AC33

Frawney Wind Farm

Environmental Statement
Volume 2
Report and Appendices
June 2014

Polar Energy
(Finlarg) Ltd

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Frawney Wind Farm Environmental Statement

Volume 2: Report and Appendices

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Atmos Consulting Ltd

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Polar Energy (Finlarg) Ltd

Version	Date	Reason
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Rosebery House,
9 Haymarket
Terrace,
Edinburgh,
EH12 5EZ

Moray House,
16-18 Bank Street,
Inverness,
IV1 1QY

Durham Dales
Centre,
Castle Gardens,
Stanhope,
County Durham,
DL13 2FJ

Mynydd Awel,
Mold Business Park,
Maes Gwern,
Mold,
CH7 1XN

Keystone
Innovation Centre
Croxton Road
Thetford
Norfolk
IP24 1JD

1 Introduction

1.1 The Application

Atmos Consulting Ltd has been appointed by Polar Energy (Finlarg) Ltd to undertake an Environmental Impact Assessment (EIA) for the proposed Frawney Wind Farm height extension development at Finlarg Hill, approximately 8km south of Forfar, to the west of the A90 in Angus (Figure 1-1), hereafter referred to as "proposed development". This document is the Environmental Statement (ES) which reports the EIA of the proposed development application.

This application is presented as an alternative proposal to the consented five turbine scheme (80m to tip), which was approved on appeal in January 2014 (PPA-120-2032).

The grant of consent of the five turbine scheme has established the principle of a commercial wind energy development at the site. The Reporter found that the consented scheme accorded with the development plan and that there were no material considerations to lead him to alter his conclusions in respect of the conformity.

The application is for four wind turbines of up to 92.5m tip height (57m hub height) with associated crane hardstanding, new and upgraded access track, substation, temporary construction compound and permanent meteorological mast. The candidate turbine is an Enercon E70 of 2.3MW capacity, which would provide a total site capacity of 9.2MW. Figure 3-2 presents the proposed infrastructure and turbine coordinates. This application seeks consent to alter the consented wind farm at Frawney (13/00532/EIAL) by increasing the tip height of the turbines from 80m to 92.5m while removing one turbine to reduce the potential impact. This change in turbine height will increase the wind farm output by 5.2MW by effectively increasing the blade length, the hub height will increase by only one metre.

The development site is centred on NGR 341650 742250, located on the eastern flanks of Finlarg Hill, to the north of Over Finlarg farmhouse and buildings, from 200m to 250m Above Ordnance Datum (AOD). The site comprises open rural working agricultural grassland, dominated by two electricity power lines orientated from southwest to northeast. There are limited stands of woodland on the site, mostly located to the north and outside of the development area. The rural area includes a number of hamlets and individual farmsteads including Tealing approximately 3.5km to the south.

1.2 The Applicant

The Frawney Wind Farm development is being progressed by Polar Energy (Finlarg) Ltd (Polar Energy). The development site is located within land owned by the proprietor of Over Finlarg Farm, who is financially involved in the project.

The owners of Polar Energy have been successfully developing wind energy projects in Scotland since 2006. Recent achievements include gaining consent for two sites of three wind turbines (2 x 7.5MW) in Aberdeenshire. Polar Energy have concluded further land lease options for other sites in Aberdeenshire and Angus with further capacity for up to 25MW of clean, renewable energy.

Atmos Consulting Ltd (Atmos) is acting as agent on behalf of Polar Energy to manage the planning application process.

1.3 Purpose of the Environmental Statement

This ES reports the findings of the EIA process by describing the proposed development, the current conditions at the site and the likely impacts which may result from the proposed development. Where appropriate, mitigation is proposed and any residual impacts are highlighted.

This ES has been submitted to Angus Council as part of an Application for Full Planning Permission and has been prepared to inform the Council, statutory consultees and the public about the likely significant environmental effects of the proposed application on the environment.

1.4 The EIA Regulations

EIAs have been required for certain major developments since the implementation in the UK of the European Council Directive on Environmental Assessment (85/337/EEC). The Directive was first implemented in the UK in 1988 and subsequently amended by Directive 2011/92/EU ('The EIA Directive') on the assessment of the effects of certain public and private projects on the environment. Directive 2011/92/EU is implemented by the Environmental Impact Assessment (Scotland) Regulations 2011 ('The EIA Regulations'). These regulations set out the information which must be included in the ES, which are covered in detail in Section 2.4.

1.5 Requirement for an EIA

Schedule 1 of the regulations lists large scale or high impact developments which will always require an EIA, whereas Schedule 2 lists developments which may or may not require an EIA depending on the likelihood the development will have significant effects on the environment by virtue of factors such as its nature, size or location.

Reference to the EIA Regulations and Circular 3/2011 (Scottish Government, 2011) indicates that the proposed development falls within Schedule 2, Paragraph 3(i) of the EIA Regulations, as it is an *"installation for the harnessing of wind power for energy production (windfarm) where (ii) the hub height of any turbine or height of any other structure exceeds 15 metres."*

A Schedule 2 development will require EIA if it is likely to have significant effects on the environment by virtue of factors such as its size, nature or location. The requirement for a full EIA for a proposed development can be determined via a request to the local planning authority for a screening opinion under Part 2 Regulation 5 of the EIA Regulations. In this case, a screening opinion was not sought since it was assumed that the proposed development would be of a size and nature that may have significant effects and, therefore, require an EIA. Accordingly, the application will be for EIA development and this ES is submitted in support of the planning application. The scope of the ES was determined through consultation with Angus Council as outlined in Chapter 2.

1.6 Structure of the ES

The ES is published in the following manner:

- Volume 1: Non-Technical Summary;
- Volume 2: Environmental Statement and Appendices; and

- Volume 3: Figures.

The Non-Technical Summary provides an overview of the ES and is intended for review by the general public. It is brief and includes a description of the proposed development, a summary of the predicted significant environmental effects and proposed mitigation measures.

The ES is structured around the following chapter headings:

- Chapter 1: Introduction;
- Chapter 2: EIA Approach and Methodology;
- Chapter 3: The Development;
- Chapter 4: Planning and Energy Policy;
- Chapter 5: Noise;
- Chapter 6: Landscape and Visual;
- Chapter 7: Ecology;
- Chapter 8: Ornithology;
- Chapter 9: Hydrology, Hydrogeology and Soils;
- Chapter 10: Cultural Heritage;
- Chapter 11: Transport and Access;
- Chapter 12: Socio-economics and Recreation; and
- Chapter 13: Infrastructure, Aviation and Safety.

1.7 The EIA Team

The EIA team was led by Atmos Consulting with assistance from specialist consultants listed in Table 1-1.

Table 1-1: EIA Team

Chapter	Company Undertaking the Work
Planning	Atmos Consulting
Noise	Atmos Consulting
Landscape and Visual	Andrew Jones
Ecology	Atmos Consulting
Ornithology	Atmos Consulting
Hydrology, Hydrogeology and Soils	Atmos Consulting
Cultural Heritage	Archas Cultural Heritage Ltd
Transport and Access	Atmos Consulting
Socio-economics	Grangeston Economics
Infrastructure, Aviation and Safety	Atmos Consulting

1.8 Additional Documents

1.8.1 Planning Statement

A Planning Statement is submitted which assesses the proposed development in the context of adopted and emerging planning policies, setting out the arguments for and against the proposed development and concluding with recommendations about the overall acceptability of the proposals in relation to the planning context.

1.9 Contact Details

The ES can be purchased from Atmos for £200 for a paper hard copy or £10 for a CD copy.

Contact:	Atmos Consulting Ltd., Rosebery House, 9 Haymarket Terrace, Edinburgh, EH12 5EZ
E-mail:	frawney@atmosconsulting.com
Tel:	0131 346 9100

2 EIA Approach and Methodology

2.1 The EIA Process

EIA is the process of compiling, evaluating and presenting all the significant environmental effects of a proposed development. The assessment is designed to help identify significant adverse environmental effects. This assessment can then lead to the identification and incorporation of appropriate mitigation measures into the scheme design to minimise or avoid environmental impact.

The main steps which have been followed in this assessment process are as follows:

- Determining the requirement for an EIA ('screening');
- Determining the scope of the assessment ('scoping');
- Completion of baseline surveys to provide a description of the environmental character of the area likely to be affected by the proposed development;
- Relevant natural and man-made processes that may change the character of the site have been identified;
- Consideration has been given to the possible interactions between the proposed development and both existing and future site conditions;
- Using the initial designs of the proposed development, the possible environmental effects (both direct and indirect) have been predicted for the short and long term taking into account the cumulative effects with other known development proposals in the area;
- Recommendations have been made to avoid, minimise or mitigate adverse effects and enhance positive effects. Alterations to the design have then be re-assessed and the effectiveness of mitigation proposals determined;
- Assessment of any residual impacts, which will remain after mitigation; and
- Consultation (undertaken throughout the EIA process).

The results of the EIA are set out in this ES. The various stages of the EIA process are outlined below.

2.2 Screening

Screening is an important part of the EIA process and represents the first process of assessing the need for, and requirements of, an EIA. 'Screening' (as defined by Part 2, Regulation 5 of the Regulations) allows the proposed development to be initially assessed by the Regulatory Authorities to determine whether, based on an initial description the project, it is likely to require an EIA to be completed. The subsequent 'Screening Opinion' is based on the criteria set out within the EIA Regulations 2011 and indicates whether an EIA is likely to be required. In the case of the proposed development a screening opinion was not sought since it was assumed that the proposed development would be of a size and nature that may have significant effects and, therefore, require an EIA.

2.3 Scoping

Scoping is the second formal stage in the EIA process and is used to ensure that all the environmental issues that could involve significant effects are identified and appropriate methods for information collection and impact assessment are devised. The scoping process has involved the following key stages:

- Preliminary appraisal of the predicted likely effects of the proposals from a list of environmental issues derived from the EIA Regulations;
- Preliminary investigations to inform the scoping report which accompanied a request to Angus Council for a Scoping Opinion;
- Confirmation from Angus Council and other statutory consultees (including SNH) on the content of each assessment; and
- Direct consultation by the EIA team with a number of statutory and non-statutory organisations during the EIA process.

A scoping study was undertaken by Atmos and submitted to Angus Council in November 2008. Alongside the production of the scoping report some initial consultations with aviation and telecommunication operators was undertaken. The scoping exercise was undertaken for a seven turbine development, up to 110m tip height with a maximum energy output of 17.5MW, within a study area of approximately 42ha (Figure 3-1, layout a). Atmos received a scoping response from Angus Council on 02 April 2009 (Ref: N.1.5/DS/IAL), which included letters from Scottish Natural Heritage (SNH) (Ref: CNS REN WF FRAWNEY) dated 27 January 2009 and Scottish Environment Protection Agency (SEPA) dated 16 January 2009. The response did not include any correspondence from Historic Scotland, Scottish Water or Transport Scotland. The Scoping Response from Angus Council is included in Appendix 2-1.

After initial consultation and scoping responses in 2009, the project was put on hold due to an objection to the proposals by Defence Estates (MOD) in relation to potential conflict with the operation of their Air Traffic Control (ATC) radar at Royal Air Force (RAF) Leuchars. At this time, it was not clear whether a mitigation solution to the potential conflict could be found.

In 2011, Polar Energy decided to progress the project due to technological advances and development of mitigation solutions for radar and wind turbines. Atmos were commissioned by Polar Energy to revisit the design of the proposed wind farm by undertaking an updated feasibility study within the original study area of approximately 42ha. Based on the available constraints within the study area, a proposed development of five wind turbines clustered on the eastern flanks of Finlarg Hill were considered to be feasible to be taken forward to planning. A scoping meeting to discuss the revised design with Angus Council was undertaken on 12 March 2012. SNH were also invited to this meeting, although were unable to attend.

Angus Council have confirmed through the scoping process that the following list of topics is to be considered within the EIA:

- Site selection/design;
- Description of project;
- Landscape and visual assessment;
- Noise assessment;
- Ecological assessment (including ornithology);

- Cultural heritage assessment;
- Hydrological and hydrogeological assessment;
- Transport and access;
- Electromagnetic Interference / air traffic safety;
- Socio-economic assessment; and
- Cumulative impact assessment.

Each of the above environmental topics is dealt with under a separate chapter in the ES and has been prepared by a specialist in that field.

2.4 Consultation

Effective consultation is a fundamental part of the EIA process. The various EIA team members have consulted with parties relevant to their technical specialism in order to obtain baseline information or to agree aspects of their methodology. A full list of these consultees is presented in Table 2-1.

Table 2-1: Consultees

Statutory Consultees	Non Statutory Consultees
Angus Council	Arqiva Limited and Arqiva Services Limited
Historic Scotland (HS)	ATKINS
Scottish Environment Protection Agency (SEPA)	Bear Scotland Ltd.
Scottish Government	Botanical Society of the British Isles (BSBI)
Scottish Natural Heritage (SNH)	British Telecom (BT)
Scottish Water	Butterfly Conservation
	Civil Aviation Authority (CAA)
	Cable&Wireless
	Ericsson
	Everything Everywhere (Orange)
	Friends of Angus Herpetofauna
	Hutchison 3G UK Limited
	Joint Radio Company Limited (JRC)
	Local Bird Recorder
	McManus Museum
	Ministry of Defence, Defence Estates (MOD)
	Network Rail
	Ofcom
	Perth Museum
	Raptor Study Group
	Royal Society for the Protection of Birds (RSPB)
	Scottish Ambulance Service
	Scottish and Southern Energy (SSE)
	Scottish Badgers
	Scotways
	Scottish Wildlife Trust (SWT)
	Tay District Salmon Fisheries Board
	Tayside Bat Group

Statutory Consultees	Non Statutory Consultees
	Tayside Biodiversity Partnership
	Tayside Police
	Transport Scotland

2.4.1 Consultation with Angus Council

In June 2012, an application for planning permission for five wind turbines of 100m tip height on land at Over Finlarg and Nether Finlarg was submitted to Angus Council (Ref: 12/00577/EIAL).

Subsequent correspondence and discussions with Angus Council throughout 2012 and early 2013 indicated that the scale of the proposed scheme was considered by the planning officers to be too great for the location in terms of its potential landscape and visual impacts, particularly in terms of residential amenity.

Angus Council's Renewable Energy Implementation Guide, which was published in June 2012, subsequent to the submission of planning application 12/00577/EIAL, notes that the Igneous Hills landscape character is "*considered to have scope for turbines circa 80m in height which do not disrupt the principle ridgelines or adversely affect the setting of important landscape features monuments such as Kinpurney Monument and Auchterhouse hillfort*." In response to planning application 12/00577/EIAL SNH also expressed concerns regarding the height of the proposed turbines and suggested a reduction in tip height to approximately 87m in line with those turbines proposed at Govals Farm, 1km northwest of Frawney.

Taking the above into account, potential alternative options for a smaller and more contained scheme were investigated and presented to Angus Council via a series of letters, emails and meetings held from March to May 2013. The options are presented fully in Chapter 3 of this ES.

The discussions resulted in a scheme which has since been consented on appeal (13/00532/EIAL) which comprised of five wind turbines up to 80m tip height and ancillary infrastructure; which would be 20m less than the previous scheme (Ref: 12/00577/EIAL). Although located within the same site boundary, a more contained layout was presented which retained the operational efficiency of the turbines while reducing the overall distances of turbines from residential properties (the distance from Govals Cottage to turbine 5 was over 1km) as well as reducing the horizontal spread of the wind turbines by over 50% (when viewed from Nether Finlarg).

In February 2014 a Pre-application Inquiry was submitted to Angus Council to investigate the possibility of reducing the number of turbines of the consented scheme from five to four while increasing the tip height from 80m to 92.5m. This reduction in turbine numbers further improves the scheme in terms of its potential impact on residential amenity while allows the wind farm capacity to increase from 4MW to 9.2MW

In their Pre-application Inquiry response, Angus Council expressed concern that the proposed scheme would present issues as it would appear to exceed the capacity of the landscape to accommodate such a development, even with the reduction to four turbines. They also consider that both the proposed increase in height and the substantial changes to the turbine proportions would cause conflict with Development Plan policy in isolation and cumulative terms. Chapter 6 addresses these concerns.

Notwithstanding the above comments in respect of landscape and visual impacts, Angus Council recognise that the amended scheme would have a total generating capacity of 9.2MW. This is a substantial increase over the 4MW capacity within the approved scheme. This environmental benefit would clearly form a key material consideration in the balancing act in the determination of any planning application, in accordance with guidance and Development Plan policy.

2.4.2 Consultation Responses to Application 13/00532/EIAL

A summary of the statutory and non-statutory consultee responses provided to planning application 13/00532/EIAL is presented in Table 2-2. It should be noted that the current scheme being applied for is located within the same land area as the original application although is more contained and, therefore, will result in less land take. Overall the environmental impacts commented upon will be no greater than those identified in the ES's for application 12/00577/EIAL and 13/00532/EIAL. The comments in Table 2-2 are considered to be relevant to the current application and have been taken into account in the re-design of the scheme and revised EIA presented in this ES; which inevitably has reduced impacts.

Table 2-2: Summary of Consultee Responses

Consultee / Date	Response/ Comments
EMI and Technical	
Atkins 24/06/2013	No objections in relation to UHF Radio Scanning Telemetry communication
Arqiva 08/08/2013	No objection
BT 28/06/2013	The wind farm project should not cause interference to BTs radio networks
Everything Everywhere 15/08/2012	No Orange microwave links affected by the proposal
Health and Safety Executive 03/07/2012	No comment
JRC 10/07/2013	In the case of the proposed wind energy development, JRC does not forsee any potential problems based on known interference scenarios and the data provided.
Vodafone 24/06/2013	No objection
Transport	
Transport Scotland 05/07/2012	No comment given the minimal impact upon trunk road traffic
JMP for Transport Scotland 30/07/2013	Having reviewed the revised application, we can confirm that the revised development proposals will not cause and significant traffic or associated environmental impacts and the truck road network. Transport Scotland therefore accept the submitted ES but would recommend the following conditions are attached to any approval issued: 1. Route Access Report 2. Any additional signing or temporary traffic control measures deemed necessary due to the size or length of any local being delivered or removed must be undertaken by a recognised QA traffic management consultant, to be approved by Transport

Consultee / Date	Response/ Comments
	Scotland before delivery commences.
Tayside Police 11/10/2012	No issues
Roads Division (Angus Council) 05/07/2013	No objection subject to a Construction Traffic Management Plan being secured by planning condition and that prior to construction the running surface of the existing access track shall be recognised in length for a distance of at least 15 metres from its junction with the public road.
Infrastructure	
Scottish Water 06/07/2012	No objection
National Grid 17/07/2013	No objection to the proposal which is in close proximity to a High-Pressure Gas Pipeline – Feeder 12 Kirriemuir to Rhynd
Scottish Gas Networks 17/07/2012	No objection
Historic Environment	
Archaeology (Council) 26/06/2013	The developer shall secure the implementation of an archaeology watching brief, to be carried out by an archaeological organisation acceptable to the council archaeology service on behalf of the planning authority, during any groundbreaking and development work.
Historic Scotland 27/06/2013	No objection – content that there would be no significant impacts on the site or setting of any heritage assets.
Natural Environment	
RSPB 10/07/2012	No comments
SNH 17/07/2013 & 28/09/2012	2013 response - Consider that the situation at Frawney and the surrounding area has not changed such that our advice would alter from our previous response. The recommendation we made previously to reduce the turbine heights to be commensurate with those of the proposed Govals (12/00570/EIAL) development appears to have been adopted. Irrespective of the outcome of the Govals appeal the reduced height turbines at Frawney may help to mitigate the cumulative impact with other turbines in the area and those of the Govals proposal should it be allowed though appeal. We consider that Angus Council is best placed to identify the key issues and impacts of this reduced height proposal. 2012 response - It is unlikely that the proposal will have a significant effect on the qualifying interests of nearby goose Special Protection Areas (SPA) either directly or indirectly. An appropriate assessment is therefore not required. The proposal, on its own, will have significant and adverse but generally localised impacts on landscape and visual amenity. However, to improve the landscape and visual relationship between Frawney and Govals a reduction in the height of the turbines at Frawney, commensurate with Govals, is recommended. It is considered that within the Igneous Hills Landscape Character Type (LCT) and the wider content of the Sidlaw Hills, the development of Frawney, in addition to Dodd Hill and Govals and other consented developments, there will be a significant reduction in this local and regionally important landscape resource. Overall we consider that any potentially detrimental impacts on local biodiversity can be avoided through appropriate planning conditions. The

Consultee / Date	Response/ Comments
	mitigation, compensation and enhancement measures proposed in the ES should be followed, and the Ecological Mitigation Strategy (EMS); employment of an Ecological Clerk of Works and proposals for writing an Environment Management Monitoring Plan (EMMP) and associated Habitat Management Plan (HMP) are welcome along with compensatory broadleaved tree planting.
Countryside Officer (Angus Council) 15/01/2013 (2012) and 06/11/2013 (2013)	2012 response The proposed turbines are the same size as those refused at appeal at Hill of Finavon (100m compared to 99.5m). The proposed development would be located on lower ground within the Sidlaw Hills. (They would be below the 250m contour with the hills to the immediate west being circa 330m). This has substantially contributed towards the visual impact within the wider landscape being more contained than would be the case with a hilltop location. The most significant visual effects would be in relation to the views within 5km to the east and north; and within 1km to the south and west, where the turbines would often dominate views locally. The most significant effects would be in relation to nearby houses. The LVIA under estimates visual effects, most notably a slight under-assessment of receptor sensitivity. This however does not change the overall results, which means that I concur with the SNH conclusions that significant effects would result in respect of viewpoints 1, 2, 3, 4, 9, 11 &16. In terms of the impacts upon houses within 2km, I consider that the ES generally under-estimates the magnitude of impacts upon houses, many of which would clearly experience significant effects. In respect of Cumulative Landscape Effects, the combination of Govals, Frawney and Dodd Hill together would create a windfarm character which would be at least "landscape with windfarms" within LCT8; locally becoming "windfarm landscape". Cumulative visual effects are contained within 6.6.3 of the ES. Whilst cumulative impacts are described, there are only cumulative wirelines from three viewpoints and there appears to be no formal assessment of impacts. Using cumulative wirelines submitted in support of Govals, shows the different turbine sizes together with some being on top of hills and others being on lower ground would further increase the lack of design coherence. Given the above I would consider that the cumulative impact from Carrot Hill would be high. The A90(T) would experience the most significant sequential cumulative effects. Cumulative wirelines are not provided for nearby houses, but it is nevertheless likely that a number of houses would experience significant cumulative impacts. The 2013 response reiterated the comments above but added that "from more distant viewpoints, this size (80m to blade tip) is broadly in scale with the landscape... More locally, the turbines often would appear large and likely to dominate other landscape features".
Countryside Access Officer (Angus Council) 10/12/2012	The development should not significantly alter public access, but the visual effects of the development may be a consideration.
Aviation	
MOD 18/07/2013	The MOD objected, in a letter to Angus Council dated 17th August 2012 to the previous planning application (12/00577), on the grounds that the proposed development would have an unacceptable impact on the Air Traffic Control (ATC) radar at RAF Leuchars. The MOD noted that if the

Consultee / Date	Response/ Comments
	develop is able to overcome these unacceptable impacts that all turbines should be fitted with appropriate aviation lighting. As you are aware, the MOD has been in discussions with the applicant since the submission of this objection letter with a view to reaching agreement on appropriate mitigation to address the unacceptable impacts of this development. The letter also stated that the MOD was willing to remove their objection subject to the composition of the enclosed conditions, as agreed with the applicant. I can confirm that the MOD has undertaken a full assessment of the revise proposal. This assessment has confirmed that the turbines will be 21.8km from, in line of sight to, and will cause unacceptable interference to the ATC radar at RAF Leuchars. As such the MOD would object to this revised proposal. In light of the outcome of the assessment, the mitigation proposal previously submitted to the MOD has also had a technical and operational review. This mitigation proposal previously submitted to the MOD has also had a technical and operational review. This mitigation proposl has been accepted but the MOD, and I can confirm that the MOD will raise no objection to this revised planning application subject to the inclusion of the planning conditions at Annex A on any forthcoming consent.
Dundee Airport 26/06/2013	This development would not infringe the safeguarding surfaces for Dundee Airport.
Environmental Protection - Water Environment and Noise	
SEPA 08/08/2012 & 04/07/2013	Reiterated its response to the 2012 planning application as the revised application did not change their previous position. SEPA's principal area of concern is centred on construction activities and the creation of access roads and consider that the production of a Construction Method Statement (CMS) is essential, to be fully implemented by all operators on site. SEPA has no objection subject to a planning condition being attached to any consent ensuring that no development can commence until a full site specific Environmental Management Plan (EMP) incorporating a Construction Method Statement (CMS) and a Site Waste Management Plan (SWMP) is submitted at least one month prior to commencement of development and approved by the planning authority, in consultation with SEPA and other agencies such as SNH. Detailed guidance on the content of the CMS is also provided by SEPA. It is unclear from the application whether the developer intends to utilise borrow pits. It should be noted that should infilling the borrow pit use waste materials like peat, shrubbery, fencing materials or any imported 3rd party waste, as part of the works, is regarded as a waste disposal activity and therefore requires SEPA authorisation. SEPA request confirmation as to whether borrow pits are intended. Should the developer wish to import inert wastes to assist the formation and construction of the access roads they would be required to submit a Paragraph 19 Waste Management Licence exemption for "relevant work". SEPA does not have any concerns regarding the ecological impacts of this proposal as long as SEPA Pollution Prevention Guidelines are followed, appropriate licences are in place and suitable mitigation measures are employed. Impacts on Private Water Supplies (PWS) have been assessed by the developer. From the data provided it is considered unlikely that the proposed development will have an adverse impact on PWS in the area.

Consultee / Date	Response/ Comments
Scottish Government Environmental quality 15/08/2012	No objection
Scottish Water 03/07/2013	Scottish Water assets are not affected
Environmental and Consumer Protection (Angus Council) 06/12/2012; 26/03/2013 & 03/04/2013	14/10/2013: 1. The rating level of noise immissions from the combined effects of the wind turbines (including the application of any tonal penalty) when determined in accordance with the attached Guidance Notes (to this condition), shall not exceed at any property lawfully existing at the date of this planning permission (a) the LA90 dB (A) levels, shown in tables A & B, during the respective periods described in these tables; where there is more than one property at a location the noise limits apply to all properties at that location or (b) LA90 35dB (A) at wind speeds up to 10 m/s at 10m height at any other location. Where the occupiers of a property have a financial interest in the development, the absolute lower limit of the above noise levels may be increased to 45dB (A) For the avoidance of doubt "Financial Interest" is defined as either:- (a) owning, or having a share in ownership, of the land on which the turbine is to be sited; (b) leasing the land on which the turbine is sited; which lease shall be for a period exceeding 20 years; or (c) being a share holder or owner of the applicant (or their successors as operators of the wind turbine) 2. The wind farm operator shall continuously log power production, wind speed and wind direction, all in accordance with Guidance Note 1(d). These data shall be retained for a period of not less than 24 months. The wind farm operator shall provide this information in the format set out in Guidance Note 1(e) to the Local Planning Authority on its request, within 14 days of receipt in writing of such a request. 3. No electricity shall be exported until the wind farm operator has submitted to the Local Planning Authority for written approval a list of proposed independent consultants who may undertake noise compliance measurements in accordance with this permission. Amendments to the list of approved consultants shall be made only with the prior written approval of the Local Planning Authority. 4. Within 21 days from receipt of a written request from the Local Planning Authority following a complaint to it from an occupant of a dwelling alleging noise disturbance at that dwelling, the wind farm operator shall, at its expense, employ a consultant approved by the Local Planning Authority to assess the level of noise immissions from the wind farm at the complainant's property in accordance with the procedures described in the attached Guidance Notes. The written request from the Local Planning Authority shall set out at least the date, time and location that the complaint relates to and any identified atmospheric conditions, including wind direction, and include a statement as to whether, in the opinion of the Local Planning Authority, the noise giving rise to the complaint contains or is likely to contain a tonal component. 5. The assessment of the rating level of noise immissions shall be undertaken in accordance with an assessment protocol that shall previously have been submitted to and approved in writing by the Local

Consultee / Date	Response/ Comments
	Planning Authority. The protocol shall include the proposed measurement location identified in accordance with the Guidance Notes where measurements for compliance checking purposes shall be undertaken, whether noise giving rise to the complaint contains or is likely to contain a tonal component, and also the range of meteorological and operational conditions (which shall include the range of wind speeds, wind directions, power generation and times of day) to determine the assessment of rating level of noise immissions. The proposed range of conditions shall be those which prevailed during times when the complainant alleges there was disturbance due to noise, having regard to the written request by the Local Planning Authority to investigate a complaint, and such others as the independent consultant considers likely to result in a breach of the noise limits. 6. Where a dwelling to which a complaint is related is not listed in the tables attached to these conditions, the wind farm operator shall submit to the Local Planning Authority for written approval proposed noise limits to be adopted at the complainant's dwelling for compliance checking purposes. The proposed noise limits are to be those limits selected from the Tables specified for a listed location which the independent consultant considers as being likely to experience the most similar background noise environment to that experienced at the complainant's dwelling. The rating level of noise immissions resulting from the combined effects of the wind turbines when determined in accordance with the attached Guidance Notes shall not exceed the noise limits approved in writing by the Local Planning Authority for the complainant's dwelling. 7. The wind farm operator shall provide to the Local Planning Authority the independent consultant's assessment of the rating level of noise immissions undertaken in accordance with the Guidance Notes within 2 months of the date of the written request of the Local Planning Authority for compliance measurements to be made undertaken, unless the time limit is extended in writing by the Local Planning Authority. The assessment shall include all data collected for the purposes of undertaking the compliance measurements, such data to be provided in the format set out in Guidance Note 1(e) of the Guidance Notes. The instrumentation used to undertake the measurements shall be calibrated in accordance with Guidance Note 1(a) and certificates of calibration shall be submitted to the Local Planning Authority with the independent consultant's assessment of the rating level of noise immissions. 8. Where a further assessment of the rating level of noise immissions from the wind farm is required pursuant to Guidance Note 4(c), the wind farm operator shall submit a copy of the further assessment within 21 days of submission of the independent consultant's assessment pursuant to paragraph (d) above unless the time limit has been extended in writing by the Local Planning Authority. 9. Prior to the commencement of development the make and model of the turbine selected for use in the development shall be submitted for the written approval of the Planning Authority. In the event that any turbine other than the candidate turbine is selected for use the developers submission shall be accompanied by any supporting information considered necessary by the Planning Authority. Once approved all turbines shall be operated and maintained in accordance with the approved specification. 10. No wind turbine shall be micro sited any nearer to Govals cottage than is shown in Figure 3-2 Site layout in volume 3 of the Environmental statement dated June 2013 unless approved in writing by the Planning Authority

Consultee / Date	Response/ Comments
	11. Prior to the commencement of development a mitigation scheme to address any impacts caused by shadow flicker shall be submitted for the written approval of the Planning Authority. Once approved the operation of the wind farm shall take place in accordance with the scheme unless the Planning Authority gives written consent to any variation. For the avoidance of doubt the mitigation scheme shall apply to all sensitive receptors including all residential properties and office buildings within 10 rotor diameters of a turbine. 12. That in the event of a pollution incident or interruption to supply, caused by the wind farm development, affecting or likely to affect any private water supply, the wind farm operator shall provide an immediate temporary supply to those affected until permanent mitigation can be effected to the satisfaction of the Planning Authority. Any replacement supply shall be of a quality to meet the private water supplies (Scotland) Regulations 1992 or any other appropriate Regulation in force at the time. In any case a permanent replacement supply or mitigation measures shall be provided no later than one month after the supply is first affected.
Community Councils and Neighbouring Councils	
Inverarity Community Council 26/07/2013	Objects to the Frawney application because of visual impact/effect; noise nuisance; cumulative effects on surrounding area; flicker; lack of strategic planning and effect on tourism. Any planning approval must include adequate and comprehensive safeguards to protect local residents living very close to the proposed turbines.
Tealing Community Council 03/10/2012	No comment
Dundee City Council 24/06/2013	No comment to make
Perth and Kinross Council 26/09/2012	No objections

2.4.3 Public Consultation

The proposed development has a maximum generating capacity of 9.2MW and, therefore, can be categorised as a 'Local Development' under the Planning Act 2006, as defined in Scottish Planning Circular 5 2009: Hierarchy of Developments. 'Major' and 'National' developments require a Pre-Application Consultation (PAC) to be undertaken for a minimum of 12 weeks prior to the application being submitted, with the requirement of reporting this consultation in a PAC report. 'Local Developments' and, therefore, this development, do not legally require a PAC report to be submitted with the application. Despite this, engagement with the local community is a key aspect of the EIA process and, therefore, public consultation has been undertaken as follows.

Public Exhibitions

No further public consultation has been undertaken in respect of this proposal. Public exhibitions were held to present earlier proposals in 2012.

Other Public Consultation

In order to inform the hydrology assessment (Chapter 9) for the consented application, questionnaires relating to private water supplies were circulated to properties not on mains supply within the water catchment of the proposed development site. Additionally the local landowners were interviewed to provide details on water supplies located within their land. The results of these questionnaires and interviews have informed the hydrology assessment presented in Chapter 9.

Public Consultation Feedback

Relevant feedback provided to the applicant during the public consultations helped to inform the design and assessment of the proposed development. Consultation throughout the EIA process has also resulted in information being provided and issues being raised for the following key environmental areas:

- Aviation;
- Ecology and ornithology;
- Landscape and visual amenity;
- Noise;
- Private water supplies;
- Telecommunication links; and
- Transportation.

Full details of the consultation feedback relevant to each discipline are provided in the relevant chapter of this ES.

Public Consutation Responses to Application 13/00532/EIAL

The Inverarity Community Council provided a response to the original planning application 13/00532/EIAL in which they objected to the Frawney application. The Frawney Wind Farm sits within the community council area of Tealing. Tealing Community Council held a public meeting on 30th July 2012 to discuss the then three current local wind farm applications. They reported that the majority in attendance only had concerns about Dodd Hill (application 12/00490/EIAL) which has now been refused and dismissed at appeal. The invitation to the meeting was circulated both on their website, by e-mail and via hard copy newsletters to most residents in the area. Residents were advised to contact the Angus Council planning department directly with any comments either for or against the application since the Tealing Community Council did not feel that they could comment on behalf of the community when they did not have enough feedback from residents to provide a valid letter of support or objection.

A total of 71 letters were sent to Angus Council commenting on application 13/00532/EIAL. Seventy of these were letters of objection and one was in support of the application. A summary of the responses provided to planning application 13/00532/EIAL from members of the public is presented Table 2-3. The comments are considered to be relevant to the current application and have been taken into account in the re-design of the scheme and revised EIA presented in this ES; which inevitably has reduced impacts.

Table 2-3: Summary of Public Comments to Application 13/00532/EIAL

Discipline	Summary of Comments
Landscape	• The hill will be scarred by the construction methods. Turbines will stand high up on Finlarg Hill and will not fit into the rural landscape. • Potential for enormous damage to the landscape. • Proposal is unacceptable due to significant and localised impacts on landscape and visual amenity. • More consideration should be given to creation of larger scale wind farms in less prominent and sensitive landscapes – rather than close to major traffic routes and close to residential properties.
Visual/ Drive distraction	• Road uses will find the wind farm a distraction from A90; ruining lovely road journey through peaceful Angus. • Views from Petterden junction and Carrot Hill would be permanently damaged. • The turbines will dominate the views from many locations changing the skyline due to their size, location, design and colour. The turbines will be out of proportion with other structures or natural features in the area. • Views from Govals Cottage will be unacceptable due to two nearest turbines. • Turbines are visually pleasing – there are more unsightly elements presently in Tealing including: the 750ft high broadcasting transmission mast at Balcalk; the array of masts on Craigowl and 7 overhead transmission lines emanating radially from the Tealing Substation; which are all eyesores.
Cumulative Impact	• Cumulative impact upon our local landscape will be completely intolerable. • Cumulative impact with Dodd Hill and Govals as well as a number of already built and approved turbines in the area. • Cumulative impacts in conjunction with Govals and Dodd Hill from Carrot Hill. • Some of the smaller turbines in the area were missed out from the cumulative assessment. • Cumulative effects will have a significant impact on tourism to the area.
Residential amenity	• The people living nearby wind farms will suffer an intolerable intrusion into their lives caused by the close proximity of the turbines to their home – causing stress from noise and intermittent shadow flicker. • 2km is considered to be more appropriate for set back from properties. • Assessment focusses on the orientation of the properties in relation to the position of the turbines and ignores impact on receptors using their amenity ground and travelling from and returning to their properties; therefore underestimating the impact on receptors of the highest sensitivity.
Noise	• The turbines will cause harmful infrasound noise creating health problems. • The development would create noise pollution and may breach Article 8 of the Human Right act. • Having been close up to turbines, there is an acceptance that there is noise within approx. 400yards however at 1000yards with noise from A90, noise from wind farm is expected to be well below current background levels.

Discipline	Summary of Comments
Ecology/ Wildlife	• Wildlife may suffer through disturbance of habitat. • Bat surveys not considered to be representative of optimal conditions.
Transport/ Traffic	• During construction there will be additional heavy traffic problems for locals and visitors.
Planning	• Non compliance with Angus Planning Guidelines – specifically in relation to height at 100m not conforming with the 'Renewable Energy Implementation Guide' where 80m tip height turbines would be considered more suitable. • Non compliance with policy ER34 and ER35.
Socio-economics/ Tourism	• Lack of socio-economic benefits; no jobs brought to local area. • No/ negligible CO_2 savings. • Initiatives to reduce CO_2 must be pursued. As a community Tealing can and must be responsible and do our bit for the environment and support wind farm development. • The anticipated financial support from a wind farm would be beneficial for the Tealing Village Hall. • Effects on tourism. • Reduction in value to properties. • Tealing landscape has low scenic value and wind turbines are unlikely to deter visitors returning. • Similar concerns regarding property values decreasing were expressed when the traveller's site was imposed upon the community over 20 years ago – the concerns proved unfounded. • The Michelin factory wind turbines are now accepted by the community as part of Dundee; despite earlier concerns.

2.5 Schedule 4

The approach to this EIA has followed the requirements of the EIA Regulations. Schedule 4 of the Regulations sets out the information that must be included in the ES, summarised in Table 2-4. This also identifies where the corresponding information can be found in the ES.

Table 2-4: Information Contained within the ES

Required information (EIA Regulations)	Relevant Section of this ES
1. A description of the proposed development, comprising information about the site and the design and size of a project.	A description of the development proposals and characteristics is presented in Chapter 3.
2. An outline of the main alternatives considered and an indication of the main reasons for the chosen scheme.	A summary of development alternatives considered by the applicant is included in Chapter 3. This includes detail of how the development has evolved from that submitted in the original planning applications 12/00577/EIAL and 13/00532/EIAL to the current application by taking into account consultation responses and concerns.
3. A description of the aspects of the environment likely to be affected by the proposed development, including, in particular, population, flora, fauna, soil, water, air, climatic factors, material assets, including the architectural and	The predicted individual environmental effects of the proposals are reported in Chapters 5 – 13 inclusive. Effects on population are discussed in relation to visual impacts, traffic, noise and air quality. Material assets are

Required information (EIA Regulations)	Relevant Section of this ES
archaeological heritage, landscape and the inter-relationship between the above factors.	addressed through land use, soil geology and waste, hydrological and cultural heritage effects.
4. A description of the likely significant effects of the proposed development on the environment, which should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the proposed development, resulting from: (a) the existence of the development; (b) the use of natural resources; and (c) the emission of pollutants, the creation of nuisances and the elimination of waste.	The predicted significant effects of the proposed development are reported as residual effects after relevant mitigation measures in each of the technical chapters of the ES (Chapters 5 to 13). Effects have been predicted in relation to the project's construction and permanent use of land. The operation and nature of these effects and their duration are reported. Prediction methods are discussed in each relevant technical chapter of the ES.
5. A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment.	The overall approach to mitigation is discussed in Section 2.7 of this ES. Specific mitigation measures are reported in each relevant technical chapter.
6. A Non-Technical Summary of the information provided under paragraphs 1 to 5 above.	A Non-Technical Summary (NTS) accompanies this ES as Volume 1.
7. An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the applicant in compiling the required information.	Assumptions and limitations in the EIA process are reported in Section 2.9 of this ES. Other areas of uncertainty, where they have been identified, are reported in the relevant technical chapters.

