of national guidance is the promotion of a national rate for voluntary community benefits for onshore wind equivalent to £5,000 per MW installed generating capacity per year, index linked for the operational lifetime of the development for community benefits packages.

The Applicant is adhering to the best practice recommendation and proposing a community benefit package of up to £150,000 per annum or £6 million over the 40-year life of the Proposed Development, based on a figure of £5,000 per each of the 30 MWs installed generating capacity.

At this stage, figures are indicative and subject to a number of factors, including the dependence of installed generating capacity on available technology and turbine procurement.

While this benefit package is a voluntary contribution by the Applicant, its benefits are not a material planning consideration.

The OnWPS (2022) states that:

> *"The Scottish Government remains committed to the principles of a just transition to a net zero economy, and that means ensuring that communities across Scotland feel the benefits of this transition. Community benefit and shared ownership can be transformational for the communities who host renewable developments, and we must ensure that industry continue to deliver on these expectations."*

The Applicant is keen to explore interest in part community shared ownership in the Proposed Development. This would provide an opportunity for the communities around the site to invest in the Proposed Development, receiving up to five percent of the project net profit after tax in return.

Consumer Savings

The RenewableUK(2019) report on quantifying the benefits of onshore wind identifies that the deployment of onshore wind to replace gas led generation could reduce electricity costs by 7% by 2035. The Proposed Development would make a contribution (albeit minor) to this saving.

Tourism and Recreation Effects

Evidence on the Effect of Wind Farms on Tourism and Recreation

There have been a number of research exercises completed regarding the effect of wind farms on tourism and recreation. A summary of the most relevant and highly regarded research is included in this sub-section.

The Economic Impacts of Wind Farms on Scottish Tourism study by Glasgow Caledonian University (Glasgow Caledonian University, 2008) is one of the first studies on the impacts of wind farms on tourism in Scotland.

It included a literature review, an intercept survey of tourists currently in the studied areas, an internet survey, and a GIS study on the effect on accommodation and an economic analysis of the results.

The study covered the areas of Caithness and Sutherland, Perth Kinross and Stirling, Dumfries and Galloway, and the Scottish Borders.

The literature review, which particularly considered international studies, found that:

- There is little evidence of negative outcomes in sensitive areas, as they generally don't have wind farms approved;
- Although a significant number of individuals reported a loss of value, some thought that they enhanced the landscape;

- In Denmark, an established wind farm market, turbines are seen as a positive impact on the landscape;
- Hostility to wind farms decreases over time; and
- There is no evidence to suggest serious negative economic impacts of wind farms on tourists.

The research presented findings from a number of surveys, the review of secondary research suggests that on average around 91.3% of tourists surveyed were not discouraged from visiting an area containing a wind farm, when reviewing more recent and Scottish based results the figure is nearer 95%.

Overall, the study concluded that; "*…the findings from both primary and secondary research relating to the actual and potential tourism impact of wind farms indicate that there will be neither an overall decline in the number of tourists visiting an area nor any overall financial loss in tourism-related earnings as a result of a wind farm development.*"

The subsequent report from the Economy, Energy and Tourism Committee (Scottish Parliament, 2012) presented a number of findings, including the following points in regard to the relationship between renewable energy targets and tourism objectives:

> *'While some strongly held localised and anecdotal opinion exists, the Committee has seen no empirical evidence which demonstrates that the tourism industry in Scotland will be adversely affected by the wider deployment of renewable energy projects, particularly onshore and offshore wind."*

The report also found:

> *"Whilst care always needs to be taken in terms of the planning process and decisions on the siting of individual projects in areas popular with tourists and in our rural and wild land areas, no one has provided the Committee with evidence, as opposed to opinion."*

A 2012 report commissioned by the Scottish Government (ClimateXChange, 2012) subsequently found that the findings of the Glasgow Caledonian University report were robust, and that there had been no adverse effect on tourism in the areas considered in the original report.

Since the study by Glasgow Caledonian University was produced in 2012, there has been a significant growth in both the installed capacity of onshore wind energy in Scotland and the tourism economy. In 2008, there was 1.7GW of installed wind energy capacity in Scotland, and by 2017, this had increased to 11.1GW (UK Government, 2022).

If there were to be negative impacts for the tourism sector associated with the development of onshore wind energy, they would have become apparent in this time period; however, this is not the case.

In 2012, an inquiry was held by the Scottish Parliament's Economy, Energy and Tourism Committee into the achievability of the Scottish Government's renewable energy targets, which included a review of some of the evidence presented above. In the final report, entitled Report on the Achievability of the Scottish Government's Renewable Energy Targets (Scottish Parliament Economy, Energy and Tourism Committee, 2012).

The committee concluded that:

> *"Several witnesses made assertions that there would be a negative impact on Scotland's tourism industry from renewable developments. However, these assertions were contradicted by research evidence from VisitScotland and others. Whilst care always needs to be taken in terms of the planning process and decisions on the siting of individual projects in areas popular with tourists and in our more rural and remote rural areas, no witness has provided the Committee with robust, empirical evidence, as opposed to anecdotal comment and opinion, that tourism is being negatively affected by the development of renewable projects. However, given the importance of this issue, the Committee recommends that VisitScotland and the Scottish Government continue to gather, and take account of, evidence from visitors to Scotland."*

BiGGAR Economics published recent research (2021) into the relationship between the onshore wind and tourism sectors in Scotland. This study was undertaken to find empirical evidence of a relationship between the development of onshore wind farms and the tourism sector in Scotland.

Their analysis of 44 wind farm case studies in Scotland found no evidence of a link between wind farm development and trends in tourism employment.

The analysis of trends at the local authority area level found no overall relationship between the growth in the number of wind turbines and the level of tourism-related employment.

Stirling specific data demonstrated the construction of 21 wind turbines in the area between 2009 and 2019, equating to an increase in capacity of 46.4 MW. Over the same time period, employment in the tourism sector was shown to have increased by 48.8%.

Overall, the research completed to date confirms that the tourism sector is not adversely affected by onshore wind farms. In fact, the tourism sector has continued to grow across Scotland as more wind farms have been developed.

Evidence on the Attitudes of Tourists Regarding Wind Farms

In 2011, VisitScotland commissioned Wind Farm Consumer Research (VisitScotland, 2011) into attitudes of tourists towards wind farms, which surveyed 2,000 people in the UK and 1,000 people in Scotland, who had visited Scotland recently.

Although the majority (86-91%) were in agreement about the importance of the natural scenery and landscape, for most of the respondents (80-83%) their decision to stay in the UK for a short holiday would not be affected by the presence of a wind farm. In general, the respondents did not feel that wind farms ruined the tourism experience.

In response to criticism in 2015 that this research was now out of date, VisitScotland indicated that it planned to update the work and in a newspaper article a spokesperson said that:

"VisitScotland supports the drive for renewable energy and recognises the potential of Scotland's vast resource. It is well documented that the vast majority of potential visitors would not be discouraged from visiting Scotland on account of windfarm developments. Windfarms and other renewable energy projects are a part of the landscape in nearly every destination in the world" (Press and Journal, 2015).A more recent, and regular, piece of research focused on public opinions is issued quarterly by

the Department for Energy Security And Net Zero(DESNZ), in their 'Public Attitudes Tracker' (UK Government, 2022).

In December 2021, this reported that support for renewable energy remained steady at 85% and 88% over the 2021/2022 period. Levels of support have remained between 74% and 85% since the question was first asked in March 2012.

Opposition to renewable energy remained at its lowest point across the tracker at 1%, having previously fluctuated between 2% and 5% between March 2012 and June 2020. The current levels are the highest they have been in terms of support for renewables and the lowest opposing renewables since the survey commenced in 2012.

Local Attractions

It is not anticipated that the Proposed Development will have a negative effect on the footfall of local tourist attractions.

A 2019 publication by Visit Scotland discusses "screen tourism", a phenomenon that sees members of the public plan trips to certain areas and attractions in order to feel a deeper connection to the location of a favoured film or television series. The paper goes on to identify Braveheart (released in 1995) and Outlander (first broadcast in 2014) as influential in the decision making of domestic, European and American tourists.

It seems likely that the increased interest in Scottish culture, history and castles (and associated visitor numbers) inspired by these productions is set to continue.

The construction of Braes of Doune Wind Farm, 18km to the north of Stirling Castle, began in 2005. Despite clear visibility of this development from the castle itself, visitor numbers have grown considerably in the interim, with reported 2023 numbers nearly 40% higher than those from 2005 (Association of Leading Visitor Attractions, 2024).

This is perhaps unsurprising when research by the National Trust for Scotland, concerning the attitude of visitors to heritage attractions regarding climate change, is considered.

A media release (National Trust for Scotland, 2021) reported key findings, including that over 90% of National Trust for Scotland visitors consider climate change to be a global emergency, and 86% are of the opinion that the world should combat this by doing *"everything necessary, urgently"*.

Whilst the research did not seek to gather visitor's views with particular reference to onshore wind farms, it can reasonably be assumed that these would be supportive. Therefore, the effect from the Proposed Development on tourism within the study area is expected to be Negligible and Not Significant as per the EIA regulations.

Accommodation Providers

The research on wind farms and tourism finds no evidence of adverse impacts on the tourism sector. It is worth noting DECC/RenewableUK research (2012) estimated that the expenditure of workers who visit the local area, at all stages of the wind farm lifecycle can benefit the accommodation and food service sector to the value of around £7,500 per MW constructed.

Trails and Paths

As there are no paths within the footprint of the Proposed Development Site, no walking routes will be disrupted by the construction of the Proposed Development. Impacts on the nearby North Third Reservoir paths are considered in Chapter 5 Landscape and Visual.

The Applicant is currently exploring options to enhance opportunities for access and recreation, via the creation of a connection from the minor road located to the north-west of the Proposed Development to the Proposed Development access tracks.

The Applicant is committed to providing and maintaining public access to the access road network. This includes provision of waymarked trails, signage and interpretation boards as appropriate.

The effect on recreation in the vicinity of the Proposed Development Site is considered Negligible and therefore Not Significant.

12.5 Assessment of Cumulative Effects

Construction Effects

The cumulative effects of the construction phase of the Proposed Development along with the cumulative sites as listed in Chapter 5: Landscape and Visual, would generate additional construction related spend, employment and GVA.

This scale of wind farm activity within 10km of the Proposed Development suggests there is increased economic opportunity in terms of cumulative investment and resultant employment impacts as local capacity to take up the opportunities grow.

The addition of the Proposed Development will positively contribute to this and could result in increased beneficial effects in terms of job creation and opportunities for local businesses.

Within 10km of the Proposed Development there are three operational wind farms, Craigengelt, Kingsburn and Earlsburn, and a single turbine at Craignannet. There is also the consented Shelloch Wind Farm and the in-planning Earlsburn Extension.

It is anticipated that when considering the schemes cumulatively, there would therefore be a Minor Beneficial effect on the economy at the Local Regional and National Level on socio-economic during construction.

Operational Effects

The cumulative effects of the operation phase of the Proposed Development would generate additional operation related spend, employment and GVA.

This scale of wind farm activity within 10km of the Proposed Development suggests there is increased economic opportunity in terms of cumulative investment and resultant employment impacts as local capacity to take up the opportunities grow.

The Proposed Development will positively contribute to job opportunities for local people and businesses. It is anticipated that when considering cumulative schemes, there would therefore be a Minor Beneficial effect on the economy at the Local Regional and National Level on socio-economic during operation.

Cumulative Tourism and Recreation Effects

The Site is in a location where consented wind farm schemes could cumulatively have a beneficial impact upon public access in the local area.

Even in the instance that another wind farm is under construction at the same time as the Proposed Development, an effect on the availability of tourist accommodation is unlikely, due to the close proximity of many providers within the City of Stirling. A Negligible cumulative effect is therefore predicted.

Evidence regarding the effect of wind farms on tourism indicates that windfarms do not detract from the tourist experience in Scotland. Therefore, when considering cumulative effects, it is expected that these would be not significant. As such a Negligible cumulative effect on tourism is predicted.

12.6 Mitigation Measures

No mitigation measures have been considered for the Proposed Development as there are no significant adverse effects anticipated.

12.7 Residual Effects

There are no significant adverse effects anticipated for the Proposed Development.

There are potential minor beneficial effects in relation to the development, construction and operational phases of the Proposed Development (including in cumulative terms). These relate to the enhancement of access for tourism and recreation purposes, and of employment and GVA, in the context of both local and national economies.

12.8 Summary and Statement of Significance

The socio-economic impact during construction of the Proposed Development was assessed as minor beneficial in the Stirling area, and negligible in Scotland. The annual economic impacts related to operation were assessed as negligible for both study areas. All effects have been assessed as not significant.

Table 12-17 provides a Summary and Statement of Significance for Socio-economic.

Table 12-17: Summary and Statement of Significance

Potential effect	Magnitude Effect	Assessed Effect	Statement of Significance
Socio-economic – Development Phase			
Spend	**£585,842**	Negligible to minor beneficial	Not Significant
Employment	Up to 5 jobs	Negligible to minor beneficial	Not Significant
GVA	**£390,170**	Negligible to minor beneficial	Not Significant
Socio-economic – Construction Phase			
Spend	**£4,747,950**	Minor beneficial	Not Significant
Employment	Up to 34 jobs	Minor beneficial	Not Significant
GVA	**£2,051,114**	Minor beneficial	Not Significant
Socio-economic – Operation Phase (per annum)			
Spend	**£754,324**	Negligible to minor beneficial	Not Significant
Employment	Up to 6 jobs	Negligible to minor beneficial	Not Significant

Potential effect	Magnitude Effect	Assessed Effect	Statement of Significance
GVA	**£324,359**	Negligible to minor beneficial	Not Significant
Tourism and Recreation			
Local Attractions	Attractions are not expected to have their characteristics affected by the Proposed Development. Therefore, minimal / very little effect	Negligible	Not Significant
Trails and Paths	No core paths in the vicinity of the Proposed Development are expected to be negatively affected by the Proposed Development Improvement in access to the site using access tracks	Minor beneficial	Not Significant

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Chapter 13: Climate Change and Carbon Balance

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	Environmental Impact Assessment (EIA) is a means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 (EIA Regulations)
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1
The Planning Act	The Town and Country Planning (Scotland) Act 1997 (as amended)
Capacity Factor	Capacity factor is the ratio of the actual energy produced in a given period, to the hypothetical maximum possible, *i.e.*, running full time at rated power.