The approach has also been informed by relevant best practice guidance on EIA generally (for example the IEMA Guidelines for Environmental Impact Assessment) and on specific environmental subjects (for example noise, air quality and landscape and visual assessment). Technical guidance has been referred to in the appropriate chapters of this ES.

The reporting of the assessment of environmental effects in this ES is presented in Chapters 5 to 13 in a consistent, structured format, with reference to technical standards, guidelines and legislation. The assessments have also taken into account the findings of consultation undertaken during the EIA and scoping.

2.6 Prediction and Evaluation of Impacts

Throughout this ES the terms impacts and effects have been used interchangeably. The EIA Regulations refer to the requirement to report the significance of effects. A two stage assessment has, therefore, been undertaken in all cases whereby the potential impacts/effects have been identified and then their significance assessed in relation to the setting.

2.6.1 Types of Impacts

Three types of impact have been identified, based on the different phases of the proposed development:

- Construction impacts – temporary and short term that occur during construction;
- Permanent impacts – long term that result in a permanent change; and
- Operational impacts – resulting from the use of the site.

In most of the chapters within this ES, the significance of an effect is described as a function of impact magnitude 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 impacts 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.

2.6.2 Receptor Sensitivity

Different receptors are affected to a different extent depending on their setting, size and importance. Where appropriate, it may be necessary to relate the extent of the impact 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 2-5: Receptor Sensitivity

Sensitivity	Importance	Feature Examples
High	National/ International	Residential (occupied) properties, World Heritage Sites, Scheduled Monuments, Sites of schedulable quality, A-listed buildings or buildings of equivalent quality, Gardens and Designed Landscapes (GDLs), 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, Habitat 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, battlefield sites, 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; local nature reserve, non-productive aquifer.

2.6.3 Magnitude of Impact

The extent of any effect is based on the scale of the effect and this will vary from site to site and location to location. Table 2-6 provides examples of the magnitude of the effect as used within the assessment of the proposed development.

Table 2-6: Magnitude of Impact

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

2.6.4 Assessment of Significance of Effects

The determination of effect significance arising from the proposed development is a key stage in the EIA and is crucial to informing the decision-making process. For the purposes of this EIA, the following criteria have been used (as appropriate) to inform the assessment of impact significance:

- Spatial extent and magnitude of impact;
- Duration of impact;
- Sensitivity of receptor;
- Comparison with legal requirements, policies and standards;
- Comparison with applicable environmental thresholds;
- Effectiveness of mitigation; and
- Consultation responses.

The significance of effects reflects judgements as to the sensitivity of the affected receptor(s) and the nature and magnitude of the predicted impact(s). For example, a large adverse impact on a feature or site of low importance will be of a lesser significance than the same impact on a feature or site of high importance. For some environmental topics such as noise, significance can be evaluated quantitatively with reference to established levels and criteria. However, for most effects, significance is evaluated through professional judgement with reference to some or all of the criteria listed above. Table 2-7 shows the interrelationship between the magnitude and the sensitivity or importance of the feature.

It is important to note that terminology in chapters such as Landscape and Visual and Ecology relate to the specific guidance as outlined within those chapters and associated appendices and so they may not relate to Table 2-7.

Table 2-7: Assessment Criteria Significance

Receptor Sensitivity Importance	Magnitude of Effect			
	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

The significance of effects arising from the proposed development have been categorised throughout this ES 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 significant improvement (or deterioration) to the existing environment.

This scale has been adopted to provide a consistent approach to evaluation and reporting of the significance of environmental effects across the various disciplines presented in the ES. Based on the impact significance scale, any impact assessed as minor or below will not be considered significant. Any effect greater than minor has been evaluated as being significant.

2.7 Mitigation Measures

The EIA Regulations require the ES to include *"a description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment"*. Wherever reasonably practical, mitigation measures are proposed for each significant adverse impact predicted, taking various forms including:

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

Where none of these are deemed possible, the proposed development will seek to include measures to offset any significant adverse effects. Wherever possible, mitigation has been developed to ensure that no significant residual (negative) environmental effects are predicted.

The mitigation measures presented in this ES are recognised by the applicant as being an integral part of the delivery and design of the project.

2.8 Cumulative Impacts

In addition to the assessment of direct impacts of the proposed development, an assessment is also undertaken of the likely interrelationship and cumulative impacts of the development proposals. The assessment of interrelationship impacts is required as specified in Schedule 4, Part I of the EIA Regulations and refers to the interaction between the different environmental aspects, for example water and ecology.

Under cumulative impacts, adjacent proposed developments are considered in conjunction with the development in order to assess whether the resulting impact of all developments is of greater significance than the sum of the individual constituents.

The assessment of cumulative effects for a wind farm development is considered to be most important in terms of landscape and visual effects. Chapter 6 (Landscape and Visual) considers all developments (operational, consented and in planning/ potential appeal) within a 30km radius of the proposed development.

For chapters of this ES other than landscape and visual, operational, consented and in planning wind farms within 10km of the proposed development have been considered cumulatively. It should be noted that not all developments within this 10km radius will be relevant to each discipline and, therefore, will be considered on case by case basis in the relevant cumulative impact sections. In general the cumulative development sites (shown on Figure 6-28), located within 10km of the proposed development site have been considered. With the overall increase in trend of smaller scale wind turbines being subject to planning applications in recent years it was considered sensible to include all sizes of wind turbines up to 5km from the proposed site. Greater than 5km from the site the influence of smaller turbines diminishes with distance and, therefore, it was considered sensible to include only those wind turbines and developments greater than 50m tip height.

2.9 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 impacts. 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 ES 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 ES.

The environmental impacts reported in this ES and the level of mitigation described effectively set the minimum standard which will be achieved by the final development. The Applicant has a commitment to ensuring that, where details of the proposed development differ from those assessed in the EIA, the proposed development will not have any adverse environmental impacts which are significantly worse than those which have been assessed in the EIA and reported in this ES.

3 The Development

3.1 Introduction

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

3.2 Site Description

The development site is centred on NGR 341650 742250, located on the eastern flanks of Finlarg Hill, to the north of Over Finlarg farmhouse and buildings, from 200m to 250m Above Ordnance Datum (AOD). The site, which includes land owned by both Over Finlarg Farm and Nether Finlarg Farm, comprises open rural working agricultural grassland, dominated by two electricity power lines orientated from southwest to northeast. There are limited stands of woodland on the site, mostly located to the north and outside of the development area. The rural area includes a number of hamlets and individual farmsteads including Tealing approximately 3.5km to the south.

There are no international, national or local designations within the site boundary or in the immediate surrounding area.

There is one operational two bladed Gaia wind turbine (18.3m hub height, blade diameter 13m, tip height 24.8m) located at Nether Finlarg Farm, in the field to the west of the farmhouse. The original approved planning application was for two turbines and there is potential for the second turbine to be built. A single wind turbine has also been consented at North Tarbrax (45m tip height) approximately 1.6km east of the proposed site.

Just over 5km to the northeast of the site, on the eastern side of the A90, are two operational three bladed wind turbines at Wester Meathie. These turbines are 45.6m to blade tip height. Also to the southwest at just over 5km there is another operational 46m tip height turbine at Balkemback Farm.

The closest operational commercial wind development consists of eight turbines at Arkhill (81m tip height) approximately 6km to the west of the site. Two operational turbines are located at the Michelin Tyre Factory in Dundee (120.5m tip height), approximately 10km to the southeast; and there is one locally consented single turbine at Tealing Airfield (93.5m tip height) approximately 5km to the south.

3.2.1 Site Selection

The selection of an appropriate site which has the potential to support a wind development is a complex and lengthy process. It involves examining and balancing a number of technical, economic, environmental and planning issues. Only when it has been determined that a site is not subject to major known technical, economic, environmental or planning constraints is the decision made to invest further resources in developing the proposal and conducting an EIA.

In accordance with the EIA Regulations the main design alternatives have to be studied with key reasoning, taking into account the environmental effects.

The eastern flank of Finlarg Hill was selected as a suitable site for a wind development by the applicant because it met the following criteria:

- A high predicted annual mean wind speed across the site;
- Available grid connection to the site;
- Suitable road access;
- The site itself does not support any international or national, ecological, landscape or cultural heritage designations; and
- The site is large enough to accommodate the development without significantly affecting the current agricultural operations.

Site Selection Policy

In October 2012 Angus Council published their Angus Council Local Development Plan Main Issues Report for consultation purposes. The consultation period ran until 4th January 2013. The purpose of the consultation was to seek views on the big issues affecting Angus and how Angus should develop over the next 20 years. It provided an early opportunity to inform and shape the strategy and content of the new Local Development Plan.

Atmos Consulting provided a response to the Main Issues Report in January 2013 on behalf of Polar Energy. The response focused upon wind energy development opportunity in Angus. The key points from the response are discussed here in the context of site selection for renewable energy development and why the proposed development site at Over Finlarg is considered to be a suitable location.

It is considered that the landscape and topography of Angus, its settlement pattern and particular constraints present, all combine to limit the opportunities for commercial onshore wind energy development in Angus. A significant part of the Angus area for example is classified as Highland in the Tayside Landscape Character Assessment which underpins the Development Plan - primarily the Angus Glens and the area to the north of the Highland Boundary Fault, for which the Council has identified as having very limited scope for wind energy development. This is reflected in the SNH objection to the Nathro Hill Wind Farm application which has been made to the Scottish Government.

The particular character of Angus and level of constraints present is reflected in the number of applications submitted and schemes constructed, as indicated on the SNH wind farm activity maps. These show clearly that the area has not experienced the intensity of wind energy schemes experienced in many other parts of Scotland.

It is noted that the Angus Council area has a relatively low level of installed and approved onshore wind electricity generation capacity when compared with many Scottish Council areas and that there has also been a relatively high proportion of schemes submitted to planning which have not achieved planning permission.

Polar Energy commissioned Atmos to undertake a GIS assessment of the development constraints to wind energy development in Angus in order to inform the response to the Main Issues Report. The mapped results of the assessment are shown in Figures 3-7 and 3-8 of this ES. The GIS exercise undertaken was a constraints mapping exercise for Angus using an industry standard approach which has similarities to the process for preparing spatial frameworks for wind farms. The purpose of the exercise was to establish potentially unconstrained areas for wind energy development in principle, which would require further detailed evaluation as to whether they could accommodate a wind energy scheme. The assumptions made in the assessment were deliberately conservative so as to provide a realistic assessment of the likely development potential.

The following constraints were applied in this exercise:

- Wind speed – areas of less than 7m/s wind speed at 50m excluded (NOABL);
- 650m separation from all mapped buildings. This includes non-residential buildings and does not take into account any potential financial involvement in a particular scheme of individual properties, resulting in a conservative strategic level assessment. If non-residential buildings were excluded then a greater number of small potentially unconstrained areas would have been revealed;
- Settlements;
- International and nationally designated areas for nature conservation, landscape and the historic environment;
- Roads, pipelines, railways and transmission lines;
- Cycle routes;
- Local level designations; and
- Aviation and radar.

Also shown on Figures 3-7 and 3-8 are the wind farms in Angus which are built, consented and in planning.

Figure 3-7 shows the specific development constraints mapped in detail, whilst Figure 3-8 shows constrained and unconstrained areas arising from the constraints assessment. The Highland area of Angus, whilst having large areas without physical constraint, is subject to the landscape considerations as set out in the Implementation Guide and is subject to landscape and visual constraints. Similar policy restrictions apply to the area classified as Coast. The main points to note from the constraints assessment are as follows:

- There are relatively very few 'unconstrained' areas outwith the Highland parts of Angus capable of supporting a commercial scale wind farm development.
- The now operational Arkhill Wind Farm is located within an 'unconstrained' area. This is the only significant scale consented wind farm development in Angus.
- The Frawney Wind Farm site sits within an 'unconstrained area'.
- Many of the 'unconstrained' areas are already subject of developer activity. This includes the consented wind farm at Govals Farm.
- A number of schemes have been pursued within 'unconstrained' areas in the lowland areas which have been refused and/or dismissed at appeal. These include proposed wind farms at Dodd Hill, Mountboy, Montreathmont Moor, Dusty Drum, East Skichen and Corse Hill.
- That 'unconstrained' areas may be subject of constraints at the detailed assessment stage, including access issues, EMI and RAF Leuchars radar which may prevent development of a number of them.

In summary, the actual opportunity for onshore wind energy development at a significant scale is very limited in Angus as illustrated by the constraints assessment and the points made above. The proposed Frawney Wind Farm is located within one of the few 'unconstrained areas' within the Lowland and Hills character type, which is viewed as the preferred general area for wind farm development; which highlights the reasons that this site is one of only a few potentially suitable for wind energy development in

Angus. Given the combination of technical and environmental constraints and current policy steer away from the Highland or Coastal areas the level of development proposals which will come forward in the future in Angus will be modest.

3.2.2 Site Design

The design of a wind development is driven by the key objective of positioning turbines so that they capture the maximum energy possible within a suitable area determined by environmental and technical constraints. These key constraints to site design which need to be taken into account during the design process include:

- Landscape character and visual amenity;
- Proximity to noise sensitive receptors;
- Presence of watercourses, private water supplies and related infrastructure;
- Presence of ornithology;
- Presence of protected habitats and species;
- Ground conditions and topography;
- Presence of cultural heritage features;
- Key recreational and tourist routes; and
- Presence of power lines, pipelines and telecommunication links.

The studies undertaken for the proposed development indicate that the key site constraints are:

- Proximity to residential properties for noise emission levels and potential shadow flicker effects;
- Watercourses, drains and underground culverts;
- Springs and boreholes;
- Private water supply pipelines;
- Presence of two 132kv pylons operated by SSE;
- A national grid gas pipeline;
- Ten telecommunication links crossing the site, including three Scottish Hydro links operated by JRC; and
- Visual amenity.

Figure 3-9 presents the constraints identified above and demonstrates that the areas available for positioning wind turbines and associated infrastructure is relatively limited on this site.

Residential Properties

Residential amenity was considered from an early design stage ensuring that turbines would be positioned no closer than 700m from uninvolved properties and 400m from financially involved properties.

To further refine the acceptability of positioning turbines in proximity to residential properties, noise monitoring and modelling plus a shadow flicker assessment were undertaken to ensure that no significant impacts would result.

Noise measurements were undertaken at four residential properties in the vicinity of the proposed development. Noise modelling using these background noise measurements was undertaken for the proposed turbine layout to predict the likely sound level which will result from the proposed development at nearby properties. If the difference between measured background noise levels and predicted noise levels is more than 5dB(A) then compliance is not met with ETSU-R-97: 'The Assessment and Rating of Noise from Wind Farms' (Department for Trade and Industry (DTI), 1996a) and a significant impact would result. Applying design criteria in accordance with ETSU guidance, therefore, ensures that no exceedences of acceptable noise levels will occur for the proposed development. The full assessment is provided in Chapter 5.

The current layout comprises turbines of 70m rotor diameter. Since shadow flicker is only likely to occur up to ten rotor diameters from the turbines and within 130 degrees of north, no significant effects were predicted since the only properties within 700m of the proposed turbine positions are located due south at Over Finlarg. Further information on this assessment is provided in Chapter 13.

Considerations of potential views from residential properties are discussed below under 'Visual Amenity'.

Water Environment

The minimisation of watercourse crossings and avoidance where possible of works in the vicinity of watercourses and private water supply infrastructure was a key consideration during the site design, to reduce the likelihood of pollution and damage to the receiving environment and protection of human health. Watercourses, underground culverts and private water supplies were identified from OS base mapping at 1:50,000 and 1:10,000 scales and confirmed during site survey and consultation. Buffers were applied to all watercourses (50m), private water supply pipes (20m), springs and boreholes (250m) within the development area, within which no infrastructure is proposed. The new and upgraded access track will cross one watercourse, an underground culvert in two locations and one private water supply pipe within the development site. It should be noted that the previous infrastructure layout (Table 3-2: iteration d) crossed two private water supply pipes and therefore impacts have been reduced for the current proposed design. Mitigation to protect and design all crossings of water resources appropriately is outlined in Chapter 9.

Electricity Pylons

Through consultation and site survey, the two 132kv power lines which run through the site were accurately mapped. A buffer of 1.5 times the topple distance was applied (confirmed by SSE as appropriate) within which no turbines could be proposed.

National Grid Gas Pipeline

Through mapping and consultation a gas pipeline is identified running in a north-south orientation along the eastern boundary of the proposed development area. A sufficient buffer was applied to the pipeline to ensure no infrastructure was positioned in proximity to it. The turbines are approximately 400m at its closest point.

Telecommunication Links

The highest of the Sidlaw Hills is Craigowl Hill, located to the southwest of the proposed development site. Adjacent to Craigowl Hill is Gallow Hill, on the side of which is located the Angus transmitting station, which provides television and radio services to the region. As a result of this proximity, ten telecommunication links were identified through consultation as crossing the site. Appropriate buffers have been applied and these are avoided where necessary.

Three of the links are operated by JRC on behalf of Scottish Hydro. Wind farm infrastructure can be problematic located within 1km of these links and, therefore, JRC were commissioned in 2012 to undertake a detailed coordination assessment to confirm the acceptability of positioning wind turbines in proximity to their three links. The assessment specifically looked at the turbine coordinates proposed in June 2012 in the original planning application 12/00577/EIAL (Table 3-2: iteration d). The results of this detailed assessment confirmed that the now approved wind farm design would be acceptable with no interference issues envisaged. On 10th July 2012, JRC confirmed clearance in writing in their response to planning application 12/00577/EIAL. It should be noted however that the new turbine positions are closer together than before and the distance between the JRC operated links and the turbines would be greater than that previously assessed. It is considered, therefore, unlikely for there to be any interference issues.

Visual Amenity

SNH note in 'Siting and Designing windfarms in the landscape V1 (December 2009)' that "*Design is a material consideration in the planning process and SNH believes that good siting and design of windfarms is important for all parties involved, helping to produce development which is appropriate to a landscape whilst delivering Scottish renewables targets*". In accordance with this guidance the landscape and visual impact of the proposed development has been a key consideration in the design of the site layout from an early stage in the design process.

The design strategy for the key elements of the proposed development has taken into account the following objectives:

- To provide a turbine layout with a simple form, which relates to the landscape character of the site and its surroundings;
- To create a turbine layout that reflects the scale of the landscape in which it is located;
- To ensure that the design and layout of the turbines expresses the function of the development as an energy generator as clearly as possible by avoiding complexity and visual confusion;
- To achieve a balanced composition of the turbines against the landscape and skyline;
- To create a design that takes account of the relevant national, regional and local policy and guidance; and
- To respond to the various constraints identified.

The original scoping layout (Figure 3-1, layout a) presented a widely spaced turbine array that covered a large area of Finlarg Hill at varying topographic heights and was visible from an extensive area. To reduce the potential visibility of the scheme the turbines were repositioned lower down the hill in a cluster within the centre of the site. The design submitted to planning in 2012 (ref: 12/00577/EIAL; Figure 3-1, layout d) achieved a contained layout that minimised the potential landscape and visual effects for a scheme of that size and scale (100m tip height).

As explained in Chapter 2 detailed consultation with Angus Council throughout 2012 and early 2013 indicated that the scale of the proposed scheme was considered by the planning officers to be too great for the location in terms of its visual impacts, particularly in terms of residential amenity. Potential alternative options for a smaller and more contained scheme were, therefore, investigated and presented to Angus Council via a series of letters, emails and meetings held from March to May 2013. The options are presented fully in Table 3-2 and shown on Figure 3-1. The potential alternative design options have sought to address concerns on landscape scale and residential amenity by:

- reducing the overall vertical tip height and hub height of the wind turbines and hence also the rotor diameter;
- reducing the numbers of the wind turbines;
- reducing the horizontal spread of the wind turbines from key residential properties; and
- increasing the distance of the wind turbines from key residential properties.

Various options were considered between the range of 80-100m tip height turbines as presented in Table 3-2. On-going wind data being collected by a meteorological mast at the site enabled directional wind information to be fed into the development of the design. This resulted in a more contained layout which retains the operational efficiency of the turbines while reducing the overall distances of turbines from residential properties, as well as reducing the horizontal spread of the wind turbines, which was considered to further improve the scheme in terms of its potential impact on residential amenity.

The general trend of increasing distances from key residential properties and the diminishing horizontal spread between iterations of the layout is shown in Table 3-1 below. The three layouts in Table 3-1 refer to the 2012 planning application (12/00577/EIAL) layout (1d), the 2013 consented application (13/00532/EIAL) layout (1h), and the proposed height extension design assessed in this ES (2a). Figures 3-10 demonstrate the evolving design using wireframe visualisations to show how these layout iterations improve:

- The potential impacts on residential amenity, increasing distances from some key properties e.g. Govals Cottage and reduction in horizontal spread from others e.g. Nether Finlarg. The distance from Nether FInalrg (Ref. 11 and 12) to the nearest turbine 4 (T4) is now over 1km and the horizontal spread of the wind turbines has been reduced by over 50% when viewed from Govals Cottage (Ref. 7).

Table 3-1: Comparison of Distance and Horizontal Spread of Design Iterations from Residential Properties within 2km

Receptor/ Layout		1d		1h		2a	
Ref	Name	Distance (m)	Horizontal Spread	Distance (m)	Horizontal Spread	Distance (m)	Horizontal Spread
1	Over Finlarg, Farm bungalow	565	50°	716	41°	716	26°
2	Over Finlarg, Old Farmhouse	579	57°	710	44°	710	30°
3	Over Finlarg, New Farmhouse	533	47°	696	39°	696	25°
4	Over Finlarg,	811	39°	972	32°	972	21°

Receptor/ Layout		1d		1h		2a	
Ref	Name	Distance (m)	Horizontal Spread	Distance (m)	Horizontal Spread	Distance (m)	Horizontal Spread
	Farm cottages 1 & 2						
5	Lumleyden	880	13°	1039	14°	1039	12°
6	Govals Farm	758	33°	934	27°	934	14°
7	Govals Cottage	768	24°	1024	24°	1024	12°
8	Muirside cottage	1018	12°	1352	16°	1368	10°
9	Muirside farm	1107	11°	1446	15°	1452	9°
10	East Cotton of Kincaldrum	1399	12°	1696	15°	1696	8°
11	Nether Finlarg farm cottages 1-4	831	50°	761	24°	1029	24°
12	Nether Finlarg farm	881	53°	797	26°	1048	26°
13	West Tarbrax farmhouse	1300	37°	1223	18°	1488	18°
14	South Tarbrax farmhouse	1510	35°	1445	18°	1664	18°
15	North Tarbrax farmhouse	1553	20°	1666	11°	1873	11°
16	Tarbrax House	1671	30°	1600	15°	1858	15°
17	Inverarity, South lodge	1865	31°	1836	16°	1995	16°
18	Gallowfauld farmhouse	1704	20°	1808	10°	2021	10°
19	Gallowfaulds bungalow	1853	19°	1941	10°	2162	10°
20	Muiryfaulds cottage	1719	11°	1937	7°	2077	7°

Other Constraints

Two old farm steadings are located within the site boundary, although these do not present any significant constraint on site and have been avoided through design. No further sites of cultural heritage significance are identified within the site.

There are no recreational or tourist paths to be avoided on site.

The turbines have been positioned with blade tip at least 50m away from trees with the potential for bat roosts and no key ornithological constraints to development are identified.

Final Site Design

As discussed and demonstrated above the final design layout presented in this ES has been the subject of a number of iterations (Table 3-2) and refinements which have mitigated any impacts where possible to result in a proposal which balances environmental and technical issues whilst still producing an economically viable project. Design changes made as a consequence of the key constraints to site design are considered to be mitigation which is 'embedded' in the design.

Table 3-2: Turbine Layout Design Iterations

Layout	Date	No. of Turbines	Tip height	Details
a	10/2008	7	110m	Initial scoping layout: turbines are widely spaced taking into account physical constraints and buffers on site, including electricity pylons, telecommunication links, gas pipeline and watercourses.
b	06/2009	8	100m	Reduced tip height and spread of turbines to reduce visual impact.
c	12/2011	5	100m	Residential amenity considered further including potential visual, noise and shadow flicker effects. This resulted in a more contained layout of five turbines.
d	02/2012	5	100m	Refined positioning of turbines based on site surveys and consultation, and location of private water supply infrastructure.
d	02/2013	5	92.5m	Reduced tip height by 7.5m to 92.5m. Presented to Angus Council by letter on 06/02/2013 as an alternative option to reduce the landscape, visual and residential amenity impacts. Followed up by meeting on 12/02/2013. Council responded on 03/04/2013 to note that impacts would still be unacceptable.
d	02/2013	5	87m	Reduced tip height by 13m to 87m. Presented to Angus Council at the meeting of 12/02/2013 as an alternative option to reduce the landscape, visual and residential amenity impacts. Followed up by email with visualisations on 28/02/2013. Council responded on 03/04/2013 to note that impacts would still be unacceptable.
e	02/2013	4	92.5m	Reduced tip height by 7.5m to 92.5m and removed turbine 5 (the turbine closest to Govals Cottage). Presented to Angus Council at the meeting of 12/02/2013 as an alternative option to reduce the landscape, visual and residential amenity impacts. Followed up by email with visualisations on 28/02/2013. Council responded on 03/04/2013 to note that impacts would still be unacceptable.
f	04/2013	5	80m	Reduced tip height by 20m to 80m. Turbine 4 moved slightly west and turbine 5 moved substantially south (approx. 160m), from Nether Finlarg Farm to Over Finlarg Farm land. Presented to Angus Council by letter on 22/04/2013 as an alternative option to substantially reduce the scale and improve potential residential amenity effects in line with: 1) Angus Council's Renewable Energy Implementation Guide (June 2012) which notes that the Igneous Hills landscape character is "considered to have scope for turbines circa 80m in height which do not disrupt the principle ridgelines or adversely affect the setting of important landscape features monuments such as Kinpurney Monument and Auchterhouse hillfort."; and 2) Comments received from SNH on 28th September 2012 where they suggest that a reduction in tip height commensurate with the Govals development, at 87m,

Layout	Date	No. of Turbines	Tip height	Details
				would be an acceptable development. Followed up by meeting on 29/04/2013. Whilst the Council agreed that this was a marked improvement and landscape scale effects were reduced; impacts were still considered to be significant for some residential properties. Atmos agreed to have another look at reducing the spread of the turbines to create more contained views with an aim of achieving lesser residential amenity impacts.
g	05/2013	5	80m	Taking into account wind monitoring data from the site, separation distances between the turbines were amended in line with the predominant westerly wind direction. This allowed a more contained layout which retains the operational efficiency of the turbines while reducing the overall distances of turbines from residential properties as well as reducing the horizontal spread of the wind turbines; further improving the scheme in terms of its potential impact on residential amenity. A general trend of increasing distances from key residential properties (approx. 260m greater from Govals Cottage - now over 1km between turbine 5 and property) and a diminishing horizontal spread was demonstrated. The horizontal angle of view from Nether Finlarg Cottages are now more than halved compared to layout d, and significantly less than for e. This layout was presented to Angus Council by email on 08/05/2013.
h	05/2013	5	80m	In order to maintain the same site boundary as that submitted in June 2012, without any potential blade oversail of that boundary, the locations of all 5 turbines were moved slightly east from locations specified in layout g. The horizontal spread of the turbines from Nether Finlarg Cottages remains greater than half that of layout d with reduced impacts on landscape scale and residential amenity.
2a	02/2014	4	92.5m	In an effort to maximise the sites potential while reducing the visual impact of the scheme, turbine 5 of the consented scheme was removed and the tip height of the remaining 4 turbines increased by 12.5m. The visual spread of the wind farm was greatly reduced from the nearest residential properties. Consulted with Angus Council via a pre-application inquiry on the 26/02/2014.

3.3 Scheme Description

3.3.1 Scheme Outline

The proposed development would comprise four three-bladed horizontal axis turbines up to 92.5m tip height, with a combined rated output of approximately 9.2MW. The development includes all associated infrastructure including control building, underground cabling, crane hardstanding, new and upgraded access tracks, permanent met mast and temporary construction compound and laydown area

(Figure 3-2). In total approximately 1.1ha of land would be permanently lost (not including 1,385m of upgraded access track) for the proposed development with an additional 3.2ha of temporary loss during construction. This permanent loss represents only 0.3% of the area of land ownership. An additional 0.7% of the land ownership area would be temporarily lost during construction although this would be reinstated and returned to its existing agricultural use. The proposed development will be designed with an operational life of 25 years at the end of which it will be decommissioned. The development components are summarised in Table 3-3.

Table 3-3: Proposed Development Components

Turbines	
Four wind turbine generators of up to 92.5m to tip height, 57m hub height Maximum rated output 4 x 2.3MW = 9.2MW Candidate turbine: Enercon E70	
Permanent Infrastructure	
Access track	• 5m wide • 1,425m of new track; • 1,385m of upgraded track
Turbine foundation	• 15.5m x 15.5m to 1.8m depth
Crane hardstanding	• 22m x 36m
Control Building	• 8m x 4m, 2-3m high • 4m x 4m transformer area
Met Mast	• 60m high at NGR 341742, 742277
Total permanent land take (not including upgraded access track)	• 1.1ha • (plus 0.7ha upgraded access track)
Temporary Infrastructure	
Site compound including storage area	• 40m x 50m
Total temporary land take (including 5m disturbance buffer on all temporary and permanent infrastructure)	• 3.3ha

3.3.2 Site Access

Access to the development site is proposed from the south, via the A928 and Over Finlarg Farm access track. Full detail of the assessment of effects on the local road network is provided in Chapter 11.

Consultation and assessment undertaken for the access route confirms that abnormal loads carrying turbine components (towers, nacelles and blades) will be able to negotiate the route without difficulty.

As explained in Chapter 11 it is anticipated that turbine components will be delivered to the port at Dundee. These will then be transported to the proposed site via the A90 and the A928, leading onto the site at Over Finlarg Farm.

3.3.3 Wind Turbines

It is proposed to install four wind turbine generators, each of 2.3MW. The turbine will be mounted on a tapered tubular steel tower and consist of a nacelle containing the generator and associated equipment to which are attached a hub and rotor assembly including three glass/carbon fibre-reinforced polyester blades. An example of a typical turbine model which is similar to that proposed is shown on Figure 3-3.

Power from each turbine will be transmitted along underground cables to the on-site control housing.

The maximum height from the turbine base to the top of the blade tip will be 92.5m when the blades reach their highest point. The turbine hub height will be approximately 57m and the rotor (blade) radius approximately 35m (Figure 3-3). A typical colour for the tower would be semi-matt grey, designed to blend into a sky background, presenting an aesthetically sympathetic appearance. There will be no external logos, graphics or words. The final turbine colour specification would be determined by consultation with Angus Council.

The turbine will be designed to generate electricity when the wind speed reaches approximately 3.5 metres per second (m/s). When the wind speed sensors of a turbine determine there is a sufficient wind speed for operation, the yaw mechanism turns the turbine so that the blades face into the wind. In the event that the average wind speed exceeds approximately 25m/s (over storm force 10) the control system of the turbine will feather the turbine blades to capture a minimum amount of wind energy and stop generating electricity. This process will stop the rotation of the rotor and shut down the turbine. When the wind speed drops below the maximum limit, control systems will signal the turbine to start again automatically. The turbine control system is programmed to measure a sustainable wind condition before starting a turbine to prevent undue start-up and shut down of the turbine.

Modern wind turbines are designed to withstand wind speeds in excess of 52.5m/s (117 miles per hour) and have a failsafe shut down system that will stop the turbine even in the event of total power loss. A typical turbine design life span is approximately 25 years.

In built safety measures also include lightning protection, which protects the entire turbine from the tips of the blades to the foundation. In the event of a lightning strike, the system is designed to lead the lightning energy around the sensitive parts of the turbine and down into the ground minimising damage to equipment.

Noise damping is an integral part of modern turbine design to ensure that noise emissions are kept within acceptable levels. The turbine can also be operated in 'noise optimised' modes, which minimise sound emissions at different power outputs. This mode is less efficient than the normal generation mode and, therefore, not the default setting in normal operation.

Turbine Foundations

The detailed design specification for the foundations would depend on the geotechnical site investigation of the land on which the turbines would be located. This will determine the feasibility of the locations from a detailed engineering point of view, and if necessary a need for micro-siting (up to 50m around the turbine) to achieve more favourable ground conditions.

It is proposed that the foundations for the turbines would comprise a standard concrete gravity foundation constructed on poured concrete with steel reinforcement. The foundation would require approximately 330m^3 of concrete per turbine base and 37 tonnes of steel reinforcing. Concrete would be imported to the site ready mixed. The foundations would be in the order of 15.5m x 15.5m and up to 1.8m deep, in an 'inverted T' design (Figure 3-4). Actual turbine foundation design and dimensions will be specific to the site conditions as verified during the detailed geotechnical site investigation undertaken before commencing project installation and the turbine type and manufacturers specification.

The ground excavation methods would vary depending on the local ground conditions and the nature of the surface vegetation. The general processes would 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 would be backfilled as soon as practicable with spoil, pending turbine installation.

Once the turbines have been installed, the immediate construction area around the turbine bases would be restored using the retained topsoil or turf to within approximately 1m of the tower bases. A 1m wide gravel path would then be laid around the tower base. Material won from foundation excavations would, if suitable, be used in the landscaping of access tracks and other site infrastructure. If not suitable, it would be disposed of off-site to a suitably licensed facility.

When the turbine is fully operational it is expected that the land will continue to be farmed as it is currently with only a very small area of the overall site removed from agricultural use. Benefits to the farm from the revenue generated from the development are discussed in Section 3.5.3.

3.3.4 Crane Hardstanding

It is expected that the wind turbines would be erected using a set of large all-terrain cranes. A set consists of the main lifting crane and the tail crane. The main lifting crane would have a lifting capacity of up to 850 tonnes while the second, or tail crane, would have a lifting capacity of up to 500 tonnes. The area for the crane hardstanding area beside the turbine base would be approximately 22m x 36m. The crane pad would be retained for the operational period. The two cranes would lift turbine tower sections and blades from the delivery vehicles and into their assembly position. The larger crane would be used to lift the tower sections, turbine nacelle and the hub and blade assembly into their final positions. The tail crane would help to align and position the components whilst being installed. As each turbine is assembled and installed, the two cranes would be moved to the next turbine position.

Construction of the temporary crane hardstanding area would be similar to the construction of the site tracks. Surplus excavated material would be removed from the site, or used for track maintenance during construction, as appropriate. Surplus topsoil would be used to restore track edges after construction or removed from the site.

3.3.5 Access Track

Approximately 1,425m of new access track and 1,385m of upgraded access track is proposed (Figure 3-2). There is less access track required than for the consented scheme due to the removal of one turbine. The proposed access tracks would be approximately 5m wide. The tracks will be designed to have sufficient radii for turning of the construction vehicles and plant. The access tracks have been designed to avoid any sensitive features although will require the removal of small areas of drystone walls in two locations to allow appropriate routing of the tracks around the site.

Access tracks would be constructed using a 'cut track' design. Topsoil is stripped to expose a suitable rock or sub-soil horizon on which to build the track. The track is 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.

Soils removed from the excavated area would 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 will be carried out as track construction progresses.

The access track will be left in place after construction of the wind development and can be used for agricultural access as well as access to the turbine for maintenance and repair works.

Prior to the commencement of site construction, detailed engineering criteria on 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 (SEPA, 2011).

The implementation of the drainage design will be developed in response to a risk appraisal undertaken by the contractor and will be proactive, rather than being reactive to any events arising once works commence. The design will reduce the risk of sedimentation (from loose material) and pollution (from accidental spillage) of all downstream watercourses.

Drainage elements will comprise drainage ditches and cross drainage pipes, modified in specific locations to address local characteristics. The design of the drainage systems will ensure that waters are kept within their original drainage catchments and the tracks will be constructed to be as permeable as practicable, to prevent the build-up of large volumes of water and preventing any direct discharge to surface watercourses.

A Drainage Management Plan (DMP), which will detail proposed surface drainage measures to treat and deal with all the surface runoff from the site, will be designed in accordance with Sustainable Drainage Systems (SuDS) principals. This plan will form part of a Construction Environmental Management Plan (CEMP).

3.3.6 Watercourse Crossings

The wind farm development has been designed to minimise watercourse crossings or diversions. Where possible the proposed access track runs parallel with existing field boundaries and uses existing tracks.

The wind farm development will require two new crossings of an existing underground culvert within the southern section of the development area to the southeast and east of Over Finlarg Farm. Crossings of the culverts are likely to comprise of plating to distribute loads over a wider area. Pollution prevention measures will be implemented during construction to protect these features.

3.3.7 Electrical Connections

Grid Connection

On-site connections would be by underground cable, lain in trenches approximately 1.0m wide by 0.5m deep (Figure 3-4). These trenches would be located adjacent to the access tracks and would terminate at an on-site control building located at NGR 341702, 742154. The trenches will also carry earthing and communication cables for the operation of the wind development. The cables will be laid on a sand bed and backfilled using suitably graded material.

From the on-site control building, it is likely the connection would be to a 33kV grid supply point. The grid connection for the wind development site will require consent under Section 37 Electricity Act 1989 which is the subject of a separate consenting process.

Control Building

It is proposed that the control building would be approximately 8m x 4m, with a transformer housed outside the building in a fenced off area of approximately 4m x 4m. The control building would accommodate control and switch rooms and grid code compliance equipment. Figure 3-5 shows details of a typical control building of sufficient size to meet the grid connection requirements of the site. It is proposed that the control building will have a slate roof and rendered walls of a colour to be agreed with the Local Planning Authority. It is suggested that the final approved details of the control building and transformer area should be subject to a pre-planning condition, so that in the eventuality of SSE requiring the dimensions of the control building or transformer area to be altered to accommodate their grid connection equipment prior to construction, a further drawing can be submitted for approval under the planning condition.

3.3.8 Temporary Structures

Construction Compound

A temporary construction site compound and laydown area with approximate dimensions 40m x 50m is proposed at NGR 341520, 740698 (Figure 3-4). The compound and laydown area would include:

- Temporary portacabin for site office and staff welfare facilities with provision for sealed waste storage and removal;

- Storage and assembly area for turbine components;
- Parking for project related vehicles;
- Area to refuel construction vehicles; and
- Containerised storage for fuels, materials, tools and spares.

3.3.9 Micro-siting

It is normal practice to allow a small margin for adjustment of turbine, track and equipment positions, to suit actual ground conditions. It is, therefore, requested that minor changes to the turbine locations, tracks and equipment be permitted within 50m of the location given for the turbine and 20m for tracks. In the unlikely event that a greater degree of adjustment is required, Angus Council would be consulted for approval. The application area reflects these micro-siting allowances.

It should be noted that any mitigation requirements specified in this ES should also be adhered to during any micro-siting of turbines and associated infrastructure in order to ensure that there is no potential impact on protected species or habitats and hydrological features.

3.4 Construction and Development Phasing

It is scheduled that construction of the proposed development would commence in 2015. The final timetable will depend on the planning authority and procurement lead times.

3.4.1 Construction Period

The on-site construction period is estimated at approximately nine months. There are effectively two phases within this period. The first being the construction of the roads, turbine foundations, cabling and control building, the second being the actual installation of the turbines which only takes place when all other elements are in place and the turbines have been delivered. This timetable includes a programme to reinstate the temporary working areas. The proposed normal hours of operations for construction activity are between 07:00 - 19:00; 65 hours over a Monday to Saturday week, with Saturday being 07:00 to 12:00 hours. During the installation phase, there may be the requirement for extended working as some critical elements of installation cannot be stopped once started.

The programme for each phase of construction will consist of the following key operations:

- Construction of site access tracks for use by civil engineering plant and construction equipment (Figure 3-6);
- Siting of a temporary construction compound for storage of wind development components, temporary site facilities, etc. (Figure 3-4);
- Construction of wind turbine foundations and hardstanding areas (Figure 3-4);
- Excavation of cable trench and cable laying (Figure 3-6);
- Construction of control building (refer to Figure 3-5);
- Erection of wind turbines;
- Connection of on-site electrical power and signal cables;
- Commissioning of the site equipment; and

- Site reinstatement and restoration.

3.4.2 Construction Materials

The key materials which would be required for the construction of the track, turbine foundation, hardstanding and cable trenches are:

- Crushed stone;
- Geotextile;
- Cement;
- Sand;
- Concrete quality aggregate: high strength structural grade, which is not prone to significant leaching of alkalis;
- Steel reinforcement; and
- Electrical cable.