List of Abbreviations

Abbreviation	Description
CCC	Climate Change Committee
CCRA3	Climate Change Risk Assessment 2022
CO_2	Carbon dioxide
CO_2/kWh	Carbon dioxide per Kilowatt hour
ECU	Energy Consents Unit
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EC	European Commission
GB	Great Britain
gCO_2/kw	Grams of Carbon dioxide per Kilowatt
gCO_2e/kWh	Grams of Carbon dioxide Equivalent per Kilowatt hour
GHG	Greenhouse Gas
GW	Gigawatt
MWh	Megawatt Hour
NDC	Nationally Determined Contribution
NPF	National Planning Framework
PMP	Peat Management Plan
OWPS	Onshore Wind Policy Statement
RCP	Representative Concentration Pathways
SC	Stirling Council
SEPA	Scottish Environment Protection Agency
SES	Scottish Energy Strategy

Abbreviation	Description
tCO_2 eq.	Total Carbon dioxide Equivalent
Tonnes CO_2 eq.	Tonnes of Carbon dioxide Equivalent
UK	United Kingdom
UKCP	UK Climate Projections

13 Climate Change and Carbon Balance

13.1 Introduction

This Chapter of the EIA Report assesses the effects of the Proposed Development on climate change and estimating the contribution the Proposed Development would make to reducing CO_2 emissions, by an assessment of the whole life carbon balance of the Proposed Development.

It has been completed by Atmos, and is supported by Technical Appendix 13-1: Carbon Calculator Inputs.

The following assessments are considered in this Chapter:

- The vulnerability of the Proposed Development to climate change, with the Proposed Development as a receptor;
- The influence of the Proposed Development on climate change, in terms of overall balance of greenhouse gas (GHG) emissions, as estimated by the results of the Scottish Government Carbon Calculator.

The carbon calculator is an online tool produced by the Scottish Government for use in processing the determination of onshore wind farm developments in Scotland. The purpose of the tool is to comprehensively assess the predicted carbon impact of the Proposed Development.

13.2 Legislation, Planning Policy and Guidance

The relevant planning policy at a national and local level and its application to the environmental design and assessment of the Proposed Development is discussed in Chapter 4 (Planning and Energy Policy) of this EIAR. The key planning legislation, policies and guidance relevant to this Chapter are set out below:

- The Electricity Act 1989 (UK Government, 1989);
- The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 (the EIA Regulations) (UK Government, 1997);
- Fourth National Planning Framework (NPF4) (Scottish Government, 2023a);
- Onshore Wind Policy Statement 2022 (Scottish Government, 2022);
- The Draft Energy Strategy and Just Transition Plan (Scottish Government, 2023);
- COP26 – The Glasgow Climate Pact (UNFCC, 2021);
- COP27 – The Sharm el-Sheikh Implementation Plan (UNFCCC, 2022);
- COP28 - Long-term climate finance (UNFCC, 2023);
- Sixth Carbon Budget 2020 (CCC, 2020);
- Climate Change Committee's (CCC) Net Zero - The UK's Contribution to Stopping Global Warming 2019 (CCC, 2019);
- Net Zero Strategy: Build Back Greener (UK Government, 2021);
- UK Climate Change Risk Assessment 2022 (CCRA3) (UK Government, 2022);
- Climate Change (Emission Reduction Targets) (Scotland) Act 2019 (Scottish Government, 2019b);

- The Scottish Government's Energy Strategy Update (2021) (Scottish Government, 2021a);
- Scotland's Climate Assembly: Recommendations for Action (2021) (Scottish Government, 2021b;)
- Update to the Climate Change Plan 2018-2032: Securing a Green Recovery on a Path to Net Zero (Scottish Government 2020a);
- Towards a Robust, Resilient Wellbeing Economy for Scotland, a report of the Advisory Group on Economic Recovery (June 2020) (Scottish Government 2020b);
- Scottish Energy Strategy (2017) (Scottish Government, 2017);
- Progress in reducing UK emissions - 2023 Report to Parliament (CCC, 2023);
- Calculating potential carbon losses and savings from wind farms on Scottish peatlands Technical Note (Scottish Government 2018);
- Windfarm Carbon Calculator Web Tool User Guidance (SEPA, undated); and
- UKCP18 Guidance: Representative Concentration Pathways (Met Office, 2023).

Both the UK and Scottish Governments have declared a Climate Emergency (UK Government, 2019a; Scottish Government, 2019a). While this imposes no formal obligation to act, it emphasises a public and political desire to increase efforts to combat climate change.

In October 2019 Stirling Council (SC) also declared a climate emergency and subsequently published a Climate and Nature Emergency Plan 2021-2045 (SC, 2021) which sets out their vision to achieve Net Zero Greenhouse Gas emissions by 2045.

In 2019, the Scottish Government enacted the Climate Change (Emission Reduction Targets) (Scotland) Act 2019 (Scottish Government, 2019), amending the Climate Change (Scotland) Act 2009 (Scottish Government, 2009).

These amendments aimed to enhance Scotland's climate change targets for reducing emission levels. Specifically, the target was strengthened from an 80% reduction by 2050, as initially set out in the Climate Change (Scotland) Act 2009, to achieving a 100% reduction by 2045.

An interim target of a 75% reduction by 2030 was also introduced, with the Scottish Government setting out its ambition for 20GW of installed onshore wind capacity in the country by 2030.

On 18 April 2024, the Scottish Government (2024) announced that whilst the climate change target to reduce emissions by 75% by 2030 would be removed, the overarching commitment to reach Net Zero by 2045 would remain.NPF4 Policy 1 'Tackling the climate and nature crises', states the approach to development proposals:

> "*When considering all development proposals significant weight will be given to the global climate and nature crises*".

13.3 Methodology and Approach

13.3.1 Consultation

No direct commentary on climate change or carbon balance was made as part of the Pre-Application Advice (received July 2020) or Scoping Opinion (received October 2020).

Indirect references to CO_2 releases from the management of peat were made by SEPA, these have been considered as part of the EIA and reported in Chapter 8: Hydrology, Geology and Hydrogeology, Technical Appendix 8-2: Peat Landslide Hazard Risk Assessment (PLHRA) and Technical Appendix 8-3: Peat Management Plan (PMP) where relevant.

13.3.2 Assessment Methodology and Significance Criteria

Scope of the Assessment

The assessment considers the potential effects of the Proposed Development in terms of:

- The vulnerability of the Proposed Development to climate change; and
- The influence of the Proposed Development on climate change.

The assessment of the influence of the Proposed Development on climate change considers the overall balance of greenhouse gas (GHG) emissions, as climate change is recognised to be directly linked to these emissions. No specific analysis is undertaken of how climate conditions might change in direct response to the emissions balance of the Proposed Development.

Consideration of the effects of the Proposed Development on environmental receptors that may in themselves be sensitive to climate change are considered in Chapters 5 to 14 of this EIA Report where relevant.

Temporal and Spatial Study Area

The study area considered for the assessment of vulnerability of the Proposed Development to climate change consists of the infrastructure within the Proposed Development Site.

With regards to the temporal scope, changes over the operational lifetime of the Proposed Development (40 years from commissioning) are considered.

Spatially, the assessment of the influence of the Proposed Development on climate change considers GHG emissions (current levels and targets), along with renewable energy generation and grid mix, at the National Scottish scale Temporal scope, again, reflects the operational lifetime of the Proposed Development.

Future Baseline Methodology

The UK Climate Projections (UKCP18) is a set of tools and data published, that predicts how the UK climate may change in the future (Met Office, 2018).

UKCP18 uses scenarios for future greenhouse gas emissions called Representative Concentration Pathways (RCPs). RCPs attempt to capture a range of potential alternative futures and outcomes linked to global temperature increases, and include a wide variety of assumptions on socio-economic development and commitment to emissions reductions.

Over the 40-year anticipated lifetime of the Proposed Development the choice of scenario is not critical, thus, the medium emissions scenario (RCP6.0) is considered most appropriate for use as the future baseline. This scenario assumes after 2030, no further emission reductions are achieved whilst allowing for some further increase in emissions (Met Office 2018).

Vulnerability of the Proposed Development to Climate Change

Methodology

The following climate related parameters are considered to have the potential to impact upon the operation of the Proposed Development:

- Wind (speed, direction and gustiness);
- Temperature; and
- Precipitation.

The construction and decommissioning stages of the Proposed Development are not considered to be vulnerable to climate change, and are, therefore, scoped out of further consideration.

Influence of the Proposed Development on Climate Change

Methodology

In order to assess the sustainability of the Proposed Development, and the contribution which will be made towards reducing GHG emissions and the statutory requirements of The Climate Change (Scotland) Act 2009, the Scottish Government's Online Carbon Calculator v1.8.1 (updated in December 2023) was used to calculate the carbon cost and payback period of the Proposed Development.

Developed and refined based on published research (Nayak *et al*., 2008; Nyak *et al*., 2010; Smith *et al*., 2011), the calculator is a highly effective tool, which determines the balance of total carbon savings and costs over the life of the Proposed Development.

The potential carbon savings and costs associated with wind farms are:

- Carbon emission savings due to generation (based on displacing emissions from different power sources). The Carbon Calculator is limited to considering displacement of energy generation exported to the electricity grid. Although carbon intensive energy for heat and transport will be increasingly decarbonised by electrification, and, therefore, effectively displaced by green electricity, the tool does not (yet) take account of this in calculating emission savings;
- Lifetime costs associated with manufacture of turbines and construction;
- Loss and/or saving of carbon from backup power generation;
- Loss and/or saving of carbon stored in peatland (by peat removal or changes in drainage);
- Loss and/or saving of carbon-fixing potential as a result of tree felling; and
- Carbon gains due to proposed habitat improvements.

The inputs and outputs of the calculator are presented with 'Expected' values, i.e., the best estimate of the anticipated value, based on the current understanding of the Proposed Development, along with 'minimum' and 'maximum' values to give a range of possible outputs, dependant on the variables within the model.

Other outputs of the calculator include the 'payback period' and the 'carbon intensity' of the Proposed Development. The payback period is the length of time (in years) it will take the Proposed Development to offset the carbon 'costs' incurred as a result of its construction phase, and begin displacing grid-based electricity generated from non-renewable sources – and the 'carbon intensity'.

Where practicable, site-specific data (such as peat depths and length of tracks as detailed in Chapter 3: Description of Development and Chapter 8: Hydrology, Geology and Hydrogeology), have been used in the assessment.

However, there are several factors which would require extensive measurements taken over long periods, such as water table depths across the Proposed Development Site. In these instances, either standard (default) data or, in some cases, an informed estimate has been used.

The input values, sources and assumptions made are provided in Technical Appendix 13-1 Carbon Calculator Inputs.

Significance Criteria

To determine whether effects are significant under the EIA Regulations, it is appropriate to consider the sensitivity (See Chapter 2: EIA Approach and Methodology, Table 2-2) of the receptor, and the magnitude of the impact (Table 2-3), taking into account uncertainty. This is based on the professional judgement of the assessor (see Table 13-1).

Table 13-1: Categories of Significance of Effect

Significance	Definition
Major	A fundamental change to location, environment, species or sensitive receptor
Moderate	A material, but non-fundamental change to a location, environmental, species or sensitive receptor
Minor	A detectable but non-material change to a location, environment, species or sensitive receptor
Negligible	No detectable or material change to a location, environment, species or sensitive receptor

Effects assessed can be both beneficial (positive) and adverse (negative). Significant Effects are only considered to be classified as 'Major' or 'Moderate'. Effects classified as 'Minor' or 'Negligible' are considered to be Not Significant.

13.4 Baseline

Chapter 8: Hydrology, Geology and Hydrogeology and its supporting technical appendices set out the baseline for the peat conditions onsite.

As the Proposed Development Site is currently largely undeveloped, baseline carbon emissions to the atmosphere are considered to be minimal. However, it is widely acknowledged that peatlands sequester and store carbon, and that the amount sequestered by peat bog varies depending on its condition.

In terms of the baseline for determining the vulnerability of the Proposed Development to climate change a future baseline has been considered based on the maximum predicted lifetime of the Proposed Development.

Climate projections show that the trends over the 21st century in the UK are towards warmer, wetter winters, and hotter, drier summers, with an increase in frequency and intensity of extremes.

The climate parameters considered most relevant to the assessments referenced within this chapter are wind speed, temperature and precipitation.

The State of the UK Climate 2022 (RmetS, 2023) provides the latest report on observed UK climate data for the most recent decade (2012-2021). Key findings are:

- The most recent decade (2012–2021) has been on average 0.2°C warmer than the 1991–2020 average and 1.0°C warmer than 1961–1990;
- The most recent decade (2012–2021) has had 5% fewer days of both air and ground frost compared to the 1991–2020 average, and 21%/18% fewer compared to 1961–1990;
- The most recent decade (2012–2021) has been on average 2% wetter than 1991–2020 and 10% wetter than 1961–1990 for the UK overall;
- For the most recent decade (2012–2021), UK summers have been on average 6% wetter than 1991–2020 and 15% wetter than 1961–1990. UK winters have been 10%/26% wetter; and
- There have been fewer occurrences of max gust speeds exceeding 40/50/60 Kt for the last two decades compared to the 1980s and 1990s.

Wind Speed

The latest UKCP18 Fact Sheet for Wind (Met Office, 2022d), states that global projections show an increase in near surface (10 metre [m] height) wind speeds over the UK in the second half of the 21st century, in the winter season when higher wind speeds are experienced.

This would be accompanied by an increase in frequency of winter storms over the UK. The increase is modest when compared to inter-annual variability.

There are no significant changes forecast in the wind speeds over the first part of the century.

Precipitation

UKCP18 Science Overview Report (Met Office, 2022a) states that throughout the UK, the changes to precipitation projected for 2041-2060 (compared to 1981-2000) for RCP8.5 (unmitigated scenario) are an increase of 7% in winter for the 50th percentile (results for the 10th to 90th percentile range are between -5% and +21%).

For summer precipitation, this is projected to decrease by 15% (results for the 10th to 90th percentile range are between -35% and +0%).

Temperature

UKCP18 Science Overview Report (Met Office, 2022a) states that for period 2041-2060, change to annual mean temperature (compared to 1981-2000) is projected at +1.8 °C (50th percentile) for RCP8.5 (unmitigated scenario) (page 16). Results for the 10th to 90th percentile range are between +0.9°C to +2.7°C.

Other key observations from the latest UKCP18 Fact Sheet for Temperature (Met Office, 2022c) are that:

- Both winters and summers will be warmer, with more warming in the summer; and
- In summer there is a pronounced north/south divide with greater increases in maximum summer temperatures over the southern UK compared to Northern Scotland.

13.5 Assessment of Effects

13.5.1 Vulnerability of the Proposed Development to Climate Change

Wind Speed

Small increases in wind speed can result in large increases in wind power and beneficial effects for energy generation.

Wind turbines are designed to capture wind energy and built to withstand extreme conditions associated with exposed locations. However, wind energy developments could potentially be sensitive to changes in variables, including atmospheric circulation as well as changes in the frequency of extreme events (*e.g.*, storms), which could damage wind turbines or alter their efficiency.

Over the lifetime of the Proposed Development, UKCP18 shows the change in wind speeds and storms is limited to well within the limits of current inter-annual variability. These changes will have a low/negligible magnitude of effect on energy projections, and on the efficient operation of the Proposed Development (Met Office, 2022d).

Given the low/negligible magnitude of the impact and the low sensitivity of the Proposed Development as a receptor, the significance of the potential beneficial effect is assessed as Negligible and therefore is **Not Significant** in terms of the EIA Regulations.

Precipitation

The risk from increased precipitation is the potential for flooding, particularly if it is associated with extreme events. For the Proposed Development this increases the risk for potential destruction/disruption of infrastructure, *e.g.*, flooding to control building, access tracks and other infrastructure.

Appropriate buffers from watercourses are embedded in the design of the Proposed Development. Drainage and track design will be built to accommodate a 1 in 200 year flood event, or as set out by the technical experts developing the detailed design ahead of construction. As such the Proposed Development has low sensitivity to increase in precipitation.

UKCP18: Precipitation (UKCP, 2022b) shows that over the winter season precipitation in the UK is projected to increase by up to 7% at the 50th percentile. Given the embedded mitigation, the magnitude of effect on the operation of the Proposed Development is assessed as low, and the overall significance of effect is Negligible. The effect is therefore **Not Significant** in terms of the EIA Regulations.

Temperature

Wind energy developments are sensitive to cold weather events and ice forming on blades, although in the UK this has rarely been an issue. With the projected trend towards warmer, wetter winters and hotter, drier summers, the predicted magnitude of effect is negligible. The significance of effect is Negligible and **Not Significant** in terms of the EIA Regulations.

13.5.2 Influence of the Proposed Development on Climate Change

Renewable Energy Generation

The Proposed Development will consist of 4 wind turbines with total rated output of approximately 30MW. Based on DUKES (BEIS, 2022) average capacity factor between 2017 and 2021 an expected capacity factor of 26.5% can be assumed for the Proposed Development. This fits within the predicted maximum and minimum values set out in the DUKES data, based on today's operational data.

However, real time wind data and the energy yield assessment (EYA) are available for use for the Proposed Development Site and have been applied for the purposes of this assessment. This data indicates that a capacity factor of 35% is expected to be a more realistic scenario for the Proposed Development than that which is estimated by DUKES (BEIS 2022).

Based on an estimated capacity factor of 35%, the generation expected from the Proposed Development is in the region of 91,980MWh per year.

The average domestic electricity consumption per household in Scotland is approximately 3.7MWh annually (BEIS, 2022). Given that the expected generation from the Proposed Development is 91,980MWh per year, the Proposed Development is therefore expected to generate electricity equivalent to that required to power approximately 24,859 households in Scotland annually.

This is considered to be a positive effect of Moderate significance *i.e.*, a material, but non-fundamental change of the baseline condition.

Carbon Displacement and Savings

The online Reference for the completed Carbon Calculator is CZS7-1TLY-VOE0 v3.

The electricity produced from the Proposed Development is assumed to substitute energy production by entirely coal-fired generation, or a mix of fossil fuels, or the National Grid mix of energy generation.

A renewable energy development would have maximum potential to save carbon emissions when substituting coal fired generation. However, due to uncertainty in future grid mix and energy policy, it is not possible to define the electricity source for which the Proposed Development would substitute generation.

For this reason, carbon emission savings are calculated by the Scottish Government Calculator for each fuel-mix. The potential annual carbon emission savings for the Proposed Development are provided in Table 13-2.

It is shown in Table 13-2 that a grid mix of electricity generation due to the Proposed Development is expected to result in a CO_2 emission saving over time of 19,040 tonnes CO_2 equivalent.

Table 13-2: CO^2 Emission Saving over (tonnes CO_2 eq.) due to the Proposed Development

	Expected	Minimum	Maximum
Coal Fired electricity Generation	86,921	78,229	95,613
Grid mix of electricity generation	19,040	17,136	20,944
Fossil fuel mix of electricity generation	39,000	35,100	42,899

	Expected	Minimum	Maximum
Energy output from windfarm over lifetime (40 years) (MWh)	3,679,200	3,311,280	4,047,120

As noted above, the Carbon Calculator is limited to considering displacement of energy generation exported to the electricity grid; although carbon intensive energy for heat and transport will be increasingly decarbonised by electrification, and, therefore, effectively displaced by green electricity, the tool does not take account of this in calculating emission savings.

This is considered to be a positive effect of Moderate significance *i.e.*, a material, but non-fundamental change, alteration of the baseline condition.

Carbon Releases

The manufacturing, construction and installation of the wind turbines and associated infrastructure has a carbon cost, and carbon releases are generated by the requirement for extra capacity to back up wind power generation.

Carbon releases are also associated with the loss of soil organic matter that occurs through disturbance and excavation of peat during construction and drainage.

This is considered to be an adverse effect of Minor significance *i.e.*, a slight, detectable, alteration of the baseline condition.

Table 13-3: Total CO_2 emissions due to the Proposed Development (tCO_2 eq.)

	Expected	Minimum	Maximum
Emissions due to turbine life (e.g., manufacture, construction, decommissioning)	27,161	27,161	27,161
Emissions due to backup	22,285	22,285	22,285
Emissions due to reduced carbon fixing potential	1,111	289	6,251
Emissions from soil organic matter	13,131	998	99,499
Emissions due to DOC & POC leaching	3	0	63
Emissions due to felling forestry	0	0	0
Total CO2 emissions due to wind farm (tCO_2 eq.)	**63,693**	**50,734**	**155,261**

Avoided Carbon Releases due to Improvement of the Proposed Development Site

Table 13-4 shows the estimated avoided carbon emissions, over the lifetime of the Proposed Development, from improvements to the Proposed Development Site.

Peat reinstatement of the borrow pits will be undertaken during decommissioning. This will be dependent upon water table levels and borrow pit design and will be refined through further assessment prior to construction.

Due to this, it is assumed for the purpose of the carbon calculator that there will be no change in the water table depth and therefore no "gain" (in terms of the carbon calculator terminology) considered.

The total carbon gains are shown in Table 13-4. The values are negative numbers because they are atmospheric removals or avoided emissions. It should be noted that the Carbon Calculator is conservative about estimating the gains from restoration, only accounting for changes in the balance of methane to carbon dioxide emissions from the restoration of degraded bogs.

This is considered to be a positive effect of Moderate significance *i.e.*, a material, but non-fundamental change, alteration of the baseline condition.

Table 13-4: Total CO_2 due to the Proposed Development (tCO_2 eq.)

	Expected	Minimum	Maximum
Change in emissions due to improvement of degraded bogs	-71	0	-212
Change in emissions due to improvement of felled forestry	0	0	0
Change in emissions due to restoration of peat from borrow pits	0	0	0
Change in emissions due to removal of drainage from foundations & hardstanding	-333	0	-4,571
Total change in emissions due to improvements (tCO_2 eq.)	-404	0	-4,783

Potential effects on peat are considered further in Chapter 8: Hydrology, Geology and Hydrogeology.

Payback Period

The payback period is calculated by taking the total carbon cost (carbon emissions) associated with the Proposed Development and dividing that figure by the annual carbon gains from displaced fossil fuel power generation and any site improvements.

The shorter the payback period, the greater benefit the Proposed Development will have in displacing GHG emissions associated with electricity generated by burning fossil fuels.

When taking into consideration the potential renewable energy generation, displacement and savings of carbon and carbon losses, the Proposed Development is expected, conservatively, to payback the carbon cost in 3.3 years compared to the grid mix electricity generation[1] (Table 13-5).

There are no current guidelines on what payback time would be considered a significant effect, but this represents 8.25% of the operational life of the Proposed Development.

As such, conservatively, it is expected that the Proposed Development would make a positive contribution to offsetting carbon emissions after a maximum of 3.3 years, at which time it is estimated to be carbon neutral.

[1] The annual average mix of fuels used to produce electricity for the (GB) electricity grid (including nuclear and renewables). The source for the grid-mix emission factor is the list of emission factors used to report on greenhouse gas emissions by UK organisations published by BEIS https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022

This is considered to be a positive effect of Moderate significance *i.e*., a material, but non-fundamental, alteration of the baseline condition.

Table 13-5: Carbon Payback Time of the Proposed Development

	Expected	Minimum	Maximum
Coal-fired electricity generation (years)	0.7	0.5	2
Grid-mix of electricity generation (years)	3.3	2.2	9.1
Fossil fuel-mix of electricity generation (years)	1.6	1.1	4.4

Carbon Intensity

The Scottish Government's Climate Change Plan (2018) states that by 2030 Scotland will have a largely decarbonised electricity system with a grid carbon intensity of 0.05kg CO_2e/kWh.

An update to the Climate Change Plan was issued in 2020 through the Securing a Green Recovery on a Path to Net Zero: Climate Change Plan 2018–2032 – Update. The update confirmed that the carbon intensity of electricity generated in Scotland has fallen to less than 50g CO_2e/kWh in both 2018 and 2019.

The Proposed Development is expected to have a carbon intensity of 17.20g CO_2e/kWh (Table 13-6), a figure below the achieved carbon intensity target. Therefore, the Proposed Development is anticipated to further support Scotland's Climate Change Plan by maintaining and exceeding the target already achieved.

This is considered to be a positive effect of Moderate significance i.e., a material, but non-fundamental, alteration of the baseline condition.

Table 13-6: Carbon Intensity of the Proposed Development (g CO_2e/kWh)

	Expected	Minimum	Maximum
Carbon Intensity (gCO_2e/kWh)	17.20	11.35	46.89

Summary

Climate and the atmosphere are considered to have High sensitivity to changes in GHG emissions. The Proposed Development is therefore assessed to have an overall Moderate, beneficial effect on climate change, that is **Significant** under the EIA Regulations.

The Proposed Development will, therefore, make a material contribution to reducing Scotland's CO_2 emissions, and contribute directly to efforts to reduce the extent and rate of global climate change, while also generating economic and social benefits.

13.6 Assessment of Cumulative Effects

The Proposed Development will contribute up to 30 MW further installed renewable generation capacity through the installation of 4 wind turbines.

The cumulative effect of the Proposed Development with other Scotland and UK renewable generation is considered to be a material change in the climate effects of Scotland and UK energy supply, which is a major, positive, environmental effect that is **significant** under the EIA Regulations.

13.7 Mitigation and Residual Effects

This Chapter identified that negative effects are of such limited and negligible nature that they are not significant and no mitigation is required under the EIA Regulations, other than that already incorporated into the Proposed Development and recommended as best practice.

An iterative design approach was taken for the wind farm layout to avoid siting infrastructure in peat where possible, thus minimising disturbance of peat soils and associated carbon releases. Further micro-siting will be informed by detailed pre-construction ground investigations.

Additionally, Chapter 3: Description of Development proposes reinstatement and demonstrates that arrangements will be refined through further assessment prior to construction.

There are potentially Moderate beneficial effects in relation to the development, construction and operation phases of the Proposed Development on carbon saving.

13.8 Summary and Statement of Significance

The assessment of the vulnerability of the Proposed Development to Climate Change was considered to be negligible (positive) for projected changes to wind speed, and negligible for changes to temperature and precipitation.

The vulnerability of the Proposed Development to Climate Change was therefore **Not Significant** under the EIA Regulations.

A carbon balance assessment has been undertaken using the Scottish Government Calculator v1.8.1 (CZS7-1TLY-VOE0 v3). This found that there is a Moderate (beneficial) influence of the Proposed Development on Climate Change and national and international targets to combat climate change.