All materials will be transported to the site from one of the quarries located within the local area and associated HGV traffic will likely use the A90 and A928 to the site.

3.4.3 Construction Environmental Management Plan (CEMP)

It is recognised that the construction of the proposed development has the potential to cause environmental pollution on a small and localised scale. Pollution prevention and mitigation measures have been incorporated into the design (embedded mitigations). A site specific Construction Environmental Management Plan (CEMP) will be developed for the project in consultation with Angus Council and SEPA (as is required for the consented wind farm). The CEMP will define the Construction Method Statements and how environmental issues will be dealt with by the construction team. The CEMP will incorporate the findings of the EIA and will be reviewed and updated during the construction period.

The principal contractor will produce a set of control standards for subcontractors working on the proposed development. The control process for sub-contractors will include distribution of appropriate sections of the CEMP and associated procedures prior to the commencement of work. All sub-contractors would receive induction training explaining site specific environmental issues and their mitigation, prior to commencing their work on the site.

The principal contractor would be required to carry out the construction works in such a way that, as far as is reasonably practicable, the amount of spoil and waste to be disposed of is minimised. Careful consideration would be given to the location of any fuel storage facilities. Such facilities would be designed in accordance with the SEPA's guidelines, such that they are self-bunded, including the hoses and stored in a secure compound to avoid vandalism. All vehicles and plant would be regularly inspected for fuel, oil and hydraulic fluid leaks. An on-site oil spill kit will be installed to prevent pollution in the event of a spillage. Only sufficient diesel fuel for plant will be held on site and would be stored in a bunded compound.

Temporary soil mounds would be sited away from watercourses and drains, as far as is practicable. Surface water would be directed away from the construction area to avoid silty runoff entering watercourses. Further discussion on the potential impacts and mitigation proposed to manage possible pollutants on-site is presented in Chapter 9.

As far as reasonably practicable excavated stone or soil will be reused on-site, primarily for restoration of disturbed ground. Any materials to be removed from the site would be disposed of to a suitable licensed waste management facility in accordance with Duty of Care procedures. Demolition material removed from the site during decommissioning would also be disposed of as above.

3.4.4 Waste Disposal

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 and temporary office accommodation;
- Sanitary waste from chemical toilets;
- 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, taken off site and disposed of according to best practice and existing waste legislation. Waste oils and diesel will be removed from the site and disposed of by an approved waste contractor in accordance with provisions of the Special Waste Regulations 1996.

All 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 site and reused, recycled or disposed of in accordance with best practice. If fuels are required on site they will be placed within a secondary containment system capable of holding at least 110% of the original as required under the EC Directive on Dangerous Substances (76/464/EEC).

Servicing of the turbines will result in small quantities of waste lubricating and cooling oil arising, which will require safe containment and disposal. This waste oil will be removed from the site and disposed of by an approved waste contractor in accordance with the Waste Management Regulations.

In the event of the complete decommissioning of the wind turbines, all mechanical/electrical equipment will be removed from the site, the control building will be removed, the concrete bases will be covered over with soil and the entire area reinstated and reseeded.

The decommissioned turbine components will have sufficient salvage value to ensure their proper recycling. An important environmental issue in the decommissioning of the wind turbines will be the proper handling and disposal of any contaminating material (e.g. lubricating/cooling oils etc.). The applicant undertakes to ensure that all such contaminating material will be removed from the site in accordance with best practice.

3.4.5 Site Reinstatement

Reinstatement would be undertaken as soon as practicable after each stage of the project is completed. Areas of the site would be reinstated to agreed conditions. The turbine foundations and the verges of tracks would be re-graded with topsoil (stored adjacent to each excavation) and then re-seeded or cultivated as appropriate. The temporary site office and compound area would be cleared of any additionally placed hardcore and restored to the current profile.

3.4.6 Decommissioning

Once the wind development ceases operation after 25 years of generation, all major equipment and structures would be removed from the site. It is estimated that this process would take approximately three months. Unless otherwise agreed, the upper sections of the concrete foundation would be removed. The upper sections of the foundations would be removed to a depth which would permit the continuation of current land use practices. Unless required in connection with ongoing agricultural works, additional on-site access tracks would be removed and the affected area reinstated. All underground cables would be left in place. The crane hardstanding adjacent to the turbines would be removed, if required, and reinstated.

3.5 Benefits of Proposed Project

3.5.1 Emissions

The proposed development will consist of four 2.3MW wind turbines. The annual generation expected from the turbines is estimated at approximately 20,630MWh per year of electrical energy compared to 9,250MWh generation expected from the consented scheme. This is based on an average (2006 to 2012) capacity factor of 25.6% for onshore wind (which has been taken from Table 6.5 in the Digest of UK Energy Statistics, DUKES, 2014, for data from 2006 to 2012 – DECC, 2014). 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.

Each unit of wind generated electricity will displace a unit of conventionally generated electricity, therefore, saving power station emissions. Table 3-4 provides a breakdown of the estimated emissions displaced per annum and over the 25 year lifetime of the project.

Table 3-4: Estimated Emissions Displaced by the Proposed Development

Emissions	Annual	Lifetime	Source
CO_2	8,872	221,789	http://www.bwea.com/edu/calcs.html
SO_2	107	2,682	http://chp.defra.gov.uk/cms/centralised-electricity-generation
NO_x	39	980	http://chp.defra.gov.uk/cms/centralised-electricity-generation

The benefit of displacement of emissions may also be described in terms of the number of equivalent homes to be supplied on an annual equivalence basis. For a 9.2MW project, based on the average domestic consumption figures presented by DECC for 2012 the project would supply the following:

- UK consumption of 4.22MWh per annum: 4,887 households;

- Scottish consumption of 4.58MWh per annum: 4,508 households;
- Angus consumption of 5.26MWh per annum: 3,923 households.

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.

3.5.2 Local Economy

The project has the potential to have a beneficial effect on the local economy in terms of employment during the construction and operational stages, as this investment creates a number of economic opportunities for local businesses.

The use of local contractors for construction, operation and maintenance work will be encouraged wherever possible, as long as they satisfy technical requirements and are cost competitive. Local manufacturers will also be given priority for sourcing auxiliary equipment such as electrical installations (medium voltage cables, optical fibre cables etc.), fences and road construction materials. In total, just under £3 million of the construction expenditure could be spent within Scotland, of which just over £1 million could be sourced in Angus.

It is estimated that the construction of the wind farm will support 0.9 permanent full-time equivalent (FTE) jobs in the local area and over its 25 year life, will support 2.9 FTE jobs in Scotland, of which 1.4 could be based in Angus. The establishment of a local service team will be promoted, depending on the wind turbine manufacturer's requirements. Employment opportunities will also arise during the decommissioning and recycling process.

In addition to the direct economic impacts arising from the construction and operation of the development there is the potential for indirect social benefits through a community fund. The developers are proposing a community benefit package of £46,000 per annum (£5,000 per MW) over the 25 year life of the project. The economic impacts arising from the activities of the community will depend on the manner in which their available funds are spent/invested and on the balance between economic and social/community development activities.

3.5.3 Benefits to the Farm

The location of the infrastructure of the proposed development will allow continued farming operations up to the base of the wind turbines, with minimal amount of land take (1.3ha permanent loss). The new and upgraded access tracks will be able to be used by the landowner to gain better access to the land holding.

The revenue generated from the proposed development will have a positive influence on the operations of Over Finlarg Farm. The landowner proposes to utilise the revenue to make the following improvements:

- New fencing, planting hedgerows and trees to increase shelter for livestock, enhance biodiversity and create a more attractive farming landscape;
- Land and field drainage improvements;
- Improvements to soil fertility by use of phosphates and lime; and
- Repairs and improvements to the farm steading buildings which are in need of renovation.

Income from the wind farm will therefore cross-subsidise the agricultural operation with the potential for significant on-farm benefits in terms of productivity, physical appearance and biodiversity.

4 Planning and Energy Policy

4.1 Introduction

This chapter, prepared by Atmos Consulting Ltd, sets out the planning policy context for the proposed development. The chapter focuses upon the main policy relevant to the proposed development and in the interests of brevity does not seek to repeat in detail the contents of the development plan or relevant planning policy documents.

4.2 National Planning Policy

4.2.1 Scottish Planning Policy

National Planning Policy for renewable energy development is set out in Scottish Planning Policy (SPP) published in February 2010. SPP sets out how the Government wishes the development management system to operate and is clear that the planning system operates in the long term public interest and does not exist to protect the interests of one person or business against the activities of another.

SPP in paragraph 182 states that the commitment to increase the amount of electricity generated from renewable sources is a vital part of the response to climate change and that renewable energy generation will contribute to more secure and diverse energy supplies and support sustainable economic growth. It also restates national targets which were increased in 2010 (now 100% of Scottish electricity consumption from renewables by 2020).

Paragraph 187 of SPP specifies that planning authorities should support the development of wind farms in locations where the technology can operate efficiently and environmental and cumulative impacts can be satisfactorily addressed. It also provides advice as to the content of development plan policy and sets out that the design and location of any wind farm development should reflect the scale and character of the landscape. The location of turbines should be considered carefully to ensure that the landscape and visual impact is minimised.

SPP also sets out policy in respect of the preparation of spatial frameworks for developments over 20MW by planning authorities. For the preparation of spatial frameworks, it is recommended that a separation distance of up to 2km between areas of search and the edge of cities, towns and villages is used to guide developments to the most appropriate sites and to reduce visual impact. It is clear, however, that decisions on individual developments should take into account specific local circumstances and geography and not any set separation distance.

SPP also sets out other topic specific policies which are referred to in this ES as appropriate. The SPP is presently being revised by the Scottish Government.

4.2.2 National Planning Framework 2

The National Planning Framework 2 (NPF2) identifies tackling climate change and reducing dependence on finite fossil fuels as two of the major global challenges of our time. The Scottish Government supports this objective and has in place its own, higher target for electricity generated from renewable sources than that set for the UK as a whole. The 2030 vision for Scotland is to promote a greener Scotland by contributing to the achievement of climate change targets and protecting and enhancing the quality of the natural and built environments.

The NPF2 sets a development strategy which includes the realisation of the potential of Scotland's renewable energy resources and facilitates the generation of power and heat from all clean, low carbon sources. NPF2 states that better energy efficiency in buildings and more dispersed patterns of power and heat generation have key roles to play in creating a more sustainable built environment.

The NPF2 notes that small-scale renewable energy projects can make a valuable contribution locally. Cumulatively, they can make a significant contribution to the development of a more decentralised pattern of energy generation. It also notes that planning authorities have an important role in facilitating more decentralised patterns of energy generation and supply. The NPF is currently being revised by the Scottish Government.

4.2.3 Advice Sheet for Onshore Wind Turbines

The specific advice sheet on 'Onshore wind turbines' (last updated in December 2013) provides information and advice on onshore wind development. References to the web based renewable advice are made within the ES as necessary. Other Planning Advice Notes on various topics are also relevant and are referenced as appropriate.

4.3 Local Planning Policy

4.3.1 Development Plan

In the consideration of planning policy at the local level, the policies as contained in the relevant structure and local development plan are of prime importance as Section 25 of the Town and Country Planning (Scotland) Act 1997 requires determinations under the Planning Acts to be made in accordance with the relevant Development Plan, unless material considerations indicate otherwise.

When the development plan includes specific policy for a particular form of development, the starting point in consideration of applications for that type of development should be with that policy. The consideration of a proposal should be against the development plan as a whole, but the greatest weight ought to be applied to the relevant specific policies drafted for the assessment of particular types of proposal and those policies which are sufficiently up to date.

The proposed Frawney Wind Farm is situated within Angus where the current Development Plan comprises:

- TAYplan-Strategic Development Plan' approved 2012; and
- Angus Local Plan Review adopted 2009.

Key Development Plan Policies

The Tayplan, approved in June 2012, includes Policy 6: Energy and Waste/Resource Management Infrastructure. Policy 6 relates to the aim of delivering a low/zero carbon future for the city region to contribute to meeting Scottish Government energy targets and indicates that, in determining proposals for energy development, consideration should be given to the effect on off-site properties, the sensitivity of landscapes and cumulative impacts. Tayplan Policy 6 does not add any new assessment criteria to the existing Angus Local Plan Review policies.

The Angus Local Plan Review dates from 2009 and was prepared in the context of SPP6 and is more up to date than the Structure Plan, though its adoption predates SPP. The key Local Plan policies are 'Policy ER34 Renewable Energy Developments' and 'Policy ER35 Wind Energy Developments'.

'Local Plan Policy ER34' sets out that proposals for all forms of renewable energy development will be supported in principle and will be assessed against a number of criteria.

'Local Plan Policy ER35' sets out that wind energy proposals must meet the requirements of Policy ER34 above and must also demonstrate that a number of criteria are met.

Other development plan policies will be relevant to the determination of the planning application on a subject by subject basis.

4.3.2 Supplementary Planning Guidance

Angus Council approved, as supplementary guidance, the 'Angus Wind Farms - Landscape Capacity and Cumulative Impacts Study' in September 2008 for use in the assessment of wind farm applications and to provide advice on the cumulative effects of existing and potential future wind farm developments in Angus. This document was produced in response to a number of planning applications and a conjoined planning inquiry but was subsequently adopted by the Council for wider use. The study examines the various landscape types in Angus and provides a comment on landscape capacity within these areas. The document is not part of the development plan and, therefore, is of limited weight for development management purposes.

The SPG identifies the area of the site as being within one of the identified Lowland Areas (8 Igneous Hills) where the scale and type of landscape suggests that careful siting of windfarms of a medium to small scale only. Table 4.3 of the document considers wind farm categories by size and the proposed wind farm falls within the identified range. There are no landscape designations within the landscape area. The area is considered to have a medium landscape sensitivity due to the number of footpaths, viewpoints and small fishing lochs as well as hillforts, scattered dwellings and settlements in the area.

The Implementation Guide for Renewable Energy was approved by the Council in June 2012. In terms of its status, the 'Implementation Guide' does not form part of the Development Plan, but is a material planning consideration for the determination of planning applications. Its provisions should be considered alongside other material considerations, which include national planning and energy policy and the various benefits of the proposal as described in the application package. The guidance offers more detailed information and clarification of the main factors in determining renewable energy proposals, an application checklist and guidance on landscape and visual assessment issues and noise assessments. The Implementation Guide identifies the area as having scope for turbines circa 80m in height which do not disrupt the principle ridgelines or adversely affect the setting of important landscape features monuments such as Kinpurney Monument and Auchterhouse hillfort. It also states that there may be scope for turbines of greater height, where this can be demonstrated by the applicant. This will be strongly influenced by the elevation of the turbine site, the scale of the landscape and proximity of scale features and buildings.

4.3.3 Landscape Capacity Assessment for Angus

Angus Council published its finalised draft version Landscape Capacity Assessment (LCA) for Angus (prepared by Ironside Farrar) in November 2013. The Council website notes that the document is subject to completion of Scottish Natural Heritage Quality Assurance process. The document does not form part of the development plan but is capable of being a material planning consideration in the determination of planning applications.

The LCA sets out guidance in respect of landscape capacity for wind energy in Angus. The application site falls within the Landscape Character Type Tay 8, the Igneous Hills, where the guidance is that there is low capacity for turbines of up to 80m in height. It is noted that the consented Govals and Frawney wind farms already exceed the recommended turbine height, group numbers, and separation set out in the document.

4.4 Climate Change Policy

The Intergovernmental Panel on Climate Change, the principal scientific body advising governments on climate change, has confirmed the significant influence on the global climate of increases in atmospheric levels of carbon dioxide (CO_2) and other greenhouse gases as a result of human activities. A major contributor to greenhouse gases is the burning of fossil fuel (coal, gas and oil) used in power stations to generate electricity. A vital part of reducing these emissions, combating the threat of global warming and ensuring security of energy is increasing the proportion of power generated by clean, diverse and sustainable supplies of energy from renewable sources such as wind.

Since the United Nations Framework Convention on Climate Change (UNFCCC) of 1992 which placed a non-binding commitment on developed countries to reduce their greenhouse gas emissions to 1990 levels by 2000, European and National policies and programmes aimed at reducing greenhouse gases have become a fundamental part of policy and decision making, with targets being increased on a regular basis.

4.4.1 European Climate Change Programme

The EU's climate and energy package was agreed by the European Parliament and Council in December 2008, becoming law in June 2009. It aims to ensure that the EU will achieve its climate change targets by 2020, namely a 20% reduction in greenhouse gas emissions (from 1990 levels), 20% improvement in energy efficiency, and 20% share for renewables in the EU energy mix.

4.4.2 UK Climate Change Programme

The UK Climate Change Programme (2006) sets out the policies and priorities for action in the UK and internationally, designed to deliver the UK's Kyoto Protocol target of reducing emissions. The Programme set a target of a 60% reduction in CO_2 emissions by 2050; which has subsequently been revised to 80% by the Climate Change Act 2008.

The Climate Change Act sets out a framework with clear, legally binding targets to reduce greenhouse gas emissions by at least 80% by 2050 and at least 34% by 2020, measured against 1990 levels.

4.4.3 Scottish Climate Change Programme

The Scottish Climate Change Programme (2006) supplements the UK Climate Change Programme and sets out how Scotland will contribute to the UK targets to cut greenhouse gas emissions. The Programme originally committed Scotland to generating 18% of its electricity from renewable sources by 2010 and 40% by 2020, with the 2010 target quickly being met. The targets identified in the Programme were subsequently revised by the Climate Change (Scotland) Act 2009, which aims for an 80% reduction in Scotland's greenhouse gas emissions by 2050 and includes an interim target of a 42% reduction by 2020 (compared to 1990 levels).

Key elements of the strategy for achieving a substantial reduction in emissions are greater energy efficiency, making the most of Scotland's renewable energy potential and encouraging power and heat generation from clean, low carbon sources. To help ensure the delivery of these targets, this part of the Act also requires that the Scottish Ministers set annual targets, in secondary legislation, for Scottish emissions from 2010 to 2050. The Scottish Government has adopted proportionately much higher targets for renewable energy than those in the UK as a whole. The Scottish Government document, Low Carbon Scotland Meeting the Emissions Reductions Targets 2013-2027 published in 2013 confirmed that provisional data for 2012 showed that almost 39% of generation came from renewables.

The 20/20 Routemap for Renewable Energy in Scotland (SG 2012) sets out the latest target to meet an equivalent of 100% demand for electricity from renewable energy by 2020. The 2020 Routemap also made a new commitment to achieve at least 30% overall energy demand (heat and transport as well as electricity) from renewable sources by 2020.

The increasing policy commitments mean that the threshold of acceptability for wind energy development needs to change in order for the targets to be met. The change in the threshold of acceptability must occur in the context that areas such as wild land are being taken out of consideration for wind energy development through emerging policy.

The Electricity Generation Policy Statement (SG 2013) has also been published by the Scottish Government. The Electricity Generation Policy Statement 2013 examines the way in which Scotland generates electricity and considers the changes which will be necessary to meet the targets which the Scottish Government has established. The statement looks at the sources from which that electricity is produced, the amount of electricity which we use to meet Scotland's own needs and the technological and infrastructural advances and requirements which Scotland will require over the coming decade and beyond.

The Scottish Government's policy on electricity generation is that Scotland's generation mix should deliver:

- a secure source of electricity supply;
- at an affordable cost to consumers;
- which can be largely decarbonised by 2030; and

- which achieves the greatest possible economic benefit and competitive advantage for Scotland including opportunities for community ownership and community benefits.The Frawney Wind Farm will contribute towards the meeting of these aims.

4.5 Renewable Energy

4.5.1 EU Renewable Energy Directive

The current EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources sets ambitious targets for all Member States, such that the EU will reach a 20% share of energy from renewable sources by 2020. For the UK, the Directive sets a target of 15% of energy from renewables by 2020, significantly lower than the UK's own targets. The Directive improves the legal framework for promoting renewable electricity, requires national action plans that establish pathways for the development of renewable energy sources including bioenergy, creates cooperation mechanisms to help achieve the targets cost effectively and establishes the sustainability criteria for biofuels.

4.5.2 UK Renewable Energy Strategy

In July 2006, the UK Government published The Energy Challenge: Energy Review Report 2006. Annex D of this report published a Statement of Need for Renewables which emphasised the following points:

- The national need for renewable energy projects is a material consideration which should be given significant weight when proposals are being considered at a local level.
- Planning applications for renewable energy projects should be dealt with quickly.
- Planning authorities should not make assumptions about the commercial and technical feasibility of renewable projects.
- The cumulative effects of projects will not necessarily be unacceptable or incapable of reduction through mitigation measures.

4.5.3 Energy Acts

The UK Government's current energy policy is set out in three Energy Acts 2008, 2010 and 2011.

The Energy Act 2008 implements the legislative aspects of the 2007 Energy White Paper: Meeting the Energy Challenge. The Act strengthens the drive to greater and more rapid deployment of renewable in the UK with the aim of increasing the diversity of the UK's electricity mix, improving the reliability of energy supplies and helping to lower the carbon emissions from the electricity sector. The Energy Act 2008 also established enabling powers for the introduction of Feed in Tariffs (FITs) to supplement the Renewables Obligation and to incentivise small-scale low-carbon electricity generation, up to a maximum limit of 5 megawatts (MW) capacity.

The Energy Act 2010 implements elements of: The UK Low Carbon Transition Plan – a national strategy for climate and energy (published in July 2009). It takes forward important elements of the Plan related to decarbonising the power sector by facilitating the demonstration of commercial scale Carbon Capture and Storage (CCS) and improving the fairness of the energy markets through the implementation of mandated social price support and other amendments to strengthen the powers of the Government and Ofgem (the regulator) in order to better protect consumer interests.

The Energy Act 2011 provides for some of the key elements of the Coalition's Programme for Government and its first Annual Energy Statement. The Act provides for a step change in the provision of energy efficiency measures to homes and businesses, and makes improvements to the UK's framework to enable and secure low-carbon energy supplies and fair competition in the energy markets.

4.5.4 UK and Scottish Renewables Obligation

The Renewables Obligation (RO) and Renewables Obligation Scotland (SRO) and Feed In tariff introduced through the Energy Act 2008 are currently the main support mechanisms for renewable electricity projects in the UK. These schemes were introduced by the Department of Trade and Industry (now the Department for Energy and Climate Change) and the Scottish Government and are administered by the Gas and Electricity Markets Authority (the Authority), whose day to day functions are performed by Ofgem.

The RO and SRO are enforced through successive Renewables Obligation Orders which are subject to annual review. The orders place an obligation on licensed electricity suppliers to source a specific and annually increasing proportion of their electricity from renewable sources. The 2012-2013 level is 15.8% per 100MWh.

4.6 References

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5 Noise

5.1 Introduction

This chapter, produced by Atmos Consulting, assesses the noise effects arising from the proposed development. The assessment considers both the operational and construction phases of the development.

Wind turbines generate noise by two mechanisms: mechanical noise from the gearbox and generator in the nacelle; and aerodynamic noise caused by the noise of wind passing over the turbine blades. Wind turbines are designed in such a manner as to minimise mechanical noise, for example, noise sources in the nacelle are contained in insulated enclosures.

Aerodynamic noise is minimised by the design of the turbine blade, however, some aerodynamic noise is unavoidable. Aerodynamic noise increases in proportion with the speed of the turbine blade relative to the surrounding air, therefore, noise levels will increase with wind speed.

The assessment of operational noise is undertaken in accordance with relevant best practice policy and guidance. Predicted noise levels are derived from the published noise output data for the proposed model of turbine, in relation to established noise level limits. In the interests of clarity, an operational assessment data sheet and checklist is provided in Appendix 5-1 which provides an overview of the calculation methods and parameters used.

The impact of noise generated during the construction phase of the development is considered in relation to established guidance and noise limit values.

5.2 Methodology and Approach

5.2.1 Information Sources

The following sources of information were used in the completion of this chapter:

- Turbine source noise level data is taken from manufacturer supplied documents, *SIAS-04-SPL E-70 E4 OM II 2_3MW Rev1_0-eng-eng.doc* (Enercon, 2010) and *Test Report 049SE206/01*, (WIND Consult, 2006).
- Construction source noise level data is taken from Annex C of BS5228-1 '*Code of Practice for Noise and Vibration Control on Construction and Open Sites. Noise*' (BSI, 2009); and
- Current best practice for the assessment of operational turbine noise is outlined in the Institute of Acoustics' '*A Good Practice Guide To The Application of ETSU-R-97 For The Assessment and Rating of Wind Turbine Noise*' (IOA, May 2013). Reference is also made to 'Prediction and Assessment of Wind Turbine Noise. Acoustics Bulletin. 34 (No.2) (Bowdler et al. 2009), commonly know as the 'Bulletin Agreement'.

5.2.2 Consultation

Consultation was undertaken with the relevant Angus Council (AC) Environmental Health Officer (EHO). Four noise monitoring locations were proposed in a letter to AC on 14th December 2011 accompanied by a figure detailing the proposed monitoring locations. On 15th December 2011, AC agreed that the noise monitoring locations were suitable in principle and requested that the exact positioning of the sound level meters (SLM) be confirmed on site. AC also confirmed the suitability of a 10m meteorological mast being installed temporarily on site during the period of noise monitoring to record wind speed and wind direction, and forwarded current (at the time) Council guidance for noise assessments of wind turbine developments.

Following installation of the SLMs at three of the four monitoring locations, an Atmos noise consultant met with two AC EHOs to seek approval of the exact location and equipment set up. All four proposed locations were visited on 13th January 2012. However,, on this date Atmos had not been able to gain permission to install the SLM at the forth location (Govals Cottage).It was agreed with the EHOs to pursue this matter and the equipment was installed successfully at the agreed location on 2nd February 2012.

5.2.3 Overall Approach

Scottish Planning Policy (Scottish Government, 2010), which replaces SPP6 (Renewable Energy), states in Paragraph 187, "*Planning authorities should support the development of wind farms in locations where the technology can operate efficiently and environmental and cumulative impacts can be satisfactorily addressed.*" SPP advises that noise should be one of the environmental and cumulative criteria considered when deciding planning applications.

PAN45 (Scottish Executive, 2002) provides advice on noise from wind farms. However, due to the substantial growth in wind farm development since its publication PAN45, Annex 2 '*Spatial Frameworks and Supplementary Planning Guidance for Wind Farms*' has been replaced with updateable web based renewables advice. The relevant publication '*Onshore Wind Turbines*' was first published in April 2008. For the purposes of this assessment all references made to the document refer to the update published in December 12, 2013. The Onshore Wind Turbines document states:

" The Report 'The Assessment and Rating of Noise from Wind Farms' (Final Report, Sept 1996, DTI) (ETSU-R-97), 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. The framework 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."

It goes on to state;

"The Institute of Acoustics (IOA) has since published Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, The document provides significant support on technical issues to all users of the ETSU-R-97 method for rating and assessing wind turbine noise, and should be used by all IOA members and those undertaking assessments to ETSU-R-97. The Scottish Government accepts that the guide represents current industry good practice."

The assessment of operational noise is, therefore, carried out in accordance with ETSU-R-97 (hereafter referred to as ETSU) & The IOA Good Practice Guide (hereafter referred to as the IOA GPG) as recommended by 'Onshore Wind Turbines'.

Construction noise is assessed following the guidance detailed within BS5228-1:2009. BS5228 provides guidance on the control of noise from construction activities and provides calculation methods for predicting the noise levels attributable to construction activities. The standard also provides measured noise level data for a variety of construction plant and activities for use within the calculations.

BS5228 is identified in PAN1/2011 (which replaced PAN56 (Scottish Executive, 1999)) and its associated TAN, '*Technical Advice Note, Assessment of Noise*' as an appropriate method of predicting construction noise levels.

5.2.4 Assessment Methods

Operational Noise

The operational noise immission levels are calculated in accordance with ISO9613-2, '*Acoustics - Attenuation of sound during propagation outdoors: General method of calculation,*' (ISO, 1996).

The assessment of operational noise is carried out in accordance with ETSU, which sets out the method of assessing noise levels from a wind farm and calculating appropriate evaluation criteria. The ETSU assessment consists of the following steps:

- Identification of the nearest Noise Sensitive Receptors (NSRs);
- Where required, background noise survey at receptor locations in parallel with wind speed monitoring at the wind farm site;
- Generation of a background noise curve from the measured data, characterising the noise levels as a function of wind speed;
- Generation of agreed noise limits for each property;
- Prediction of received noise levels at receptors (immission levels), by means of a noise model, appropriately corrected for tonal emissions and across a range of wind speeds;
- Comparison of predicted levels with agreed noise limits;
- Assessment of any cumulative impacts; and
- Identification of mitigation in terms of layout and attenuation if necessary.

As all identified NSRs are residential buildings the sensitivity is determined to be high, as detailed in Table 2-5.

Where calculated noise levels are determined to be below the noise level limits, impact magnitude is classed as '*no change*'. Conversely, where noise levels are determined to be above noise level limits the impact magnitude is deemed to be '*substantial*.' The assessment of significance of effects of the construction and operational noise is made in accordance with Table 2-7.

Atmos have scoped out amplitude modulation (AM), low frequency sound or infrasound from the operational noise assessment, though a brief overview of recently published studies into these effects are detailed below.

It is noted that all turbines exhibit some level of amplitude modulation, often referred to as 'blade swish,' however, there are occasions when the effect of this amplitude modulation increases in level beyond the recognised norm. This phenomenon is referred to as 'Enhanced Amplitude Modulation' (EAM), or 'Other Amplitude

Modulation' (OAM). Please note, therefore, that references to AM, EAM and OAM within this report are used interchangeably, but all relate to the same phenomenon.

The report, *NANR233 'Research into Aerodynamic Modulation of Wind Turbine Noise'* (Moorhouse et al., 2007), sets out the results of a Salford University study of AM which was commissioned jointly by DEFRA (BERR, formerly DTI) and the Department for Communities and Local Government.

The results were published by way of a report which concluded that AM was only considered to be a definite factor at four and a possible factor at eight, out of the 133 sites (all the sites in the UK operational at the time of the study) considered. At the four sites, it was considered that conditions associated with AM might occur between 7% and 15% of the time.

In a statement accompanying the published report, BERR states that it "*continues to support the approach set out in Planning Policy Statement (PPS) 22 – Renewable Energy.*" PPS22, is the English equivalent of PAN45 (which now incorporates 'Onshore Wind Turbines') and, therefore, supports the use of ETSU as the most suitable assessment method. It should be noted that the noise level criteria set out in ETSU were derived taking into account the characteristics of blade swish.

Low frequency noise was a feature of early wind turbine designs, where the blades were down-wind of the tower. Modern turbines have their blades upwind of the tower, therefore, reducing the low frequency noise to below the threshold of human perception. A number of studies, (including Klug (2002), Leventhall et al (2003) Physic GmbH (2003), Leventhall (2004), and Styles et al (2005)) have been carried out in recent years which have attempted to assess the likely levels of low frequency noise and infrasound from wind turbine installations. All of these studies concluded that low frequency noise and infrasound were below perceptible levels.

In 2006, the Department of Trade and Industry (DTI) published a study that investigated claims that infrasound or low frequency noise emitted from wind turbines was causing adverse health effects. The study concluded that there is no evidence of health effects arising from infrasound or low frequency noise from wind turbines.

The *IOA Acoustics Bulletin - Prediction and Assessment of Wind Turbine Noise. 34 (No.2)*, Bowdler et al. (2009) (hereafter known as the Bulletin Agreement) preceded the IOA GPG as an unofficial, but widely recognised, attempt to set out best practice for both the acquisition of baseline data and the prediction of immission levels at receptors. The Bulletin Agreement also made comment on Low Frequency noise, infrasound and Amplitude Modulation and provided a brief review of current research into these phenomena. It states,

"… we conclude that there is no robust evidence that low frequency sound (including "infrasound") or ground borne vibration from wind farms, generally has adverse effects on wind farm neighbours."

To conclude, based on published research no perceptible impacts are associated with low frequency noise or infrasound, therefore, no significant effects will result.

It is also noted that in December 2013 RenewableUK published, *'Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effects.'* This research presented possible causes of OAM and associated dose response relationships. The research included the identification of the possible causes of OAM, the apparent directionality of the phenomenon and the potential levels of modulation required to induce 'annoyance'. The research did not, however, publish a method to predict potential levels of OAM and the prediction of OAM, therefore, remains outwith the scope of this assessment.

Construction Noise

The construction phase of the proposed development will generate noise during the haulage of plant and materials, excavation and foundation construction and the operation of various plant and machinery.

A desk-based study is undertaken to calculate the propagation of noise from the construction plant and activities to the nearest identified NSRs. Predictions of noise emissions from construction activities are made in accordance with BS5228:1–2009, Annex F 2.2. The predictions are based on worst case construction noise at each receptor e.g. concurrent and consecutive use of construction plant, and consider the noise impact throughout the construction programme.

Predicted construction noise levels are assessed against assumed evaluation criteria to identify the significance of construction noise impacts. In the absence of specific national guidance on noise limits during construction activities, the guideline noise level limits detailed in BS5228 are used to assess the potential impacts

Baseline Conditions

5.2.5 Baseline Monitoring

Noise level monitoring was undertaken by Atmos during January and February 2012 at M01 Over Finlarg, M02 Lumleyden, M03 Nether Finlarg and M04 Govals Cottage, as agreed with the Angus Council EHO. Noise monitoring was undertaken for a minimum of 14 days at all locations.

All noise monitoring equipment (calibrators, SLM's and outdoor microphones) used for the study are categorised as Class 1, as specified in IEC 61672-1 (IEC, 2002). Appendix 5-2 presents details of the noise equipment used and laboratory calibration details.

The noise monitoring equipment installed at each location consisted of a Cirrus Research, Optimus Green integrating SLM. Each SLM was fitted with an outdoor microphone kit. All equipment was calibrated on site at the beginning and end of each measurement period with no significant deviations noted.

The equipment at all locations was installed within the garden areas away from any reflecting surfaces. All measurements were made with the microphone mounted on a tripod at approximately 1.5m above the ground. Each microphone was fitted with an oversized windshield over the top of a regular sized wind shield. Measurements were undertaken continually and logged in ten minute periods.

Wind speed and direction monitoring was carried out using a 10m met mast installed on the proposed development site. in addition a tipping bucket rain gauge was deployed to account for all periods of rainfall occurring during the noise measurement period. All monitoring equipment was synchronised to UTC and set to log data in 10 minute periods.

Regression analysis of the measured baseline data is detailed within the background noise charts provided in Appendix 5-3. As described in ETSU, the noise data has been classified into two time periods, namely quiet daytime (weekdays between 07:00 and 18:00, Saturday morning from 07:00 to 13:00 and all day on Sundays) and night-time (23:00 to 07:00 all days). All periods of rainfall have been discounted from the measurement data prior to analysis. All raw data (noise, wind and rainfall) was presented to Aberdeenshire Council via email on 27th August 2012 for verification alongside the methodology used for filtering and analysing data.

M01 Over Finlarg (Old Farmhouse)

The SLM was located within the garden area of the property on 13th January 2012 away from any reflecting surfaces. Subjective observation of the noise environment at this location noted road traffic noise from the A90 and the movement of the wind in surrounding trees (which were not in leaf). Other properties within the immediate vicinity were visited with the EHO but were deemed noisier than the chosen monitoring location due to the increasing amounts of trees and plants. The measured polynomial noise levels at the monitoring location were determined to be:

$y = -0.033x^3 + 0.8562x^2 - 4.3153x + 39.214$ for Quiet Daytime; and;

$y = -0.0224x^3 + 0.5694x^2 - 1.2737x + 25.097$ for Night-time Hours.

M02 Lumleyden

A SLM was located within the garden area to the rear of the property on 13th January 2012. However, this assessment location has since been scoped out of assessment and the measured noise level data from this monitoring location is not required to be used within the operational noise assessment. This is detailed further in Section 5.3.2.

M03 Nether Finlarg

The SLM was located within the garden area of the property on 13th January 2012 away from the façades of the buildings. Subjective observation of the noise environment at this location noted road traffic noise from the A90 and movement of the wind in surrounding trees, some of which were in leaf. It is noted that a single Gaia turbine is located in close proximity to this monitoring location although this was not audible on either visit for equipment installation or de-rig. The measured polynomial noise levels at this property were determined to be:

$y = 0.2256x^2 - 1.7391x + 37.988$ for Quiet Daytime; and;

$y = 0.0854x^2 + 0.9626x + 23.168$ for Night-time Hours.

M04 Govals Cottage

The SLM was installed on 2nd February 2012, at the southern boundary of the garden area and fixed to a fence post away from any reflecting surfaces. Subjective observation of the noise environment at this location noted that the ambient noise levels were lower than the other monitoring locations, presumably due to the increased distance to the A90. No other dominant noise sources were noted. The measured polynomial noise levels at this property were determined to be:

$y = 0.0052x^3 + 0.1232x^2 - 1.0788x + 34.155$ for Quiet Daytime; and;

$y = 0.0713x^2 + 1.2356x + 22.082$ for Night-time Hours.

5.2.6 Noise Sensitive Receptors and Study Areas

NSRs are properties which are sensitive to noise and, therefore, require protection from nearby noise sources.

The proposed development is located within a rural area sparsely populated with housing and farmsteads and all NSRs identified within this assessment are residential receptors; consequently, noise levels throughout the assessment are calculated, where appropriate, to the closest garden boundary, rather than the façade of the building. This is to ensure the continued protection of existing amenity of residential outdoor areas.

Construction noise levels are expected to be highest close to the proposed turbine locations. The assessment of construction noise, therefore, considers the same NSRs as the operational noise assessment. Table 5-1 details the nearest identified NSRs which are considered within the assessment.

Table 5-1: Nearest identified NSR locations.

NSR ID	Noise Sensitive Receptor	Easting	Northing
NSR01	Govals	342087	743304
NSR02	Govals Cottage	342320	743311
NSR03	Lumleyden	340441	741539
NSR04	1 to 4 Farm Cottages - Nether Finlarg	342702	742003
NSR05	Nether Finlarg Farmhouse	342630	741814
NSR06	Over Finlarg (bungalow)	341446	741348
NSR07	Over Finlarg (old farmhouse)	341538	741390
NSR08	1 & 2 Farm Cottage - Over Finlarg	341445	741105
NSR09	Over Finlarg (new farmhouse)	341393	741367

NSRs which require considering for the operational noise assessment are usually identified through an ETSU screening assessment. The screening assessment defines a 35dB LA90 noise contour around the proposed turbines assuming that the turbines are operating at their maximum noise output. Any NSRs located within, or on the edge of, this noise contour are then included for assessment.

The screening exercise for the proposed development identified six NSR locations within the 35dB LA90 operational noise contour and a further two NSR locations close to this noise contour. However, NSR03 Lumleyden is not required to be included within the operational assessment. It is, however, included within the assessment of construction noise due to its proximity to potential construction activities.

Figure 5-1 details the NSR locations. NSRs are grouped by colour to indicate which set of baseline data are used to derive the operational noise level limits for individual NSRs.

5.3 Construction Impacts

Construction noise levels at any location will vary throughout the construction period as the combinations and locations of plant machinery vary. The key variables influencing the noise levels at each receptor are:

- The sound power levels of equipment being operated;
- The number of noise sources operating at any one time;
- The duration of operation;

- The distance between the noise source and receiver, and
- The levels of attenuation due to barrier effects, ground absorption and air absorption.

5.3.1 Predicted Impact

In the absence of detailed planned construction activities, it is possible to estimate the possible impacts from the use of various construction plant. Levels of site construction noise have been predicted at the nearest NSRs identified in Table 5-1. Calculations have been made in accordance with BS5228:1-2009, Annex F 2.2, '*Method for Activity LAeq,*' and Annex F 2.4, '*Method for mobile plant in a defined area*.'

Typical activities during wind farm construction with the highest potential to generate noise include track laying, excavating and laying of foundations, concrete batching aggregate excavation from borrow pits and transport of plant and materials along haulage routes.

No concrete batching will occur on site and no borrow pits are planned. Therefore, the plant included within the calculations has been chosen to reflect the remaining activities, with the focus on construction activities being at the base of each turbine and vehicular movements.

Noise predictions are based upon the source noise terms listed in Annex C of BS5228:2009. Smaller pieces of equipment such as generators or hand held tools have insignificant noise output in comparison to larger pieces of plant. The assessment of construction noise, therefore, includes large plant items only. The source noise levels of the plant considered within the calculation of construction noise are detailed in Table 5-2.

Table 5-2: Construction Noise Assessment Source Noise Level Data

BS 5228 Ref no.	Equipment	Octave band sound pressure levels at 10m, Hz								LAeq, dB, at 10m
		63	125	250	500	1k	2k	4k	8k	
C.2, 14	Tracked excavator	85	78	77	77	73	71	68	63	79
C.4, 3	Dumper	84	81	74	73	72	68	61	53	76*
C.4, 50	Tracked mobile crane	68	71	68	62	66	66	55	46	71
C.6, 19	Road lorry	81	79	75	70	70	70	68	65	76

* L_{AMax} at 10m

BS5228 details a calculation method to predict the noise level for a 10 hour period. In order to predict a worst-case scenario the calculations of construction noise assume that all plant for each construction activity will be operating consecutively and continuously for the full 10 hour period. Two tracked mobile cranes and one tracked mobile excavator is assumed to be operating at each turbine crane hardstanding. One tracked excavator, a dumper and a road lorry are assumed to be operating within the construction compound.

In practice this will not happen, mobile plant will move locations and will not always operate simultaneously, therefore, the predicted noise levels are likely to be much higher than in reality. Additionally, it has been assumed that ten vehicle movements an hour are made between the construction compound and the centre of the site. This is modelled as a moving point source travelling at 20kph.

In order to model topographic barrier attenuation, OS Landform Panorama contour maps have been imported into the proprietary software model CadnaA, however, barrier attenuation has not been considered from man-made structures. The construction noise levels at each of the NSRs are detailed in Table 5-3. Additionally, a noise contour map detailing the noise levels from all activities occurring simultaneously is provided on Figure 5-2.

Table 5-3: BS5228 Predicted Construction Noise Levels at NSRs

NSR ID	Noise Sensitive Receptor	Activity LAeq(10 hours)
NSR01	Govals	36.7
NSR02	Govals Cottage	35.9
NSR03	Lumleyden	32.0
NSR04	1 to 4 Farm Cottages - Nether Finlarg	38.3
NSR05	Nether Finlarg Farmhouse	38.5
NSR06	Over Finlarg (bungalow)	49.6
NSR07	Over Finlarg (old farmhouse)	50.0
NSR08	1 & 2 Farm Cottage - Over Finlarg	50.8
NSR09	Over Finlarg (new farmhouse)	43.1

National guidance on noise limits during construction activities is not available. However, BS5228 does provide advice on acceptable noise levels.

Table E1 of BS5228 suggests a daytime (07:00 – 19:00 weekdays & 07:00 – 13:00 Saturdays) noise limit of 65dB LAeq in environments where the ambient noise levels (when rounded to the nearest 5dB) are less than these values. This value is reduced for evenings and weekends (19.00 – 23.00 weekdays, 13.00 – 23.00 Saturdays and 07.00 – 23.00 Sundays) to 55dB LAeq and to 45dB LAeq for night-time (23:00 – 07:00).

Table 5-4 details the difference between the predicted noise levels and the guideline noise level limits.

Table 5-4: Margin Below Construction Noise Level Limits

NSR ID	Noise Sensitive Receptor	BS5228 Daytime		BS5228 Weekends/evenings	
		Limit dBA	Margin dBA	Limit dBA	Margin Dba
NSR01	Govals	65	-28.3	55	-18.3
NSR02	Govals Cottage	65	-29.1	55	-19.1
NSR03	Lumleyden	65	-33.0	55	-23.0
NSR04	1 to 4 Farm Cottages - Nether Finlarg	65	-26.7	55	-16.7
NSR05	Nether Finlarg Farmhouse	65	-26.5	55	-16.5
NSR06	Over Finlarg (bungalow)	65	-15.4	55	-5.4
NSR07	Over Finlarg (old farmhouse)	65	-15.0	55	-5.0
NSR08	1 & 2 Farm Cottage - Over Finlarg	65	-14.2	55	-4.2
NSR09	Over Finlarg (new farmhouse)	65	-21.9	55	-11.9

The calculated noise levels are comfortably below the daytime 65dBA noise limit and also below the weekend/evening 55dA limit at all receptors. No construction activities are anticipated at night-time.

Similar activities and plant will be required for decommissioning the turbines at the end of their life span. It is not anticipated that noise levels attributable to decommissioning will result in noise levels exceeding the calculated construction noise levels.

5.3.2 Mitigation Measures

Although it is not anticipated that noise from construction activities will exceed the derived noise level criteria, the general principles of construction site noise control as described in BS5228 will be implemented prior to any construction management plans or schedules being finalised. Where appropriate, alternative methods or arrangements which avoid or reduce noise levels, will be employed. Specific measures which will be considered are:

- Location of equipment, taking account of local topography and natural screening;
- Working methods, including the phasing of the works, location and gradient of access roads, equipment to be employed and working hours;
- Selection of plant, taking account of the characteristics of noise emissions from each item of plant and their collective effect;
- Deployment of plant, in particular the timing of on and off site movement of plant and reducing the duration of noisier operations near occupied properties;
- Working hours, where restrictions are applied to any operations where emissions of noise and vibration may have an adverse effect on the occupants of sensitive premises; and;
- Operation of plant, including fitting and proper maintenance of silencers and/or enclosures, avoiding excessive and unnecessary revving of vehicle engines, and parking of equipment in locations which avoid possible effects on noise-sensitive properties.

5.3.3 Predicted Residual Impact

Construction noise levels at all receptors will remain below the guideline noise limits during the assessed time periods. Construction noise effects are, therefore, assessed as negligible.

5.4 Permanent and Operational Impacts

5.4.1 Noise Propagation Model

Operational noise propagation calculations are undertaken in accordance with ISO9613-2, using the propriety software model CadnaA. Whilst ISO9613-2 is the adopted best practice method for the prediction of noise from wind turbines, the IOA Bulletin Agreement requires clarification as to the exact parameters used within the model. It states:

"…The output from an ISO9613-2 prediction model depends on the model input parameters…in the interests of clarity we recommend that the results of wind turbine noise predictions should be qualified by a statement of all the model inputs used."

This is reiterated in the IOA GPG, where at paragraph 4.1.5 it states:

"…The choices which are made in the calculation parameters adopted for the prediction calculation should be clearly outlined and detailed in any noise assessment so that they can be reviewed by any assessor."

A number of variable input parameters which should be qualified within the noise assessment are detailed in the IOA Bulletin Agreement including:

- Turbine sound power levels used as input;
- The atmospheric conditions assumed;
- The ground factors Gs, Gm, Gr assumed; and
- The effects of barriers.

The propagation model described in ISO9613-2 provides for the prediction of sound pressure levels based on downwind (i.e. worst case) conditions and other conditions favourable for noise propagation. When the wind is blowing in the opposite direction, noise levels will be significantly lower; therefore, the noise propagation model is inherently conservative.

The noise model calculates the predicted sound pressure level by taking the source sound power level (SWL) for each turbine in separate octave bands and subtracting a number of attenuation factors, according to the following:

Predicted Octave Band Noise Level = Lw - A

Where *Lw* is the octave band SWL in decibels (dB) and *A* represents the various attenuation factors, also in dB.

A can be defined as:

A = Adiv + Aatm + Agr + Abar + Amis

Adiv is the attenuation due to geometric divergence. This is the reduction in noise levels caused by the spherical spreading of the noise over distance from the point source. The attenuation factor therefore increases as the distance from the noise source increases.

Aatm is the atmospheric absorption of the noise in the atmosphere as sound energy is converted to heat. The level of absorption varies depending on the distance from the source and the atmospheric conditions (temperature and humidity). ISO9613-1, *'Acoustics – Attenuation of Sound during Propagation Outdoors: Part 1 – Method of Calculation of the Attenuation of Sound by Atmospheric Absorption'* (ISO, 1996) provides appropriate air attenuation factors for differing atmospheric conditions. Within the noise model, the atmospheric absorption is calculated assuming a temperature of 10°C and relative humidity of 70%.

Agr is the ground attenuation factor and represents the reduction in noise levels due to the absorption and reflection of sound energy by ground cover. The ground attenuation will vary significantly depending on the absorptive qualities of the ground cover. ISO9612-1 provides advice on appropriate ground attenuation factors based on ground cover ranging from hard ground (concrete) to soft absorbent ground. A ground attenuation factor of 0.5 is assumed in the noise propagation predictions. This is in accordance with the IOA Bulletin Agreement and the IOA GPG which recommends a ground factor of 0.5 be used for turbines with warranted sound power levels (or with emission levels which include a margin of uncertainty).

Abar relates to the attenuation due to the screening and reflection effects provided by obstacles between the source and the receiver. The level of attenuation will vary depending on the degree by which the line of sight between source and receiver is affected and the frequency considered. In relation to wind farms, local topography will usually provide the largest influence on barrier effects, however, in this assessment no barrier attenuation is included, which means that the attenuation attributable to the effects of local topography or manmade structures are not considered within the predictions.

Amis represents any miscellaneous causes of attenuation. Miscellaneous factors considered within the assessment include;

- Conversion of LAeq values to LA90;
- Concave ground profiles; and,
- Wind shear effects.

Conversion of LAeq values to LA90;

The calculated LAeq value is converted to an LA90 value as described in ETSU and reiterated in the IOA GPG, which states at paragraph 4.2.5:

"…The source sound power levels determined according to IEC 61400-11 are provided in terms of LAeq. To obtain the LA90 parameter required by ETSU-R-97, it is necessary to apply a correction to the prediction results…the assumption described in ETSU-R-97 in this regard continues to remain valid. A correction of -2dB is commonly applied."

Concave ground profiles

It is noted that the IOA GPG also recommends a correction (+3 or +1.5dBA) to the noise prediction for situations where an NSR is located "*across a valley relative to any individual turbine or where the ground falls away significantly between the turbine and NSR.*" Atmos confirms that the topography between each NSR and each turbine has been considered and concludes that no correction is required for any NSR on this occasion.

Wind shear effects

The effect of wind shear has been considered within the prediction of turbine noise by shifting the turbine sound power levels accordingly. This is detailed later within this section, specifically in Table 5-8 and Table 5-9. Additional details are shown in the Charts provided in Appendix 5-3.

5.4.2 Predicted Impact

The predicted octave band sound pressure levels from each of the turbines are summed together to give the overall A-weighted sound pressure level from all the turbines operating together. At the NSR assessment locations, this is defined as the noise immission level.

The turbine model considered for the Development is the Enercon E-70 2.3MW, with a hub height of 57m. This is a candidate turbine and is representative of a typical turbine in the class proposed for the Development.

With regards to the candidate turbine, Enercon has supplied warranted single figure, A-weighted broadband sound power level data for the E-70 2.3MW turbine model with a hub height of 57m, across a range of 10m height wind speeds from 5m/s to 10m/s. The values shown below in Table 5-5 are based on the Enercon broadband document, but include a correction of +1dB for measurement uncertainty. This is detailed within the Enercon document, which states;

"Due to typical measurement uncertainties, if the sound power level is measured according to one of the accepted methods the measured values can differ from the values shown in this document in the range of +/-1dB."

The document then goes on to detail the accepted methods of measurement.

It should be noted that although the Enercon document on its own does not represent a sound power level warranty, a warranty document which refers specifically to the aforementioned Enercon broadband document will be made available to the developer upon an order being placed.

Table 5-5: Operational Noise Assessment Source Noise Level Data (SWL dBA)

Wind Speed, (m/s)	SWL, (dBA)
5	94.6
6	99.5
7	102.3
8	103.9
9	105.5
10	105.5

The standardised octave band sound power level data input into the CadnaA noise propagation model is presented in Table 5-6. A correction has been applied to the spectra so that the logarithmic sum of the octave band noise levels is equivalent to the warranted broadband noise level plus the recommended 1dB for measurement uncertainty.

Table 5-6 Enercon E70 2.3MW Octave Band Data

E70 2.3MW Octave Band Level Data								
Wind Speed (m/s)	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
5	80.8	88.5	93.4	92.4	87.5	82.8	77.8	74.6
6	80.8	88.5	93.4	92.4	87.5	82.8	77.8	74.6
7	83.4	90.6	95.2	94.8	90.3	85.3	81.4	78.5
8	85.8	94.1	97.1	96.0	93.6	89.7	82.9	76.4
9	85.8	94.7	98.9	98.7	94.1	89.4	85.2	81.7
10	88.2	96.8	99.3	97.9	96.4	93.1	86.2	78.6

No tonal penalty is required to be added to this turbine model.

Details of the source noise level data used within the model are presented in Appendix 5-2.

An additional correction has been applied to the turbine SWL data in order to account for site specific wind shear, employing historical wind speed data. This data has been taken from a full height met mast which was installed on the Development Site after the background noise monitoring period had been completed. Ten minute average wind speed and direction data has been analysed for anemometer heights of 50m and 30m between 06/07/2012 and 24/04/2014 (101,124 data points per anemometer). The data has been cleaned including quality checks for speed and direction consistency abd anomalous readings.

In accordance with the IOA Bulletin Agreement, the wind shear exponent *(m)* was derived from the mean wind speeds U1 and U2 at heights H1 and H2, using the following standard equation;

$$m = \frac{log\left(\frac{U_1}{U_2}\right)}{log\left(\frac{H_1}{H_2}\right)}$$

Where:-

m = The shear exponent to be calculated

U_1 The wind speed measured at the lower height

U_2 The wind speed measured at the upper height

H_1 The height of the lower wind speed measurement

H_2 The height of the upper wind speed measurement

The wind speed measurements were then sorted into quiet daytime and night-time periods and the arithmetic average value of *m* calculated for 1m/s wind speed bins. Table 5-7 details the calculated wind shear values for each wind speed bin of interest.

Table 5-7 Calculated windshear values (*m*) for quiet daytime and night-time periods

Wind speed bin (m/s)	Quiet daytime *m*	Night-time *m*
4.5 - 5.4	0.229	0.274
5.5 - 6.4	0.221	0.260
6.5 - 7.4	0.202	0.234
7.5 - 8.4	0.179	0.199
8.5 - 9.4	0.171	0.176
9.5 - 10.4	0.142	0.151

The calculated wind shear correction values are applied to the wind speed reference used for predictions of wind turbine noise by adjusting the source levels detailed in Table 5-5. An interpolation of these values using a third order polynomial is then used to obtain values at integer wind speeds. As the wind shear values are different for quiet daytime and night-time periods two sets of source noise level data are derived for use in the assessment. Tables 5-8 and 5-9 detail the resultant SWL data used within the noise propagation models. The adjustment in SWL levels can be seen in the charts provided in Appendix 5-4.

Table 5-8 Turbine SWL (dBA) adjusted for derived wind shear values – Quiet Daytime

Standardised wind speed	5	6	7	8	9	10
Warranted sound power level	94.6	99.5	102.3	103.9	105.5	105.5
Corresponding hub height wind	6.6	8.0	9.4	10.7	12.0	13.3

Standardised wind speed	5	6	7	8	9	10
speeds						
Shear exponent	0.229	0.221	0.202	0.179	0.171	0.142
10m height wind speed, using shear	4.4	5.4	6.6	7.8	8.9	10.3
Corrected sound power level	97.5	101.0	103.2	104.5	105.1	105.5

Table 5-9 Turbine SWL (dBA) adjusted for derived wind shear values – Night-time

Standardised wind speed	5	6	7	8	9	10
Warranted sound power level	94.6	99.5	102.3	103.9	105.5	105.5
Corresponding hub height wind speeds	6.6	7.9	9.4	10.6	11.9	13.3
Shear exponent	0.274	0.260	0.234	0.199	0.176	0.151
10m height wind speed, using shear	4.1	5.1	6.2	7.5	8.8	10.2
Corrected sound power level	98.9	101.9	103.7	104.7	105.2	105.5

The calculated operational noise levels at receptor locations (immission levels) are presented in Table 5-10 and Table 5-11. A corresponding noise contour map detailing the maximum operational noise levels is shown on Figure 5-3. Free field noise levels are predicted to the building or the boundary of any garden/outdoor amenity area, whichever is closest to the turbine. All receptor heights are set to 4m.

Table 5-10: Operational Noise Immission Levels, dB $LA90_{(10mins)}$ – Quiet Daytime

		Wind Speed (m/s)					
ID	NSR	5	6	7	8	9	10
NSR01	Govals	28.4	31.9	34.1	35.2	35.9	36.1
NSR02	Govals Cottage	27.3	30.8	33.0	34.2	34.8	35.1
NSR04	1 to 4 Farm Cottages - Nether Finlarg	28.3	31.8	34.0	35.2	35.8	36.1
NSR05	Nether Finlarg Farmhouse	28.4	31.9	34.0	35.2	35.9	36.1
NSR06	Over Finlarg (bungalow)	31.1	34.7	36.8	38	38.7	38.9
NSR07	Over Finlarg (old farmhouse)	31.6	35.2	37.3	38.5	39.2	39.4
NSR08	1 & 2 Farm Cottage - Over Finlarg	28.6	32.1	34.3	35.4	36.1	36.3
NSR09	Over Finlarg (new farmhouse)	31.3	34.8	37.0	38.2	38.9	39.1

Table 5-11 Operational Noise Immission Levels, dB $LA90_{(10mins)}$ – Night-time

		Wind Speed (m/s)					
ID	NSR	5	6	7	8	9	10
NSR01	Govals	29.8	32.8	34.6	35.4	36.6	36.1
NSR02	Govals Cottage	28.7	31.7	33.5	34.4	35.5	35.1
NSR04	1 to 4 Farm Cottages - Nether Finlarg	29.7	32.7	34.5	35.4	36.5	36.1
NSR05	Nether Finlarg Farmhouse	29.8	32.8	34.5	35.4	36.6	36.1
NSR06	Over Finlarg (bungalow)	32.5	35.6	37.3	38.2	39.4	38.9
NSR07	Over Finlarg	33.0	36.1	37.8	38.7	39.9	39.4

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
	(old farmhouse)						
NSR08	1 & 2 Farm Cottage - Over Finlarg	30.0	33.0	34.8	35.6	36.8	36.3
NSR09	Over Finlarg (new farmhouse)	32.7	35.7	37.5	38.4	39.6	39.1

The immission levels are assessed against background derived noise level limits, as follows:

In June 2012, AC published '*Implementation Guide for Renewable Energy Proposals - Policies ER34 Renewable Energy Developments & ER35 Wind Energy Development*.' Detailed guidance on the assessment of noise from proposed wind turbine developments is given within the document in '*Section 5 Noise Assessment for Wind Energy Proposals*'. Section 5 states;

"<u>Assessment Criteria</u>

….. the criteria specified in ETSU-R-97; the assessment and rating of noise from wind farms should be used as appropriate noise assessment criteria…."

The noise level criteria as defined in ETSU are detailed in Table 5-12. The noise level criteria vary in accordance with the measured background noise levels. Additionally it should be noted that for quiet daytime periods ETSU offers a criteria range rather than a set, upper limit.

Table 5-12: ETSU Noise Level Criteria

Period	Time	ETSU Noise Limit dB(A)
Quiet Daytime	All evenings from 18:00-23:00 hours; Saturday afternoon 13:00-18:00 hours; Sunday, 07:00-18:00 hours.	35 to 40dB(A) or 'background + 5dB', whichever is higher
Night-time	23:00-07:00 hours	43dB(A) minimum or 'background + 5dB', whichever is higher

Where the occupants of a property have a financial interest in the proposed development, ETSU permits the noise level limits to be increased to 45dB(A) minimum or '*background + 5dB*', whichever is higher. For the purposes of defining 'financial interest,' the assessment follows the guidance detailed within Section 5 of the AC guidance, which states:

"Where it is suggested that any property benefits financially from the scheme and the higher absolute lower limit of 45dBA may be applied to that property, full details of the financial benefit and how the occupiers of the relevant property will receive that benefit for the life of the development should be clearly stated. A valid financial benefit is considered to be one which relates directly to the power or income generated by the turbine. One-off lump sum payments are unlikely to be considered acceptable because occupiers could change during the life of the development."

NSRs considered as financially involved and, therefore, subject to higher noise limits are;

- NSR05, Nether Finlarg Farmhouse; and,
- NSR07, Over Finlarg (old farmhouse).

The derived noise level limits for all assessment locations are detailed in Tables 5-13 and 5-14. Table 5-13 presents the daytime noise limits derived from the measured 'quiet daytime' background noise level and based on the lower end of the ETSU criteria range i.e. 35dBA or background plus 5dB. Table 5-14 presents the night-time noise limits, based on the measured 'night-time' background noise level. Figure 5-1 details which NSRs are associated with each monitoring location.

Table 5-13: Operational Noise Level Limits, Daytime.

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR01	Govals	37	38	39	41	43	43
NSR02	Govals Cottage	37	38	39	41	43	43
NSR04	1 to 4 Farm Cottages - Nether Finlarg	40	41	42	44	46	46
NSR05	Nether Finlarg Farmhouse	45	45	45	45	46	46
NSR06	Over Finlarg (bungalow)	40	42	45	48	51	51
NSR07	Over Finlarg (old farmhouse)	45	45	45	48	51	51
NSR08	1 & 2 Farm Cottage - Over Finlarg	40	42	45	48	51	51
NSR09	Over Finlarg (new farmhouse)	40	42	45	48	51	51

Table 5-14: Operational Noise Level Limits, Night-time.

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR01	Govals	43	43	43	43	44	44
NSR02	Govals Cottage	43	43	43	43	44	44
NSR04	1 to 4 Farm Cottages - Nether Finlarg	43	43	43	43	44	44
NSR05	Nether Finlarg Farmhouse	45	45	45	45	45	45
NSR06	Over Finlarg (bungalow)	43	43	43	45	48	48
NSR07	Over Finlarg (old farmhouse)	45	45	45	45	48	48
NSR08	1 & 2 Farm Cottage - Over Finlarg	43	43	43	45	48	48
NSR09	Over Finlarg (new farmhouse)	43	43	43	43	45	48

The calculated immission levels are plotted on the ETSU Operational Noise Assessment Charts in Appendix 5-3 alongside the derived noise level limits. Tables 5-15 and 5-16 detail the margin between the noise immission levels and the noise level limits. The noise immission levels do not exceed the noise level limits at any of the identified NSRs for both the daytime and night-time periods and, therefore, no significant effects are predicted.

Table 5-15: Margin Below Operational Noise Level Limits, Daytime

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR01	Govals	-8.6	-6.1	-4.9	-5.8	-7.1	-6.9
NSR02	Govals Cottage	-9.7	-7.2	-6.0	-6.8	-8.2	-7.9
NSR04	1 to 4 Farm Cottages - Nether Finlarg	-11.7	-9.2	-8.0	-8.8	-10.2	-9.9
NSR05	Nether Finlarg Farmhouse	-16.6	-13.1	-11.0	-9.8	-10.1	-9.9

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR06	Over Finlarg (bungalow)	-8.9	-7.3	-8.2	-10.0	-12.3	-12.1
NSR07	Over Finlarg (old farmhouse)	-13.4	-9.8	-7.7	-9.5	-11.8	-11.6
NSR08	1 & 2 Farm Cottage - Over Finlarg	-11.4	-9.9	-10.7	-12.6	-14.9	-14.7
NSR09	Over Finlarg (new farmhouse)	-8.7	-7.2	-8.0	-9.8	-12.1	-11.9

Table 5-16: Margin Below Operational Noise Level Limits, Night-time

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR01	Govals Farm	-13.2	-10.2	-8.4	-7.6	-7.4	-7.9
NSR02	Govals Cottage	-14.3	-11.3	-9.5	-8.6	-8.5	-8.9
NSR04	1 to 4 Farm Cottages - Nether Finlarg	-13.3	-10.3	-8.5	-7.6	-7.5	-7.9
NSR05	Nether Finlarg Farmhouse	-15.2	-12.2	-10.5	-9.6	-8.4	-8.9
NSR06	Over Finlarg (bungalow)	-10.5	-7.4	-5.7	-6.8	-8.6	-9.1
NSR07	Over Finlarg (old farmhouse)	-12.0	-8.9	-7.2	-6.3	-8.1	-8.6
NSR08	1 & 2 Farm Cottage - Over Finlarg	-13	-10	-8.2	-9.4	-11.2	-11.7
NSR09	Over Finlarg (new farmhouse)	-10.3	-7.3	-5.5	-4.6	-5.4	-8.9

5.4.3 Mitigation Measures

The assessment assumes that the turbines to be installed will be Enercon E70 2.3MW. In the event that a turbine type with higher published sound power levels other than that assessed is selected for installation on site, further noise assessments will be carried out to ensure that resulting noise levels will comply with planning conditions.

5.4.4 Predicted Residual Impact

There are no mitigating measures proposed which will lessen the impacts of noise (as detailed in Table 5-13 and Table 5-14) as the calculated immission levels at all NSRs meet the noise level criteria. Therefore, the impact of noise remains the same as the pre-mitigated impacts.

Operational noise levels across the range of assessed wind speeds at all receptors will remain below the derived noise limits for both quiet day time and night time. Operational noise effects are, therefore, assessed as negligible and not significant.

5.5 Cumulative Impacts

Through consultation with the EHO, three other wind turbine developments have been identified for consideration within the cumulative assessment of operational noise. The wind turbines identified for assessment are as follows:

- Govals Farm Wind Farm, six Enercon E-53 turbines, hub height 60m. Consented.
- Nether Finlarg, one Gaia GW11 turbine, hub-height 18m. Currently operational.

- Nether Finlarg, one Gaia GW11 turbine, hub-height 18m. Consented, construction not started.

A consented ACSA V27 turbine is also located to the east of the site at North Tarbrax (approximately 343378,742598). The noise assessment submitted as part of its planning application (12/00456/FULL) states "*that at distances of 420m away, a noise level of 35dB is expected to be recorded… Therefore, it is deemed likely that dwellings over 420m away from the proposed turbine site will not be affected by noise*". Given that the nearest receptor is NSR05 Nether Finlarg Farmhouse, which is approximately 880m from the North Tarbrax Turbine, noise emissions from this turbine have not been included in the cumulative assessment.

The cumulative assessment firstly considers the operation of the Frawney and Govals Farm turbines. Both Gaia turbines are considered separately later in this section.

Using the same propagation model parameters as detailed earlier, the noise immission levels from the cumulative operation of the Frawney and Govals Farm wind turbines are as detailed in Table 5-17 and 5-18. Additionally a noise contour plot is provided in Figure 5-4 assuming all turbines operating at maximum power output.

Table 5-17: Cumulative Operational Noise Immission Levels; Frawney and Govals Farm Turbines (dB LA90$_{(10mins)}$) Daytime

		Wind Speed (m/s)					
ID	**NSR**	**5**	**6**	**7**	**8**	**9**	**10**
NSR01	Govals Farm	33.0	36.5	38.8	40.3	41.3	41.3
NSR02	Govals Cottage	31.2	34.7	37.0	38.4	39.4	39.4
NSR04	1 to 4 Farm Cottages - Nether Finlarg	28.8	32.3	34.5	35.7	36.4	36.6
NSR05	Nether Finlarg Farmhouse	28.8	32.3	34.4	35.7	36.4	36.6
NSR06	Over Finlarg (bungalow)	31.3	34.8	37.0	38.2	38.9	39.1
NSR07	Over Finlarg (old farmhouse)	31.8	35.3	37.5	38.7	39.4	39.6
NSR08	1 & 2 Farm Cottage - Over Finlarg	28.8	32.3	34.5	35.7	36.4	36.6
NSR09	Over Finlarg (new farmhouse)	31.5	35.0	37.2	38.4	39.1	39.3

Table 5-18 Cumulative Operational Noise Immission Levels; Frawney and Govals Farm Turbines (dB LA90$_{(10mins)}$) Night-time

		Wind Speed (m/s)					
ID	**NSR**	**5**	**6**	**7**	**8**	**9**	**10**
NSR01	Govals Farm	33.5	36.8	39	40.3	41.5	41.3
NSR02	Govals Cottage	31.8	35.1	37.2	38.5	39.7	39.4
NSR04	1 to 4 Farm Cottages - Nether Finlarg	30.1	33.1	34.9	35.9	37.1	36.6
NSR05	Nether Finlarg Farmhouse	30.1	33.1	34.9	35.8	37.0	36.6
NSR06	Over Finlarg (bungalow)	32.7	35.7	37.5	38.4	39.6	39.1

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR07	Over Finlarg (old farmhouse)	33.2	36.2	38.0	38.9	40.1	39.6
NSR08	1 & 2 Farm Cottage - Over Finlarg	30.2	33.2	35.0	35.9	37.1	36.6
NSR09	Over Finlarg (new farmhouse)	32.9	35.9	37.7	38.6	39.8	39.3

Although ETSU is the recognised guidance for assessing the majority of wind turbine developments it should be noted that a second set of guidelines are produced for small 'micro' turbines. The British Wind Energy Association Small Wind Turbine Performance and Safety Standard (BWEA, 2009) states:

"This standard applies to wind turbines having a rotor swept area of 200m^2 or less. In a horizontal axis wind turbine this equates to a rotor diameter of ~16m (~52ft)."

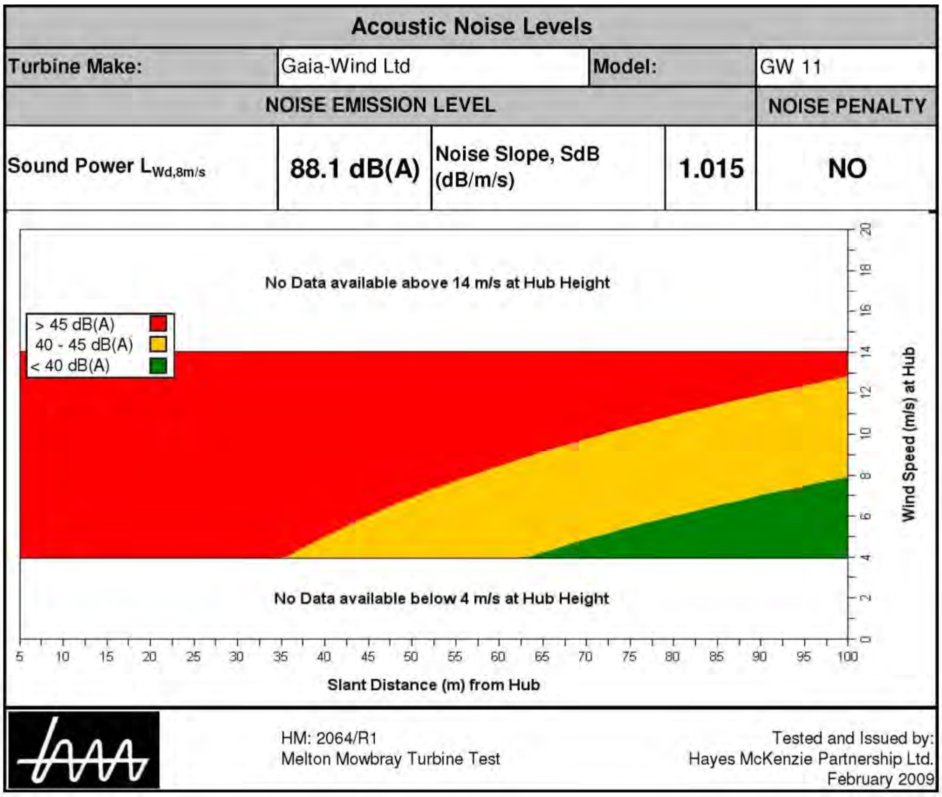
The Gaia turbines have a 13m diameter blade (swept area 133m^2), therefore, it is necessary to use the BWEA standard, as opposed to ETSU, to assess the noise immission levels of these turbines. However, as the cumulative assessment requires all turbines to be considered, it is necessary to combine both ETSU and BWEA methods into a single assessment. This brings about certain difficulties, primarily because each method uses differing noise metrics ($LA90_{(10mins)}$ for ETSU and $LAeq_{(t)}$ for BWEA) and different methods of noise propagation calculations.

In order to adequately integrate both assessment methods consultation was undertaken with the EHO and the following details agreed upon:

- As the rotational speed of the Gaia turbines is 56rpm, which is considerably higher than larger format turbines, the LAeq noise level is considered to be much closer to the LA90 noise level than the 2dB difference used within an ETSU assessment. Therefore, no correction to the LAeq is to be applied and the LAeq is to be considered as LAeq = LA_{90}.
- Noise propagation of the Gaia turbines is to be calculated in accordance with Equation A.2 of the BWEA standard.

Manufacturer supplied noise data for turbines conforming to the BWEA standards are provided in terms of a single figure sound power level (based on an 8m/s wind speed), a noise slope and a penalty indicator. This data is provided within a 'noise label,' which can be seen in Figure 5-5.

Figure 5-5: Gaia-Wind GW11 BWEA 'Noise label'



Source: Report HM: 2064/R1 (Hayes McKenzie, 2009)

EquationA.2 of the BWEA standard is as follows:

$$L_{p,Xm} = L_{Wd,8m/s} + S_{dB} *(V-8) + P - 8 - 20*Log_{10}(X)$$

Where P is the noise penalty (P=5 or 0), X is the distance in metres from source to receiver, V is the wind speed (m/s) at rotor centre and S is the specified noise slope.

Table 5-19 details the calculated cumulative noise immission levels of the two Gaia turbines at the NSRs using the above formula, where $L_{Wd,8m/s}$ = 88.1dBA and S = 1.015dB/m/s. The turbine does not require a penalty to be added, therefore P = 0.

Table 5-19: Gaia Wind GW11 (Two of) Noise Immission Levels, SPL dBA.

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR01	Govals	16.0	17.1	18.1	19.1	20.1	21.1
NSR02	Govals Cottage	16.2	17.2	18.3	19.3	20.3	21.3
NSR04	1 to 4 Farm Cottages - Nether Finlarg	29.7	30.7	31.7	32.7	33.7	34.7
NSR05	Nether Finlarg Farmhouse	35.9	36.9	37.9	38.9	39.9	40.9
NSR06	Over Finlarg (bungalow)	19.1	20.1	21.2	22.2	23.2	24.2
NSR07	Over Finlarg (old farmhouse)	20.0	21.0	22.0	23.0	24.0	25.0
NSR08	1 & 2 Farm Cottage - Over Finlarg	18.3	19.3	20.3	21.3	22.3	23.4
NSR09	Over Finlarg (new farmhouse)	18.8	19.8	20.8	21.8	22.9	23.9

Table 5-20 and Table 5-21 details the cumulative noise immission levels of all turbines by energetically adding the sound pressure levels detailed in Table 5-17 and Table 5-18 (Frawney and Govals Farm) with those detailed in Table 5-19 (2 x Gaia).

Table 5-20: Cumulative Noise Immission Levels, SPL dBA, All Turbines - Daytime

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR01	Govals	33.1	36.5	38.8	40.3	41.3	41.3
NSR02	Govals Cottage	31.3	34.8	37.1	38.5	39.5	39.5
NSR04	1 to 4 Farm Cottages - Nether Finlarg	32.3	34.6	36.3	37.5	38.3	38.8
NSR05	Nether Finlarg Farmhouse	36.7	38.2	39.5	40.6	41.5	42.3
NSR06	Over Finlarg (bungalow)	31.6	34.9	37.1	38.3	39.0	39.2
NSR07	Over Finlarg (old farmhouse)	32.1	35.5	37.6	38.8	39.5	39.7
NSR08	1 & 2 Farm Cottage - Over Finlarg	29.2	32.5	34.7	35.9	36.6	36.8
NSR09	Over Finlarg (new farmhouse)	31.7	35.1	37.3	38.5	39.2	39.4

Table 5-21: Cumulative Noise Immission Levels, SPL dBA, All Turbines – Night-time

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR01	Govals	33.6	36.8	39.0	40.3	41.5	41.3
NSR02	Govals Cottage	31.9	35.2	37.3	38.6	39.7	39.5
NSR04	1 to 4 Farm Cottages - Nether Finlarg	32.9	35.1	36.6	37.6	38.7	38.8
NSR05	Nether Finlarg Farmhouse	36.9	38.4	39.7	40.6	41.7	42.3
NSR06	Over Finlarg (bungalow)	32.9	35.8	37.6	38.5	39.7	39.2
NSR07	Over Finlarg (old farmhouse)	33.4	36.3	38.1	39.0	40.2	39.7
NSR08	1 & 2 Farm Cottage - Over Finlarg	30.5	33.4	35.1	36.0	37.2	36.8
NSR09	Over Finlarg (new farmhouse)	33.1	36.0	37.8	38.7	39.9	39.4

To complete the cumulative assessment the noise level limits are increased to 45dB(A) or 'background + 5dB', whichever is higher, at any NSRs financially involved in any of the wind turbine developments under consideration. Therefore, at NSR01 Govals, which is financially involved in the Govals Farm Wind Farm the noise limits are raised to 45dB or background plus 5dB for both daytime and night-time periods. For all other NSRs the noise level limits remain the same as detailed previously.

The cumulative immission levels are plotted on the ETSU Operational Noise Assessment Charts in Appendix 5-3 alongside the derived noise level limits. Tables 5-22 and 5-23 detail the margin between the noise immission levels and the noise level limits.

Table 5-22: Margin Below Cumulative Noise Level Limits, Daytime

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR01	Govals	-11.9	-8.5	-6.2	-4.7	-3.7	-3.7

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR02	Govals Cottage	-5.7	-3.2	-1.9	-2.5	-3.5	-3.5
NSR04	1 to 4 Farm Cottages - Nether Finlarg	-7.7	-6.4	-5.7	-6.5	-7.7	-7.2
NSR05	Nether Finlarg Farmhouse	-8.3	-6.8	-5.5	-4.4	-4.5	-3.7
NSR06	Over Finlarg (bungalow)	-8.4	-7.1	-7.9	-9.7	-12.0	-11.8
NSR07	Over Finlarg (old farmhouse)	-12.9	-9.5	-7.4	-9.2	-11.5	-11.3
NSR08	1 & 2 Farm Cottage - Over Finlarg	-10.8	-9.5	-10.3	-12.1	-14.4	-14.2
NSR09	Over Finlarg (new farmhouse)	-8.3	-6.9	-7.7	-9.5	-11.8	-11.6

Table 5-23: Margin Below Cumulative Noise Level Limits, Night-time

ID	NSR	Wind Speed (m/s)					
		5	6	7	8	9	10
NSR01	Govals Farm	-11.4	-8.2	-6.0	-4.7	-3.5	-3.7
NSR02	Govals Cottage	-11.1	-7.8	-5.7	-4.4	-4.3	-4.5
NSR04	1 to 4 Farm Cottages - Nether Finlarg	-10.1	-7.9	-6.4	-5.4	-5.3	-5.2
NSR05	Nether Finlarg Farmhouse	-8.1	-6.6	-5.3	-4.4	-3.3	-2.7
NSR06	Over Finlarg (bungalow)	-10.1	-7.2	-5.4	-6.5	-8.3	-8.8
NSR07	Over Finlarg (old farmhouse)	-11.6	-8.7	-6.9	-6.0	-7.8	-8.3
NSR08	1 & 2 Farm Cottage - Over Finlarg	-12.5	-9.6	-7.9	-9.0	-10.8	-11.2
NSR09	Over Finlarg (new farmhouse)	-9.9	-7.0	-5.2	-4.3	-5.1	-5.6

The cumulative noise immission levels do not exceed the noise level limits at any of the identified NSRs for both the daytime and night-time periods and, therefore, no significant effects are predicted.

5.6 Summary

This chapter has assessed potential noise effects from the operation and construction of the proposed development.

Predictions of noise from typical construction plant have been undertaken in accordance with BS5228:2009. The construction noise limit criteria are also derived from BS5228:2009. The construction noise of the development will not exceed the noise level limits at any receptor.

The operational noise level criteria for daytime and night-time periods are defined in accordance with ETSU-R-97.

The criterion for non-financially involved properties for quiet daytime is based on 35dBA or "background plus 5dBA" whichever is higher. This criterion has been used to define the daytime operational noise limits.

The criterion for non-financially involved properties for night-time is based on 43dBA or "background plus 5dBA" whichever is higher. This criterion has been used to define the night-time operational noise limits.

The criterion for financially involved properties is based on 45dBA or "background plus 5dBA" whichever is higher. This criterion has been used to define both daytime and night-time operational noise limits.

The operational noise from the turbines will not exceed the daytime or night-time noise level limits at any receptor.