The influence of the Proposed Development on Climate Change was therefore **Significant** (positive) under the EIA Regulations.

Table 13-7: Summary and Statement of Significance

Receptor	Potential Effect	Assessed Effect	Statement of Significance
Vulnerability of Proposed Development to Climate Change			
The Proposed Development	Changes to generation through changes in wind speed.	Negligible (Positive)	Not Significant
The Proposed Development	Damage to infrastructure or operation due to changes in temperature.	Negligible	Not Significant
The Proposed Development	Potential for flooding at the Proposed Development Site and impact on operation through changes to precipitation.	Negligible	Not Significant
Influence of the Proposed Development on Climate Change			
Climate and Atmosphere	Reduction in GHG emissions through	Moderate	Significant (Positive)

Receptor	Potential Effect	Assessed Effect	Statement of Significance
	offsetting of existing conventional generation.		

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Chapter 14: Other Considerations

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1
The Planning Act	The Town and Country Planning (Scotland) Act 1997 (as amended)

List of Abbreviations

Abbreviation	Description
ANO	Air Navigation Order
BT	British Telecommunications
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CEDA	Centre for Environmental Data Analysis
DECC	Department of Energy and Climate Change
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMI	Electromagnetic Interference
Hz	Hertz
IR	Infra Red
MoD	Ministry of Defence
NATS	National Air Traffic Services

14 Other Considerations

14.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIA Report) identifies and assesses the potential effects that the Proposed Development may have on aviation, telecommunications and as a result of shadow flicker.

The assessments reported in this chapter have been carried out by Atmos Consulting Limited.

14.2 Methodology and Approach

14.2.1 Legislation, Planning Policy and Guidance

Planning policy at a national and local level and its relevance to environmental design and assessment is discussed in Chapter 4 Planning and Energy Policy of this EIAR. The key planning policies and guidance relevant to this chapter are set out below along with other reference documentation related to each of the technical areas.

Planning and Energy Policy

- Fourth National Planning Framework (NPF4, Scottish Government 2023);
- Onshore Wind Policy Statement (Scottish Government, 2022);
- Scottish Government web-based Advice 'Onshore wind turbines: planning advice';
- The Stirling Local Development Plan (Stirling Council, 2018);

Aviation and Radar

- CAP 764 Policy and Guidance on Wind Turbines (Civil Aviation Authority 2016);
- Air Navigation Order (ANO) 2016 Article 222 (UK Government 2016);
- DAP Policy 124: Lighting of Onshore Wind Turbine Generators in the United Kingdom with a maximum blade tip height at or in excess of 150m Above Ground Level (Civil Aviation Authority 2017a);
- CAP 493 Manual of Air Traffic Services Part 1 (Civil Aviation Authority 2023);
- CAP 738 Safeguarding of Aerodromes, (Civil Aviation Authority 2020);

Telecommunications and Television

- Tall Structures and their Impact on Broadcast and other Wireless Services (Ofcom 2009)

Shadow Flicker

- Update of UK Shadow Flicker Evidence Base, 2010, Parsons Brinckerhoff (DECC, 2011); and
- Scottish Government Online Renewables Planning Advice: Onshore Wind Turbines.

14.2.2 Consultation

The assessment process has been informed by consultation with Stirling Council and relevant stakeholders including the Pre-Application Enquiry Response dated 12th May 2020 and Scoping Opinion dated 23rd October 2020.

No comments applicable to aviation, telecommunications or shadow flicker were made by stakeholders during the pre-application process.

Table 14-1 below therefore details relevant responses during the EIA scoping process. No comments from any stakeholders were provided in relation to telecommunications or shadow flicker during the EIA scoping process. Extensive direct consultation with telecommunications operators has, however, been undertaken (between February and July 2023), a summary of which can be found in Table 14-2.

Table14-1: EIA Consultation - Other Considerations

Consultee	Scoping Opinion (October 2020)	Applicant Response
Aviation and Radar		
Cumbernauld Airport	The location of this wind farm is within our airport vicinity and causes us some concern. In so far as the safeguarding of aerodrome regulations, we would object to a wind farm as it would affect aircraft operating to and from our airport.	The Applicant has undertaken detailed consultation regarding the Proposed Development with Cumbernauld Airport and a specialised aviation consultant. This included a meeting at the airport in September 2021.
Ministry of Defence (MOD)	The MOD has no concerns in relation to the proposal, subject to the provision of MOD accredited aviation safety lighting, i.e. The perimeter turbines are lit with 25 candela omni directional red lighting or infrared lighting (IR) with an optimised flash pattern of 60 flashes per minute of 200ms to 500ms duration at the highest practicable point.	The Applicant will commit to implementing MOD accredited aviation safety lighting in consultation with the MOD. See Technical Appendix 14-1 Wind Farm Reduced Lighting Scheme Proposal.
National Air Traffic Services (NATS)	The proposed development has been examined from an en-route infrastructure technical safeguarding perspective and the findings show that it will infringe NERL safeguarding criteria due to the proximity, physical size and relative orientation of the development, which is sufficient to generate false tracks. Accordingly, NATS (En Route) plc objects to the proposal.	The Applicant has undertaken consultation with NATS in order to agree suitable mitigation to ensure that the Proposed Development has no impact on NATS operations. The Applicant and NATS reached a suitable mitigation agreement in September 2023 which will ensure no impacts as a result of the Proposed Development on NATS' operations.

Table14-2: Telecommunication Consultation

Consultee	Consultee Comments	Applicant Response
Airwave/Motorola Solutions	Identified that one turbine was anticipated to have an impact on two telecommunication links.	Design altered to remove infrastructure from the buffer zones associated from those links.
Arqiva	Raised concerns about the distances of certain turbines to telecommunication buffers.	The Applicant consulted further with Arqiva confirming that they will not object to the Proposed Development on the basis that a planning condition is adopted to ensure suitable offset distances during construction.
Atkins	Confirmed no impacts to telecommunication links.	No action required.

Consultee	Consultee Comments	Applicant Response
BT (British Telecommunications)	Identified one telecommunication link in the vicinity of the Proposed Development and advised that two turbines would have an effect on the telecommunication link. Advised that they would object to the Proposed Development if the location of one turbine is not moved. BT were content that one turbine was suitably situated following Ofcom guidance.	The Applicant has designed the final layout to adhere to BT's requirements.
Ericsson	Noted that a new telecommunication link had been installed, which crosses two turbines.	The Applicant consulted Ericsson who confirmed that this telecommunication link has been decommissioned and therefore the Proposed Development will have no impact on this telecommunication link.
Joint Radio Company (JRC)	Confirmed that the layout was acceptable and that no impacts are anticipated.	No action required.
MLL Telecom	Identified a telecommunication link that was impacting on one of the turbines.	The Applicant consulted with MLL and it was confirmed that the link was identified as being non-operational as a result, it is an anticipated that MLL will have no objection.
Mobile Broadband Network Limited (MNBL)	Confirmed that no telecommunication links are anticipated to be affected.	No action required.
Virgin/O2	Confirmed that they have no telecommunications links in the vicinity.	No action required.
Vodafone	Recommended that Ofcom buffers should be applied to telecommunication links in the area.	The Applicant has consulted with Vodafone and confirmed that the current layout has no impact on telecommunication links.

14.2.3 Assessment Methodology and Significant Criteria

In order to predict and quantify the effects that will result from the Proposed Development on aviation, telecommunications and television, and the effects of shadow flicker on sensitive receptors, this assessment has considered:

- **Baseline Conditions** – a review of existing information in relation to existing public rights of way, telecommunication links, aviation, television reception, existing infrastructure on the Site and local area, and properties in the area that might be sensitive to shadow flicker effects. It is assumed that the baseline conditions will remain unaltered through the lifetime of the Proposed Development;
- **Significance of Effects** – an assessment of the effect of the Proposed Development against the baseline conditions and assessment of the cumulative effect of the Proposed Development with other existing, consented or proposed wind turbine developments in the area;
- **Mitigation Measures** – details of the proposed mitigation measures to be incorporated into the Proposed Development that will be implemented to avoid significant effects; and
- **Residual Effects** – an assessment of residual effects following the implementation of mitigation measures.

Shadow Flicker

There is no applicable legislation setting out any relevant rules or requirements for the assessment or control of shadow flicker.

The update of UK Shadow Flicker Evidence Base (DECC, 2011) reviewed international legislation relating to the assessment of shadow flicker for wind turbine development and concludes that the area within 130 degrees either side of north from the turbine, and out to 10 rotor diameters, is considered acceptable as a study area for shadow flicker assessment.

The DECC study concluded that there have not been extensive issues with shadow flicker in the UK and, in circumstances where the potential for significant shadow flicker issues effects have been identified, these have been resolved using standard mitigation.

The approach which has been taken for the Proposed Development has been to assess the potential effects of shadow flicker on residential properties within 10 rotor diameters (1630m) of each turbine.

This assessment also takes into consideration the Scottish Government Online Renewables Planning Advice: Onshore Wind Turbines (Scottish Government, 2014).

Study Area

OS mapping was used to identify properties with potential susceptibility to shadow flicker, in line with the Update of UK Shadow Flicker Evidence Base (Parsons Brinckerhoff 2011). The candidate wind turbine modelled in the assessment has an indicative rotor diameter of 163m to reflect the maximum diameter for the Proposed Development.

The area around turbine locations encompassing 10 rotor diameters (1630m) and 130 degrees either side of north (the zone of potential shadow flicker) was mapped. There are a total of three receptors within this zone of potential shadow flicker, with the potential to experience shadow flicker as illustrated in Figure 14-1.

Shadow Flicker Assessment Modelling - Cumulative sites

The closest wind farm to the Proposed Development is Craigengelt Wind Farm which is located to the south-west. Earlsburn Wind Farm lies north-west of the Proposed Development approx. 2.5km away, and its extension north of it.

Health and Safety

Given the nature and location of the Proposed Development, i.e. rural in nature and not within close proximity to settlements, it is considered that the likelihood and effect from potential accidents and disasters is minimal and therefore, excluded from detailed assessment.

Therefore, no significant effects are anticipated, and it is considered this can be scoped out from further assessment.

Nevertheless, high standards of health and safety will be established and maintained throughout the lifecycle of the Proposed Development.

At all times activities will be undertaken in a manner compliant with applicable health and safety legislation and with relevant good practice as defined under applicable statutory approved codes of practice and guidance.

This includes the Health and Safety at Work Act 1974, the Construction (Design and Management) Regulations 2015, the Work at Heights Regulations 2005 and Onshore Wind Health & Safety Guidelines 2015 (volume 1) published by Renewable UK.

14.3 Baseline Conditions

14.3.1 Aviation and Radar

NATS

The Proposed Development is located out with any NATS Consultation Zones as shown on Figure 14-2 however, during scoping consultation, NATS confirmed potential effects on Lowther RADAR, Kincardine RADAR and Prestwick Centre Air Traffic Control.

Further consultation with NATS was undertaken by the Applicant with the design adjusted to take account of NATS concerns.

Ministry of Defence

As shown in Figure 14-2 the Proposed Development lies within a low priority low flying area. The MoD confirmed they have no concerns over the Proposed Development subject to the provision of MOD accredited aviation safety lighting.

No other concerns from the MOD were raised during consultation regarding the Proposed Development.

Cumbernauld Airport

Cumbernauld Airport lies approximately 10.3km south of the Proposed Development. In response to Scoping Cumbernauld Airport confirmed that the Proposed Development lies within the Aerodrome Safeguarding zone and stated that the Proposed Development could affect aircrafts moving to and from the airport.

14.3.2 Telecommunications

The moving rotors of wind turbines have the potential to effect telecommunication and television signals by causing Electromagnetic Interference (EMI). Wind turbines cause EMI by reflection of signals from rotor blades so that a nearby receiver picks up both a direct and reflected signal.

The types of civilian and military communication signals which may be affected by EMI include TV and radio broadcasting, microwave and cellular radio communications and various navigational and air traffic control systems. A turbine located within, or near to, the communication link may interfere with the signal causing unwanted 'noise'.

The potential for negative effects on domestic television reception are greatly diminished post digital switchover, which was completed across the UK in 2012.

As shown in Figure 14-2 there are numerous fixed communications links that pass through the Proposed Development Site.

Consultation with a number of telecommunications operators was undertaken by the Applicant and the following operators raised concerns that their telecommunication links have the potential to be affected:

- Airwave;
- Arqiva;
- BT;
- Ericsson; and
- MLL.

14.3.3 Shadow Flicker

Shadow flicker can arise from the passing of the moving shadow of a wind turbine rotor-blade over a narrow opening such as the window of a nearby residence. A similar effect can also occur when the blades of a rotating turbine reflect the sun causing a flashing light.

Shadow flicker happens only when a certain combination of conditions coincide at particular times of the day and year, mainly in the winter months when the sun is low in the sky (BERR 2009).

The occurrence of shadow flicker and the extent of its effects are dependent on a number of factors, namely:

- Distance from the wind turbine;
- Turbine hub height and rotor diameter;
- Speed of blade rotation;
- The proportion of sunny weather during the months when flicker can occur; and
- The size, shape and orientation of any windows or doors of neighbouring properties.

The flickering may have the potential to cause disturbance and annoyance to residents. People with photosensitive epilepsy are usually sensitive to flickering light between 3 and 30 Hertz (Hz) per second (Epilepsy Action 2023). As detailed by Berr

(2009) turbines maximum frequency is usually under 1 hertz and therefore below the frequencies known to trigger photosensitive epilepsy.