A cumulative assessment of operational noise has been undertaken, considering the proposed Govals Farm Wind Farm and two Gaia turbines at Nether Finlarg. The assessment has determined that there will be no negative noise impacts associated with the cumulative operation of the proposed turbines and that the proposed Frawney wind turbine development is compatible, in terms of noise, with the additional consented and operational developments.

A summary of the predicted noise effects from the Frawney Wind Farm is presented in Table 5-24. The impact assessment methodology is presented in Chapter 2.

Table 5-24: Summary of Predicted Noise Effects

Operational & Construction Effects	Impact	Potential Effects on Receptors	Sensitivity	Impact Magnitude	Effect Significance
Turbine	Audible mechanical and aerodynamic noise	Noise effects at nearest receptors.	High	No change	Negligible
Turbine	Low frequency noise and infrasound	Noise effects at nearest receptors.	High	No change	Negligible
Construction activities and mobile plant	Mechanical noise	Noise effects at nearest receptors.	High	No change	Negligible

5.7 References

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6 Landscape and Visual

6.1 Introduction

This chapter, prepared by Andrew Jones, presents the Landscape and Visual Impact Assessment (LVIA) for a proposed height increase to the consented application (2013/00532/ EIAL) and a reduction in the number of turbines from five to four. The purpose of the assessment is to determine the significance of impact (or effect) on the landscape and visual resource of the area.

LVIA's are separate, although linked, procedures. Landscape effects relate to the direct physical changes to the fabric or individual elements of the landscape. They also relate to the potential indirect changes to the wider patterns of landuse, landcover and the arrangement of landscape features which determine the character of the landscape. Visual effects relate to the potential changes in views and perception of the proposed development on visual amenity within a Zone of Theoretical Visibility (ZTV).

6.2 Methodology and Approach

6.2.1 Information Sources

The methodology for the LVIA follows relevant standards and guidance, principally set out in the Landscape Institute and Institute of Environmental Management & Assessment's (IEMA) Guidelines for Landscape and Visual Impact Assessment, second edition, published in 2002 (GLVIA), but accounts for updates published in the third edition (April 2013). Of particular note, the third edition emphasises the need for well-argued narrative text to assess whether an effect is significant or not, with tables and matrices to support this. The assessment also draws upon other sources of information, in particular:

- SNH Commissioned Report F01AA303A, Visual Assessment of Windfarms Best Practice, University of Newcastle (2002);
- The Visual Representation of Windfarms: Good Practice Guide, SNH (May, 2007);
- The Strategic Locational Guidance for Onshore Wind Turbines in respect of the Natural Heritage, SNH Policy Statement No 02/02, updated 2009;
- Guidelines on the Environmental Impacts of Windfarms and Small Scale Hydroelectric Schemes; SNH (2002)
- Siting and Designing Wind Farms in the Landscape, SNH (2009, version1)
- Assessing the Cumulative Impact of Onshore Wind Energy Developments, SNH (March 2012);
- Angus Wind Farms Landscape Capacity and Cumulative Impacts Study, Ironside Farrar, (2008); updated by the Strategic Landscape Capacity Assessment for Wind Energy, November 2013; and
- Renewable Energy Implementation Guide, Angus Council (June 2012).

6.2.2 Consultation

The scope of assessment for the LVIA, including the study area radius, methodology and the proposed number and location of representative viewpoints were established and agreed through liaison with SNH and Angus Council during consultation for the consented application (2013/00532/ EIAL) in 2012. The key LVIA consultation responses and outcomes are detailed within Table 6-1.

Table 6-1: Consultation Responses

Consultee	Response	Comment
Angus Council	03/03/2009 – meeting to discuss initial landscape viewpoints. Suggested addition of Cat Law - often visited as a viewpoint for wind farms- particularly re cumulative impacts; Western End of Forfar e.g. Forfar Loch Country Park or Balmashanner Hill; Tulloch Hill, Airlie Memorial Tower - representative view from the Angus Glens; Craigowl Hill close to the site; and Turin or Finavon Hills as a better alternative to the A932, as visibility form the lower elevation is likely to be limited. Discussed format of photomontages to be in line with current SNH guidance. Provided an up to date list of the status of all wind farms in Angus.	Viewpoints and photomontage format was agreed in March 2012. Methodology is presented in Appendix 6-1. Viewpoints are presented in Table 6-3. Visualisations are presented on Figures 6-6 to 6-27; and Figures 6-34 to 6-36.
	02/04/2009 – Scoping response. Follow GLVIA methods. Include impacts on local and wider landscape, locally designated sites and visual dominance from local properties. Agree viewpoints with council. Consider the Tayside Landscape Character Assessment and SNH guidance documents. Cumulative effects to be considered in combination, in succession and in sequence.	All recommended guidance is referred to in this assessment. Viewpoints were discussed at two meetings and finally agreed in March 2012. Cumulative assessment included in Section 6.6.
	12/03/2012 – meeting to discuss LVIA and cumulative methodology, 30km study area, agree viewpoints, cumulative viewpoints and cumulative effects (within 60km study area). Provided an up to date list of the status of all wind farms in Angus.	16/03/2012 - Follow up email from Atmos to Angus Council to confirm minutes, list of viewpoints and cumulative views. These are presented in Table 6-3.
	14/03/2012 – email to confirm that the single frame images could be extracted from 50mm equivalent photos with a 70mm field of view if of high resolution and taken in good light.	Single frame photomontages are included on Figures 6-6 to 6-21 (for viewpoints up to 15km from the development site).
	28/08/2012 – Email (post submission) - Request for additional information on residential properties within 2km of the site.	14/09/2013 – provided supplementary information on residential amenity for properties within 2km of the site.
	15/01/2013 – Response to planning application 12/00577/EIAL It is a weakness that the assessment does not consider the proposed turbines in relation to landscape scale in accordance with SNH guidance "Siting and Designing Windfarms in the Landscape". A number of the visualisations demonstrate that the proposed turbines at 100m to blade tip are out of scale with the	Alternative options for the development to aim to reduce impacts on landscape scale and residential amenity were investigated and discussed via a series of meetings, email correspondence and

Consultee	Response	Comment
	landscape, appearing larger than the hills in the background and out of scale with the small and medium scale houses, farms, trees and field patterns. The proposed turbines are the same size as those refused at appeal at Hill of Finavon (100m compared to 99.5m). The proposed development would be located on lower ground within the Sidlaw Hills. (They would be below the 250m contour with the hills to the immediate west being circa 330m). This has substantially contributed towards the visual impact within the wider landscape being more contained than would be the case with a hilltop location. The most significant visual effects would be in relation to the views within 5km to the east and north; and within 1km to the south and west, where the turbines would often dominate views locally. The most significant effects would be in relation to nearby houses. The LVIA under estimates visual effects, most notably a slight under-assessment of receptor sensitivity. This however does not change the overall results, which means that I concur with the SNH conclusions that significant effects would result in respect of viewpoints 1, 2, 3, 4, 9, 11 &16. In terms of the impacts upon houses within 2km, I consider that the ES generally under-estimates the magnitude of impacts upon houses, many of which would clearly experience significant effects. In respect of Cumulative Landscape Effects, the combination of Govals, Frawney and Dodd Hill together would create a windfarm character which would be at least "landscape with windfarms" within LCT8; locally becoming "windfarm landscape". Cumulative visual effects are contained within 6.6.3 of the ES. Whilst cumulative impacts are described, there are only cumulative wirelines from three viewpoints and there appears to be no formal assessment of impacts. Using cumulative wirelines submitted in support of Govals, shows the different turbine sizes together with some being on top of hills and others being on lower ground would further increase the lack of design coherence. Given the above I would consider that the cumulative impact from Carrot Hill would be high. The A90(T) would experience the most significant sequential cumulative effects. Cumulative wirelines are not provided for nearby houses, but it is nevertheless likely that a number of houses would experience significant cumulative impacts.	telephone calls through March to May 2013.
	03/04/2013 – email correspondence post meeting of 12/02/2013 noting that impacts on landscape scale and residential amenity would still be unacceptable from the options presented (options included 92.5m and 87m tip turbines as well as a four turbine option).	Further options to tighten up layout and further reduce tip height, whilst maintaining economic viability of scheme were explored.

Consultee	Response	Comment
	29/04/2013 - Meeting (post submission) – further design alternative presented comprising five turbines at 80m tip within boundary of Over Finlarg Farm. Whilst the Council agreed that this was a marked improvement and landscape scale effects were reduced; impacts were still considered to be significant for some residential properties.	Atmos agreed to have another look at reducing the spread of the turbines to create more contained views with an aim of achieving lesser residential amenity impacts.
	Meeting of 29/04/2013 and Email correspondence 21/05/2013 – (post submission) Landscape: At the meeting of 29/04/2013 the Council noted the positive amendments made to the proposal in reducing the tip height to reduce impacts on landscape scale. They also noted that they believe the site does have some potential for renewable energy development. They advised that they still had some remaining concerns about how the turbines of 80m in height at this location fits in with SNH's policy guidance on wind farm siting and design whereby the wind farm should appear as a minor feature, both horizontally and vertically in relation to the surrounding landscape. .However, being away from hilltops and higher ground does provide positive mitigating effects in line with Angus policy guidelines. Visual: Whilst not raised at the meeting and has not been addressed directly in the inductive submission for the latest iteration, the Council wish to highlight that careful consideration of effects, both as a standalone proposal and cumulatively, should be given from hilltops in the Sidlaw range. Particularly taking account of consented schemed to the west and south and proposed schemes to the north and east in cumulative terms. Residential Amenity – Visual Effects: The Council note and welcome the positive changes made in the most recent iteration in relation to lowering the vertical extent of the turbines and providing a greater degree of containment in the horizontal extent as experienced from nearby properties. However, the Council do feel that the latest design is comparable to, and would give rise to similar effects as, other recent cases refused by Committee and dismissed at Appeal. In any subsequent application we would expect that cognisance of this is given whilst undertaking this assessment.	The current design addresses concerns on landscape scale and residential amenity as far as possible whilst retaining a scheme that would be economically viable and of measurable benefit to Government renewable energy targets and carbon savings.
	26/03/2014 – Preapplication inquiry. Follow Tayplan and Angus Local Plan Review. Landscape character and visual impact are key matters for assessment. Commented that the consented turbines at Frawney have similar proportions to those at the adjacent Govals wind farm. The proposed height extension would introduce a disjointed and harmful effect on the landscape, as the proportions would contract significantly from the approval and Govals.	All recommended guidance is referred to in this assessment. The separation distance between the two wind farms clearly shows two distinct wind farms. From a commercial point of view it is unreasonable to expect different wind farms to erect identical wind turbines. Any visual gain from such a

Consultee	Response	Comment
		correlation is minimal and is entirely outweighed by the tripling of the power output.
SNH	27/01/2009 – Scoping response. Include effects on landscape resource and visual effects referring to relevant guidance documents including SNH publications and Tayside Landscape Character Assessment. Consider sensitivity statements in this guidance in light of today's technological advances and larger turbines. Consider cumulative landscape and visual effects in combination, succession and sequence. The CLVIA study area should be at least 50km. Provided comment on initial viewpoints and suggested addition of Carrot Hill, A90 north of Claverhouse Dundee and A90 Newlands.	Comments on viewpoints incorporated into final list, agreed in March 2012. CLVIA study area 60km as shown on Figure 6-28.
	03/03/2009 – meeting to discuss initial viewpoints with the council.	Comments on viewpoints incorporated into final list, agreed in March 2012.
	29/02/2012 – SNH confirmed that someone would attend the meeting with Angus Council on 12/03/2012. On 08/03/2012 SNH pulled out of meeting due to lack of resources.	16/03/2012 - Follow up email from Atmos to SNH to confirm minutes of meeting held with Angus Council, list of viewpoints and cumulative views.
	20/03/2012 – SNH reviewed the revised list of viewpoints, the subsequent minutes of meeting and comments by Angus Council. SNH commented that it would be useful to retain the viewpoint from the A933 to predict visibility from the northeast of the site.	Viewpoint from A933 included as VP18 (Table 6-3).
	28/09/2012 – Response to planning application 12/00577/EIAL - The proposal, on its own, will have significant and adverse but generally localised impacts on landscape and visual amenity. However, to improve the landscape and visual relationship between Frawney and Govals a reduction in the height of the turbines at Frawney, commensurate with Govals, is recommended. It is considered that within the Igneous Hills Landscape Character Type (LCT) and the wider content of the Sidlaw Hills, the development of Frawney, in addition to Dodd Hill and Govals and other consented developments, there will be a significant reduction in this local and regionally important landscape resource.	These comments have been carefully considered and the scheme has been reduced in scale by 20m in vertical tip height from 100m to 80m.

6.2.3 Overall Approach

The LVIA methodology is set out at Appendix 6-1 of this ES. The methodology explains that the significance of landscape and visual effect is a product of the sensitivity of the host landscape or visual receptor and the magnitude of change from the existing situation. Effects can be considered adverse or beneficial and can be permanent or temporary in nature depending on the type of development in question and nature of the receiving environment.

The full methodology for undertaking the photography and presentation of wind farm visualisations including wireframes and photomontages is presented in Appendix 6-1.

6.3 Baseline Conditions

The proposed development is located on the eastern fringe of the Sidlaw Hills area of Angus, to the north of Dundee. These hills are located between the lowland valleys and mountains of the Scottish Highlands to the north and the Firth lowlands to the south. Whilst considerable areas exhibit a large, open character with notable areas of mixed farmland, moorland, coniferous forestry plantations and woodland, human influence is also evident, with a dispersed settlement pattern and notable built influences at various points, including power lines, pylons, communication masts and existing wind turbines on the Sidlaw Hills to the west. The site itself already has a consented wind farm consisting of five turbines of up to 80m tip height and this forms part of the baseline.

6.3.1 The Site Landscape and Fabric

The landscape fabric of the development site consists of open, ascending landform with the proposed turbines sited between 220m and 250m AOD. Landform continues to rise to the west to a local high point of 336m AOD at Finlarg Hill, with further high points within 2km of the site at Ironside Hill (356m), Gallow Hill (378m) and Craigowl Hill (455m).

Land cover across the site is defined by large scale, open, mixed farmland with fields divided by post and wire fencing or stone walling. Vegetated features are then limited across much of the site which add to the overall scale and simplicity of the landcover. However, towards the south and east some woodland shelter belts are present. These, provide screening and shelter to residential properties within the site at Over Finlarg and Nether Finlarg. In the wider site context notable coniferous woodland plantations exist to the south and east to provide local containment. The site is also defined by existing tall built elements, with pylons carrying two power lines, from north to south either side of the proposed turbines and a domestic scaled turbine present at Nether Finlarg. The landscape fabric of the site is, therefore, considered to be of medium sensitivity to change on account of its simple scale, frequency, contrast and coverage of moderately valued elements. Refer to Appendix 6-1 for detailed methodology.

6.3.2 Landscape Policy and Designation

Within the study area of 30km, a number of designated landscapes exist (Figure 6-1). There are no national landscape designations within 30km, the nearest being The River Tay (Dunkeld) National Scenic Area (NSA) at a minimum of 34km to the west. There are, however, several local landscape designations as follows (refer to Table 6-2 for the baseline sensitivity):

- Areas of Great Landscape Value (AGLV) – 25-30km+ to the southwest around Perth and along the River Tay;
- Special Landscape Areas (SLAs)/ AGLVs – 12-30km+ to the south, in Fife;
- GDL's – none within 5km; Glamis Castle (5.5km northwest); and within 10km at Balgay Park and Baxter Park, Dundee; Drumkilbo House and Airlie Castle; and
- Conservation Areas (CA) – Glamis at 5.5km. Trottick; Dundee; Murroes; Forfar and Dunnichen within 10km.

While no local landscape designations exist within Angus, there are three 'principal geographical areas' defined. These include the Highland, Lowland and Hills and Coast. The proposed development is located within the Lowland and Hills area, with the Highlands at 15-30km+ to the north and the Coast at 13-30km+ to the southeast.

Local policy considers that the Highlands and Coast areas are the most sensitive to wind farm developments. These are indicated on Figure 6-1.

6.3.3 Landscape Character

The landscape character across much of the study area is defined within the Tayside Landscape Character Assessment (LCA), SNH Review No.122, LUC, 1999. At approximately 12km to the south, the character is defined within the Fife LCA (SNH Review No.113, CRC, 1999). In excess of 30km to the northeast the character is defined in the SNH Review No.102 South and Central Aberdeenshire LCA. These reports have provided a valuable benchmark for assessing landscape character. However, it should be noted that since publication, for some areas of the landscape, the baseline character is now very different. This is often as a result of (wind) energy developments and other infrastructure, as indicated in Chapter 4 of the LCA and its Appendix C. Where this is the case it has been noted within the assessment. This has also been recognised in with Strategic Landscape Capacity Assessment for Wind Energy (Angus Capacity Study), which has provided further guidance on character and capacity.

Within the study area and of relevance to the proposed turbines, where there is a high potential for theoretical visibility and effect on key characteristics, four principal LCTs are present (Figure 6-2). These include the Igneous Hills LCT, the Broad Valley Lowland LCT (Strathmore), the Dipslope Farmland (Tealing Farmland) and the Low Moorland Hills. Beyond these LCTs, at distances in excess of 12-15km (even with some intermittent visibility from the fringes of the Firth Lowlands, Highland Foothills, Glens and Summits and the Coastal Flats of Fife (Figures 6-3 to 6-5), the expansive nature of the intervening landscape and its key characteristics, combined with general distance, orientation and separation of these LCTs, will reduce the degree to which the character is affected. A summary of the condition and sensitivity to change is recorded below for the host LCT and the principal LCTs surrounding the site.

Igneous Hills LCT

The proposed turbines are located within the Igneous Hills LCT, which extends over the Sidlaw Hills. This LCT extends to cover the surrounding area at 8km east, 3km north and 2-3km to the south. It also extends to over 30km to the southwest as an elevated linear LCT. As a result any direct effects on character will be limited to this LCT. The Tayside Landscape Assessment summarises the landscape characteristics of the LCT as follows:

"...the Sidlaws are lower and less extensive than the Ochils. They are most distinct at the southern end where southeast facing scarp (the Braes of the Carse) rises almost vertically over the Carse of the Gowrie and where the shallower, north facing dipslope meets the Strath Tay near Scone. Further to the north the hills subside, partly along their southeastern side, gradually merging into the farmland plateau. From the north the hills continue to present a distinctive profile of smooth rounded hills which contain views within Strathmore. The lower elevation is reflected in more productive agricultural land".

The Igneous Hills LCT is an elevated landscape, with conical summits and unimproved grass moorland, distinctive scarp, dipslopes, short glens, and notable areas of coniferous forestry in prominent geometric plantations and shelterbelts. The LCT also reflects a long history of settlement with burial mounds, medieval castles and mottes and other hill-forts and follies exploiting the natural defences of steep slopes. There are many tall modern influences with telecommunication masts at a number of summits, power lines and operational wind turbines. The sensitivity of this landscape to change is defined in the Angus Capacity Study and is considered to be Medium on account of its scale, varied characteristics, which are generally of moderate value.

Surrounding LCT's

The surrounding areas will have differing levels of sensitivity to development depending on the composition and quality of the key characteristics and the related tolerance to the nature of the change, coupled with their location and relationship with the Igneous Hills LCT.

The lower lying intermittently settled character of the Dipslope Farmland LCT (Tealing Farmland) and the Broad Valley Lowland LCT (Strathmore) are generally considered to be of medium sensitivity (as defined in the Angus Capacity Study), given their medium to large open scale, gentle landform with moderately valued characteristics. The nearest sections of the Low Moorland Hills LCT (Forfar Hills) are then considered to be slightly higher with a medium to high sensitivity (Angus Capacity Study). This is due to the more complex topography and varied landscape pattern, particularly in the backdrop to Forfar. However, from the nearest sections of these LCTs, existing views are occasionally defined by operational wind turbines and other tall structures, principally pylons and series of masts at hill tops.

Although the key natural heritage characteristics of the Highland Foothills, Glens and Summits to the northwest and the settled character of Coastal Flats of Fife are considered to be sensitive in the wider landscape and noted in part by the NSA and AGLV designations, there is a clear separation from the Sidlaw Hills area. This is due to the general scale, elevation, distance and orientation away from the proposed site, combined with the open scale of the intervening landscape and an emerging baseline of wind turbine characteristics. This will moderate the overall sensitivity. The baseline sensitivity of these LCT's is detailed in the landscape baseline summary (Table 6-2).

6.3.4 Historic Landscape (Setting)

A number of historic features exist within the study area. These include the GDL's and CA's identified above (Figure 6-1). Whilst these are considered in detail within the cultural heritage assessment (Chapter 10), they have been identified as part of this landscape assessment, as they can be important elements in determining landscape character. The potential effect on the landscape setting (the visual and contextual relationship with their surroundings) is also important, and is considered in the LVIA.

There are no CA's or GDL's within 5km of the site, where there is high potential for effect on the landscape setting. However, the nearest CA and GDL lies at approximately 5.5-7km at Glamis and Glamis Castle. The character and appearance of these areas are strongly defined by a low lying, well vegetated context and their immediate context on the fringes of the Strathmore Valley lowland rather than by the more elevated hill elements. The sensitivity to change is summarised in Table 6-2.

6.3.5 Non Designated Natural Heritage Areas

The SNH Policy Statement No 02/ 02 'Strategic Locational Guidance for Onshore Wind Farms in respect of the Natural Heritage', has identified different areas of natural heritage sensitivity across Scotland. The proposed development site and much of its surrounding context lies in a zone defined as having the 'Lowest' Natural Heritage

Sensitivity to Wind Turbines (Map 5 within the guidance). This zone represents the "*...areas at the broad scale with least sensitivity to wind farms, with the greatest opportunity for development, within which overall a large number of developments could be acceptable in natural heritage terms, so long as they are undertaken sensitively and with due regard to cumulative impact*".

This does not necessarily imply the absence of natural heritage interest, but with good siting and design it should however enable such localised interests to be respected.

6.3.6 Tayside LCA, Wind Farm Guidance

Chapter 4 of the Tayside LCA considers the issue of wind power and the possible landscape effects connected with the development of wind farms. It was recognised that pressure for wind farm development may occur in a number of Tayside areas and the Sidlaw Hills are identified as one of these areas. The report confirms that "Over the years, the Sidlaws (among other areas) have accommodated a considerable amount of development including masts, pylons, roads, plantations and reservoirs. While the overall aim should be to reduce the impact of these past developments, the different character and quality of these areas suggests that they may be better for wind farm development. The suitability of areas will vary considerably within the hills, and it is inevitable that some degree of landscape impact will result. However, it is possible that the balance between benefits and impacts is easier to find in the Sidlaws, than in more sensitive landscapes".

An indicative map (Appendix C of the Tayside LCA), then illustrates the sensitivities of the landscape for wind farm development in the Sidlaws. As indicated, the proposed development site will lie within an area of lowest constraint. This area stretches to the west of the A90, from Tealing to the summit of Finlarg Hill and covers the whole development site.

6.3.7 Landscape Baseline Summary

Table 6-2: Landscape Baseline Conditions

Character Type (SNH Review Vol 122 & 113)	Distance min/max)	Sensitivity to change
Igneous Hills – Sidlaw Hills	0-30km+	Medium
Dipslope Farmland	2-34km	Medium
Low Moorland Hills	2.5-25km	Medium - High
Broad Valley Lowland	4-25km	Medium
Firth Lowlands	12-30km	Medium - Low
Highland Foothills, Glens and Summits	13-30km	Medium
Coastal Flats of Fife	13-30km	Medium - Low
Designated Landscape		
AGLV's	11-25km	High - Medium
Conservation Areas (setting)		
Within 5-10km - Glamis	5-10km	High - Medium
Gardens and Designed Landscapes (setting)		
Beyond 5km – listed above	5-25km	Medium - High
Application Site		
Landscape Fabric	0km	Medium

6.3.8 Visual Baseline Conditions

The purpose of the visual assessment is to define the ZTV of the development (the extent of land/sea, from which it may be possible to see any part of the proposed development) and to then determine how visible the proposals will be, from a number of representative viewpoints. This will help to establish the potential effects on visual receptor groups and general visual amenity.

The computer generated ZTVs to hub height (57m) and blade tip height (92.5m) (Figures 6-3 to 6-5) identify key stretches of the landscape, from which the proposed wind development may theoretically be visible within the defined 30km radius, in line with the Visual Representation of Windfarms, Good Practice Guidance (SNH). Figures 6-3 to 6-4 are based on a bare earth computer model and make no allowance for any screening effects that may arise due to existing vegetation or built development). As a result they give an exaggerated impression of the potential degree of visual exposure of a proposed development and, therefore, can present an unrealistic worst-case scenario.

To limit this exaggerated impression, significant areas of vegetation and forest plantation woodland have been built into the terrain model (assumed 10m high) to provide a more realistic impression of anticipated visibility using woodland areas identified on the 1:25k OS base (Figure 6-5). However, the real extent of the ZTV will be reduced further still as a result of more intermittent areas of vegetation, buildings and other screening elements that will, in practice, provide further screening and filtering of views towards the development. The ZTV will also be reduced further, at a localised level, by the subtle variations of landform that are not covered by the digital terrain modelling data (DTM).

6.3.9 Key Visual Receptors

A range of visual receptors and receptor groups can be expected to be affected by the proposed development from both static and sequential points. These receptors will include, but not be limited to residents, travellers and those visiting the area for recreational, amenity and tourism purposes. The extent of the effect upon certain groups will then vary according to their level of sensitivity to the type of development. For example travellers on trunk roads used primarily for commercial travel and/or commuting will be less sensitive than roads used for tourism or journeys of a recreational nature. For ease of presentation the assessment identifies three key groups: (1) local residents; (2) the travelling public; and (3) tourists /recreational visitors to the area. They are detailed full in in the Methodology in Appendix 6-1.

It is generally considered that local residents with primary and immediate views from their homes and visitors, whose principal preoccupation is with the enjoyment of the outdoor environment, particularly from valued scenic points, will be most sensitive to changes in the visual environment, as these views will be consistently available. These are identified in the visual effects (Section 6.5).

Local residents and tourists with secondary views, for example those who are travelling through the area or who are working outdoors, may be less preoccupied with the scenic quality of their surroundings. Travellers are then judged to be less sensitive to changes within their visual environment given that the visual experience and view available will be transient and changing. The recreational visitors and tourists receptor group also embraces a broad category with often different objectives and, therefore, levels of sensitivity. Those receptor groups with a primary interest and focus on the landscape context (i.e. hill walkers) will generally have a higher level of sensitivity to change in their landscape and visual environment than those, whose attention may be more focused on their occupation/pastime, rather than the wider landscape, these include those visitors engaged in cultural pursuits; cyclists and equestrians for example.

6.3.10 Representative Viewpoint Appraisal

To help define the extent of visual effect, it is accepted practice to agree upon a number of representative viewpoints within the visual envelope of the development with the Local Authority. These ideally include a broad range of sensitive viewpoints and visual receptor groups, from which the assessment of both of the existing baseline conditions and of the impacts arising from the proposed development will be assessed. This will establish how visible the proposals will be from specific locations and to gauge the anticipated effects upon wider visual amenity.

Guidance in the Visual Representation of Wind Farms (SNH) states that "there is a need to balance the likely significance of effects and how typical or representative the view is from the area, whilst avoiding the inclusion of atypical features." The viewpoint photomontages for the proposed development (refer to Appendix 6-1 for methodology) have, therefore, also been taken from range of publically accessible points, to cover a representative range of viewing distances, elevations and orientations, with different viewing experiences. The micro-siting of viewpoints on-site has, as a result, sought to maximise an open and clear view where available, whilst remaining tied to the identified 'key receptor group' for the viewpoint in question.

A total of 22 viewpoints have been assessed. They were agreed in consultation with Angus Council and SNH in March 2012 and are the same as those used for the consented application (2013/00532/ EIAL). They include viewpoints from local residential receptors and core paths within the area. The locations are shown on Figure 6-5 with the existing and predicted views illustrated on Figures 6-6 to 6-27. The existing viewpoint characteristics have been reviewed in accordance with current guidance and the methodology in Appendix 6-1. The baseline sensitivity to change is detailed below in Table 6-3 and the visual characteristics of each viewpoint are provided in Section 6.5, with a description of the predicted magnitude and extent of effect.

Table 6-3: Representative Viewpoint Baseline

VP	Location	Grid Ref	Distance / Direction of View	Key Receptor Group (Represented) Static*/Sequential**	Baseline Sensitivity - Key Receptor
1	Govals	E342301 N743302	1km South	Residents *	High
2	A928	E340954 N741032	1.1km North	Travellers** (Residents –primary view)	Medium – Low
3	Road to West Tarbrax	E343311 N741718	1.7km West	Residents * (Travellers)**	High
4	Gallowfauld	E344007 N742332	2.2km West	Residents * (Travellers)**	High
5	A928 Milton of Ogilvie	E338768, N743423	2.9km East	Travellers** (Residents)*	Medium – Low
6	Tealing	E341651,	4km	Travellers**	Medium – Low

VP	Location	Grid Ref	Distance / Direction of View	Key Receptor Group (Represented) Static*/Sequential**	Baseline Sensitivity - Key Receptor
		N738069	North	(Residents)*	
7	Craigowl Hill	E337737, N740049	4.1km East	Workers (restricted area)* (Tourists) **	Medium - Low
8	A90 junction, Douglastown	E344558, N746027	4.5km Southwest	Travellers**	Medium - Low
9	Carrot Hill	E346372, N740827	4.9km West	Tourists - Core path	High
10	A90 North of Claverhouse, Dundee	E341887, N735386	6.7km North	Travellers ** (Residents)*	Medium - Low
11	Balmashanner Hill	E346041 N748539	7.4km Southwest	Tourists– Fort/ Core Path297 **	High - Medium
12	Kinpurney Hill	E332287 N741744	9km East	Tourists - Core Path209 ** Heritage	High
13	Dundee Law	E339157 N731330	10.9km North	Tourists * (Residents)*	High - Medium
14	Kirriemuir	E338744 N754490	12.4km South	Tourists */** (Residents)*	High - Medium
15	Egno Moss to Arlie	E334034 N752498	12.6km South	Tourists Core path 250**	High - Medium
16	Turin Hill	E351459 N753544	14.7km Southwest	Tourists * Heritage	High
17	Tentsmuir	E349556 N728240	15.9km Northwest	Tourists **	High - Medium
18	A933 (north of Froickheim	E 358892 N750830	19km West	Travellers Tourists Core path118**	Medium - Low
19	Cat Law	E331888 N760993	21km South	Tourists *	High
20	Arbroath, Montrose road	E364751 N742696	23km West	Travellers ** (Residents)*	Medium - Low
21	Megginch	E323805 N724681	24.7km Northeast	Tourists *	Medium
22	White Catherthun	E354786 N766030	26.9km Southwest	Tourists * Heritage	High

6.4 Construction Impacts

6.4.1 Predicted Landscape Impacts

During the construction period, there will be some temporary effects on the site landscape as the result of ground disturbance. This will include minor earthworks but it will not involve any removal of notable landscape fabric elements or characteristic features. The four proposed turbines will occupy four of the consented turbine locations (2013/00532/ EIAL) which were chosen to sit away from associated site fabric elements and other notable built infrastructure elements. The turbines have also been located at a lower elevation, to reduce the potential visibility across the more elevated hill top points of the Sidlaw Hills to the west and help anchor the turbines into the local context.

This has helped to moderate the effect on the site fabric and character and its contribution to the wider landscape context. The magnitude of effect on the landscape fabric of the site is, therefore, considered to be, medium to low. When combined with a medium sensitivity to the proposed change, the extent of effect is judged to be moderate to minor.

All effects on the site fabric are also substantially reversible in the long-term, following decommissioning of the turbines.

With regard to the wider landscape character of the study area it is anticipated that there will be no significant effect on the key characteristics of the surrounding LCTs until the later stages of construction when the turbines are more visible from these areas. These operational effects are discussed in Section 6.5.

6.4.2 Predicted Visual Impacts

Site activity will inevitably be visible from local points around the site. Principally, effects during construction will arise from the presence of plant used to construct the extensions to the site track and cable trenches, wind turbine foundation and crane pads, for the construction of the control building and for the progressive erection of the turbines. The presence of this machinery on site will only be temporary.

Whilst there will be a degree of visual disturbance arising from construction activity, the proposals aim to minimise disturbance to the land itself and careful thought has been given to the detailed siting of the turbines in order to minimise potential disturbance to the physical landscape and the impact on views. The access track will also be contained, where possible within the existing site undulations and will otherwise be integrated, where necessary, with minor earth bunds which will tie into the existing landform character with natural flowing contours. As a result of their temporary nature, construction effects are judged to be considerably lower than those during the operational phase of the development and will not be significant. The operational effects are discussed in Section 6.5.

6.4.3 Mitigation Measures

The principal opportunity for incorporating mitigation into the scheme has evolved, during the scheme development, where consideration was given to issues such as the sensitive routing and construction of the access track and the detailed scaling and positioning of turbines, to avoid any potential tree, vegetation or field boundary loss.

The final layout presented in this ES has also been the subject various refinements (Table 3-2) which have sought to provide a more contained layout from the consented application (2013/00532/ EIAL). As a result the number of turbines has been reduced from five to four. This has provided a smaller footprint, which will help to reduce the potential residential amenity effects, particularly from the north. . The proposal will now be further away from most of the nearest residential properties and the horizontal spread of the proposed development will now be reduced by up to a third from significant points to the north. This will help to contain the development context where and provide a degree of comparability with existing tall structures which traverse the site..

This has resulted in a proposal which balances environmental and technical issues whilst still producing an economically viable project and safeguarding amenity. Design changes made as a consequence of the key constraints to site design are considered to be mitigation which is 'embedded' in the design.

6.4.4 Predicted Residual Impact

The potential effect on the site fabric is not considered to be significant. Potential effects will also be minimised by using the existing tracks on site as far as possible and will be short-term. Good site management plus reinstatement at the end of the construction phase will minimise the extent and duration of these effects. The potential for landscape improvement has been identified by the landowner of Over Finlarg Farm and it is anticipated that improvements could be made in line with the underlying elements of site fabric and surrounding landscape characteristics. This would aim to improve the slightly degraded nature of the landscape fabric and vegetation pattern across the development site by planting trees, hedgerows and creating further defined fence lines and drystone walls which would contribute to the wider protection and enhancement of landscape character.

6.5 Permanent and Operational Impacts

In the medium term, during the operational lifetime of the turbines, the principal landscape effects will arise from the presence of the four turbines and the movement of their blades. There will also be occasional vehicle movements required for maintenance but these are unlikely to be significant. The judgements made regarding the landscape and visual effects are based on the operational effects of the development as these will be the more enduring, although still temporary, effects given the anticipated 25 year operational lifespan of the wind turbines.

6.5.1 Predicted Effects on Landscape Character

The ZTVs (Figures 6-3 to 6-5) indicate that there will be some intervisibility between the proposed turbines and the principal LCT's surrounding the site. These include the site location within the Igneous Hills LCT and the adjacent Broad Valley Lowland LCT, Dipslope Farmland LCT and the Low Moorland Hills LCT. As the ZTVs also demonstrate, the zones of visibility will remain largely the same as the consented application (2013/00532/ EIAL) with no new areas of notable visibility. Beyond these LCTs, visibility will be restricted to intermittent distant views to just the extended blade tips of the turbines. At these locations they will also be seen in a clearly separate section of the surrounding landscape, resulting in limited opportunity for potential significant effects on the landscape character.

Igneous Hills LCT

The proposed wind turbines will be located within the Igneous Hills LCT, at a lower elevation, to the east and to the side of the Sidlaw Hills range. This LCT is, therefore, the area of landscape most immediately susceptible to being affected by the proposal.

As the ZTVs (Figures 6-3 to 6-5) indicate, the potential for high theoretical visibility across much of this LCT will be limited by the gentle landform of Finlarg Hill. This hill defines the eastern end of the Sidlaw Hills as it merges with the surrounding lowland. This landform variation associated with the hillside will contain notable visibility, as for the consented scheme, within the LCT to 2km to the north and south and to 4-5km to the east. From most points immediately to the west and from much of the central part of the LCT, the visual exposure of the turbines will be limited. This will reduce the potential to affect the more distinctive profile of scarps, dipslopes, conical summits and short glens and the setting of any important landscape features and monuments, which form the key character of the LCT. Where the ZTVS do indicate isolated visibility, from more elevated local summits, such as Kinpurney Hill, Auchterhouse Hill and Craigowl Hill, the proposed turbines will be seen at a distant low point, notably away from the setting of any distinctive landform peaks or summits and wholly below the expansive distant skyline.

Where the turbines are more visible, across the eastern fringes of the LCT, they will be seen against the less pronounced, eastern slopes of the Sidlaw Hills, where they merge into the lowland landscape. Although the scale in this LCT does vary, at this particular point the turbines will be seen against a larger, simple scaled landform context, with open fields, grass moorland and notable areas of coniferous forestry. They will also be seen with other tall landmark structures at more prominent, elevated points including existing wind turbine influences, within the LCT and adjacent to the LCT at around 5km. These elements have modified local landscape scale and combine to provide a simple palette of larger scaled, moderately valued key characteristics, the strength, consistency and open nature of which will help to accommodate and contain the profile of the proposed turbines at a separate point away from the smaller scaled enclosed valleys and principal ridgelines that define the more central sections of the LCT to the west

As a result the magnitude of change on the key characteristics of this LCT is considered to be the same as for the consented scheme. This will be medium to high within 4-5km to the east, but more generally low to negligible elsewhere. When combined with a baseline sensitivity of medium, the extent of effect is judged to be locally moderate to major across the immediate eastern fringes, but more generally minor to negligible. This is reinforced within the Tayside LCA, which indicates that the site lies at a low fringe point within the LCT, which is more suitable for wind energy development.

Predicted Effects on Surrounding LCT's

The ZTV's (Figures 6-3 to 6-5) indicate that there will be some intervisibility between the proposed turbines and the surrounding LCTs. These primarily include the Dipslope Farmland LCT, Low Moorland Hills LCT and the Broad Valley Lowland LCT, where they adjoin the Igneous Hills LCT to the west and southwest of Forfar.

As the ZTVs indicate, the proposed turbines will be visible from northwestern sections of the Dipslope Farmland LCT, and the southwestern sections of the Low Moorland Hills LCT. This is the same as the consented scheme and will principally be from the more open, elevated, fringe slopes that orientate towards the site and Sidlaw Hills within 4-7km (viewpoints 6, 8, 10 and 11 represent the type of view). Elsewhere and from the majority of the central sections of these LCTs, landform descends away from the site, towards the coast (Dipslope Farmland LCT) or towards Forfar (Low Moorland Hills LCT) and the potential for significant effects on more valued key characteristics, including the varied backdrop to Forfar, will be limited.

Where visible, from the nearest fringe areas, the proposed turbines will be observed at varying degrees, behind undulating and interlocking landform, associated primarily with fringe slopes of the neighbouring Igneous Hills LCT. They will also be viewed typically against a moderately flat, or slightly sloping, elevated skyline and clearly beside the sweeping, notable scale of the Sidlaw Hills. This landform variation will help to contain the profile of the turbines within these LCTs and strengthen the connection of the turbines with the adjoining Igneous Hills LCT. The proposed turbines will be further observed across a simple pattern of open fields, with notable coniferous plantation woodland and few other smaller scaled landcover elements. They will also be seen with a number of other existing tall structures in the surrounding context, including a series of hill top masts, power lines and occasionally existing wind turbine influences.

The magnitude of effect on the wider arrangement of key characteristics of the LCTs will, therefore, be the same as for the consented scheme. This will be medium to low, where the proposed turbines will be viewed as an addition to the existing composition of tall elements in a separate elevated LCT. This in turn will be peripheral to the general focus, balance and orientation of key characteristics within these LCTs. When combined with the respective baseline sensitivities, the extent of effect is considered to be no more than moderate from isolated fringe points of the Low Moorland Hills LCT and more typically moderate to minor, or less, elsewhere, with the underlying character of the landscape at these points remaining largely "with views of wind farms" (Angus Capacity Study).

From the Broad Valley Lowland LCT, visibility will only be gained from intermittent locations, at 8-15km to the north. This will largely be restricted to just the blade tips of one or two turbines from most key central locations, around Kirriemuir (viewpoints 14 and 15). As a result the turbines will only be distantly evident, sitting notably behind intervening landform associated with neighbouring LCTs and, therefore, as minor incomplete elements in a clearly separate landscape. The expansive scale, focus and orientation of key characteristics then help to reduce the profile of the turbines further. This will represent no more than a Low magnitude of change, which is the same as for the consented scheme. When combined with a medium sensitivity to the change, the extent of effect is judged to be no more than Minor to Moderate.

Although the ZTVs also indicate further visibility from the Firth Lowlands LCT, the Highland Foothills, Glens and Summits LCTs and the Coastal Flats of Fife, this will be more typically limited to the blade tips, with the remaining sections sitting notably behind intervening landform associated with separate areas of the wider landscape. The turbines will, therefore, be seen usually as minor elements in a clearly separate, distant landscape, beyond the context of these LCTs and notably away from the focus, orientation and composition of key elements with no significant effect predicted.

6.5.2 Effects on Landscape Designation

Given the location of the proposed turbines at a fairly sheltered point on the eastern fringes of the Sidlaw Hills and within a clearly separate distant landscape from designated areas, the extent of visibility from the range of designations in the study area will be low as was the case for the consented scheme. This will include the two more sensitive Geographical Areas of the 'Highlands' and 'Coast' within Angus. Also, given the character and quality of the designations being predominantly gained from views away from the context of the wind farm, along the valleys, hills and coastal edges, it is not considered that the proposed turbines, located at a distance in excess of 11-30km, will undermine the integrity or setting of these features. The overall magnitude and extent of effect will not, therefore, be significant. This is summarised in Table 6-4.

6.5.3 Effects on Historic Landscape (Setting)

The majority of GDL and CA's within the study area are connected with the lower lying settled landscapes or the southern fringes of the Sidlaw Hills. They are identified on Figure 6-1 and are detailed in Section 6.3. There are no CA's or GDL's within 5km of the proposed turbines. The nearest CA and GDL lies at approximately 5.5-7km at Glamis and Glamis Castle. While the bare ground ZTVs (Figures 6-3 to 6-4) indicate some isolated points of visibility on the fringes, the well vegetated context will reduce any notable visibility. This is indicated by the extent of coverage shown on Figure 6-5. The underlying nature, setting, sense of place and historical focus of these areas will, therefore, remain intact, with the turbines being physically, culturally and visually separate from these areas. This will also be the case for more distant CA's and GDLs and also for other historic sites at local high points, such as the Scheduled Monument at Kinpurney Hill. This is detailed in the viewpoint assessment (Table 6-4).

6.5.4 Landscape Effects Summary

The landscape assessment has shown that effects on landscape character will be limited in extent and significance and will be no greater than for the consented scheme (2013/00532/ EIAL). Where they do occur they are limited again to the immediate lower fringe areas of the Sidlaw Hills, largely within the Igneous Hills LCT and typically within 4-5km to the east as recognised in the Reporters decision for existing permission. Whilst the proposed turbines are also visible from isolated fringe points of the Dipslope Farmland LCT and the Low Moorland Hills LCT, they will be seen to the rear of intervening landform. These elements help to contain the visual profile of the proposed turbines and strengthen their association with adjacent, Igneous Hills LCT. Given the fringe location the turbines will also be peripheral to the focus and orientation of more valued key characteristics in the surrounding landscape, such that the overall balance on the fringes of these LCTs will largely remain as "a landscape with views of wind farms" as defined in the Angus SPG for Renewable Energy Implementation and Table 4: Levels of Acceptable Landscape Character Change).

Given the siting of the proposed wind farm at a fairly contained point on the fringes of the Sidlaw Hills and within an area of lowest constraint (defined in the Tayside LCA), the potential for effect on the landscape character of the wider area will be reduced. This is due to the notable sweeping, open scale of the Sidlaw Hills, which will positively screen the proposed turbines from much of the study area to the north, west and south. This will limit any significant effect on the character of the AGLV and SLA landscapes to the south and west, the two more sensitive Geographical Areas within Angus and the setting of any "important historic landscape features or monuments" as defined in the Angus SPG for Renewable Energy Implementation. It will also include much of the immediate host landscape across the Sidlaw Hills and most other low lying settled landscapes.

From the nearest sections of the Igneous Hills LCT, where there is potential for notable change, the turbines will be viewed with an overall height and spread which relates directly to the lower slopes of the Sidlaw hills and to other wind farm elements in the LCT. While the turbines will have a slightly taller blade tip height (from 80m to 92.5m), the clearer change will result from the reduced spread of development and density of turbines in the landscape. Importantly, the potential for notable or distinct skylining and "disruption to the principal ridgelines'' (Angus SPG, for Renewable Energy Implementation), will still be limited. Furthermore the proposed turbines will be viewed alongside other tall built characteristics, including power lines, communications towers, television masts and existing wind turbine influences at a similar height, which often rise to much taller points of overall elevation. The height increase will, therefore help to reduce the potential for notable disruption to the scale relationships that exist between various natural characteristics and built elements which have modified character at this fringe location of the Igneous Hills LCT.

Within the Igneous Hills LCT the proposed wind farm will also contribute to an accepted wind farm character, when combined with existing wind turbine elements, which is defined in the SPG for Renewable Energy Implementation, as "a landscape with occasional wind farms". It is, therefore, considered that the proposed site has the capacity to absorb the type and scale of development proposed. When considered together, the size and scale of the development would not threaten the wider landscape character of the area and the overall effect within the study area is, therefore, considered to be Moderate to Minor. Landscape effects are summarised in Table 6-4.

Table 6-4: Landscape Effects Summary

Character Type (SNH Review.122)	Baseline Sensitivity	Intervisibility with the site	Magnitude of Effect	Extent of Effect
Igneous Hills – Sidlaw Hills	Medium	Medium Low – Negligible	Medium-High (5km east) Low – Negligible	Moderate - Major Minor – Negligible
Dipslope Farmland	Medium	Medium – Low	Medium – Low(4-7km) Low – Negligible	Moderate – Minor
Low Moorland Hills	Medium – High	Low – Medium	Medium – Low (4-7km) Low – Negligible	Moderate – Minor
Broad Valley Lowland	Medium	Low	Low	Minor – Moderate
Firth Lowlands	Medium - Low	Low	Low – Negligible	Minor – Negligible
Highland Foothills, Glens and Summits	Medium	Low	Low – Negligible	Minor
Coastal Flats of Fife	Medium - Low	Medium-Low	Low	Minor
Designated Landscape				
AGLV's	High - Medium	Low – Negligible	Low – Negligible	Minor – Negligible
Conservation Areas (setting)				
5-10km - Glamis	High - Medium	Low – Negligible	Low - Negligible	Minor – Negligible
Gardens and Designed Landscapes (setting)				
Beyond 5km	Medium - High	Low – Negligible	Low – Negligible	Minor – Negligible
Application Site				
Landscape Fabric	Medium	High	Medium – Low	Moderate – Minor

6.5.5 Principal Zones of Theoretical Visibility

As the ZTVs (Figures 6-3 to 6-5) illustrate, the principal zones of visibility will remain the same as the consented application (2013/00532/ EIAL). They will be concentrated across the immediate lower fringe slopes of the Sidlaw Hills, to the southeast side of hill range, extending primarily to the east and typically with 4-5km. Further key zones of visibility will then extend up to 7km to the northeast, 4-6km to the south and around 8-20km to the north/northeast. More extended visibility will also be found at intermittent points along the south side of the Firth of Tay and from elevated south facing slopes of the Highland Foothills.

The potential for significant additional areas of visibility as a result of the height increase from the consented turbines would, therefore, be limited. This is particularly the case within 5km, where the ZTV shows no notable new areas. Elsewhere there will be no significant change in the Hub height ZTV and only a minor extension to the blade tip ZTV. This is limited to an area at 8-10km to the north, over the Strathmore farmland.

Visibility will also be notably restricted from most locations to the west, including the large majority of the Sidlaw Hills area. In turn, these hills will then help to positively screen the turbines from most points to the northwest across the Strathmore Valley and to the southwest across the Firth Lowlands, where views will be typically limited to just the extended blade tips of individual turbines. Also, the underlying variation in landform and landcover patterns (Figure 6-5) will restrict visibility from most of the lower lying settled landscapes. As a result, notable visibility is restricted chiefly to the lower fringe slopes to the southeast of the Sidlaw Hills, to the east of the proposed turbines.

6.5.6 Representative Viewpoint Effects

The analysis detailed in Table 6-5, refers to the potential visual effects on the 22 representative viewpoints identified in the visual baseline and summarises the anticipated residual effect compared to the consented scheme (2013/00532/ EIAL). To help understand the assessment, reference should be made to the existing panoramas, wireframes and photomontages (Figures 6-6 to 6-27), which illustrate the existing and proposed view from each location. It should be noted that these viewpoints are representative locations from publicly accessible places. For further details on the effects on identified receptor groups, including residential amenity and the principal private views from properties in 2km reference should be made to Sections 6.5.7- 6.5.10 and Table 6-6 below. Reference should also be made to Section 6-7, which discusses the cumulative effects in more detail.

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Table 6-5: Representative Viewpoint Effects

No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
1	Govals	High	From this local point to the north, a slightly ascending panorama is available to the south, across large arable fields. The view is curtailed in the near to mid distance by uniform, undulating terrain, but extends slightly further to Finlarg Hill to the southwest and then stretches out to Dodd Hill to the east. It is a simple scaled view across open fields defined by post and wire fencing and few other landscape elements. Tall landmark structures in the form of two power lines, define the view at low and high points, with further masts at elevated points to the rear of Finlarg Hill. In this context all four proposed turbines will be clearly visible, sitting just to the rear of the local skyline (Figure 6-6). At this point the turbines will be viewed as two pairs, but with no overlapping or stacking. They will also occupy a spread of approximately 14˚ in the local view, which is a reduction of over a third from the consented application. The open landform continues to slope to provide a degree of scale and simplicity in the immediate context and the turbines will not conflict with any distinctive landform or landcover patterns in the wider view. The turbines will also sit in between two power lines, alongside masts with a greater overall elevation at more prominent hill summits and would also be seen below the overhead power line that traverses the foreground view. This will represent a Medium to High magnitude of visual change and result in a visual effect of Moderate to Major significance. This is representative of residents at one property at Govals Cottage with a principal view, but from Govals Farm the principal view lies to the east and away from the development with no significant effect on the key view from the property. From this point the height increase from the consented turbines would only form a Minor change in the nature of the consented view. This will be offset by the notable reduction in the horizontal spread with a Minor beneficial visual effect resultant.	Medium - High	Moderate - Major	Minor Beneficial
2	A928	Medium-Low	Located on the A928 on the southern boundary the proposed development, an open, simple scaled view is available to the north. It is defined by the smooth, sweeping landform of the Sidlaw Hills, which curtails further views to the west and northwest. The foreground view is characterised by large, open fields with stone	Medium - High	Moderate	Minor Beneficial

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No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
			walls, isolated trees and intermittent woodland surrounding farmsteads. Two power lines and telecommunication towers provide notable built elements, traversing the view at low and high points. The view to the northeast stretches to the far distance over slightly undulating open farmland where existing wind turbine influences are present on Fotheringham Hill. From this viewpoint all four turbines will be visible on the broad descending, open slopes, occupying up to 12˚ of the view, with the turbine towers, hubs and blades visible as prominent elements (Figure 6-7). This will reduce the spread from the consented application, by a quarter. The turbines will also be viewed as two pairs. The distinctive profile of smooth hills, coupled with the open, simple scaled farmland and presence of other notable built elements, provides a degree of scale and form, where the proposed turbines will rise to a comparable height to the underlying landform and pylon structures to the west. This helps to contain the turbines within the site context, where they will not be out of scale with the nature of their setting. They will also not form an entirely new element given the presence of the existing wind turbines at Wester Meathie. This will help to moderate the effect and the magnitude of visual change will be medium to high. When combined with the sensitivity of travellers on a road mainly used for commercial travel and/or commuting rather journeys of a recreational nature and with peripheral views away from the direction of the road, the extent of effect is considered to be Moderate at this nearest, point on the A928. The height increase from this point would be balanced by the clear reduction in spread of turbines with Minor beneficial residual effect predicted.			
3	Road to West Tarbrax	High – Medium	From this viewpoint to the east alongside the A90, a broad panorama is available to the west. It stretches over flat, open farmland in the near and mid distance, towards sweeping hill slopes, which define the eastern fringes of the Sidlaw Hills. These slopes are characterised by low rounded hills and an open, simple scaled landcover pattern. Various tall landmark structures then traverse the slopes, both within the lower lying farmland and at key hill top summits. In this context, the tower, hub and blades of all four turbines will be visible on the lower, open slopes of Finlarg Hill to the rear of the immediate context and focus of	Medium - High	Moderate (Minor-Negligible)	Minor - Negligible

No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
			the view over flat open farmland. The tower of all four turbines will be mostly backclothed by the surrounding landform, with the hubs sitting just on or above the rolling skyline. Although there would be a slight height increase in the blade diameter this would be balanced by the reduction in the number of turbines visible and the looser density in the layout, with the nearest turbine omitted. From this point, they will occupy about 16˚ of the view and will be seen as a regular group of staggered, even spaced turbines (Figure 6-8). The turbines will also be fairly contained against the slopes of Finlarg Hill and will not therefore straddle multiple landform elements. They will also sit away from more prominent distinctive landform summits across the Sidlaw Hills to the southwest and will also be viewed with other tall landmark structures at similar elevated points. This will result in a Medium to High magnitude of visual change. When combined with the sensitivity from the key receptor group of residents at an isolated point away from their property curtilage and its key views, the extent of visual effect is considered to be Moderate at this point. Views from the property are contained and screened to the west. This will reduce the potential for effect, with no significant effect on key views from the property. This is also the case for properties at Nether Finlarg Farm, South/North Tarbrax, Tarbrax House and most of the properties at Gallowfauld.			
4	Gallow-fauld	High - Medium	Located at approximately 2km to the east of the nearest turbine, the majority of the view from the access track to properties at Gallowfauld is defined by open fields, outer buildings of local farmsteads and traffic on the A90. To the rear the rolling slopes of the Sidlaw Hills rise just above the farm outbuildings in the mid distance and curtail further views west. A number of tall landmark structures traverse the hill slopes at regular points. In this view, all four turbines will be present, sitting to the rear of the immediate focus of the view and behind farmstead outbuildings, with the turbine hubs and blade tips sitting on or above the slopes of Finlarg Hill. They will occupy a spread of 9˚ in the view and will be seen as a two pairs of turbines, with no notable clustering (Figure 6-9). While slightly taller than the consented layout the more evident change will result from the reduced density of turbines by omitting the nearest turbine. This would provide a looser, balanced arrangement. The turbines will also be seen in the context of other tall elements at similar and more elevated points and will not	Medium	Moderate (Minor-Negligible)	Minor - Negligible

No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
			altogether be the tallest element or form an entirely new element with other existing wind turbine influences to the north. As a result the magnitude of visual change is considered to be Medium. When combined with the sensitivity from the key receptor group of residents at this isolated point to the side of the key focus or curtilage of properties, the extent of visual effect is considered to be no more than Moderate. However, principal views from properties at Gallowfauld are generally orientated away from the development, with a number of screened views to the west. This will reduce the potential for significant effects from most properties at this point.			
5	A928 Milton of Ogilvie	Medium - Low	From a point at 2.9km to the northwest, the proposed wind farm will not be perceptible and the height increase would not, therefore, be that discernable from this point. The turbine will sit substantially to the rear of the rolling hill slopes at this viewpoint, with visibility of only the extended blade tip of one turbine (Figure 6-10). This will also be located to the side of any more notable landform elements with no visual conflict or overlap with any distinctive elements of fabric. The turbine will be less evident than other existing landmark structures in the view representing a Negligible magnitude of visual change. When combined with a medium to low sensitivity to change from the key receptors of travellers, the extent of effect is considered to be negligible. This will be the case for much of this area within the Sidlaw Hills to the northwest, given the limited ZTV coverage in this area.	Negligible	Negligible	Negligible
6	Tealing	Medium - Low	The view from Tealing, at approximately 4km to the south of the proposed wind farm, is defined by flat arable fields, dispersed settlement and intermittent vegetation in the local view. This view then rises towards the Sidlaw Hills in the mid distance, with Craigowl Hill and the telecommunications tower providing a clear focus, along with other tall landmark structures at Gallow Hill and across Tealing Hill. The Sidlaw Hills then curtail further views to the north, with vegetation and coniferous woodland restricting views to the east. From this point on a minor road, the proposed turbines will be barely discernible, sitting substantially to the rear of Tealing Hill, with views to just two extended blade tips (Figure 6-11). As a result the height increase would not be discernable from this point. The turbine tips will still be faintly visible alongside the more notable pylon and	Negligible	Negligible	Negligible

No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
			will not conflict with any other elements of the view. This will represent a negligible magnitude of visual change. When combined with the sensitivity to change from the key receptors of travellers at this point engaged in commercial travel and/or commuting rather recreational tourism the extent of visual effect is considered to be negligible. Given the limited ZTV coverage from the rest of Tealing, the extent of visual effect from this area is considered to be no greater.			
7	Craigowl Hill	Medium - Low	From a notably elevated viewpoint at 4.1km to the west, a sharply descending, expansive view is available across the eastern fringes of the Sidlaw Hills. The underlying context of smooth rounded hills with notable areas of moorland, grassland and forest, defines the near and mid distance view. These hills merge with lowland farming areas to the east and south, with a characteristic patchwork of open fields and areas of notable coniferous woodland plantation. At various locations tall landmark structures punctuate the open farmland areas. From this orientation, settlement is also limited to the east. The majority of the blade diameter of three turbines and the hub and blade tips of the remaining turbine will be visible from this point, sitting to the rear of the rolling hill terrain (Figures 6-12). They will sit below the low moorland and forested hill slopes of Fothringham Hill and entirely below the distant skyline. They will then be seen as a loose line of turbines, occupying 4˚ in the view. Given this fairly contained location, they will be viewed in the context of the Sidlaw Hill fringes and not in the wider lowland context. They will also be seen with other tall landmark structures in the same context including existing wind turbines at Fothringham Hill and at separate elevated points within the Sidlaw Hills to the north and south. This will represent a medium to low magnitude of visual change given the existing wind turbine influences at more immediate points to the north. The extent of effect will be Moderate to Minor, when combined with the key receptors of outdoor workers at this remote point, with limited access for recreational use. This will not represent a notable change from the consented layout, with a slight imperceptible change to the height and reduction in the spread of turbines	Medium - Low	Moderate - Minor	Negligible
8	A90 junction,	Medium - Low	Located at approximately 4.5km to the north, on the A90, a view is channelled along the road towards the sloping slopes of Kincaldrum Hill in the mid distance. These	Medium	Moderate - Minor	Minor Beneficial

No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
	Douglas-town		slopes are defined by regular sized arable fields and a strong pattern of linear woodland strips, emphasising the landform of the hill slopes. The slopes also contain further views to the south and west and combined with the vegetated roadside vegetation, provide a fairly contained view. At various locations, tall landmark structures define the elevated skyline. From this viewpoint all four turbines will be visible, but they will sit notably behind the broad elevated slopes of Kincaldrum Hill, at a secluded point, with the hubs visible above the vegetated hillside (Figure 6-13). The turbines will also sit above a lower, moderately flat section of the hillside and occupy up to 3˚ of the view, a reduction of 50% from the consented scheme. The turbines will be observed with other notable built elements, which punctuate the skyline at similar points and in the wider successional view with existing turbines to the east. In doing so there will not be any significant overlap or contrast in the overall view. These elements help to moderate the visual effect and as a result the magnitude of visual change will be medium. When combined with the sensitivity to change from the key receptors of travellers at this point on the A90 engaged primarily in commercial travel and/or commuting rather journeys of defined routes for recreational nature, the extent of effect is considered to be Moderate to Minor.			
9	Carrot Hill	High	From a notable high point at 4.9km to the east, a wide panorama is available to the west. It is defined throughout by open, undulating farmland, with large, simple scaled fields divided by stone walls and interspersed with linear woodland strips. The view is then defined in the mid distance by the sweeping Sidlaw Hills. These provide some scale, elevation and containment to the view, with an elevated focal point at Craigowl Hill and lower, gentler slopes at Finlarg Hill and Hayston Hill. These slopes define the eastern fringe of the Sidlaw Hills as they merge into lowland farmland. At this point the slopes are defined by a number of tall built structures, which traverse the hillside and define hill summits. The view extends into the far distance to the north, towards the Highland foothills, which undulate at a similar height in the perspective to the Sidlaw Hills. From this viewpoint the tower, hub and blades of all four turbines will be visible within the gentle, undulating, lower slopes of Finlarg Hill, with the hubs generally sitting on or	Medium	Moderate	Minor – Negligible

No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
			below the elevated skyline (Figure 6-14). This will help to contain the overall profile of the development where the turbines will largely be seen in the context of the open farmland slopes and alongside two rows of pylons and will not be viewed wholly as the tallest built elements in the view. From this viewpoint the turbines will occupy up to 6˚ of the wider view through 180˚, but will not conflict with any more distinctive hill summits or more intricately scaled, lower lying settled areas, further to the north. Although the blades are slightly longer than the consented scheme the hubs remain at the same point and the greater visual change would arise with the reduced density from five to four turbines and the more evenly spaced layout. The turbines will also be seen with other existing wind turbine influences which sit at similar points to the side of landform elements to the north and will not therefore be seen entirely as a new element. This will represent a medium magnitude of visual change. When combined with the sensitivity of visitors, the extent of visual effect is considered to be no more than Moderate, with the underlying nature of the view, as one defined by tall landmark structures on the Sidlaw Hills slopes and other hillsides, surrounded by a simple scale and character, will provide a degree of capacity to accommodate this change.			
10	A90 North Claver-house, Dundee	Medium - Low	A wide, slightly descending panorama is available to the north from this viewpoint to the south of the proposed development on the A90. It stretches along the direct route of the A90 as it crosses open farmland, defined by scrubby hedgerows, occasional lines of mature trees and more dispersed settlement pattern at lower points in the view. The view rises gently in the mid distance to the moderately flat skyline of Carrot Hill, Dodd Hill and Tealing Hill. These hills curtail further views north. To the west the view is strongly defined by the quickly ascending landform of Craigowl Hill, which is emphasised by the telecommunications tower at its summit. Further tall structures then sit on the skyline at various points, alongside notable areas of coniferous plantation. From this viewpoint, three turbines will be evident in the view, siting to the rear of the low, moderately flat hills in the mid distance, with views to just the hubs. The remaining turbine will be barely discernible with views to just the extended blade tips above coniferous plantation (Figure 6-15). From here, the turbines will sit just to the side of the carriageway and will occupy approximately 4˚ of the 180˚view, which is	Medium - Low	Moderate - Minor	Negligible

No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
			already characterised by tall structures at elevated points. This will represent a medium to low magnitude of visual change. When combined with the sensitivity to change from the key receptors of travellers engaged primarily in commercial travel and/or commuting rather journeys of defined routes for recreational nature, the extent of visual effect is considered to be Moderate to Minor. Given the limited ZTV coverage from the rest of this area and the lower lying areas of dispersed settlement, the anticipated extent of visual effect from this area is considered to be no greater.			
11	Balmash-anner Hill	High - Medium	From this high point on Core Path 297 to the northeast, a sweeping view is available across open, elevated, simple scaled fields, defined by low stone walls, post and wire fencing and occasional linear woodland strips. The view extends to the southwest and is contained by the rolling landform of Fothringham Hill in the near distance, Hayston Hill and Finlarg Hill in the mid distance, and between the two elements in the far distance, by Dodd Hill and Carrot Hill. Settlement is limited in the view given the higher elevation, but other tall built elements including pylons, masts and occasional farm out buildings provide scale contrast in the view. At this point, the full blade diameter of all four turbines will sit just below a lower, flatter section of the elevated skyline, to the side of Finlarg Hill (Figure 6-16) and to the side of the higher Sidlaw Hills. From here the turbines will occupy up to 2˚ of the view, a clear reduction by half from the consented scheme. The turbines will also be observed as two regular pairs. The underlying nature of the rolling landform then provides a degree of simplicity and scale to help anchor the turbines into the view, with the Sidlaw Hills landform rising to a comparable height in the view. This lower fringe point will limited the potential for disrupting views to principle ridgelines across the Sidlaw Hills and more distinctive landform elements. They will also be seen with other tall structures at similar points and with existing turbines at Ark Hill and at Wester Meathie which provide a more prominent focus in the view. This will represent a medium to low magnitude of visual change. When combined with the sensitivity to change from the key receptors of visitors on the core path, with a transient side view, the extent of visual effect is considered to be no more than Moderate to Minor, given the existing wind turbine influences at similar points. More frequently from this core path, visibility and extent of effect will be quickly reduced, by intervening landform, land cover and the general focus and direction of the footpath away	Medium - Low	Moderate - Minor	Minor Beneficial

No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
			from the proposed development. This will also be the case for other locations on Balmashanner Hill where landform limits notable visibility to the southwest.			
12	Kinpurney Hill	High	From a notable high point at 9km to the west, the turbines will barely be visible, with very slight views to the extended blade tip of one turbine (Figure 6-17). From this viewpoint the turbine will sit substantially beyond the context of the view and to the rear of the rolling, forested upper slopes of the Sidlaw Hills. It will also be viewed at a lower point away from other notable peaks at Auchterhouse Hill and Craigowl Hill, with no notable conflict of elements and will sit notably behind the significant wind farm influences of Ark Hill which dominates the intervening view across the, smooth rounded hills, with notable woodland. The magnitude of visual change and extent of effect will, therefore, be Negligible when combined with a baseline sensitivity h for the key receptor group of tourists and hill walkers to this viewpoint.	Negligible	Negligible	Negligible
13	Dundee Law	High - Medium	At 10.9km to the south, from a notable point in Dundee, the hubs of all four turbines will be visible, sitting in two pairs, just above the distant, sloping, slightly elevated skyline (Figure 6-18). The height increase will not be that discernable from this point but a reduced horizontal spread from the consented layout will be evident. The turbines will, therefore, sit substantially to the rear of this expansive view, defined by the notably built up foreground of Dundee and the contrasting well vegetated, undulating farmland area. Both of these areas provide strong elements of structure, scale and human influence in the view. The turbines will be viewed to the lower east side of the Sidlaw Hills, which stretch across a large section of the view to the west and extend to a much greater height to provide further clear elements of landform variation and a distinctive backdrop to the view. In this context, several landmark structures exist across the hill range, including telecommunications towers and wind turbines at more prominently elevated points, including key summits such as Craigowl Hill. From this viewpoint the turbines will not conflict visually with any principle ridgelines, summits or other valued features and will not stand at the tallest point on the skyline, with the general scale of the landform helping to accommodate the vertical scale. From this point a range of panoramas are available throughout 360˚, with a wide range of natural and built elements present, including further wind turbines at the	Low	Moderate - Minor	Minor - Negligible

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No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
			Michelin Tyre factory to the east. The magnitude of visual change is, therefore, judged to be low. When combined with the sensitivity to the type of change from the key receptor group of tourists at this urban viewpoint, the resultant extent of effect is judged to be, no more than Moderate to Minor. This will also be typical from other points and receptor groups including residents in the city, where a wide range of elements and foci define the view, with the turbines gradually sitting further to the rear of the distant skyline.			
14	Kirriemuir	High - Medium	From a prominent point in Kirriemuir at 12.4km from the proposed turbines, an expansive view is available to the southeast, over the lower fringes of the settlement and across the broad low lying Strathmore Valley area. The view is defined by key changes in landform as it drops through the valley to rise again to the Sidlaw Hills in the mid to far distance. In this context, the proposed turbines will be barely visible, with views only evident to the extended blade tip of one turbine (Figure 6-19). The remaining sections will then sit below a section of the elevated Sidlaw Hills to the eastern end of the hill range. Where visible it will also be viewed as minor indistinct element and with other tall elements on the hills including the more notable existing wind farm influences of Ark Hill which sits at a prominent point on the principal ridgelines which overlooks the Strathmore valley to the north. This will represent a Negligible magnitude of visual change and extent of effect. This will be the case for much of this area to the northwest, given the limited ZTV coverage in this area.	Negligible	Negligible	Negligible
15	Egno Moss to Arlie	High - Medium	The proposed turbines will not be that legible from this stretch of the core path 250 to the west of Kirriemuir. Figure 6-20 shows that only the extended blade tips of two turbines will potentially be visible over the bare ground. The remaining two turbines will sit below the distant elevated skyline, which forms a minor linear element, separated from the broad foreground context by the descending landform of the Strathmore Valley. As the photomontage shows, woodland and mature trees in the foreground context will further filter views to the Sidlaw Hills, from this point. Where visible over bare ground the tips will be observed alongside the more notable wind farm influences of Ark Hill which is prominent on the principal ridgeline overlooking the Strathmore Valley. As a result the magnitude of visual change and extent of	Negligible	Negligible	Negligible

No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
			effect is considered to be negligible.			
16	Turin Hill	High	From this remote high point at 14.7km to the northeast, the proposed turbines will be viewed at a mid-point of elevation on the east side of the Sidlaw Hills, which define this wide panorama to the southwest (Figure 6-21). From this viewpoint, the tower, hub and blades of all four turbines will be visible as a row with equal spacing's in a small 1˚section of the expansive view and with the tower and hubs sitting below the skyline. The turbines will sit at a lower point away from any more extended views to more distinctive hill top summits and will not disrupt views to principle ridgelines or to any more intricate lower lying settled landscapes. They will also be seen with the existing Ark Hill turbines which are present in the view towards Kinpurney Hill further to the southwest. The turbines will, therefore, only form a minor element and a slight change to the nature of the view to the southwest and at a separate point to the rear of the main context of the viewpoint. The magnitude of visual change will, therefore, be Low to Negligible and the extent of visual effect will be no more than Moderate to Minor when combined with the sensitivity of tourists at this point with a range of expansive views from this point.	Low Negligible	Moderate - Minor	Negligible
17	Tentsmuir	High - Medium	At this distance of 15.9km to the southeast, the turbines will be fairly indistinct. They will sit at a secluded distant point between two undulations in landform, sitting notably beyond the expansive Firth of Tay area. From this point the full blade diameter of two turbines will be faintly visible with the hubs of the remaining two visible, as they sit increasingly to the rear of landform (Figure 6-22). Where the hubs are visible they will be backclothed by more elevated landform to the north, but will not interrupt the view to more distinctive landform summits. As a result, only the blade tips of the turbines will be visible above the skyline. Where visible, they will also be seen beyond the developed foreshore of Broughty Ferry and Dundee, with a range of tall structures defining the intervening view. These include the tower blocks, cranes, a single wind turbine at Scotston Hill and telecommunications masts at elevated points on the Sidlaw Hills. The view also includes the two operational turbines at the Michelin Tyre factory, which sit at a closer point and within a view towards Craigowl Hill. The addition of the proposed turbines will, therefore, only represent a low magnitude of visual change. When combined with the baseline sensitivity from the key receptors of visitors on this coastal path, the extent of visual	Low	Moderate - Minor	Negligible

No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
			effect will be no more than Moderate to Minor.			
18	A933 (north of Froickheim	Medium - Low	From this distant point to the east, the proposed turbines will be viewed in a small, distant, peripheral section of the view towards the Sidlaw Hills. From this viewpoint the turbines will sit within the undulating lower slopes of Finlarg Hill and below the elevated skyline (Figure 6-23). The sweeping foreground context and interlocking nature of the landform pattern then provides a degree of scale, containment and separation from the proposed wind farm context. The turbines will, therefore, sit away from the main focus of the view over lowland farmland. This will help to reduce the prominence of the turbines to minor indistinct elements, where they will also be viewed with the more elevated telecommunications towers at Craigowl Hill and the Ark Hill turbines which will extend above the Sidlaw Hills skyline. This will represent a low to negligible magnitude of visual change from this point on the A933 and result in no more than a Minor extent of visual effect. Given the extent of visibility on the ZTVs, the extent of effect is considered to be no greater from most other points to the east across Rossie and Montreathmont Moor and the core path 118 network.	Low - Negligible	Minor	Negligible
19	Cat Law	High	From a notable summit in the highland foothills, at 21km to the north, the proposed turbines will be barely legible in the expansive panorama to the south. Where visible they will sit in a small section of the view and substantially behind a moderately flat, fringe area of the intervening Sidlaw Hills in the far distance, with faint views to the blade tips (Figure 6-24). They will then sit entirely below the distant skyline, which will help to reduce the prominence of the turbines. When combined with the clearly defined elements of scale, elevation, distance and a prevailing horizontal aspect across the Strathmore Valley, this will reduce the prominence further, where they will also be seen with other wind turbine influences at similar locations. This will represent a Low to Negligible magnitude of visual change and when combined with the baseline sensitivity from the key receptor group of hill walkers, the extent of effect will be Minor to Negligible with no notable overlap or conflict with more distinctive peaks or principle ridgelines across the Sidlaw Hills. This will be the case for much of the highland foothills area to the northwest.	Low – Negligible	Minor – Negligible	Negligible
20	Arbroath	Medium -	At this distant, low lying point on the fringes of the ZTV, the proposed turbines will not	Negligible	Negligible	Negligible

No	Location	Sensitivity	Visual Effect / Cumulative Effect	Magnitude	Extent of Effect (Represented)	Residual Effect (height increase)
	, Montrose road	Low	be legible in the view. From this point, only the extended blade tips of one turbine will actually be evident, sitting to the rear of housing and below the far distant skyline to the side of Craigowl Hill (Figure 6-25). The focus and containment of the view from this point will be clearly defined by the urban fringes of Arbroath. As a result the magnitude and extent of effect will be Negligible from this point of the ZTV.			
21	Megginc h	Medium	From this point to the southwest, the proposed wind turbines will not be evident in the general context of views to the northeast (Figure 6-25), which are strongly defined by the nearer hills slopes, directly to the north and south and by the open, flat expanse of the firth lowlands landscape between. Figure 6-26 also shows vegetation around this point, which will restrict any view further. As a result the magnitude and extent of effect will be Negligible from this point.	Negligible	Negligible	Negligible
22	White Cather-thun	High	From this remote, distant, high point to the northeast, a range of panoramas are available throughout 360˚. In this context the proposed turbines will be faintly observed at a mid-point on the slopes to the east side of the Sidlaw Hills. These continue to define the distant skyline to the southwest (Figure 6-27). From this viewpoint the blade diameter of all four turbines will be visible in a small section of the view, with the hubs sitting on or just above the skyline. From this distance and elevation, the turbines will be viewed as a minor indistinct group in a separate, distant section of the view and in a similar view to the existing wind turbine influences at Ark Hill. The overriding scale of the intervening view will help to reduce the profile of the turbines. As a result the magnitude of change will be Low to Negligible in the broad context of the view, with only a minor addition to elements within the broad view. When combined with the baseline sensitivity from tourists, the extent of effect will be no more than Minor.	Low - Negligible	Minor	Negligible

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6.5.7 Effects on Key Visual Receptor Groups

The extent of effect upon visual receptors will depend on the principal aspect of the receptor and the orientation of key views, which in turn will depend on the existence or otherwise of intervening, landform, built elements and/or vegetation. The extent of effect will also depend on the distance from the proposed development, the mobility or static nature of the receptor and the potential for the development to attract the eye or to become a focal point in the view, to the detraction or benefit of competing visual elements. This will include the presence or absence of other comparable features, including existing wind farm elements.

6.5.8 Effects on the Residential Amenity

The assessment of effects on residential amenity is an additional measure of visual effect, which can be related to LVIA. As for the main LVIA it will define the susceptibility to change "in particular views" but in contrast it will deal with the effects on "private views" from property, rather than the "publically accessible" points dealt with in the LVIA. The usual approach to establishing the level of significance on residential amenity is to define the key orientation, and the focus of principal views for each property (or group of properties), as these are fixed, constantly available views with a greater degree of amenity or value attached to them. This is recognised in GLVIA (3rd edition) which describes the susceptibility (or sensitivity) to visual change as a function of 'the occupation or activity of people experiencing the view at a particular location and the extent to which their attention or interest may be focused on the view'.

GLVIA also addresses residential amenity as 'residents at home, especially using rooms normally occupied in waking or daylight hours, that are likely to experience views for longer than those passing through'. Views from other points away from the principal, constant focus, and within the wider curtilage or from the general approach to the properties will, therefore, be less susceptible, as these views are secondary or peripheral to the amenity value and at sequential or transitory points.

Table 6-6, provides a summary of the visual effects on residential properties within 2km of the proposed development, in line with the guidance published in GLVIA and the Methodology in Appendix 6-1. The location of each property within 2km of the site is shown on Figure 6-40. Figures 6-41 to 6-60 illustrate the proposed views from each of the properties using wireframes, photographs and diagrams to illustrate principal orientations, along with some photomontages from key properties (Refs 4, 7, 8 and 11).

The evolution of the site design, resulting in the proposed layout is described fully in Chapter 3 and shown on Figure 3-1. The latest iterations of the design (were driven primarily by the aim to minimise impacts on residential amenity and scale with cumulative effects. Table 3-1 presents a comparison of the design iterations in respect of potential views from residential properties (over bare ground and away from key focus) within 2km of the site. Figures 3-10 also illustrate how the distances to the proposed turbines and reduced horizontal spread between the various design iterations improve the key views from the properties over and above the consented layout (2013/00532/ EIAL).

The combined effects on residential amenity are also dealt with in GLVIA to help reach an overall conclusion on the level of significance. Here GLVIA states that 'this may be considered by aggregating properties as a way of assessing the effect on the community as a whole'.