There are three dwellings within the study area with the potential to experience some shadow flicker: Easter Cringate Cottage (Receptor 1), Ryecroft (Receptor 2) and Craigengelt (Receptor 7), as illustrated in Figure 14-1.

14.4 Assessment of Effects

14.4.1 Aviation and Radar

The Applicant has undertaken consultation with NATS in order to agree suitable mitigation to ensure that the Proposed Development has no impact on NATS operations. The Applicant and NATS reached a suitable mitigation agreement in September 2023 which will ensure no impacts as a result of the Proposed Development on NATS operations.

As the turbines tips exceed 150m, aviation safety lighting is required. The Applicant will commit to implementing MOD accredited aviation safety lighting in consultation with the MOD.

A bespoke lighting scheme is required to be developed that maintains flight safety for aviation operations in the area. MOD and CAA have specific requirements that are required to be met.

The Applicant appointed Straten Consultancy Services Limited to develop an reduced lighting scheme proposal that meets CAA and MOD requirements (Technical Appendix 14-1).

14.4.2 Telecommunication

Having taken account of consultees concerns no impact on telecommunications are anticipated.

14.4.3 Shadow Flicker

A Shadow Flicker model was run using Wind Pro. The model also takes account of cumulative effect from multiple turbines. Figure 14-1 shows the hours per year predicted to be experienced at the properties identified.

UK Government guidelines (Parsons Brinckerhoff, 2011) note that a limit of up to 30 hours per year or 30 minutes on the worst affected day is considered acceptable.

As shown on Figure 14-1, there are three properties that may experience shadow flicker. Of these, Receptor 7 is not anticipated to experience any shadow flicker, due to its positioning to the south east. Receptors 1 and 2 are in the ranges of 21-40 and >50 hours per year respectively.

This method of quantifying shadow flicker does not take account of cloud cover or turbine orientation, true flicker is expected to be around one third of these values. When quantified using average sunshine hours per month data from the Centre for Environmental Data Analysis (CEDA), the predicted shadow flicker hours experienced was reduced to 11 hours for Receptor 1 and 19.8 hours for Receptor 2.

Considering this, there is no anticipated significant adverse effects from shadow flicker.

14.5 Assessment of Cumulative Effects

14.5.1 Shadow Flicker

The nearest wind turbine developments to the Proposed Development are the operational Craigengelt, Earlsburn and Kingsburn Wind Farms.

The Earlsburn and Kingsburn Wind Farms lie to the southwest >2.5km from the Proposed Development and therefore are unlikely to have cumulative shadow flicker effects on the identified receptors.

Craigengelt Wind Farm sits immediately to the southwest of the Proposed Development, the rotor diameter of these turbines is 90m. Considering a 900m cumulative study area for Craigengelt for shadow flicker, receptor 1 is the only cumulative receptor.

Receptor 1 is almost due north of the closest Craigengelt turbine. The area true north of a turbine typically experiences minimal shadow flicker as the main effects are caused by the rising and setting sun.

Therefore it is not anticipated that there will be cumulative shadow flicker impacts as a result of the Proposed Development.

14.6 Mitigation Measures

14.6.1 Aviation and Radar

NATS

The Applicant and NATS reached a suitable mitigation agreement in September 2023 which will ensure no impacts as a result of the Proposed Development on NATS operations and MOD operations.

As the turbines tips exceed 150m, aviation safety lighting is required. A bespoke lighting scheme is required to be developed that maintains flight safety for aviation operations in the area. MOD and CAA have specific requirements that are required to be met. The Applicant appointed Wind Power Aviation Consultants (WPAC) Limited to develop an aviation lighting strategy that meets CAA and MOD requirements (Technical Appendix 14-1).

Subject to the approval of the CAA aviation lighting report, and the agreement of suitable mitigation measures with NATS, it is anticipated that the Proposed Development will not adversely affect aviation interests.

14.6.2 Accordingly no further mitigation is deemed necessary.Telecommunication

No further mitigation is deemed necessary.

14.6.3 Shadow Flicker

No further mitigation is deemed necessary.

14.7 Residual Effects

Following implementation of mitigation, it is considered that there will be **no significant** effects on aviation interests as a result of the Proposed Development.

It is considered that there will be **no significant** effects on telecommunications and television reception a result of the Proposed Development.

It is considered that there will be **no significant** effects as a result of Shadow Flicker.

14.8 Summary and Statement of Significance

14.8.1 Aviation and Radar

Subject to the implementation of agreed mitigation with NATS, aviation safety lighting in agreement with the MOD and CAA and Cumbernauld; will be **no significant** effects as a result of the Proposed Development.

14.8.2 Telecommunication

Subject to suitable planning condition to satisfy concerns from Arqiva and Airwave/Motorola; **no significant** effects are anticipated on telecommunication links as a result of the Proposed Development.

14.8.3 Shadow Flicker

There are three properties within the study area for potential shadow flicker, however modelling has determined no properties will experience significant shadow flicker as a result of the Proposed Development.

Taking into account the positioning of turbines from neighbouring operational wind farms in relation to cumulative receptors, **no significant** effects are anticipated as a result of the Proposed Development.

14.9 References

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Chapter 15: Schedule of Mitigation

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Glossary of Terms

Term	Definition
The Applicant	Drummarnock Wind Farm Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1

List of Abbreviations

Abbreviation	Description
ACoW	Archaeological Clerks of Works
BPM	Best Practicable Means
BPP	Bird Protection Plan
CAA	Civil Aviation Authority
CEMP	Construction Environment Management Plan
CTMP	Construction Traffic Management Plan
DIA	Drainage Impact Assessment
DMP	Drainage Management Plan
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EnvCoW	Environmental Clerk of Works
GWDTE	Ground Water Dependent Terrestrial Ecosystem
HGVs	Heavy Goods Vehicles
HMP	Habitat Management Plan
MOD	Ministry of Defence
NATS	National Air Traffic Services
OPMP	Outline Peat Management Plan
PLHRA	Peat Landslide Hazard Risk Assessment
pLNCS	Potential Local Nature Conservation Site
PMP	Peat Management Plan
PWS	Private Water Supply
SC	Stirling Council
SCAS	Stirling Council Archaeology Service
SEPA	Scottish Environment Protection Agency

Abbreviation	Description
SSPCA	Scottish Society for the Prevention of Cruelty to Animals
SUDS	Sustainable Drainage Systems
WQMP	Water Quality Management Plan

15 Schedule of Mitigation

15.1 Introduction

This Chapter of the EIA Report provides a summary of the mitigation measures identified through the assessments as being required to address particular effects and to demonstrate how Schedule 4, Part 7 of the EIA Regulations is met.

An EIA Report is required to include: "*A description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements*".

The mitigation measures included in the EIA for the Proposed Development fall into the following categories:

- Embedded mitigation, incorporated into the design of the Proposed Development, such as the use of existing infrastructure where possible. All embedded mitigation measures are detailed within Chapter 3: Description of Development as well as the relevant technical chapters; and
- Additional mitigation measures, including monitoring and enhancement, identified as a result of the EIA, e.g., topic specific management plans such as a Habitat or Peat Management Plan.

The additional mitigation measures that have been identified are presented in the relevant technical chapters of the EIA Report (Chapters 5 to 14) and are summarised in the Schedule of Mitigation below.

15.2 Schedule of Mitigation

A Schedule of Mitigation, proposed to address potential significant adverse effects arising from the Proposed Development, is provided in Table 15-1.

The Schedule of Mitigation is supported by an Outline Construction Environment Management Plan (CEMP) provided in Technical Appendix 15-1.

The Outline CEMP should be read in conjunction with Chapters 5 to 14 and their respective technical appendices, in particular, the CEMP is supported by:

- Technical Appendix 6-5 Outline Habitat Management Plan (HMP).

Table 15-1: Schedule of Mitigation

ID	Section Reference	EIA Report Chapter and Document	Phase	Mitigation Commitments
Landscape & Visual				
LV - 01	5.13	Chapter 5 Landscape and Visual	Operation	Measures to reduce effects upon the landscape resource and upon views and visual amenity were predominantly achieved through the design of the Proposed Development, as described in Chapter 3: Description of Development and the Design and Access Statement.
Ecology				
EC-01	6.6.1	Chapter 6 Ecology	Design Mitigation	A Pollution Risk assessment will be carried out identifying materials, areas and activities of greatest risk and laying out controls on these. From this a Pollution Prevention Plan (PPP) will be prepared. The PPP will be a sub plan of the Construction Environmental Management Plan (CEMP). A PPP will also be in place during operation and decommissioning phases.
EC-02	6.6.1	Chapter 6 Ecology	Design Mitigation	Turbines have been sited at least 50m between features of potential value for bats and a wind turbine.
EC-03	6.6.2	Chapter 6 Ecology	Pre-construction	A pre-construction survey, focussing on otter but also covering other protected species, will be undertaken within two weeks from the start of construction, covering suitable habitat up to 200m from construction areas.
EC-04	6.6.3	Chapter 6 Ecology	Construction	A CEMP will be prepared in advance of commencement of works.
EC-06	6.6.3	Chapter 6 Ecology	Construction	Works to be overseen by an Environmental Clerk of Works (EnvCoW) and their role and responsibilities will be detailed in the CEMP. In outline, this role will include ongoing monitoring of environmental/ecological constraints, review and audit of the appointed contractor's environmental performance, delivery of toolbox talks, and supervision of construction works.
EC-07	6.6.3	Chapter 6 Ecology	Construction	There will be no direct discharges to any natural watercourses, with all drainage waters being dispersed as overland flows, as directed by the EnvCoW to avoid erosion or siltation of existing watercourses in the process.
EC-08	6.6.3	Chapter 6 Ecology	Construction	All discharges from the proposed works areas will be made over vegetation filters at an appropriate distance from natural watercourses.
EC-09	6.6.3	Chapter 6 Ecology	Construction	Wind turbines and associated infrastructure including tracks and other hardstandings will have a micrositing allowance of up to a radius of 50m.

ID	Section Reference	EIA Report Chapter and Document	Phase	Mitigation Commitments
EC-10	6.6.3	Chapter 6 Ecology	Construction	Site drainage measures, including drainage ditches and silt traps, will be provided to collect and treat increased surface run off.
EC-11	6.6.3	Chapter 6 Ecology	Construction	Appropriate bunded storage will be in place for storage of fuels/oils, with onsite storage of hydrocarbons to be kept to a minimum.
EC-12	6.6.3	Chapter 6 Ecology	Construction	Use of wet-cement products within the hydrological buffer will be avoided, insofar as possible (and in agreement with the EnvCoW and SEPA (Scottish Environment Protection Agency)).
EC-13	6.6.3	Chapter 6 Ecology	Construction	Wastewater emanating on-site (sewage, wastewater from site office) will be taken off-Site for disposal/treatment at controlled facilities. To this effect, welfare facilities for construction site workers will include self-contained port-a-loos with an integrated waste holding tank. No water will be sourced on the Site, nor will any wastewater be discharged from the Site.
EC-14	6.6.3	Chapter 6 Ecology	Construction	Infiltration interception drains to be used for upslope 'clean' water collection and dispersion.
EC-15	6.6.3	Chapter 6 Ecology	Construction	Flow attenuation and filtration check dams used to reduce velocities, with consideration given to gradient with drains to determine spacing requirements; and Silt fences, straw bales and biodegradable matting will be used to control surface water runoff for deposition areas.
EC-16	6.6.3	Chapter 6 Ecology	Construction	Silt fences, straw bales and biodegradable matting will be used to control surface water runoff for deposition areas.
EC-17	6.6.3	Chapter 6 Ecology	Construction	Deposition areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff.
EC-18	6.6.3	Chapter 6 Ecology	Construction	Incidental habitat loss will be avoided by minimising the footprint of construction activities. This will be achieved by operating machinery and storing materials within the footprint of permanent construction features wherever practicable.
EC-19	6.6.3	Chapter 6 Ecology	Construction	The EnvCoW will ensure that vehicles and their operators do not inadvertently stray onto adjacent habitat areas.
EC-20	6.6.3	Chapter 6 Ecology	Construction	Best practice techniques for vegetation and habitat re-instatement will be adopted and implemented on areas subject to disturbance, such as the temporary construction compound area, as soon as is practicable.

ID	Section Reference	EIA Report Chapter and Document	Phase	Mitigation Commitments
EC-21	6.6.3	Chapter 6 Ecology	Construction	Following conclusion of the construction period and commissioning of the Proposed Development materials and other temporary infrastructure will be removed off-site and all temporary construction areas will be reinstated.
EC-22	6.6.3	Chapter 6 Ecology	Construction	The surface layer of soil and vegetation will be stripped separately from the lower soil layers, stored separately, and replaced as intact as possible once the construction phase is complete. Turf material will be replaced as far as possible in similar locations to where it was removed.
EC-23	6.6.3	Chapter 6 Ecology	Construction	Soils removed from the excavated area will be stored separately in piles, no greater than 3m in height, directly adjacent to, or near the tracks on ground appropriate for storage of materials i.e., relatively dry and flat ground, a minimum of 50m away from any watercourses. Wherever possible, reinstatement of ground disturbed to facilitate construction of the track will be carried out as track construction progresses.
EC-24	6.6.3	Chapter 6 Ecology	Construction	Given that the Bannock Burn potential Local Nature Conservation Site (pLNCS) intersects the Proposed Development Site, double silt fences will be installed adjacent to the burn to prevent sediment/silt infiltration ingress.
EC-25	6.6.3	Chapter 6 Ecology	Construction	No refuelling will be permitted at works locations within the 50m of watercourses.
EC-26	6.6.3	Chapter 6 Ecology	Construction	There will be no direct dewatering to watercourses during the construction phase. All outflows from drainage associated with construction will be by diffuse overland drainage at appropriate locations and through Sustainable Drainage Systems (SUDS).
EC-27	6.6.3	Chapter 6 Ecology	Construction	The time between excavating and backfilling of individual sections of cable trench is minimised near Ground Water Dependent Terrestrial Ecosystems (GWDTEs). As a rule, we advise backfilling within three days to minimise drying and disturbance.
EC-28	6.6.3	Chapter 6 Ecology	Construction	Impermeable barriers and/or clay plugs will be used to avoid the trenches acting as preferential conduits of groundwater.
EC-29	6.6.3	Chapter 6 Ecology	Construction	Areas of identified sensitivity (GWDTE and flushes) will be marked out / fenced-off to prevent accidental vehicular access.
EC-30	6.6.3	Chapter 6 Ecology	Construction	Excavations/holes will be covered at the end of each working day, or a wooden plank placed inside to allow faunal species to escape, should they enter the hole. Any temporarily exposed open pipe system would be capped in such a way as to prevent wildlife gaining access.
EC-31	6.6.3	Chapter 6 Ecology	Construction	No in-channel obstructions (floodlighting, fencing or diversions) will be permitted within

ID	Section Reference	EIA Report Chapter and Document	Phase	Mitigation Commitments
				watercourses unless specifically authorised in writing by the relevant authority (i.e. SEPA and/or a suitably experienced freshwater Ecologist).
EC-32	6.6.3	Chapter 6 Ecology	Construction	Measures shall be implemented to reduce the potential for even non-significant construction impacts to bats, e.g., downward-directed artificial lighting will be used to shine light to the working area only and reduce 'light leakage' that may temporarily affect bat flightlines.
EC-33	6.6.3	Chapter 6 Ecology	Construction	In the event that a protected species is discovered on site all work in that area would stop immediately and the EnvCoW would be contacted. Increased buffer areas may be required in these locations. Details of the local police Wildlife Crime Officers, NS Area Officer, and Scottish Society for the Prevention of Cruelty to Animals (SSPCA) relevant Officer would be held in the site emergency procedure documents.
EC-34	6.6.3	Chapter 6 Ecology	Construction	No new ground will be cleared without a prior inspection by the EnvCoW to ensure dispersal by reptiles, should they be present, or the presence of mountain hare forms before clearance. Clearance will occur in a manner to ensure dispersal routes for reptiles.
EC-35	6.6.3	Chapter 6 Ecology	Construction	A Site speed limit of 15mph will be in place at all times to reduce the risk of collision and protected species mortality associated with construction vehicles.
EC-36	6.6.4	Chapter 6 Ecology	Operation	15.9ha of peatland compensation should form part the restoration strategy as described in the Outline HMP (TA 6-5). The compensation accounts for the loss of M20 Eriophorum vaginatum Blanket and raised mire (0.4ha) and M25 Molinia caerulea – Potentilla erecta mire (0.1ha).
EC-37	6.6.4	Chapter 6 Ecology	Operation	The EnvCoW will monitor the condition of sensitive habitats, including areas of GWDTE, restored peat and watercourses.
EC-38	6.6.4	Chapter 6 Ecology	Operation	Details of the reinstatement and monitoring programme will be included in the HMP (TA 6-5). Quadrats should be established in year 1 following the start of restoration with surveys carried out in year 3 and 5. Further suggested surveys should be carried out in years 7, 10, 15 and 40.
EC-39	6.6.4	Chapter 6 Ecology	Operation	Hardstanding areas at each turbine location will be retained for use in on-going maintenance operations, with the edges as far as possible blended to the adjacent contours with natural vegetation being allowed to re-establish.
EC-40	3.4.3	Technical Appendix 6-5 HMP	Operation	6.2ha of heathland will be created as part of the restoration strategy.

ID	Section Reference	EIA Report Chapter and Document	Phase	Mitigation Commitments
Ornithology				
OR-01	7.4.3 & 7.5.1	Chapter 7 Ornithology	Construction	A Bird Protection Plan (BPP) would be developed by a suitably experienced ornithologist, and agreed in consultation with NatureScot, in advance of works commencing on the site. The BPP would set out in sufficient detail the measures and procedures that would be followed to ensure the protection of sensitive species as well as legally protected species during construction.
OR-02	7.5.1	Chapter 7 Ornithology	Construction	Timings of works/pre-commencement surveys and disturbance free buffer zones: • If site clearance and construction activities are required to take place during the main breeding bird season, from mid-March to August inclusive, pre-commencement survey work would be undertaken to ensure that nest destruction and disturbance to sensitive species (i.e., breeding raptors and waders) are avoided. • Where applicable, construction would not take place within specified disturbance-free buffer zones for certain sensitive species during the breeding season. • Disturbance-free buffer zones around nest sites of sensitive species would be applied and monitored closely. For breeding waders, disturbance-free buffer zones are only required until chicks have hatched and are capable of walking away from any sources of disturbance.
OR-03	7.5.1	Chapter 7 Ornithology	Construction	A suitably qualified Environmental Clerk of Works (EnvCoW) would be employed to oversee activity at key points for the duration of the construction and reinstatement periods (at a frequency to be agreed with Stirling Council (SC) and NatureScot), to ensure natural heritage interests are safeguarded. The role of the EnvCoW would include the following specific roles with regard to the ornithology interest of the site: • Prior to the start of construction and/or the breeding bird season, the EnvCoW would make contractors aware of the ornithological sensitivities within the site (particularly with regard to the potential presence of sensitive breeding species, i.e. breeding waders and raptors); and • The EnvCoW would undertake 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.
OR-03	7.5.1	Chapter 7 Ornithology	Operation	As part of the Proposed Development an outline HMP has been produced (see Technical Appendix 6-5). Approximately 13ha of habitat will be enhanced through measures, to include:

ID	Section Reference	EIA Report Chapter and Document	Phase	Mitigation Commitments
				• 6.2ha of heathland to provide suitable breeding habitat for Short-eared owl; and • 6.8ha of wet grassland to provide suitable breeding habitat for waders. Habitat change and disturbance for birds during the construction works will be further considered in the final HMP and BPP once final construction phasing is known.
OR-04	7.5.2	Chapter 7 Ornithology	Pre-construction/ Construction/ Operation	Post consent survey and monitoring: • The exact scope of works would be confirmed after consultation but is likely to include collision monitoring, flight activity surveys and breeding wader and raptor/ owl surveys. It is important that any monitoring is designed to assess the actual versus predicted impacts on birds and to allow for a flexible monitoring plan to be undertaken during the post construction period. • It is proposed that ornithological monitoring should take place during and post-construction, in line with NatureScot guidance (SNH, 2009). The approach is outlined as follows: – Year-round collision monitoring: no formal monitoring is proposed but carcasses of all species found on site should be recorded. – Targeted wader surveys should also be undertaken to monitor the status of nesting wader species within the vicinity of the Proposed Development, in order to further determine the displacement effect , and the effectiveness of the HMP. These surveys should be undertaken in Year 0, 1, 2, 3, 5, and 10. Upon completion of surveys in Year 10, the need for further monitoring should be assessed.
Hydrology, Geology and Hydrogeology				
HY-01	8.7.2	Chapter 8 Hydrology, Geology and Hydrogeology	Construction	A Construction Method Statement will be produced to ensure safe environmental and water environment construction methods.
HY-02	8.7.2	Chapter 8 Hydrology, Geology and Hydrogeology	Construction, Operation and Decommissioning	Develop and implement Construction Environmental Management Plan (CEMP) pre-construction to contain specific measures for good practice and mitigation as required during construction to maintain legal, planning, best practice and the integrity of sensitive environmental receptors.
HY-03	8.7.2	Chapter 8 Hydrology,	Construction	Develop Pollution Prevention Plan (PPP) to identify activities of greatest risk and prepare controls. The PPP will reference the extensive guidance and outline protocols for pollution

ID	Section Reference	EIA Report Chapter and Document	Phase	Mitigation Commitments
		Geology and Hydrogeology		control and will include reference to fuel, oils, cementitious materials, other hazardous substances and prohibited materials.
HY-04	8.7.2	Chapter 8 Hydrology, Geology and Hydrogeology	Construction	Appointment of an EnvCOW ensuring the requirements of the Construction Environmental Management Plan, Drainage Management Plan (DMP) and Peat Management Plan (PMP) are implemented, undertake regular site inspections to ensure that activities remain compliant with legislation, planning conditions and good practice.
HY-05	8.5.4	Chapter 8 Hydrology, Geology and Hydrogeology	Construction	All infrastructure and drainage to be positioned a minimum of 50m from watercourses (where possible) - to protect watercourses from sediment pollution and flow disturbance. Those which are not will be provided and numbered on a plan with photos etc. following micrositing as final locations of infrastructure can still move (within 50m)
HY-06	8.7.3	Chapter 8 Hydrology, Geology and Hydrogeology	Construction, Operation and Decommissioning	Develop a Drainage Impact Assessment (DIA) and implement a DMP with detailed methods for the collection and treatment of surface water runoff. This is to understand drainage inch points, protect watercourses and install precautionary drainage. The DIA will inform the temporary and permanent drainage design and the DMP to protect watercourses.
HY-07	8.7.3	Chapter 8 Hydrology, Geology and Hydrogeology	Construction	All watercourse crossings to be WAT-SG-25 compliant, to be bottomless arch designed based on best practice guidelines and designed to accommodate the 1 in 200 year event with 20% added for climate change. This is to avoid effects on the flow, bottom, banks and ecology of watercourses.
HY-08	8.7.3	Chapter 8 Hydrology, Geology and Hydrogeology	Construction, Operation and Decommissioning	Prepare and implement a Water Quality Monitoring Plan (WQMP) to address surface and ground water quality and protection and include measures for different rainfall and flow conditions. This will record the existing water condition, inform design requirements, and avoid deterioration to water quality during construction.
HY-09	8.7.4	Chapter 8 Hydrology, Geology and Hydrogeology	Construction and Operation	Develop the Outline Peat Management Plan (OPMP) which has been prepared in support of the EIAR into a detailed PMP in order to minimise peat disturbance and maximise re use of peat soil.
HY-10	8.7.4	Chapter 8 Hydrology, Geology and Hydrogeology	Construction	Achieve a peat balance between peat excavation, reinstatement and reuse to avoid the need for residual peat excavations to be taken off site.

ID	Section Reference	EIA Report Chapter and Document	Phase	Mitigation Commitments
HY-11	8.7.4	Chapter 8 Hydrology, Geology and Hydrogeology	Construction and Operation	Carry out monitoring of vegetative recovery of the finished borrow pit surfaces, effectiveness of constructed berms in holding peat in place, and moisture content of the peat deposit to measure the effectiveness of peat reuse in borrow pits.
HY-12	8.5.7	Chapter 8 Hydrology, Geology and Hydrogeology	Construction	Implement precautionary appropriate mitigation and control measures for working in peat as in Peat Landslide Hazard Risk Assessment (PLHRA) Technical Appendix 8-3 in order to avoid peat landslides.
HY-13	8.7.5	Chapter 8 Hydrology, Geology and Hydrogeology	Construction and Operation	Carry out further data collection, site visit and risk assessment of Muirpark PWS to provide security of supply should there be interruptions to the PWS supply.
HY-14	8.7.5	Chapter 8 Hydrology, Geology and Hydrogeology	Construction and Operation	Baseline monitoring of the Muirpark PWS source including pre and post construction monitoring.
HY-15	8.7.5	Chapter 8 Hydrology, Geology and Hydrogeology	Construction	Agree temporary contingency plans with owner of Muirpark agricultural pond to provide security of registered PWS supply should there be interruptions or contamination.
HY-16	8.7.5	Chapter 8 Hydrology, Geology and Hydrogeology	Construction	Regularly monitor water flow and quality during works adjacent to the Muirpark agricultural pond to provide security to agricultural use of the pond supply.
Transport & Access				
TR-01	9.6	Chapter 9 Transport & Access	Construction	Develop a Construction Traffic Management Plan (CTMP) to address impacts on Minor Roads within the Study Area due to increased traffic and heavy goods vehicles (HGVs) from the Proposed Development, a comprehensive CTMP will be developed to minimize these effects. The CTMP will reduce construction vehicle numbers and manage vehicle impacts through routing and scheduling. Additionally, measures will be implemented to reduce and manage construction staff travel by private car.