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Table 6-6: Residential Amenity within 2km (comparison of consented and application schemes)

ID	Property	Distance (nearest WT – consented)	Distance (nearest WT – 4 turbine)	Horizontal Spread (consented)	Horizontal Spread (4turbine)	Orientation / Principal focus of View from Property	Magnitude (Principal View / Focus)	Residual Effect
1	Over Finlarg, Farm bungalow (Figure 6-41)	716m	716m	41°	26°	Nearest receptors to the south of the site (landowner tenanted). Orientation north to south but screened to north by outbuildings. Principal private view over gardens to the south. The turbine hub and tips will be theoretically visible to the rear of large farm outbuildings between two existing power lines away from key focus.	Low	Not Significant
2	Over Finlarg old farmhouse (Figure 6-42)	710m	710m	44°	30°	Nearest receptors to the south (landowner). Orientation north to south but screened to north by outbuildings. Principal view south. The turbine hub and tips will be theoretically visible to the rear of large farm outbuildings between two existing power lines away from key focus.	Low	Not Significant
3	Over Finlarg new farmhouse (Figure 6-43)	696m	696m	39°	25°	Nearest receptors to the south (landowner tenanted). Orientation north to south but screened to north by outbuildings. Principal view south. The turbine hub and tips will be theoretically visible to the rear of large farm outbuildings, between two existing power lines away from key focus.	Low	Not Significant
4	Over Finlarg, 1 & 2 farm cottage (Figure 6-44)	972m	972m	32°	21°	Orientation north to south (landowner tenanted). It is understood that one cottage is currently unoccupied. The turbine hubs and tips will be theoretically visible to the rear of Over Finlarg farm and its outbuildings, between two existing power lines away from focus south.	Medium	Not significant
5	Lumleyden (Figure 6-45)	1039m	1039m	14°	12°	Orientated north to south and nestled on the lower slopes of Finlarg Hill. View towards proposal contained by landform. No views to the proposed	Negligible	Not significant

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ID	Property	Distance (nearest WT – consented)	Distance (nearest WT – 4 turbine)	Horizontal Spread (consented)	Horizontal Spread (4turbine)	Orientation / Principal focus of View from Property	Magnitude (Principal View / Focus)	Residual Effect
						scheme.		
6	Govals (Figure 6-46)	934m	934m	27°	14°	Key orientation and focus of private views are along access road to the east. Secondary views to the south from wider curtilage/garden are moderately contained by farm sheds. Turbines will be visible from wider curtilage but peripheral to key focus and to the rear of outbuildings.	Low	Not significant
7	Govals cottage (Figure 6-47)	1024m	1024m	24°	12°	Orientation north – south. All turbines will be clearly visible in key view to the south, in a simple, open context. However, they sit between various power lines and telecommunication masts and are not the tallest element in perspective. The horizontal spread of the proposed scheme is reduced by a third from the the consented application (2013/00532/ EIAL) and the height increase would only form a Minor change in the nature of the consented view. Represented by Viewpoint 1 of the LVIA (Figure 6-6).	Medium	Significant, minor residual benefit compared to the consented layout
8	Muirside Cottage (Figure 6-48)	1352m	1368m	16°	10°	Key orientation of private views to the east and west, with aspect to the north. Turbines will be visible in oblique rising view from the house, to the southwest. The horizontal spread of the proposed scheme is reduced by a third from the consented scheme(2013/00532/ EIAL) . Although slightly taller it will still be observed below the height of the intervening pylons in perspective. The turbines also sit in context with tall elements and will not notably extend the spread of tall structures in the wider panorama but add some density, with no notable overlapping. While the turbines will represent new elements in this section of the view the, underlying	Low - Medium	Significant minor residual benefit compared to the consented layout

ID	Property	Distance (nearest WT – consented)	Distance (nearest WT – 4 turbine)	Horizontal Spread (consented)	Horizontal Spread (4turbine)	Orientation / Principal focus of View from Property	Magnitude (Principal View / Focus)	Residual Effect
						nature of the view to series of tall elements, remains.		
9	Muirside farm (Figure 6-49)	1446m	1452m	15°	9°	Orientation to the east. Private views to south and west partially screened by outbuildings and notably to west by woodland. The turbines would be visible in secondary view over bare ground but no existing visibility through mature vegetation.	Low to Negligible	Not significant
10	East Cotton of Kincaldrum (Figure 6-50)	1696m	1696m	15°	8°	Key private views to north to distant hills. Views to site over gardens, ascending fields and woodland shelterbelts, which curtail the view, with pylons dominating the view to east and west. Blade tips visually recessive and sit further behind trees, not that discernible.	Low to Negligible	Not significant
11	1-4 Nether Finlarg Farm Cottages (Figure 6-51)	761m	1029m	24°	24°	Nearest receptors to the east with key orientation northwest to southeast. Turbines will be visible in primary view to the west but at a distance of one quarter, further away than the consented scheme (2013/00532/ EIAL). One existing Gaia turbine also in the context at Nether Finlarg Farm. The proposed scheme will be visually looser and more regular, compared with the consented application. The proposed turbines are still comparable in the perspective to the pylons at similar distance. Within 5-10 years the new shelterbelt planting will reduce potential visibility and the visual effect.	Medium	Significant (until shelterbelt is established)
12	Nether Finlarg farm (Figure 6-52)	797m	1048m	26°	26°	Key aspect of private views lie east and south within the mature gardens. Notable boundary screening to the west and large farm buildings to the north provide high containment. Visibility limited in key views from the house. Proposed	Low	Not significant

ID	Property	Distance (nearest WT – consented)	Distance (nearest WT – 4 turbine)	Horizontal Spread (consented)	Horizontal Spread (4turbine)	Orientation / Principal focus of View from Property	Magnitude (Principal View / Focus)	Residual Effect
						scheme is further away and visually more simple than the consented scheme (2013/00532/ EIAL) , while still relating to the scale of existing tall structures.		
13	West Tarbrax Farmhouse (Figure 6-53)	1223m	1488m	18°	18°	Property and key private views orientated north to south with notable, evergreen boundary screening and large outbuildings to the west providing containment. No discernible views in key focus of property.	Negligible	Not significant
14	South Tarbrax Farm house (Figure 6-54)	1445m	1664m	18°	18°	Key orientation north to south with main views from house over gardens to the east. Visibility from house to the proposed turbines is blocked by farm shed which will limit the potential for effect on key views from the house. Secondary, oblique views available away from house and garden context.	Low	Not significant
15	North Tarbrax farmhouse (Figure 6-55)	1666m	1873m	11°	11°	Key orientation north to south alongside the A90. Secondary views towards the site are screened by mature boundary vegetation and large outbuildings. Visibility of turbines limited to partial views from wider curtilage of the garden with no views from the house.	Low	Not significant
16	Tarbrax House (Figure 6-56)	1600m	1858m	15°	15°	Property orientated east to west with notable boundary screening to the west providing containment. No significant visibility.	Negligible	Not significant
17	Inverarity, South Lodge (Figure 6-57)	1836m	1995m	16°	16°	The property is located at a low point with notable boundary vegetation and dense conifer plantation containing views, with no visibility to the proposed turbines.	Negligible	Not significant

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ID	Property	Distance (nearest WT – consented)	Distance (nearest WT – 4 turbine)	Horizontal Spread (consented)	Horizontal Spread (4turbine)	Orientation / Principal focus of View from Property	Magnitude (Principal View / Focus)	Residual Effect
18	Gallowfaulds Farm (Figure 6-58)	1808m	2021m	10°	10°	Key aspect of property over gardens to the south. Views to the site are screened by mature boundary vegetation, outbuildings and other silo structures. No clear views.	Low	Not significant
19	Gallowfaulds Bungalow (Figure 6-59)	1941m	2162m	10°	10°	Key aspect lies over gardens to the north west with some visibility towards the site in the mid distance, across flat open fields, outer buildings and traffic on the A90. Proposed scheme is further away than the consented scheme (2013/00532/ EIAL), with a looser regular layout. Also comparable in perspective to existing tall structures at similar points.	Low - Medium	Not significant
20	Muiryfaulds (Figure 6-60)	1937m	2077m	7°	7°	Key Aspect to the south along the A90. View to the site will be peripheral and partially screening by outbuildings.	Low	Not significant

As Table 6-6 illustrates a relatively small number of residents will experience any significant direct views of the proposal in key/ principal views from their property. As for the consented scheme, these principally include Govals Cottage and Nether Finlarg Cottages, and to a lesser degree Muirside Cottage, given the existing context of the view. However, in time, with the gradual establishment of existing shelterbelt planting to the west of Nether Finlarg Cottages the potential for views towards the site will be reduced with no significant effect predicted in the medium to long term, typically over 5-10 years. It is considered that where significant effects were anticipated with the consented scheme (2013/00532/ EIAL), the proposed application will help to balance these to a degree. From the isolated points noted to the north, the horizontal spread of turbines will be substantially reduced by up to a third. Where this is not the case, from the closest points to the east, the nearest turbine will now be further away from the receptors and the density and balance of turbines will be improved.

From slightly further away from the site, where there is potential for open views at Gallowfaulds Bungalow, the nature of the existing context and the broader, intervening separation across the A90, to a number of existing tall elements in the mid distant view, will reduce the extent of significance. While there is also likely to be potential for some effect away from the principal aspect of houses, within the wider curtilage and general approach to the properties at other points within 2km, where a clear and open view is available, the proposed turbines will generally be visible at a separate point away from the principal focus and orientation of properties, and they will therefore be less significant.

Given the dispersed nature of properties in this part of Angus, the proposed turbines do not lie close to large numbers of properties, clusters of properties or settlement patterns. The visual change as a significant effect in principal views from property will, therefore, be experienced by a relatively small number of people. When considered together, in line with GLVIA, the overall extent of effect the proposed change to the consented scheme, on residential amenity and key views within the community as a whole within 2km is not, therefore, considered to be significant or unacceptable.

Beyond these points and from the majority of settlements in the wider study area, visibility will be limited. These include the principal settlements at Forfar, Kirriemuir, Dundee, Arbroath, Coupar Angus and Blairgowrie and other local areas of settlement at Glamis, Charleston, Tealing, Milton of Ogilvie and Letham. This limited visibility is due to the notable landform variation and the relatively contained context of the proposed development. The effect from these more distant points will, therefore, not be significant.

6.5.9 Effects on Travellers

The ZTVs show that there will be potential visibility from intermittent points along the A90, between Forfar and Dundee and from the A928 to the south of the site, then to a lesser degree along the A926 around Kirriemuir. Most travellers on these roads will be primarily engaged in commercial travel and/or commuting, rather than on roads which are more specifically defined routes for recreational journeys. In reality, local intervening landform around the site context, combined with the general orientation of routes will limit the extent of coverage and the potential for notable visibility from most sections of the trunk roads. While there will be isolated Moderate effects for 2km on the A928 directly to the south and for up to 4km on the A90 directly to the east, the proposed turbines in general will not typically result in a significant change in views for travellers on most sections of the trunk roads.

Elsewhere from other local roads and the majority of core paths used for more recreational journeys, in the area, notable visibility will be limited to only open, high points of core path 297 to the northeast and core path 208 at Gallow Hill to the southwest. From these points the turbines will be viewed beyond the local context and at varying degrees to the rear of intervening landform.

Elsewhere, the notable landform variation will limit the extent to which the proposed turbines are seen from other core paths. As a result the turbines will not result in a significant change in the view for most travellers on these roads and footpaths. Given the transient nature of the views and the underlying context around the site the extent of effect will be on the whole will not be significant.

6.5.10 Effects on Visitors and the Tourism / Amenity Resource

This receptor group comprises a broad category with different objectives and, therefore, differing levels of sensitivity. A number of significant tourist areas, in the study area are located within the low-lying, lowland valleys and are as such, generally screened from the proposed development, with no notable effect. A number of further recreational tourist areas exist across the Sidlaw Hills, around Kinpurney and Auchterhouse Hill tops, (including the core paths identified in Section 6.5.9). However, the ZTVs illustrate that a combination of notable intervening land form and coniferous woodland, reduces visibility from a large majority of these points. Where views are available from other elevated hill tops to the east at Carrot Hill and Turin Hill, there is potential for more notable effects, the proposed turbines will normally be seen within a broad, simple scaled fringe area of the Sidlaw Hills and with a range of existing comparable scaled built characteristics. These will help to accommodate the profile of the proposed turbines in the wider view. The overall extent of effect on this receptor group is, therefore, not considered to be significant.

6.5.11 Visual Effects Summary

The visual assessment shows that, geographically, the extent of significant visual effect is relatively low, restricted principally to the transitional fringe areas of open farmland on the southeastern fringes of the Sidlaw Hills within 4-5km. This is comparable to the consented scheme (2013/00532/ EIAL). More extended visibility will occur from isolated points of elevation across neighbouring hillsides to the east, including Balmashanner Hill, Carrot Hill, Dodd Hill and Fothringham Hill. However, at these points, the number of potential visual receptors is generally limited and the change will be experienced by small numbers of people, usually on an intermittent or occasional basis. From the majority of locations, the proposed turbines will normally be viewed alongside Finlarg Hill and notably to the side of the main Sidlaw Hills range. As such they will avoid any notable "disruption to principal ridgelines or adversely affect the setting of important landscape features monuments" in line with the Angus SPG for Renewable Energy Implementation (June 2012). In addition they will not significantly alter the existing infrastructural and landform scale with a number of other tall landmark structures defining the same section of the view. Beyond these areas, which include the immediate Sidlaw Hills context to the west and the lower lying settled landscapes and valued areas, views will be notably restricted to isolated points, primarily with views to only the extended blade tips. This is due to the distance and nature of the large intervening Sidlaw Hills ridgeline.

The detailed viewpoint assessment has indicated a reasonable picture regarding the significance of effects upon visual receptors. These effects will be the same as for the consented scheme (2013/00532/ EIAL) but with some slight residual improvement compared to the consented scheme. This is due to the reduced spread of turbines in key views from the north and south and the greater distance to the nearest turbines from points to the east. As for the consented scheme, in EIA terms, there will be significant effects of Moderate to Major or more, at just one viewpoint within 2km of the development site (Govals). Moderate significant effects were noted from four viewpoints at the A928, bordering the site to the south, the road to West Tarbrax, Gallowfauld and Carrot Hill. No significant effects are predicted on key receptors at the remaining 17 viewpoints assessed.

As the summary table of effects of residential amenity further indicates, that by reducing the number of turbines from five to four will improve the layout and spread of turbines from the nearest significant points, such that this will balance any additional perceptibility of the increase in height of the blade diameter. .When considered together with the effects on all relevant key receptor groups, the overall effect on visual amenity is not considered to be significant nor would the change in turbine number and scale be overwhelming to the extent that it would become unacceptable.

6.6 Cumulative Impacts

The purpose of the cumulative assessment is to consider the potential effects upon the landscape and visual environments in relation to existing wind turbine developments and other known consented and proposed wind turbine developments in the area. It raises questions over thresholds of acceptable change (spatial and temporal) and the landscape's capacity to accept change. The 'Guidelines for Landscape and Visual Effect Assessment' (3rd edition, 2013) advises that "cumulative landscape and visual effects result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future".

6.6.1 Scope of the Cumulative Assessment

The potentially significant cumulative effects arising from the proposed turbines will be confined to an area, within which one or more operational, consented or 'in planning' wind farms are located within 30km of a defined sensitive receptor as noted above.

This section does not consider the magnitude or significance of the effects arising from the individual cumulative developments, or all of them together, but looks at the additional landscape and visual effects arising from the proposed Frawney turbines, with one or more of the identified wind farms, on the identified study area.

As supported by the SNH publication, 'Assessing the Cumulative Impact of Onshore Wind Energy Developments' (March 2012), there are a number of specific factors which can influence the extent of cumulative landscape and visual effects. These include effects on sense of scale; sense of distance; existing focal points and/or effects on the skyline. Of note, based on the conclusions of the landscape and visual effects sections above, it is anticipated that potentially significant landscape and visual effects arising from the proposed turbines will be restricted to 4-5km, principally to the east across the lower fringes slopes of the Sidlaw Hills. The assessment will, therefore, focus on the further effects within this study area.

Potential sources for cumulative effects considered in this assessment include operational wind farms, consented wind farms and those 'in planning'. The status of all considered wind farm sites (Figure 6-28) was current at the time of writing (30 February 2014).

Given the number of wind developments within the peripheries of the study area, proposals have been reviewed and selected for detailed illustration and assessment, where they are likely to have a potential for significant effect. These also include turbines under 50m vertical tip height within the immediate context up to 5-6km. Where it was shown that effects will be insignificant from such areas, further schemes at similar points, typically 'in planning' have not been selected for detailed illustration and assessment to avoid repetition and focus on insignificant effects. This is in line with SNH guidance for Cumulative Impact of Onshore Wind Energy Developments (SNH, 2012).

The cumulative sites included in the illustrated assessment are listed in Table 6-7. The cumulative ZTVS are indicated on Figures 6-29 to 6-33. The anticipated cumulative visual effects have been illustrated from the representative viewpoints VP7, VP9, VP10, VP11 and VP12 (Figures 6-34 to 6-38) using wireframes and photomontages. Sequential cumulative visibility for the main route corridor adjacent to the proposed development, the A90, is also assessed with reference to Figure 6-39.

Given the consented nature of the previous five turbine scheme at Frawney (2013/00532/ EIAL) and the adjacent site at Govals Farm it is important to note that the accepted (or consented) level of landscape character change is slightly different than defined in Angus Councils Capacity Study which predates the consent of these sites. The cumulative assessment will therefore focus on the potential for significant additional change as a result of the height extension of the consented turbines at Frawney and the reduction in turbine number from five to four.

Table 6-7: Cumulative Sites for Detailed Illustrative Assessment

Name	Status	No. of Turbines	Tip Height (m)	Distance from Site (km)
Scotston Hill	Operational	1	80	7.8
Michelin Tyre Factory	Operational	2	120.5	9.8
Drumderg	Operational	16	107	26.5
Lochelbank	Operational	12	91	40.5
Tullo	Operational	7	100	43.5
Methil Docks	Operational	1	81	42.3
Ark Hill	Operational	8	81	5.7
North Mains of Cononsyth	Operational	1	67	16.0
Wester Meathie	Operational	2	45.6	5.6
Tealing Airfield	Consented	1	93.5	5.2
Dundee Cold Stores	Consented	1	91	11.7
Welton Of Creuchies	Consented	4	99.5	22.8
East Memus	Consented / Under Construction	1	86.5	18.3

Name	Status	No. of Turbines	Tip Height (m)	Distance from Site (km)
Pickerton	Consented	1	77	17.9
West Main Farm	Consented	1	61	11.2
Cruivie farm	Consented	1	67	20.2
North Tarbrax	Consented	1	45	1.7
Dunswood	Consented	1	77	21.5
Govals Farm	Consented	6	87	1.3
Henderston Quarry	In Planning	1	66	7.6
Nathro Hill	In Planning	17	135	26.3
Bamff	In Planning	7	111	21.8
Stotfaulds Farm	In Planning	1	77	8.2
Newmill of Balgavies	In Planning	1	67	13.6
New Downie Farm	In Planning	1	54	12.4
Ingliston Farm	In Planning	1	77m	7.5
Ascurry Farm	In Planning	1	77m	12.5

6.6.2 Cumulative Landscape Effects

The cumulative ZTVs (Figures 6-29 to 6-33) show that the combined zones of shared theoretical visibility from the range of cumulative sites is varied. Similar to the consented scheme at Frawney (2013/00532/ EIAL), the proposed height extension ZTV will combine with various operational and consented schemes in the area to provide only localised extensions to the extent of coverage of accepted wind turbine elements in the area. This will primarily be across the Igneous Hills LCT fringes to the east and northeast (Figures 6-29a to 6-30c). This coverage will, however, be reduced to fairly minor points when combined with the local operational schemes below 50m tip height at Wester Meathie and North Tarbrax (Figures 6-33). This will also be the case for the other more elevated operational and consented cumulative sites, particularly across the Igneous Hills LCT including Ark Hill and notably, the adjacent site at Govals). The influence of these cumulative sites, will clearly extend across much wider areas of the surrounding landscape to the north and south, and often carry a greater influence over the principal ridgelines and setting of important landscape features and monuments of the surrounding area, such as Kinpurney Monument and Auchterhouse Hill fort, this was recognised in the Reporters decision for existing permission.

As a result, the proposed turbines at Frawney, although slightly taller than the consented turbines, still sit with a lower overall elevation than the adjacent sites and at a location which is more notably away from the key sensitivities. These include the principal ridgelines and defined landscape features. Having reduced the number of turbines from five to four this has also reduced the influence with a more contained horizontal spread than the adjacent sites. The proposed Frawney Wind Farm will therefore constitute a more rational element at a more appropriate, lower lying, contained, fringe area of the Igneous Hills LCT.

This is in line with Table 4 in the Angus SPG for Renewable Energy Implementation which sets out Angus Council's view on the level of acceptable landscape character change within the various landscape types. For the Igneous Hills LCT, the Acceptable Future Character is defined as "Landscape with Occasional Windfarms". The accompanying guidance for the Igneous Hills LCT states that there is scope for turbines circa 80m in height. While the height extension is towards the upper end of this approximate scope the important thing to note is the locational guidance which states that turbines "do not disrupt the principle ridgelines or adversely affect the setting of important landscape features monuments such as Kinpurney Monument and Auchterhouse hillfort".

This is reinforced within the Angus Capacity study within Figure 6-4, which identifies the site context as an area having the "highest underlying capacity" and at a point beyond defined areas which may be limited by cumulative impact.

From the surrounding fringe areas of the Dipslope Farmland LCT, Low Moorland Hills LCT and the Broad Valley Lowland LCT to the east, the effects associated with the height increase of the contented scheme at Frawney will not be significant. The reduced horizontal spread will more typically provide a clearer change in the balance of characteristics. The landscape will therefore remain essentially as one 'with views of wind farms'. It is, therefore, considered that the degree of additional cumulative change that will arise from the proposed height extension to the Frawney development, in combination with the operational and consented sites will not be significant, with the surrounding landscape having the capacity to absorb the type and scale of development proposed at this location, without significant cumulative effect on the underlying characteristics. With the addition of further potential developments 'in planning', there will be a limited intervisibility with the cumulative sites at Bamff and Newmill of Balgavies and New Downie Farm (Figures 6-31a-c). There will then be intermittent or alternating intervisibility with the sites at Nathro Hill to the north and Henderston Quarry and Stotfaulds to the west and east respectively. However, from the immediate context within 5km the notable landform pattern will help to reduce notable visibility and potential for effect on key characteristics. As a result the extent of additional cumulative effects from the Frawney turbines, in combination with these sites in planning, on the landscape character, is not considered to be significant.

In summary, the proposed height extension to the consented Frawney turbines (2013/00532/ EIAL) will still constitute a reasonable change to the overall spread of operational and consented wind turbine influences, at an appropriate and importantly, a comparatively low, contained point in the landscape. While there will be some intensification in the wind turbine influence locally with Govals Farm, the two schemes will remain evident as separate developments with a distinct change in topographical setting ensuring that Govals Farm remains both separate and more dominant in the landscape. This point was recognised in the Reporters decision for the consented scheme. As a result, there will be no notable additional effects on the consented level of character change, across the Igneous Hills LCT and surrounding fringe areas as a result of the height extension to the consented Frawney scheme (2013/00532/ EIAL).

6.6.3 Cumulative Visual Effects

In accordance with the SNH publication, 'Assessing the Cumulative Impact of Onshore Wind Energy Developments' (March 2012), there are two types of cumulative effects on visual amenity. They comprise effects arising from combined and sequential views. Combined views then include 'in combination' visibility, where cumulative sites lie within the same arc of vision at the same time or 'in succession', where the observer has to turn to see the various developments.

Combined Visual Effects

As the cumulative wireframes and photomontages indicate (Figures 6-34 to 6-38), there will be some potential for 'in combination' and 'successive' visibility from intermittent points across the fringes of the Sidlaw Hills and within the surrounding lowland areas. However, the general scale of intervening landform coupled with the distance, orientation and elevation of the identified wind farm sites, will typically limit the prominence of most separate developments in the general view. .

The notable exception to this will be the recently consented site at Govals Farm, which gained approval at the same time as the previous Frawney scheme, in January 2014.

In the context of this development, the Frawney wind turbines will be seen in most views within 10-15km to the east, north and south, in combination with Govals Farm (Figures 6-34, 6-35, 6-37 and 6-38). It will also be seen in some elevated views to the west across the Sidlaw Hills, (Figure 6-36 and 6-37). At these points, there will be some potential for high intervisibility in combined viewsand a degree of cumulative visual effect. This is due to the proximity of the cumulative sites on the southeastern fringes of the Sidlaw Hills. However, the two schemes will remain clearly separate developments given the distinct change in topographical setting and the additional visual effect or contribution of the Frawney turbines will not be the significant factor.

From the vast majority of these points, the cumulative site at Govals Farm will often be more prominent in the landscape and elevated in the view, given the additional elevation at a neighbouring hill summit. Govals Farm will also have greater potential for disrupting principal ridgelines and the wider pattern of characteristics in the area (Figures 6-35 to 6-38). In these cases the proposed Frawney turbines will sit at a lower point, to the side of more notable landform ridges and mostly backclothed by open sweeping landform. In some local views to the north and south, there will be varying degrees of overlap between the Frawney turbines and the Govals Farm site, with some potential for conflict in the layout and arrangement of elements in the view (Figure 6-34). However, the proposed changes to the Frawney scheme have sought to lessen these from the consented scheme (2013/00532/ EIAL). As part of this mitigation by design, the height increase in the proposed Frawney turbines has sought to relate to the taller scale of the consented turbines at Govals and help the scale relationship. In addition the reduction in turbines from five to four sought to lessen the potential overlap and contrast in the layout and spacing of the turbines at both developments.

At other more distant points views would also include the operational site at Ark Hill which is seen more occasionally in combined views from the north and to the west across high points of the Sidlaw Hills (Figures 6-36 and 6-37). The operational turbine at Scotston Hill and the consented turbine at Tealing will also be seen in combined and successive views from points to the south between 4km and 7km (Figure 6-34).

In most combined views, therefore, the proposed height extension to the consented Frawney development (2013/00532/ EIAL) will only constitute a very minor change to the pattern of consented development in the view, often sitting at a lower fringe point of the Sidlaw Hills, notably to the rear of intervening elevated landform. With the omission of one turbine and a reduced spread and density of turbines at Frawney, this change from the consented layout could also be considered to be of a minor beneficial change.

Sequential Visual Effects

The cumulative ZTVs (Figures 6-29 to 6-33) illustrate that within 10-15 km of the proposed site theoretical cumulative visibility is widespread along the A90. This is illustrated further in Figure 6-39, which indicates cumulative site visibility. It shows that theoretical sequential visibility, to the operational and consented sites is generally split to the north and south of the site, in each case with views of up to five sites. To the north, this will theoretically be in combination with Ark Hill, Scotston Hill, Wester Meathie and North Tarbrax and Govals. To the south this will theoretically be combined with Govals Michelin Tyre Factory and Scotston Hill once more, along with Dundee Cold Stores and Tealing airfield. With the additional of key schemes in planning there will be additional visibility to Nathro Hill, to the north of the proposed Frawney development.

The filtering and screening effects of areas of roadside planting and forestry will reduce some theoretical visibility along with orientation or sites and direction of travel. However, for most points between Dundee and Forfar, the view along the road is open and expansive and from the majority of these points the proposed turbines at Frawney will theoretically be seen with one or more wind farm, as noted above,. While the proposed turbines, will add a small amount to the overall sequential cumulative effect for the A90 road, the contribution of the proposed development to the extent of visibility in sequence from this key route, would not be significant given the separation and orientation of most sites and the occasional nature of the sequence of views between them.

While there would be a higher potential for more variable visibility between Frawney and Govals Farm within 5-7km, they would actually be viewed at most locations in combined views, noted above, with sequential visibility actually being limited.

Taken together, the extent of cumulative visual effect, arising from the proposed Frawney wind farm height extension to the consented scheme (2013/00532/ EIAL), is not considered to change the consented pattern of development and is therefore considered to be acceptable, with a degree of separation and distance between sites and existing wind turbines of comparable scale to the proposed Frawney turbines.

6.7 Summary

Following the consent of the previous five turbine layout, a four turbine proposal has been developed, with a slightly larger blade diameter (92.5m to tip). While this will extend the height of the four remaining turbines slightly, the hub height will remain similar. As the LVIA has demonstrated, the more evident change within the scheme will be the reduction in the number of turbines. This will represent a reduction in terms of horizontal scale and density in the layout, with the four proposed turbines now being sited slightly further away from the nearest properties than the consented scheme (2013/00532/ EIAL).

Given the location and the character of the receiving environment and the consented nature of the wind farm development within it, the landscape has the ability to accommodate this minor change with a reasonable effect on the landscape and visual resource. The proposed development has also included further design changes to the consented layout which aim to reduce adverse effects on the more sensitive landscape and visual receptors. These include residential properties in close proximity to the site. In doing so, the proposed development, while slightly taller, is now more contained horizontally and of greater height comparability with other consented turbines, at an adjacent point to the north. The proposal will also sit away from notable landscape fabric elements and other tall landmark structures and at an appropriate point in the landscape that will still avoid 'disruption to the principle ridgelines or adversely affect the setting of important landscape features monuments'. This has resulted in a scheme which is considered to be appropriate in scale and location within its landscape setting with a very modest residual effect compared to the consented scheme, on residential amenity. Furthermore, whilst there will be acknowledged changes in the local landscape, these will be completely reversible and temporary given the wind farm's anticipated life span of no more than 25 years.

6.8 References

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7 Ecology

7.1 Introduction

This chapter, prepared by Atmos Consulting Ltd, presents the results of an Ecological Impact Assessment (EcIA) of the proposed development. The purpose of this EcIA is to provide an independent assessment on the potential effects of the development on the nature conservation interest of the application site and its immediate environs.

The proposed development consists of four wind turbines and associated infrastructure (access track, electrical cable, control building and construction compound). This is a revision to the consented wind farm (13/00532/EIAL) which was for five turbines of 80m tip height and 56m hub height. This EcIA relates to the revised scheme of four turbines of 92.5m tip height and 57m hub height. Further description of the Site and details of the development can be found in Chapter 3 The Development.

The application site, hereafter referred to as the 'Site', is covered entirely by the ecological 'Survey Area' across which all surveys were undertaken (Figure 7-2). The original Survey Area was designed to encompass the proposed turbine locations of layout d (Figure 3-1 Site Design Iterations A), as applied for in application 12/00577/EIAL and the associated infrastructure. This application was subsequently withdrawn and a new planning application 13/00532/EIAL for five turbines was consented in February 2014 layout h (Figure 3-1 Site Design Iterations B). Under this current application (Figure 3-2 Site Layout) the layout of the turbines remains the same as in the consented application (13/00532/EIAL) but with the removal of Turbine 5 and a slight increase in tip and hub height of the remaining four turbines.

This chapter is supported by three Technical Appendices, which contain the supporting information on the key features of nature conservation interest on which this assessment is based, namely: Phase 1 Habitats (Appendix 7-1: Habitat Survey Report) and Bats (Appendices 7-2: Bats and 7-3: Supplementary Environmental Report on Bats).

7.2 Methodology and Approach

7.2.1 Information Sources

The following sources of information were used in this assessment:

- Information on statutory sites was obtained from the website of the statutory agency SNH via the 'Site Link Portal' (http://www.snh.org.uk/snhi/);
- Protected species records were obtained within the NO44 10 km Grid Square on the National Biodiversity Network (NBN) Gateway website (http://www.searchnbn.net/) to inform the surveys which might be required on the Site;
- Aerial photography of the Site was examined using photography available in the public domain on the www.bingmaps.co.uk and www.maps.google.co.uk web pages;
- Consultation responses/data;
- Results of the extended Phase 1 Habitat Survey (Appendix 7-1);
- Results of the National Vegetation Classification (NVC) survey of potential Groundwater Dependent Terrestrial Ecosystems (GWDTE) (Appendix 7-1); and

- Results of protected species surveys including bats (Appendices 7-2 and 7-3), otter, water vole and badger.

7.2.2 Consultation

Table 7-1 summarises the consultations undertaken in relation to ecology.

Table 7-1: Consultation Responses

Consultee	Response	Comment
SNH	27/01/2009 and 02/04/2009 EIA Scoping response: Impacts unlikely on River Tay SAC due to distance and no SSSIs located within the vicinity of the proposed Site. Recommend consulting the NBN Gateway for animal and plant species within the area. Recommended a Phase 1 habitat survey and NVC survey of important semi-natural habitats is undertaken at an appropriate time of year. Mammal surveys for European protected species should be undertaken along with species identified on the UKBAP. 13/02/2012: No specific site relevant information received in response to data request but generic guidance documents were referred to. 12-14/03/2012: Subsequent email and telephone communications with SNH confirmed the Site to be classified as a 'low risk' site and proposed bat survey approach of undertaking three visits to the site each consisting of a transect survey and static detector deployment for a period of three days would be fit for purpose. 20/03/2012: Email communications with SNH confirmed the absence of great crested newts from the Angus region.	Phase 1 habitat survey, NVC survey and mammal surveys undertaken. In line with guidance, bat surveys were scheduled for May, July and September 2012; each visit consisting of a transect survey and static detector deployment for a period of three days. The habitat was assessed for great crested newts but newts were considered unlikely to be present on site.
	28/09/2012 (Response to Appl 12/00577/EIAL): Overall we consider that any potentially detrimental impacts on local biodiversity can be avoided through appropriate planning conditions. The mitigation, compensation and enhancement measures proposed in the ES should be followed, and the Ecological Mitigation Strategy (EMS); employment of an Ecological Clerk of Works and proposals for writing an Environment Management Monitoring Plan (EMMP) and associated Habitat Management Plan (HMP) are welcome along with compensatory broadleaved tree planting.	This ES includes the same measures as previously proposed in appl. 12/00577/EIAL and therefore it is anticipated appropriate planning conditions can be implemented as noted by SNH.
	17/07/2013 (Response to Application 13/00532/EIAL): We consider that the situation at Frawney and surrounding area has not changed such that our advice would alter from our previous response (28/09/2012).	SNH had no objection to the previously submitted scheme subject to the measures proposed in their response to the application in 2012 (12/00577/EIAL).

Consultee	Response	Comment
SEPA	16/01/2009: EIA Scoping response noted reference to IEEM guidelines and requirement for taking account of seasonal variations in surveys. Additional advice on pollution prevention measures was also provided through reference to SEPAs Pollution Prevention Guidelines. 17/02/2012: Information received on the Kerbet Water catchment which the site is located within; as well as additional information on gauging and monitoring stations. 08/08/2012 (Response to planning application 12/00577/EIAL): SEPA do not have any concerns regarding the ecological impacts of the proposal as long as PPGs are followed, appropriate licences are in place and suitable mitigation measures are employed to reduce impacts to any receiving waterbodies. Highlight the requirement for a CEMP. Stress that the watercourses in the vicinity of the site are small upland streams and are sensitive ecosystems and form headwaters for larger watercourses and it is crucial that all necessary mitigation measures are taken to preserve their good status. Watercourses in the area include the Gallowfauld Burn which drains to the Kerbert Water and then to the Dean Water. Ultimately, these watercourses drain to the River Tay SAC, the boundary being 5.5km downstream of the proposed development area. The River Tay is designated a SAC for its populations of Salmon, Lamprey species and Otters. It is important to ensure that there is no deterioration in water quality of the receiving waterbodies from siltation and possible pollution impacts during the construction phase of the development. Two small areas of GWDTE were identified through the survey work carried out within the development area. However, upon further assessment by the surveying contractor and the hydrology survey supplied, it was established that neither of these areas were groundwater dependent as the locally raised water levels were considered to be a direct result from the manipulation of natural surface water drainage to increase productive agricultural land. 4/07/2013 (Response to application 13/00532/EIAL): These changes do not change our previous position although we have provided a full response. The	The overall status of the Kerbet Water is Moderate and the overall ecological status is also Moderate. Within the marked perimeter the only noted watercourse is the Corbie Burn / Gallowfauld Burn which is part of the greater Kerbet Water catchment area. SEPA had no objection to the previously submitted scheme subject to the measures proposed in their response to the application

Consultee	Response	Comment
	development area is designated a Drinking Water Protected Area (Groundwater) under the Water Framework Directive and is a designated Nitrate Vulnerable Zone under the Nitrates Directive. The same concern regarding watercourses in the area ultimately draining into the River Tay SAC. Two small area of potential GWDTE established as not dependent on ground water. No concerns regarding the ecological impacts as long as our Pollution Prevention Guidelines are followed, appropriate licences are in place and suitable mitigation measures are employed to reduce impacts to any receiving waterbodies.	in 2012 (12/00577/EIAL).
McManus Museum Local Biological Record Centre	29/02/2012: Information on protected and notable species within 2km of the Site.	Most of the records provided were older than 2000. Records of protected species included otter *Luta lutra* (1998), badger *Meles meles* (1975), red squirrel *Sciurus vulgaris* (1995) and pine marten *Martes martes* (1936); none of these records were within the survey area.
Perth Museum	03/02/2012: No information held for Angus area.	n/a
Angus Council	12/03/2012: Meeting held to discuss ecological scope of works in 2012 where Atmos presented the proposed scope of works in relation to Ecology. SNH could not attend the meeting but Atmos had held a telephone conversation with SNH prior to meeting (12/03/2012). Angus Council confirmed that they feel that the SNH scoping response approach was appropriate and the Site is of low sensitivity with regards to ecology. It was confirmed that planning submission prior to completion of bat surveys was acceptable with further data provided within a Supplementary Information document in September 2012 although SNH would need to postpone comment until this information is received. 13/01/2013 – Decision (13/00532/EIAL) Conditions relating to ecology - At least two months prior to the commencement of any works in connection with the planning permission hereby approved, the following shall be submitted to and approved in writing by the planning authority: 1. A full, site specific Environmental Management and Monitoring Plan	Supplementary Information on bat surveys was submitted in September 2012.

Consultee	Response	Comment
	(EMMP), incorporating a Construction Method Statement (CMS) and a Site Waste Management Plan (SWMP), which must be approved in writing by the planning authority, in consultation with the Scottish Environment Protection Agency and Scottish Natural Heritage 2. A full, site specific Ecological Mitigation Strategy (EMS) which must be approved in writing by the planning authority, in consultation with and Scottish Natural Heritage.	
SWT	No response received to date.	n/a
Tayside Bat Group	06/02/2012: Five records of bats within 5km of the Site were provided.	Records of maternity roosts in Glamis as recent as 2003, also maternity roost at Easter Denoon to west in 2009. The closest roost is at Mains of Kinettles in 1994. All records are of Pipistrelle species.
Tayside Biodiversity Partnership	No response received to date.	n/a
Butterfly Conservation	19/02/2012: Detailed list of moth and butterfly records for Site and 2km buffer.	Two species are recorded within the Site: Green-veined White *Pieris napi* (butterfly conservation status low) in 1998 at Lumley Den and Painted Lady *Vanessa cardui* (butterfly conservation status low) in 1995 at Lorns Hill. Six records within 2km of; Small White *Pieris rapae* (butterfly conservation status low), Green-veined White, Common Blue *Polyommatus icarus* (butterfly conservation status low), Red Admiral *Vanessa atalanta* (butterfly conservation status low), Small Tortoiseshell *Aglais urticae* (butterfly conservation status low but concern over recent decline) and Small Heath *Coenonympha pamphilus* (UKBAP priority species, butterfly conservation status high), all recorded between 1995 and 1999.
Friends of Angus Herpetofauna	No response received to date.	n/a
Tay District Salmon Fisheries Board	No response received to date.	n/a
Scottish Badgers	10/02/2012: Only road traffic accident information available for area.	

7.2.3 Overall Approach

A number of guidance documents have been published in relation to undertaking ecological assessments in relation to developments and wind farms in particular. Initial baseline survey work follows the standard Phase 1 methodology as described in the 'Guidelines for Baseline Ecological Assessment' (IEA, 1995) as set out in the 'Handbook for Phase 1 Habitat Survey – a technique for Environmental Audit' (JNCC, 2010).

Additional species specific guidance comes from publications including the 'Water Vole Conservation Handbook' (Strachan and Moorhouse, 2006), 'Bat Survey Good Practice Guidelines' (Hundt, L. 2012) and 'Otters and Development' (SNH, 2010).

7.2.4 Nature Conservation Legislation

National Planning Policy and Legislation

National guidance on planning policy in Scotland is provided by the Scottish Government in the form of the Scottish Planning Policy (SPP) and via National Planning Framework 2 (NPF2), which have superseded National Planning Policy Guidelines (NPPGs), individual Scottish Planning Policies (SPPs), Planning Advice Notes (PANs) and Circulars.

The SPP has three primary objectives for the planning system:

- To set the land use framework for promoting sustainable economic development;
- To encourage and support regeneration; and
- To maintain and enhance the quality of the natural heritage and built environment.

Guidance on nature conservation planning policy is provided by several sections of the SPP, which, in general, advocate protection through the planning system of statutory and non-statutory sites of biodiversity value, as well as species protection and conservation in the wider countryside. The SPP also recognises that careful planning can be used to reconcile nature conservation and development, even in sensitive areas.

National legislation for the special protection of selected species is provided in the Wildlife and Countryside Act 1981, as amended in Scotland (WCA). Schedule 5 of the WCA provides special protection to selected animal species other than birds, through section 9(4) of the Act, against damage to "*any structure or place which [any wild animal included in the schedule] uses for shelter and protection*", and against disturbance whilst in such places. Amendments to the Act within Scotland with reference to specific species have also occurred during recent years.

The Protection of Badgers Act 1992 (as amended) provides protection to badgers and their setts.

A number of animal species termed European protected species (EPS) are provided protection through inclusion on Schedule 2 of The Conservation (Natural Habitats, &c.) Regulations 1994, as amended, which transpose into Scottish Law EC Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the "Habitats Directive"). The Regulations, commonly referred to as the "Habitats Regulations", extend protection against deliberate disturbance to those animals wherever they are present, and provide tests against which the permission for a development that may have an effect on an EPS must be assessed before permission can be given.

The Nature Conservation (Scotland) Act 2004 (NCSA) sets out a series of measures designed to conserve, protect and enhance the biological and geological natural heritage of Scotland. Among these measures is a requirement to establish a list of species considered by the Scottish Government to be "*of principal importance for the conservation of biological diversity in Scotland*". This list is as set out in the Scottish Biodiversity Strategy (Scottish Executive, 2004).

In addition to species protection, the WCA, NCSA and Habitats Regulations also set out requirements/procedures for the notification, designation and protection of a range of statutory site designations in order to preserve important nature conservation resources. With respect to non-avian ecology these include Special Areas of Conservation (SAC) and Sites of Special Scientific Interest (SSSI).

SACs are designated under the 'Habitats Directive' to protect sites supporting examples of natural habitats listed in Annex 1 to the Directive and populations of species listed in Annex 2 to the Directive (which excludes birds). Annex 1 habitats and Annex 2 species at a site may represent either a "primary reason for [its] selection" as a SAC, or being, "present as a qualifying feature, but not a primary reason for site selection". SSSI's are sites of national importance for nature conservation, and can be notified for their ecological interest. The Wildlife and Countryside Act 1981 (as amended) provides for the protection of SSSIs.