ID	Section Reference	EIA Report Chapter and Document	Phase	Mitigation Commitments
				Specific measures includes: • Reporting to the security gate upon commencement; • Developing a logistics plan; • Identifying approved haul routes; • Providing site induction packs; • Erecting temporary construction site signage; • Imposing speed limits; • Scheduling staggered delivery times; • Including control measures in contractor tender enquiries; • Prohibiting HGV lay-ups in surrounding roads; • Maintaining clean and safe roads; and • Installing a wheel cleaning facility on-site.
Cultural Heritage				
CH-01	10.5.1	Chapter 10 Cultural Heritage	Design Mitigation	The design of the Proposed Development has sought to avoid or minimise (as far as reasonably possible) effects to heritage assets particularly avoiding and minimising direct effects due to setting change to Stirling Castle and Kings Yett Cairn. Each iteration of the design has been reviewed to ensure that direct physical effects to known heritage assets are avoided. Similarly, how turbines will appear within the setting of heritage assets has been a key consideration in design refinements, including the number and location of turbines. Further detailed information on the evolution of the design of the Proposed Development is presented in Chapter 3: Description of Development of this EIA Report.
CH-02	10.6.1	Chapter 10 Cultural Heritage	Construction	One non-designated heritage asset, Muirpark, farmstead (SC HER Ref. 2730; low importance) could be physically affected as a result of any micrositing due to the operation of machinery and plant during the upgrading of the access track to the south of the heritage asset. Micrositing will be restricted so that movement of the access track is limited to the north to avoid interaction with the asset.
CH-03	10.6.1	Chapter 10 Cultural Heritage	Construction	Good practice measures to prevent, reduce, and/or where possible offset potential physical effects to previously unrecorded heritage assets, including buried archaeological remains are proposed. Measures which may be adopted include: • The fencing off and marking out the elements of Muirpark, farmstead (SC HER Ref. 2730; low importance) refer to Technical Appendix 10-1) to avoid physical effects;

ID	Section Reference	EIA Report Chapter and Document	Phase	Mitigation Commitments
				• Implementation of a working protocol should previously unrecorded heritage assets, including buried archaeological remains (e.g. archaeological deposits and features) be discovered; • The use of a Construction Environmental Management Plan (CEMP), supplemented by toolbox talks as appropriate, to highlight the historic environment sensitivities of areas of the Proposed Development Site to those working on the Proposed Development. An outline CEMP is provided as Appendix 15-1; and • Appointment of an Archaeological Clerk of Works (ACoW) to supervise targeted ground-breaking operations and provide onsite advice on avoidance of effects (e.g. providing onsite identification and recording of previously unrecorded The Stirling Council Archaeology Service (SCAS) will be consulted to provide guidance on appropriate conditions to be applied to any prospective consent.
Noise				
N-01	11.4.5	Chapter 11 Noise	Construction and Decommissioning	Use of Best Practicable Means (BPM) during construction, controlled through adoption of CEMP include: • Restricting works : 07:00 to 19:00 Monday to Friday and 07:00 to 13:00 on Saturdays and excluding Sundays and Scottish local and national holidays, unless specifically agreed otherwise with Stirling Council. • Outside the working hours, construction activities will be limited to turbine erection, maintenance, emergency works, dust suppression, and the testing of plant and equipment, unless otherwise approved in advance in writing by Stirling Council. • If blasting is required, the mitigation measures will be considered as per BS 5228 and included in the final CEMP • To control the movement of vehicles to and from the site a site management regime will be developed and implemented through a CTMP.
N-02	11.4.5	Chapter 11 Noise	Operation	Adoption of a turbine curtailment strategy (provided as Technical Appendix 11-4), which is the calculated noise mitigation required in order to meet the applicable noise limits at one receptor, Ryecroft. Curtailment is set out with reference to both wind direction (angular degrees relative to the north) and wind speed (raging from 4m/s to 12m/s standardised to 10m height) and specifies the operational modes that each turbine should use for each scenario.

ID	Section Reference	EIA Report Chapter and Document	Phase	Mitigation Commitments
Other Considerations				
OC-01	14.6.1	Chapter 14 Other Consideration	Operation	A suitable mitigation plan has been agreed by the Applicant and NATS in September 2023 to ensure that there will not be any impacts on National Air Traffic Service (NATS) operations and (Ministry of Defence) MOD operations due to the Proposed Development.
OC-02	14.6.1	Chapter 14 Other Considerations	Operation	As the turbines tips exceed 150m, aviation safety lighting is required. A bespoke lighting scheme is required to be developed that maintains flight safety for aviation operations in the area. MOD and Civil Aviation Authority) CAA have specific requirements that are required to be met. The Applicant appointed Straten CSL to develop an aviation lighting strategy that meets CAA and MOD requirements (Technical Appendix 14-1).

15.3 References

UK Government (1997) Town and Country Planning (Scotland) Act 1997 (as amended) Available at: https://www.legislation.gov.uk/ukpga/1997/8/contents. [Accessed: 30/04/2024].

UK Government (2017). The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 (the EIA Regulations). Available at: https://www.legislation.gov.uk/ssi/2017/101/contents/made [Accessed: 30/04/2024].

Chapter 16: Summary of Predicted Residual Effects

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Glossary of Terms

Term	Definition
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Environmental Impact Assessment Regulations	Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1

List of Abbreviations

Abbreviation	Description
BPP	Bird Protection Plan
CAA	Civil Aviation Authority
CEMP	Construction Environment Management Plan
CTMP	Construction Traffic Management Plan
DIA	Drainage Impact Assessment
DMP	Drainage Management Plan
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EnvCoW	Environmental Clerk of Works
GVA	Gross Value Added
GWDTE	Ground Water Dependent Terrestrial Ecosystem
HGVs	Heavy Goods Vehicles
HMP	Habitat Management Plan
LCT	Landscape Character Type
LLA	Local Landscape Area
MOD	Ministry of Defence
NATS	National Air Traffic Services
NVC	National Vegetation Classification
OPMP	Outline Peat Management Plan
PLHRA	Peat Landslide Hazard Risk Assessment
pLNCS	Potential Local Nature Conservation Site
PMP	Peat Management Plan
PWS	Private Water Supply
WQMP	Water Quality Management Plan

16 Summary of Predicted Residual Effects

16.1 Introduction

This Chapter of the Environmental Impact Assessment (EIA) Report provides a summary of the key conclusions of the EIA, namely the residual effects – the effects of the Proposed Development that are predicted to remain, following implementation of the proposed mitigation.

16.2 Residual Effects

The residual effects of the Proposed Development following the implementation of embedded and additional mitigation are assessed within each technical chapter of this EIA Report (Chapters 5 to 14).

There are potential Minor beneficial effects in relation to the development, construction and operational phases of the Proposed Development relating to the enhancement of public access for tourism and recreation purposes, and of employment and Gross Value Added (GVA), in the context of both local and national economies (Chapter 12: Socioeconomics, Tourism & Recreation).

There are potential Moderate beneficial effects in relation to the development, construction and operation phases of the Proposed Development on carbon saving (Chapter 13: Climate Change and Carbon Balance).

No significant adverse effects are predicted for the following topics and as such no specific mitigation measures (Chapter 15), in addition to the embedded mitigation which has been incorporated within the design, are proposed:

- Cultural Heritage (Chapter 10);
- Socio-economics, Tourism and Recreation (Chapter 12); and
- Climate Change and Carbon Balance (Chapter 13).

Following the implementation of mitigation measures as outlined in Chapter 15, no significant adverse residual effects are predicted within the following topics:

- Ecology (Chapter 6);
- Ornithology (Chapter 7);
- Transport and Access (Chapter 9);
- Noise (Chapter 11); and
- Other Considerations (Chapter 14).

Significant residual effects are predicted in relation to Landscape and Visual (Chapter 5). The effects on Landscape and Visual have been minimised in so far as possible through design modifications and input to the design process.

A moderate adverse effect is predicted on direct and indirect loss of Groundwater Dependent Terrestrial Ecosystems (GWDTE) (Chapter 8 Hydrology, Geology and Hydrogeology).

A summary of residual effects is presented in Table 16-1.

Table 16-1: Summary of Residual effects

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
Landscape and Visual (Construction)		
The Site		**Significant (Major)**
Landscape and Visual (Operation)		
The Site	(LV – 01) Measures to reduce effects upon the landscape resource and upon views and visual amenity were predominantly achieved through the design of the Proposed Development, as described in Chapter 3: Description of Development and the Design and Access Statement.	**Significant (Moderate)** Cumulative – Not Significant
Lowland Hills (149) Landscape Character Type (LCT) – Central		**Significant (Moderate)** effect is predicted from a very localised area around the Site and to the northeast of Craigengelt Wind Farm (extending to the eastern boundary of the host LCT and approximately 4km to the north, in the Touch Hills). In terms of wider effects, these are not judged to be higher than **Not Significant (Minor).** Cumulative – Will reflect findings of primary assessment
Lowland Hill Fringes (150) LCT - Central		Not significant (Minor) Cumulative – Will reflect findings of primary assessment
Lowland River Valleys (152) LCT – Central		Not significant (Minor) Cumulative – Will reflect findings of primary assessment
Carselands (153) LCT		Not significant (Minor) Cumulative – Will reflect findings of primary assessment
Lowland Valley Fringes (154) LCT		Not significant (Minor) Cumulative – Will reflect findings of primary assessment
Rugged Moorland Hills (216) LCT		Not significant (Minor) Cumulative – Will reflect findings of primary assessment
Southern Hills Local Landscape Area (LLA)		There will be some direct and very localised effects on the landscape fabric of the LLA and on landscape character. These effects are recognised in the landscape assessment for the host LCT (Lowland Hill – Central). However, as the Proposed Development is located in an area which has been altered by wind turbines (as recognised in the qualities

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
		of the designation), and will generally be seen as an extension to an operational wind farm in views towards the LLA, this is not judged to significantly alter the overall integrity of the Southern Hills LLA. Furthermore, the experience of the LLA from large areas of the LLA, to the west of the operational Craigengelt Wind Farm, will not be altered. Cumulative – Will reflect findings of primary assessment
Viewpoint 1 - North Third Reservoir		**Significant (Major)** This is mainly because the proposed turbines are larger and closer to the view point and will stand out prominently in southwest views. This addition will bring a medium-large scale change to the landscape, notably visible from the local road east of the site. Cumulative – Will reflect findings of primary assessment
Viewpoint 2 - Lewis Hill		**Significant (Major)** This is mainly because the proposed development is larger and will extend the horizontal field of view, creating some visual stacking of turbines. Cumulative – Will reflect findings of primary assessment
Viewpoint 3 - Carron Bridge at Northshields		**Significant (Major)** This is due to the fact that the turbines in the Proposed Development will be larger than those in the existing Wind Farms, likely distinguishing it as a separate entity. This addition will amplify the presence of wind turbines on the northwest horizon. Cumulative – Will reflect findings of primary assessment
Viewpoint 4 - Tomtain		**Significant (Moderate)** This is mainly because the proposed turbines will be larger and while the proposed development can be interpreted as an extension of the adjacent wind farm, it will also create a noticeable gap between the eastern and western layouts. When viewed alongside existing schemes, the Proposed

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
		Development will enhance the presence of wind farms in the landscape. Cumulative – Will reflect findings of primary assessment
Viewpoint 5 - M9 / A811 overpass		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Viewpoint 6 - Meikle Bin		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Viewpoint 7 - Bannockburn Memorial		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Viewpoint 8 - Stirling Castle		**Significant (Moderate)** This is mainly due to the elevated sensitivity of the viewpoint, from Stirling Castle. Effects on similar views, from less sensitive parts of Stirling, are likely to fall just below the threshold of significance. Cumulative – Will reflect findings of primary assessment
Viewpoint 9 - M80 at Denny Myothill Road overpass		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Viewpoint 10 - Wallace Monument		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Viewpoint 11 - Falkirk Wheel		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Viewpoint 12 - Dumyat		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Viewpoint 13 - Clackmannan Tower		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Viewpoint 14 - Ben Cleuch		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Viewpoint 15 - Ben Ledi		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Viewpoint 16 – Crow Road		Not Significant (Minor)

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
		Cumulative – Will reflect findings of primary assessment
Stirling		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Denny		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Bridge of Allan, Cowie, Fallin and Throsk		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
M9		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
A872 (and northern extents of M80)		Not Significant (Minor) Cumulative – Will reflect findings of primary assessment
Core Paths within 5km		From Core Paths top the northeast, within 5km, **Significant (Major) sequential effects** Cumulative – Will reflect findings of primary assessment
Residential Visual Amenity		
Easter Cringate Cottage	(LV – 01) Measures to reduce effects upon the landscape resource and upon views and visual amenity were predominantly achieved through the design of the Proposed Development, as described in Chapter 3: Description of Development and the Design and Access Statement.	High magnitude of visual change - it is not considered that the Proposed Development will breach the residential visual amenity threshold.
Ryecroft		High magnitude of visual change - It is not considered that the Proposed Development will breach the residential visual amenity threshold.
Craigengelt (and Craigengelt Bungalow)		High magnitude of visual change - It is not considered that the Proposed Development will breach the residential visual amenity threshold.
Ecology		
Bannock Burn potential Local Nature Conservation Site (pLNCS)	(EC-24) Given that the Bannock Burn pLNCS intersects the Proposed Development Site, double silt fences will be installed adjacent to the burn to prevent sediment/silt infiltration ingress.	Negligible – No Significant Effect
Loch Coulter Burn potential Local Nature	(EC-24) Given the strong possibility that there is a	Negligible – No Significant Effect

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
Conservation Site (pLNCS)	hydrological connection between Loch Coulter Burn pLNCS and the Proposed Development Site, this site will be treated as per Bannock Burn pLNCS; double silt fences will be installed adjacent to the burn to prevent sediment/silt infiltration ingress.	
Loch Coulter potential Local Nature Conservation Site (pLNCS)	(EC-24) Given the strong possibility that there is a hydrological connection between Loch Coulter pLNCS and the Proposed Development Site, this site will be treated as per Bannoch Burn pLNCS; double silt fences will be installed adjacent to the burn to prevent sediment/silt infiltration ingress.	Negligible – No Significant Effect
M19 Calluna vulgaris – Eriophorum vaginatum blanket mire	(EC-36) 15.9ha of peatland compensation should form part the restoration strategy as described in the Outline HMP (TA 6-5). This compensation accounts for loss of M20 Eriophorum vaginatum Blanket and raised mire (0.4ha) and M25 Molinia caerulea – Potentilla erecta mire (0.1ha).	Moderate Adverse Effect (Construction). Whilst not significant in EIA terms, the amount represents a noted loss at the local level and compensation and enhancement is intended equal to 15.9ha of blanket bog. The Habitat Management Plan (HMP) (Technical Appendix 6-5) describes measures to create new bog matching the M19 National Vegetation Classification (NVC) type. Negligible – No Significant Effect (Operation & Decommission)
M20 Eriophorum vaginatum Blanket and raised mire	(EC-36) At least 15.9ha of peatland compensation should form part the restoration strategy as described in the Outline HMP (TA 6-5). This includes loss of M20 Eriophorum vaginatum Blanket and raised mire (0.4ha) and M25 Molinia caerulea – Potentilla erecta mire (0.1ha).	Minor Adverse Effect (Construction) Negligible – No Significant Effect (Operation & Decommission)
M23 Juncus effusus/acutiflorus-Galium palustre rush-pasture	(EC-27) The time between excavating and backfilling of individual sections of cable trench is minimised near Ground Water Dependent Terrestrial Ecosystems (GWDTEs). As a rule, we advise backfilling within three days to minimise drying and disturbance. (EC-29) Areas of identified sensitivity (GWDTE and flushes) will be marked out / fenced-off to prevent	Negligible - No Significant Effect

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
	accidental vehicular access.	
M25 Molinia caerulea – Potentilla erecta mire	(EC-36) At least 15.9ha of peatland compensation should form part the restoration strategy as described in the Outline HMP (TA 6-5). This includes loss of M20 Eriophorum vaginatum Blanket and raised mire (0.4ha) and M25 Molinia caerulea – Potentilla erecta mire (0.1ha).	Negligible - No Significant Effect
M35 Ranunculus omiophyllus – Montia fontana rill	(EC-09) Where possible, the micro-siting allowance of 50m should be used to move the working corridor outwith the Zone of Influence of the M35 to ensure that the integrity of the M35 is maintained.	Negligible - No Significant Effect
H21 Calluna vulgaris - Vaccinium myrtillus - Sphagnum capillifolium heath	(EC-41) 6.2ha of heathland will be created as part of the restoration strategy as described in the Outline HMP (TA 6-5). This also relates to the provision of suitable breeding habitat for Short-eared owl (see OR-03).	Minor Adverse Effect (Construction) Negligible – No Significant Effect (Operation & Decommission)
Bats	(EC-02) Turbines have been sited at least 50m between features of potential value for bats and a wind turbine. (EC-32) Measures shall be implemented to reduce the potential for even non-significant construction impacts to bats, e.g., downward-directed artificial lighting will be used to shine light to the working area only and reduce 'light leakage' that may temporarily affect bat flightlines.	Negligible - No Significant Effect
Ornithology		
All species (Nest damage or destruction during construction)	(OR-01/OR-02) Implementation of good practice through a Construction Environment Management Plan (CEMP) and Bird Protection Plan (BPP). Timing of Works, Pre-Commencement Surveys and Implementation of Disturbance-Free Buffer Zones.	No significant negative effects
All species (Direct habitat loss and change)	None required.	No significant negative effects

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
All species, including lapwing, curlew, snipe and short-eared owl (Disturbance/ displacement during construction)	(OR-01/OR-02/OR-03) Implementation of good practice. Disturbance free zone of 300m around any lapwing, snipe and curlew nests and 500m around any short-eared owl nests. CEMP and BPP Timing of Works, Pre-Commencement Surveys and Implementation of Disturbance-Free Buffer Zones, Environmental Clerk of Works (EnvCoW).	No significant negative effects
All species, including lapwing, curlew, snipe and short-eared owl (Disturbance/ displacement during operation)	(OR-04/OR-05) Habitat Enhancement Operational monitoring through HMP and Breeding bird surveys.	No significant negative effects
All species including kestrel, curlew and short-eared owl (Collision with turbines during operation)	(OR-05) No formal monitoring required. Any dead birds to be reported to Nature Scot. A monitoring program will be established which will likely to include collision checks, flight surveys, and targeted surveys for breeding waders and raptors/owls.	No significant negative effects
Ornithology (Residual Cumulative Effects in NHZ 17 on the IOFs)		
Lapwing (Habitat Loss/Disturbance/ Displacement)	((OR-04/OR-05) Habitat Enhancement Operational monitoring through HMP and Breeding bird surveys.	No significant negative effects
Curlew (Habitat Loss)	(OR-04/OR-05) Habitat Enhancement Operational monitoring through HMP and Breeding bird surveys.	No significant negative effects
Curlew (Disturbance/Displacement)	(OR-04/OR-05) Habitat Enhancement Operational monitoring through HMP and Breeding bird surveys.	No likely significant negative effects
Curlew (Collision Mortality)	None required.	No significant negative effects
Snipe (Habitat Loss/Disturbance/ Displacement)	(OR-04/OR-05) Habitat Enhancement Operational monitoring through HMP and Breeding bird surveys.	No significant negative effects
Short-eared owl (Habitat Loss/Disturbance/	(OR-04/OR-05) Habitat Enhancement	No significant negative effects

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
Displacement)	Operational monitoring through HMP and Breeding bird surveys.	
Short-eared owl (Collision Mortality)	None required.	No significant negative effects
Kestrel (Collision Mortality)	None required.	No significant negative effects
Hydrology, Geology and Hydrogeology		
Sediment pollution of watercourses	(HY-05) All infrastructure and drainage to be positioned a minimum of 50m from watercourses - to protect watercourses from sediment pollution and flow disturbance. (HY-06) Develop a Drainage Impact Assessment (DIA) and implement a Drainage Management Plan (DMP) (HY-07) All watercourse crossings to be WAT-SG-25 compliant (HY-08) Prepare and implement a Water Quality Monitoring Plan (WQMP)	Minor – Not Significant
Other pollution of surface water	(HY-03) Develop Pollution Prevention Plan (PPP (HY-05) All infrastructure and drainage to be positioned a minimum of 50m from watercourses - to protect watercourses from sediment pollution and flow disturbance. (HY-06) Develop a DIA and implement a DMP (HY-08) Prepare and implement a Water Quality Monitoring Plan (WQMP)	Minor – Not Significant
Watercourse crossings (WC1, WC3, WC5 and WC6)	(HY-06) Develop a DIA and implement a DMP (HY-07) All watercourse crossings to be WAT-SG-25 compliant (HY-08) Prepare and implement a WQMP	Minor – Not Significant
Watercourse crossings (WC2 and WC4)	(HY-06) Develop a DIA and implement a DMP (DMP) (HY-07) All watercourse crossings to be WAT-SG-25	Minor – Not Significant

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
	compliant (HY-08) Prepare and implement a WQMP	
Change in surface water flow	N/A	Negligible – Not Significant
Change in groundwater flow	N/A	Minor – Not Significant
Change in groundwater quality	N/A	Minor – Not Significant
Peat Loss and Disturbance	(HY-09) Develop the Outline Peat Management Plan (OPMP) into a detailed Peat Management Plan (PMP) (HY-10) Achieve a peat balance between peat excavation, reinstatement and reuse to avoid the need for residual peat excavations to be taken off site. (HY-11) Carry out monitoring of vegetative recovery of the finished borrow pit surfaces, effectiveness of constructed berms in holding peat in place, and moisture content of the peat deposit to measure the effectiveness of peat reuse in borrow pits.	Minor – Not Significant
Peat Stability	(HY-12) Implement precautionary appropriate mitigation and control measures for working in peat as in Peat Landslide Hazard Risk Assessment (PLHRA) Technical Appendix 8-3 in order to avoid peat landslides.	Negligible – Not Significant
Private Water Supply – Muirpark PWS	(HY-13) Carry out further data collection, site visit and risk assessment of Muirpark Private Water Supply (PWS) to provide security of supply should there be interruptions to the PWS supply. (HY-14) Baseline monitoring of the Muirpark PWS source including pre and post construction monitoring.	Minor – Not Significant
Muirpark - Agricultural Pond	Regularly monitor water flow and quality during works adjacent to the Muirpark agricultural pond	Minor – Not Significant

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
	to provide security to agricultural use of the pond supply.	
GWDTE – Direct Loss	N/A (no additional mitigation beyond embedded mitigation in infrastructure design)	**Moderate – Significant**
GWDTE – Indirect Loss	N/A (no additional mitigation beyond embedded mitigation in infrastructure design)	**Moderate - Significant**
Transport and Access		
Minor Roads (Severence)	(TR-01) A Construction Traffic Management Plan (CTMP) will be prepared to address and minimise the impacts on Minor Roads within the Study Area due to increased traffic and heavy goods vehicles (HGVs) from the Proposed Development. It will reduce construction vehicle numbers and manage vehicle impacts through routing and scheduling. Additionally, measures will be implemented to reduce and manage construction staff travel by private car, such as: • Reporting to the security gate upon commencement, • Developing a logistics plan, • Identifying approved haul routes, • Providing site induction packs, • Erecting temporary construction site signage, • Imposing speed limits, • Scheduling staggered delivery times, • Including control measures in contractor tender enquiries, • Prohibiting HGV lay-ups in surrounding roads, • Maintaining clean and safe roads, and • Installing a wheel cleaning facility on-site.	Not Significant
Minor Roads (Driver Delay)	(TR-01) A CTMP will be prepared to address and minimise the impacts on Minor Roads within the	Not Significant

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
	Study Area due to increased traffic and HGVs from the Proposed Development. It will reduce construction vehicle numbers and manage vehicle impacts through routing and scheduling. Additionally, measures will be implemented to reduce and manage construction staff travel by private car, such as: • Reporting to the security gate upon commencement, • Developing a logistics plan, • Identifying approved haul routes, • Providing site induction packs, • Erecting temporary construction site signage, • Imposing speed limits, • Scheduling staggered delivery times, • Including control measures in contractor tender enquiries, • Prohibiting HGV lay-ups in surrounding roads, • Maintaining clean and safe roads, and • Installing a wheel cleaning facility on-site.	
Minor Roads (Pedestrian Delay and Amenity)	Not required however, CTMP implemented as 'good practice'.	Not Significant
Minor Roads (Fear and Intimidation)	Not required however, CTMP implemented as 'good practice'.	Not Significant
Minor Roads (Accidents and Safety)	Not required however, CTMP implemented as 'good practice'.	Not Significant
Minor Roads (Hazardous and Large Loads)	Not required however, CTMP implemented as 'good practice'.	Not Significant
Cultural Heritage		
King's Yett Cairn (SM2580)	(CH-01) The design of the Proposed Development has sought to avoid or minimise (as far as	Minor

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
	reasonably possible) effects to heritage assets.	
Dundaff Hill, Mound (SM6553)	N/A (no additional mitigation beyond embedded mitigation in infrastructure design	Minor
Dundaff Hill, Enclosure (SM7131)	N/A (no additional mitigation beyond embedded mitigation in infrastructure design)	Minor
Stirling Castle (SM90291)	(CH-01) The design of the Proposed Development has sought to avoid or minimise (as far as reasonably possible) effects to heritage assets.	Minor
Buckie Burn Sheiling-Hut (SC HER Ref: 3379)	N/A (no additional mitigation beyond embedded mitigation in infrastructure design)	Minor
Noise		
Easter Cringate Cottage	(N-01) Use of Best Practicable Means (BPM) during construction, controlled through adoption of CEMP.	No significant residual effects
Ryecroft	(N-01) Use of Best Practicable Means (BPM) during construction, controlled through adoption of CEMP. (N-02) Adoption of turbine curtailment strategy.	No significant residual effects
Craigengelt	(N-01) Use of Best Practicable Means (BPM) during construction, controlled through adoption of CEMP.	No significant residual effects
Craigengelt Bungalow	(N-01) Use of Best Practicable Means (BPM) during construction, controlled through adoption of CEMP.	No significant residual effects
Muirpark	(N-01) Use of Best Practicable Means (BPM) during construction, controlled through adoption of CEMP.	No significant residual effects
Todholes Farm Cottage	(N-01) Use of Best Practicable Means (BPM) during construction, controlled through adoption of CEMP.	No significant residual effects

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
Shankhead	(N-01) Use of Best Practicable Means (BPM) during construction, controlled through adoption of CEMP.	No significant residual effects
Shankhead Farm	(N-01) Use of Best Practicable Means (BPM) during construction, controlled through adoption of CEMP.	No significant residual effects
Townhead Farm	(N-01) Use of Best Practicable Means (BPM) during construction, controlled through adoption of CEMP.	No significant residual effects
Greathill House	(N-01) Use of Best Practicable Means (BPM) during construction, controlled through adoption of CEMP.	No significant residual effects
Socio-economics, Tourism and Recreation		
Public Access (tourism and recreation)	N/A	Minor beneficial
Employment & GVA (local and national economies)	N/A	Minor beneficial
Climate Change and Carbon Balance		
Vulnerability of Proposed Development to Climate Change		
The Proposed Development (Changes to generation through changes in wind speed)	N/A	Negligible Not Significant
The Proposed Development (Damage to infrastructure or operation due to changes in temperature)	N/A	Not Significant
The Proposed Development (Potential for flooding at the Proposed Development Site and impact on operation through changes to precipitation)	N/A	Not Significant
Influence of the Proposed Development on Climate Change		
Climate and Atmosphere (Reduction in GHG emissions through offsetting of existing conventional generation)	N/A	Significant (Positive)

Receptor	Mitigation Measures (refer to Chapter 15 for detail)	Residual Effect
Other Considerations		
National Air Traffic Service (NATS)	(OC-01) The Applicant and NATS reached an agreement in September 2023 on a suitable mitigation plan to prevent any adverse effects on NATS and (Ministry of Defence) MOD operations resulting from the Proposed Development	No significant effects
Civil Aviation Authority (CAA)/Ministry of Defence (MOD)	(OC-02) The Applicant appointed Straten CSL to develop an aviation lighting strategy that meets Civil Aviation Authority (CAA) and MOD requirements (Technical Appendix 14-1).	No significant effects

16.3 References

UK Government (2017). The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 (the EIA Regulations). Available at: https://www.legislation.gov.uk/ssi/2017/101/contents/made [Accessed: 30/04/2024].