More recently legislation for controlling the spread of invasive non-native species has been introduce through the Wildlife and Natural Environment Act 2011 (WANE) and in Scotland the Wildlife and Natural Environment (Scotland) Act 2011 (WANESA). WANESA and WANE amend and expand section 14 of the WCA so that there is an emphasis on prevention of the spread of non-native species and the new offences under the 2011 Act are based on a general no release policy. This means that it is an offence to 'release, or allow to escape from captivity any non-native animal, to a place outwith its native range' or to 'plant, or otherwise causes to grow, any plant in the wild at a place outwith its native range'. Non-native includes native species 'beyond their native range'. Within this Act there are also additional control measures regarding the keeping of invasive plants and animals and reporting the presence of invasive plants and animals.

The protection of fresh water quality and the improvement of fresh waters come under the EC Directive 78/659/EEC (Freshwater Fish Directive) which was adopted by the UK in 1978. Under Article 5 of the directive member states should establish a Pollution Reduction Programmes (PRP) to ensure compliance with the directive. These PRPs now refer to the Water Framework Directive 2000/60/EC (WFD) which will replace the Fresh Water Fish Directive. The aims of the WFD are to 'prevent deterioration and enhance the status of aquatic ecosystems, promote sustainable water use, reduce pollution and contribute to the mitigation of floods and droughts'.

Regional and Local Planning Policy

Structure and Local Development Plans form the basis on which decisions about development and future land use are made in Scotland, and effectively incorporate national, regional and strategic policies within the local framework. After the Planning etc. (Scotland) Act 2006 these Structure Plans and Local Plans are gradually being replaced by Strategic Development Plans (SDPs) and Local Development Plans (LDPs). As such the current Angus Development Plan includes the following planning policy documents:

- TAYplan Strategic Development Plan (approved June 2012)
- Angus Local Plan Review (Adopted 2009)
- Cairngorms National Park Local Plan (Adopted 2010)

The relevant structure plan for the area is the TAYplan Strategic Development Plan (2012-32) and the Angus Local Plan Review (adopted 2009).

The key TAYplan Strategic Development Plan policies which relate to the ecology aspects of this development are:

Policy 2: Shaping better quality places

Policy 3: Managing TAYplan's Assets

Policy 6: Energy and Waste/Resource Management Infrastructure

The Angus Local Plan has six policies which cover nature conservation and which are relevant for this development, they are:

- Policy ER1 : Natura 2000 and Ramsar Sites,
- Policy ER2 : National Nature Reserves and Sites of Special Scientific Interest,
- Policy ER3 : Regional and Local Designations,
- Policy ER4 : Wider Natural Heritage and Biodiversity,
- Policy ER6 : Trees, Woodlands and Hedgerows, and
- Policy ER7: Trees on Development Sites.

Other Nature Conservation Initiative

Under Section 2 (4) of the NCSA Scottish Ministers are required to publish a list of species of flora, fauna and habitats considered to be of principal importance for the purposes of biodiversity, including species considered to be important to the Scottish public. This list is known as the Scottish Biodiversity List and includes many common species such as heather *Calluna vulgaris* and brown hare *Lepus europaeus*.

Other nature conservation initiatives include Biodiversity Action Plans (BAPs) which are part of the British government's strategy for the implementation of the 1992 Convention on Biological Diversity, to which it is a signatory. BAPs have been developed for the UK and devolved to local levels (LBAPs), to protect a number of rare species and habitats and reverse the decline of more widespread, but declining, species and habitats. As with the Scottish Biodiversity List, LBAPs also include species which are not rare or declining, but are considered important to the local public. Under the NCSA, the Scottish Executive and other bodies exercising a public function have a duty to give due regard to the conservation of biodiversity. The following BAPs and LBAPs are, therefore, relevant to this EcIA:

- The UK Biodiversity Action Plan (BAP) January 1994;
- The Scottish Biodiversity Strategy (Scottish Executive, 2004); and
- Tayside Local Biodiversity Action Plan (BAP) (2010).

The area of the proposed Frawney Wind Farm is covered by the Tayside LBAP which raises awareness of local biodiversity and identifies priority habitats and species within

Tayside as a whole. Most of the work of the Tayside LBAP is addressed through various Habitat Action Plans (HAPs) and individual Species Action Plans (SAPs).

The Tayside Biodiversity Partnership comprises a number of sub groups (six habitat sub groups and one species sub group) which includes local groups and key organisations committed to understanding, safeguarding, restoring and celebrating biodiversity within the Tayside area. Several species interest groups are also being set up to prepare plans and take specific actions forward.

7.2.5 Evaluation of Ecological Receptors

Following consultations, desk study and field surveys, the following criteria are applied to assess the nature conservation value of the ecological 'receptors', i.e. the sites, habitats, ecosystems, species, populations, communities or assemblages (both on and off-site) that could be impacted by the proposed development. As there is rarely comprehensive quantitative data on the wider habitat or species population resource, particularly below the international and national level, the nature conservation evaluation of receptors necessarily also involves a qualitative component. This requires a suitably trained and experienced ecologist to make a professional judgement based upon a combination of published sources, consultation responses and knowledge of both the Site and the wider area.

The categories of ecological value used in this chapter are described in Table 7-2.

Table 7-2: Criteria for the Evaluation of Nature Conservation Receptors

Value	Criteria	Examples
International	Nature conservation resource, i.e. site, habitat or populations of species, of international importance. N.B. Includes designated sites, but may also include off-site ecological receptors on which the qualifying population(s) or habitat(s) of designated sites are considered, from the best available evidence, to depend.	European sites: • SPAs and SACs • (p)SPAs and (c)SACs Other International sites: • Ramsar wetlands • Habitats and populations/ assemblages of species (including birds) that represent the qualifying interests of internationally designated sites.
National	Nature conservation or geodiversity conservation resource, i.e. site, habitat or populations of species, of national importance. N.B. Includes designated sites, but may also include off-site ecological receptors on which the qualifying population(s) or habitat(s) of designated sites are considered, from the best available evidence, to depend.	SSSIs (biological and geological) All populations of W&CA Schedule 8 plants. All viable populations of species listed as Critically Endangered, Endangered, Vulnerable or Threatened in relevant Red Data Books*. Nationally important population /assemblage of an EPS, Schedule 1 and/or 5 species.
Regional	Nature conservation or geodiversity conservation resource, i.e. site, habitat or population of species, of regional importance. Includes high quality undesignated and designated sites, e.g. where a County-designated site is below SSSI	Sites/populations that meet SSSI designation criteria but have not been designated due to there having been better examples in the relevant Area Of Search. Regionally important population/area of a species and habitat of Principal Importance or UK BAP priority species and habitats.

Value	Criteria	Examples
	standard but still recognised as being significant in the context of the wider region e.g. central lowlands.	Regionally important population/assemblage of an EPS, Schedule 1 and/or 5 species. Regionally important assemblages of other species. Regionally designated geodiversity sites.
County/High Local	Nature conservation or geodiversity conservation resource, i.e. site, habitat or species, of importance in the context of Angus.	Local Nature Reserves. County important population/area of a species and habitat of Principal Importance or UK BAP priority species and habitats. County-important population/assemblage of an EPS, Schedule 1 and/or 5 species. County-important assemblages of other species. County-designated geodiversity sites.
Local	Nature conservation or geodiversity conservation resource, i.e. site, habitat or species, of importance in the context of Forfar and Dundee area.	A breeding population of a species or a viable area of a habitat that is listed in a Local BAP because of its rarity in the locality. A breeding population of a species on the Scottish Biodiversity List has been identified by the local authority as being a material consideration in terms of its planning process. All breeding populations of an EPS, Schedule 1 and/or 5 species that have not been captured in higher categories above. Assemblages of other species that are of importance in the context of the local authority area. Locally-designated geodiversity sites.
Less than Local	Unremarkable habitat/common species that are of some value in the context of the site, but not more widely.	Other species and habitats which are, in the opinion of the assessor, of note and for which mitigation measures could be recommended as a good practice measure.
Negligible	A resource that is of little/no intrinsic nature conservation or geodiversity value.	Common, widespread, modified and/or impoverished habitats. Species of Least Concern which are widespread and/or common locally.

* This is terminology post-1994; but should be interpreted as including equivalent criteria pre-1994.

7.2.6 Impact Magnitude

The magnitude of an impact depends upon the nature and sensitivity of a receptor and the range of potential effects arising from the implementation and operation of a proposed development.

In assessing the likely magnitude of an effect, it is necessary to have as great an understanding as possible of its timing, intensity, frequency, duration and reversibility. For the purposes of this assessment, the nature of the effects on specific receptors is described in the impacts section, and then the magnitude of these effects is summarised as being in one of the categories 'no significant impact'; 'imperceptible'; 'low'; 'medium' or 'high', depending upon the extent of the area or population deemed likely to be affected by the development.

Table 7-3 provides an indication of the terms in which the magnitude of ecological impacts is considered in this chapter. The following definitions have been applied in respect of timescales:

- 'immediate' - within approximately 12 months;
- 'short-term' - within approximately 1 to 5 years;
- 'medium-term' - within approximately 6 to 15 years;
- 'long-term' - more than 15 years.

Table 7-3: Levels of Impact Magnitude

Magnitude	Description
No Impact	No detectable effects on the ecological resource, even in the immediate term.
Barely perceptible	Detectable effect but reversible within 12 months. Not expected to affect the conservation status of the site, habitat or species under consideration.
Low	Detectable effects, and may be irreversible, but either of sufficiently small scale (or short duration, if reversible) to have no material effect on the conservation status of the site, habitat or species population.
Medium	Noticeable effect on the nature conservation status of the site, habitat or species population, but would not threaten the long-term integrity of the system. Replaceable or reversible given time. Effect on nature conservation status likely to be detectable in short- and medium-term.
High	Significant effect on the nature conservation status of the site, habitat or species, likely to threaten the long-term integrity of the ecosystem. Not replaceable or reversible. Will be detectable in short-, medium- and long-term.

7.2.7 Impact Significance

The determination of impact significance involves the interaction of both the nature conservation value of the site, habitat, or species population or assemblage concerned, together with the magnitudes of the various impacts upon it. The more ecologically valuable a site and the greater the magnitude of a given impact, the higher the significance of that impact is likely to be.

An EcIA is undertaken in relation to the baseline conditions that would be expected to occur if the proposed development were not to take place and, therefore, may include possible predictions of future changes to baseline conditions, such as environmental trends and other completed or planned development. Both negative and positive impacts are possible.

Table 7-4 shows in general terms the way in which the significance of ecological impacts is considered in this report. It is important to appreciate that this does not represent a rigid framework for assessment and that there are gradations between different categories of site and impact, and on occasion the significance of a particular impact may not accord precisely with the categories shown below. Impacts identified as minor are considered not to be significant for the purposes of this EcIA.

Table 7-4: Generalised Impact Significance Matrix

Nature Conservation value of Receptor	Magnitude of Potential Impact (+ve and –ve)			
	High	Medium	Low	Barely Perceptible
International	Exceptional	Major	Moderate	Minor
National – GB & Scotland	Exceptional	Major	Moderate	Minor

Nature Conservation value of Receptor	Magnitude of Potential Impact (+ve and –ve)			
	High	Medium	Low	Barely Perceptible
Regional – Central Lowlands	Major	Moderate	Minor	Minor / No impact
County – Angus	Moderate	Moderate	Minor	No significant impact
Local – Forfar and Dundee	Minor	Minor	Minor	No significant impact
Less than Local	Minor / No impact	Minor / No impact	No significant impact	No significant impact
Negligible	No significant impact	No significant impact	No significant impact	No significant impact

7.2.8 Survey Methodologies

The survey methodologies, survey timings and results are presented in detail in Appendices 7-1, 7-2 and 7-3. A summary of the specific surveys carried out within the Survey Area are detailed in Table 7-5. It should be noted that whilst surveys were undertaken in 2012, the habitats and farming practices within the site have not changed in the last two years and, therefore, results are still considered to be valid and robust.

Table 7-5: Ecological Surveys Undertaken Within the Survey Area

Survey Type	Dates Completed	Technical Appendix
Habitat surveys: Extended Phase I Habitat Survey Groundwater dependent terrestrial ecosystems (GWDTEs)	 March 2012 April 2012	 Appendix 7-1 Appendix 7-1
Bats	March - April 2012 July and August 2012	Appendix 7-2 Appendix 7-3
Protected Species: Otter, water vole, badger	April 2012	No Appendix
Habitat assessments: red squirrel *Sciurus vulgaris*, pine marten *martes martes*, wildcat *Felis sylvestris*, reptiles and amphibians.	March and April 2012	No Appendix

7.2.9 Assessment Methods

The methodology adopted in this assessment has involved the following key stages:

- Determine baselines;
- Review development for impacts;
- Evaluate Significance;
- Identify mitigation; and
- Assess residual impacts.

7.3 Baseline Conditions and Evaluation of Ecological Receptors

7.3.1 Designated Sites

This section relates to non-avian designated sites; avian designated sites are covered in Chapter 8 of this ES. There are no ecologically designated sites within or immediately adjacent to the Site. Five designated sites are present within 5km which are designated for nature conservation interest (Figure 7-1).

Statutory Designated Sites

River Tay SAC

The Kerbet Water which is part of the River Tay SAC is situated approximately 2.8km to the northeast of the Site (straight line distance) although downstream distance from the development site boundary along watercourses is approximately 5.5km. The River Tay SAC is designated for: river lamprey *Lampetra fluviatilis*, brook lamprey *Lampetra planeri*, sea lamprey *Petromyzon marinus*, Atlantic salmon *Salmo salar* and otter *Lutra lutra*, as well as clear water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels. This site is recognised as being of International nature conservation value.

Gagie Marsh SSSI

This SSSI is situated 4.5km to the southeast of the Site on the Murroes Burn. It is designated flood plain fen community. It is a small area of 5.2ha with tall fen vegetation covering the majority of the site, which grows as a mat of floating vegetation over deep, liquid silt. Plants here include water horsetail *Equisetum fluviatile*, marsh marigold *Caltha palustris*, bottle sedge *Carex rostrata*, brown sedge *Carex disticha*, water mint *Mentha aquatica* and marsh cinquefoil *Potentilla palustris*. This site is recognised as being of National nature conservation value.

Carrot Hill Meadow (SSSI)

This SSSI is situated 4.5km to the east of the Site and is designated for its spring fen community, which is a scarce habitat type in Angus. The site supports species rich mire communities, characteristic of ground flushed by springs. There is a wide variety of sedges including dioicious sedge *Carex dioica*, tawny sedge *Carex hostiana* and long-stalked yellow sedge *Carex lepidocarpa*. This site is recognised as being of National nature conservation value.

Auchterhouse Hill SSSI

This SSSI is situated 5km to the west of the Site. It is a large area covering 238ha and is important for its subalpine dry heath (or upland dwarf shrub heath); it is the richest area of upland heathland in the Sidlaws Hills in Angus. The site comprises an extensive area of subalpine dry heath with associated mires and springs adding diversity to the site. This site is recognised as being of National nature conservation value.

Whitehouse Den SSSI

Situated 1km to the southeast of the Site this SSSI is designated for its geology, in particular the Silurian – Devonian Chordata. These are shales of the Arbuthnott Group

Dundee Formation laid down 390 million years ago and contain fossil material of acanthodian fish. This site is recognised as being of National nature conservation value.

Non-Statutory Designated Sites

There are three local wildlife sites located within 5km of the Site but outwith the Survey Area. These are; Whitehouse Den located approximately 1.5km southeast at the same site as the Whitehouse Den SSSI which is designated for geological features, Brighty Wood (a mixed plantation) located 4.5km to the southeast and Shielhill Wood 4.6km to the south. No other non-statutory wildlife sites are known to exist within 5km of the Survey Area although SWT did not respond to consultations to confirm this is the case. Although no further information is available on these sites they are recognised as being of Local conservation value.

Within 5km of the Site there are approximately 20 ancient woodland sites which are listed on the Ancient Woodland Inventory (AWI). The closest of these are a number of areas close to the boundary but outwith the Survey Area to the southeast at Corbie Den. Although not an official nature conservation designation, ancient woodlands are areas which have been in continuous woodland cover since approximately 1750 and because of their age must be considered as a non-renewable resource, even though they do not benefit from any form of statutory protection. These woodlands are recognised as being of Local conservation value.

Within the Survey Area are seven areas of woodland which are part of the National Inventory of Woodland and Trees. This is a survey carried out by the Forestry Commission Scotland (FCS) of all woodland over 2ha, classifying the woodland by the age, species and stocking. These woodlands are recognised as being of Less than Local conservation value.

7.3.2 UK and Tayside Biodiversity Action Plans

Biodiversity Action Plans (BAPs) are part of the British Government's strategy for the implementation of the 1992 Convention on Biological Diversity, to which it is a signatory. BAPs have been developed for the UK and devolved to local levels (LBAPs), to protect a number of rare species and habitats and reverse the decline of more widespread, but declining, species and habitats.

In addition to the overall UK BAP, the area affected by the proposed development is covered by the Tayside LBAP. Local habitat action plans (LHAP) have been produced for many habitats of which the following may be present within the Survey Area:

- Cropped areas;
- Farm buildings;
- Farm tracks and verges;
- In-bye wetlands;
- Lowland mixed broadleaves;
- Ponds, pools and lochans;
- Private gardens;
- Public and private buildings;
- Transitional wetlands; and
- Wet grassland.

The LBAP has also identified over 400 plant and animal species of conservation concern (SoCC), which are known to occur in Tayside and are nationally rare, threatened, declining or otherwise considered to be locally important.

7.3.3 Desktop Study and Consultations

A summary of the responses from consultees is presented in Table 7-1. Not all of the consultees responded and most of the records provided were more than ten years old. The local record centre provided records of over 3000 species of flora and fauna. The records of EPS included otter, badger, red squirrel and pine marten which were prior to 2000 and there were no records within the Survey Area.

The only significant record from the Butterfly Conservation was for a small heath butterfly which is a UK Biodiversity Action Plan (UKBAP) priority species. The Tayside Bat Group provided records of Pipistrelle Species within the local area but not within the Survey Area, some records were as recent as 2003.

SEPA provided information on the water quality of the Kerbet Water which is approximately 5.5km downstream of the Survey Area. The Kerbet Water is connected to the Survey Area by the Corbie Burn and the Gallowfauld Burn which flows from the ornamental pond at Nether Finlarg into the Corbie Burn. The Kerbet Water has been classified by SEPA as having an overall ecological status of Moderate under the Water Framework Directive (WFD). The aim of the WFD is to achieve Good status for all Scotland's waterbodies by 2015. The classification given by SEPA is based on the ecological and chemical condition of the watercourse.

A search of the NBN Gateway website returned records of UKBAP and Scottish List species of reptiles, fish, insects, mammals, vascular plants and lichens, as summarised in Table 7-6. Although there were records of the EPS brown long-eared bat *Plecotus auritus* and European otter, in the local area, there were no records within the Survey Area.

Table 7-6: Species Records for OS Grid Square NO44 for 1990-2012

Species	UK BAP	Scottish List	Notes
Amphibians	None	None	
Reptiles	Adder *Vipera berus* Common Lizard *Zootoca vivipara* Slow-worm *Anguis fragilis*	None	General records for all three species.
Fish	Atlantic Salmon Brown/Sea Trout *Salmo trutta* European Eel *Anguilla Anguilla*	Atlantic Salmon European Eel Brook Lamprey	Records of salmon and eel on Kerbet Water in last 20 years. General record for sea trout.
Mammals	Brown Long-eared Bat Eurasian Red Squirrel European Otter	Brown Long-eared Bat Eurasian Red Squirrel European Otter	Several records for red squirrel. Otter records for area in excess of 20 years ago.
Plants	Lesser Butterfly-orchid *Platanthera bifolia*	Scots Pine *Pinus sylvestris* Black-bindweed *Fallopia convolvulus* Bluebell *Hyacinthoides non-*	No details available. Bluebell is also protected in UK legislation under Schedule 8 of the Wildlife

Species	UK BAP	Scottish List	Notes
		scripta Charlock *Sinapis arvensis* Corn Mint *Mentha arvensis* Harebell *Campanula rotundifolia* Heather *Calluna vulgaris* Lesser Butterfly-orchid Narrow-leaved Bitter-cress *Cardamine impatiens* Sun Spurge *Euphorbia helioscopia*	& Countryside Act (1981)
Insects	Small Heath Small Pearl-bordered Fritillary *Boloria selene*		
Lichen	Orange-fruited Elm-lichen *Caloplaca luteoalba*	*Lecania cyrtella* Orange-fruited Elm-lichen *Ramalina fraxinea*	Orange-fruited Elm lichen Inverarity, Douglastown and Kirkton in 1998. No details for the other two.

7.3.4 Survey Results - Habitats and Flora

The habitats present within the Survey Area have been mapped using the Phase 1 classification system and are presented on Figure 7-2, with a full habitat survey report, including target notes and a species list, presented in Appendix 7-1. Additional areas supporting wetland habitats in close proximity to proposed infrastructure were also surveyed using NVC methodology and where possible assigned NVC categories. All wetland areas subject to NVC surveys were limited in expanse but are identified on Figure 7-2 and described in more detail in Appendix 7-1. The following sections give the ecological evaluations of the habitats found within the Survey Area along with brief descriptions, more detailed descriptions of the individual habitats can be found in Appendix 7-2.

Although the original Phase 1 Habitat survey was undertaken in 2012, the proposed layout of the revised wind farm including turbines and ancillary infrastructure is all located with the original Phase 1 Survey Area; furthermore, as stated in section 7.2.8 above, the habitats and farming practices within the site have not changed in the last two years. Therefore, the baseline data from the 2012 surveys represent a robust baseline for the assessment of ecological impacts presented in this chapter of the ES.

Flora

A total of 79 taxa of flora were recorded within the Survey Area (Appendix 7-1). Since surveys were undertaken in March and April 2012 it is possible that some species remained undetected, however, the survey information is considered sufficient to provide confidence that the habitats present have been well documented. No invasive non-native species of flora were recorded. The nature conservation value of the species present is considered to be of negligible nature conservation value.

Grassland and Arable

Cultivated/Disturbed Land - Arable

Just over 50% of the Survey Area was within enclosed arable fields which were being used for crop and silage production. The field margins did support some tall ruderal and scrub species. This habitat would have no intrinsic botanical value although it would have some nature conservation value in that it would provide potential foraging and refuge areas for mammals, reptiles and amphibians. Such habitats are unremarkable and generally widespread and common at lower levels within the local area, as well as the wider area of Tayside. Therefore, this habitat has been assessed to be an ecological receptor of negligible conservation value in terms of non-avian ecology.

Semi-improved – Neutral Grassland

Over 20% of the Survey Area was covered by semi-improved neutral grassland, found mostly on the eastern slopes of Finlarg Hill. These fields were being used for grazing livestock and some of the wetter areas were heavily poached by cattle. Although this habitat could provide potential foraging for mammals such as badgers or refuge for reptiles and small mammals, it has no botanical value and is widespread and common in the local area. Therefore, this habitat has been assessed to be an ecological receptor of negligible conservation value in terms of non-avian ecology.

Improved Grassland

The improved grassland covered almost 16% of the Survey Area and included fields which were used for grazing livestock. This habitat supported a low diversity of common improved grassland species with a few herbs present. As there was a limited variety of species in this habitat and as it was heavily grazed it was considered to be of negligible nature conservation value in the context of this Site.

Semi-improved – Acid Grassland

Located to the northwest of the Survey Area were two areas of semi-improved acid grassland covering just under 2% of the Survey Area. This habitat was dominated by mosses and grasses. It was limited in its extent and of low botanical interest but could provide limited foraging for mammals and reptiles, therefore, was considered to be an ecological receptor of less than local conservation value.

Cultivated/Disturbed Land – Amenity Grassland

There was one small area of amenity grassland at Nether Finlarg which was planted with a mix of grass species. This was a very small area in relation to the whole Survey Area and was of very low botanical interest so was considered to be of negligible nature conservation value in the context of this Site.

Marshy Grassland

There were six small areas of marshy grassland which had a limited variety of species and were small in their extent within the Survey Area so were of low botanical interest, although they could provide foraging and refuge for mammals and reptiles. These areas were considered to be of negligible nature conservation value in the context of this Site.

Woodland

Coniferous Woodland

Within the Survey Area there were three small coniferous plantations and one very small area of scattered conifers. The dominant species within these plantations was Sitka spruce *Picea sitchensis*, with some lodgepole pine *Pinus contorta*, Scots pine *Pinus sylvestris* and Japanese larch *Larix kaempferi*. These were mature plantations and were densely planted, so had very little vegetation cover in the understorey, other than around the edges or along pathways where there was semi-improved neutral grassland and ruderal species. This habitat was assessed to be of little botanical interest although it may support habitat for red squirrels. Additional isolated small areas of coniferous woodland were present within the Survey Area, but these were all very limited in extent. In close proximity to the Survey Area are larger more ecologically diverse coniferous woodland habitats, including some registered on the Ancient Woodland Inventory.

The coniferous woodland is assessed as being an ecological receptor of less than local conservation value as it may support other species including potentially red squirrel.

Broadleaved Woodland

Small areas of broadleaved plantation woodland are present within the Survey Area, particularly around the residential properties. In addition there were a number of scattered deciduous trees throughout the Survey Area, mostly along field boundaries and track edges. A good variety of trees in this habitat type included penduncalate oak *Quercus robur*, ash *Fraxinus excelsior*, beech *Fagus sylvatica* and sycamore *Acer pseudoplatanus* and ranging in age from young to very mature. Generally the canopy layer was open so the ground flora was varied, mostly composed of grasses but also other species such as snow drops *Galanthus nivalis*, bracken *Pteridium aquilinum*, bramble *Rubus fruticosus* and rosebay willowherb *Chamerion angustifolium*. Although these pockets of broadleaved woodland are small and planted with some non-native species, they are varied so provide some botanical interest and also offer shelter and foraging for mammals, particularly roosting bats and badgers, invertebrates and birds. Consequently this habitat is considered to be of less than local nature conservation value.

Mixed Woodland

Around the farms and houses and along field boundaries were areas of mixed woodland with a ground flora which was a mix of grass and ruderal species or shrubs. More ornamental species such as eucalyptus *Eucalyptus species* and Lawsons cypress *Chamaecyparis lawsoniana* could be found around the houses and farms. The variety of food sources and refuge places available within this habitat could provide good habitat for species such as badgers, bats and other small mammals. As such this habitat was considered to be of less than local nature conservation value.

Other Habitats

Scrub – Continuous and Scattered

Throughout the Survey Area there was scattered scrub, consisting of gorse *Ulex europaeus*, mostly individual bushes along ditches and field margins, although the main area of scattered scrub was found on the slopes of Finlarg Hill. A small area of continuous scrub of blackthorn *Prunus spinosa* was found in a corner of a field next to Tarbrax Wood in the south of the Survey Area.

Although this habitat offers some potential to provide cover for mammals, reptiles, birds, amphibians and invertebrates these areas are assessed to be of negligible nature conservation value.

Bracken - Scattered

There were two areas of scattered bracken *Pteridium aquilinum* which were found on Finlarg Hill. Although these areas could provide temporary cover for mammals, reptiles, birds, amphibians and invertebrates they are of little botanical interest so are assessed to be of negligible nature conservation value.

Tall Ruderal

The main area of tall ruderal habitat which was dominated by rosebay willowherb was found on the banks of the small burn to the north of the Survey Area. This type of habitat could also be found around the field margins. This habitat had limited botanical interest although it could provide cover for mammals, reptiles, birds, amphibians and invertebrates it covered a small (<0.1%) part of the Survey Area, as such it is considered to be of negligible nature conservation value.

Buildings

Within the Survey Area there were two clusters of buildings at Over Finlarg and Nether Finlarg with two further cottages to the south of Over Finlarg Farm. These comprised of a variety of domestic and agricultural buildings both old and new. Over Finlarg Farm included three houses, two of which were built of stone with slate roofs and a third built of harled brick and slate roof. The farm buildings were a variety of old stone built and newer open walled metal structures. Nether Finlarg was very similar with a mix of domestic and agricultural buildings, old and new.

As there was no botanical interest or suitable habitat for fauna around the buildings other than potentially for roosting bats; the buildings and associated ground, was considered to be of less than local nature conservation value in relation to the Survey Area.

Boundaries

The field boundaries were mostly a mix of old stone walls and wire and post fences, with both present on occasions. There were one or two boundaries with hedges and these were generally of hawthorn *Crataegus monogyna*. These would not offer great potential for protected species other than commuting bats or small birds or mammals. As this habitat did not support any valuable flora or fauna it was considered to be of negligible nature conservation value in relation to the Survey Area.

Quarry

An area below one of the coniferous plantations to the north of the Survey Area had been used for extracting stone. This area was bare ground and would not offer any habitat for protected species. As this habitat did not support any valuable flora or fauna it was considered to be of negligible nature conservation value in relation to the Survey Area.

Marginal Vegetation

A small area of marginal vegetation was evident close to Q3 (Figure 7-2). This was a wet area where possibly the field drain had collapsed and a wet channel had formed. This was a very small area and possibly ephemeral in nature so would not provide suitable habitat for any protected species or support botanical species of interest so this habitat was considered to be an ecological receptor of negligible conservation value.

Bare Ground and Tracks

There were small areas of bare ground associated with the sheep wash pens and the areas around the farm buildings. All of the tracks in the Survey Area are rough gravel tracks. This habitat is of no interest botanically and of very limited suitability for faunal species, therefore, it was considered to be an ecological receptor of negligible conservation value.

Groundwater Dependent Terrestrial Ecosystems

A number of small areas were identified as supporting wetland habitats which had potential vegetation assemblages which may be associated with groundwater. From the NVC surveys (Appendix 7-1) these areas were assessed both in terms of their botanical community and the hydrological regime present. In all cases it was assessed that these small areas were not dependent on groundwater systems despite the habitats present falling into categories of moderate and high groundwater dependence. It is assessed that they don't confirm groundwater dependency because the extensive network of artificial drains associated with the agricultural landscape have created wet areas where drains had collapsed or surface drainage had collected. This is confirmed by the results from the hydrology survey (Chapter 9) which states that the water on the Site is mostly surface water and that the groundwater is located deeper down. As a result the areas of potential groundwater dependent terrestrial ecosystems were assessed to be ecological receptors of negligible nature conservation interest.

Aquatic Habitats

Standing Water

There were four areas of standing water within the Survey Area, all of which were artificial to some degree. These ponds were within an intensely farmed area with large areas of ploughed arable land and a surrounding habitat which was relatively open.

These ponds and the land immediately surrounding them would provide some botanical interest and some variety in the context of the local area but they would provide limited habitat for faunal species such as great crested newts *Triturus cristatus* as such this habitat is considered to be of less than local nature conservation value.

Running Water

Most of the ditches within the Survey Area were overgrown with tall ruderal vegetation and many of these ditches had been diverted through culverted pipes forming field drainage networks and only a short section supported any standing or flowing water at the time of the survey.

There was also a small burn which ran from the lined pond to the east for approximately 200m and then became culverted through a field drain. This was approximately 0.5m wide and 0.5m deep with immediately adjacent habitat dominated by tall herb species. It is considered very unlikely that the culverted drainage system and associated ditches and burns within the Survey Area supported any fish or invertebrate species of nature conservation value and as such are assessed to be of less than local conservation value.

7.3.5 Survey Results - Bats

Bat surveys were undertaken by a team of suitably experienced ecologists across the Site during 2012 (between March and late August). Three types of survey methodologies were undertaken at the Site: roost assessments, activity transects and static recording. Full details of the methodological approach are presented in Appendices 7-2 and 7-3. The surveys were undertaken on the basis of a five turbine layout (Application 13/00532/EIAL) which was consented in February 2014. Under this application Turbine 5 has been removed and the tip height of the turbines has been increased to 92.5m. As the Bat Technical Appendices have not been altered to reflect these changes, they will be discussed in the relevant section of this chapter.

The surveys undertaken in July and August 2012 are reported in Appendix 7-3 to complete the required surveys to meet recently introduced guidance published by the Bat Conservation Trust (Hundt, L. 2012) and agreed by SNH (email to Atmos Consulting from Mark Moore, SNH 14th March 2012) and Angus Council (meeting 12th March 2012). The original application for the Frawney Wind Farm (ref: 12/00577/EIAL) was submitted prior to completion of these additional bat surveys and, therefore, were presented as supplementary information in September 2012. This report now forms Appendix 7-3 of this ES.

It should be noted that four of the static recording locations (Figure 7-3, T1-T4) were at the originally proposed turbine locations of layout d (Figure 3-1 Site Design Iterations A), as applied for in application 12/00577/EIAL. This application was subsequently withdrawn and a new planning application 13/00532/EIAL for five turbines was consented in February 2014 layout h (Figure 3-1 Site Design Iterations B). Under this current application (Figure 3-2 Site Layout) the layout of the turbines remains the same as in the consented application but with the removal of Turbine 5.

As the turbines remain in locations which are not used extensively by bats and the coverage of the surveys is adequate for the revised layout, the surveys carried out in 2012 would remain valid. Although the surveys carried out in 2012 are now almost two years old, the level of bat activity recorded is not sufficient to warrant additional surveys.

Habitat Assessment

The Site was dominated by relatively open and intensive agriculture with a land use dominance of improved pasture and arable fields. A number of habitats such as small ponds, woodland copses and shelter belts and sheltered environments around farm buildings offered some suitability for bats. However, the majority of these were isolated features with a lack of good connectivity between each other or the wider landscape,

Field boundaries across the Survey Area were generally formed by post and wire fences or stone walls with no significant field margins offering suitable foraging habitat or navigational features.

Throughout the Survey Area a number of buildings, primarily residential and agricultural were present which offered an array of suitable roosting locations. In addition a number of mature trees with features capable of supporting roosting bats were also present (Appendix 7-2).

Roost Assessments

The roost assessments identified a number of suitable structures and trees that were capable of supporting roosting bats.

Nether Finlarg was dominated by large modern agricultural and light industrial buildings and as such offered few opportunities for roosting bats overall. Over Finlarg Farm included a number of older farm buildings (in particular the central stone farm buildings and farmhouse) which offered suitable roosting opportunities.

To the north of Nether Finlarg was an avenue of mature beech trees, the majority of which had suitable roosting opportunities for bats and it was possible that a number of these trees were used for roosting although no definitive evidence to confirm this was identified by roost inspections.

Within the Over Finlarg Farm a number of trees offering good opportunities for roosting bats were also identified. These were primarily trees located north and east of the Old Farmhouse, although a single tree located west of the farmhouse also offered significant potential for supporting roosting bats.

During the roost assessment surveys not all of the suitable features could be fully accessed to undertake internal inspections using an endoscope and torches due to the height of the feature or lack of access to buildings. Inspections (undertaken where possible) did not identify any definitive evidence to suggest the features were used as roosts at the time of the survey.

Due to the lack of connectivity to the majority of the potential roost locations and general lack of suitable foraging areas, the ‘attractiveness’ of these features to bats may be somewhat reduced. It should be recognised that bats are transient species in many situations and roosts may only be used by a small number of bats on a sporadic basis. This is particularly likely where large maternity roosts are present within the wider landscape and smaller roosts of males are often located away from the main maternity roosts.

Activity Transects

During the April 2012 activity transect only a single bat pass was recorded during the two transect surveys. This identifies extremely low activity levels (0.2 bat passes per hour) across the Survey Area with no activity of bats within 500m of any proposed infrastructure.

During the dusk and dawn transects undertaken in July 2012 a total of 15 common pipistrelle and 34 soprano pipistrelle *Pipistrellus pygmaeus* bat passes were recorded across the northern transect with only a single pipistrelle pass from the southern transect during the dawn survey. A total of 49 bat passes recorded during the southern transect in August 2012, although no records within the northern transect were recorded.

The surveys during July and August 2012 increased the species richness of the Site to at least three species. In addition a single call could not confidently be assigned to any species, but was confirmed as a bat.

Static Recorders

The static detectors also recorded very low activity during the period of deployment in April with a total of only two soprano pipistrelle *Pipistrellus pygmaeus* passes at Static

Location H2 (along avenue of beech trees). This results in an extremely low activity rate of 0.05 bat passes per hour at this location. No activity was detected at any of the monitored proposed turbine locations (Figure 3-1 Site Design Iterations A; layout d as proposed in application 12/00577/EIAL).

During July and August 2012 increased levels of activity were noted with moderate levels recorded during August.

However, taking all months into account levels across the site remained low. Activity across static locations was not uniform with static locations at habitat locations suitable for bats (e.g. woodland edges, farm buildings, hedges etc.) supporting far greater activity than at more open locations. Species richness on Site based on static detector data was dominated by common pipistrelle and soprano pipistrelle with nine passes of *Myotis* species and a single pass of an unidentified bat making up the remainder of the records.

Summary

The spring bat survey monitoring visit recorded extremely low levels of bat activity with only two species present: common pipistrelle *Pipistrellus pipistrellus* and soprano pipistrelle and a total of three passes from two transects and five nights static monitoring. The additional surveys undertaken in July and August 2012 in order to meet current guidance identified a greater level of bat activity across the Survey Area than had been identified during the April 2012 surveys.

Both common pipistrelle and soprano pipistrelle are generally widely distributed throughout Scotland. Pipistrelle bats are identified as being of medium risk from wind turbines at the species level but at low risk at the population level (Natural England, 2009). Consequently, the nature conservation value assigned to bats as part of this assessment is local. For much of the Site, however, where the habitats are open and relatively exposed with limited foraging potential, the value is more likely to be negligible.

7.3.6 Survey Results - Otter

Otter have been recorded from virtually all types of water and waterways in the UK, including rivers and streams of all sizes, and will use smaller watercourses, including dry watercourses, as commuting routes or as foraging habitat.

In April 2012 an otter survey of the Survey Area was undertaken to determine the extent and suitability of habitat present within the Site and to identify the presence of any signs of otter. The survey methodology was in accordance with the approach detailed in the SNH 'Otters and Development' guidance document (SNH, 2010). During the walkover survey, a thorough check for otter resting places i.e. holts (dens) or couches (above ground resting places) was undertaken by an ecologist experienced in otter survey. The following field signs were sought, with those which can be regarded as definitive, i.e. they provide certain confirmation of the presence of this species, marked with an asterisk. Field signs sought included:

- Otter spraint (faeces)*;
- Otter holt (den);
- Footprint*;
- Couch (resting place above ground); and

- Pathways and slides into water.

No signs of otter activity were observed within the Survey Area. The watercourses surveyed were predominantly minor drains along field boundaries, set within predominantly very narrow field margins or buffer strips. The quantity of water present within these drains varied but non supported substantial quantities of water.

Two small sections of consistently flowing watercourses were present within the Survey area: the Gallowfauld Burn to the east of the Site fed by a small pond within the grounds of Nether Finlarg Farm; and the 200m section of ditch leading from the small reservoir in the north of the Site which ultimately then runs through culverted drainage ditches.

These sections were very limited in size and suitability for use by otter and combined with the majority of other ditches being unsuitable to support fish populations or other food sources for otter, the Site is assessed to be sub-optimal habitat for otter.

Despite thorough searches, no signs of otter were identified during the surveys. It is not certain that otter will always be absent from the Site although it is considered that any presence of otter will be on an extremely sporadic basis and the Site is very unlikely to form part of any established otter territory.

Therefore, the conservation value for otter has been assessed to be of negligible nature conservation value within the Site.

7.3.7 Survey Results - Great Crested Newt

Two water bodies were present within the Survey Area: a small lined reservoir used for private water supply located in the north of the Survey Area and an ornamental pond located within the grounds of Nether Finlarg. The latter of these forms the collection source for Gallowfauld Burn which flows offsite to the east.

Both ponds offered low to moderate suitability for great crested newts although it should be noted that consultation with SNH confirmed that Angus does not support great crested newt populations and as such it is unlikely that great crested newts would be present within these ponds. As such presence/absence surveys for the species were not undertaken and the species was assessed to be absent from the Site. As a result this species is not considered further in this ecological assessment.

7.3.8 Survey Results - Wildcat

There are no recent records (within last 20 years) of wildcat in the local area and their distribution is more concentrated across the Highlands and Aberdeenshire. However the habitat within the Survey Area could be considered to offer some suitability for the species. As the majority of the Survey Area is open farmland den sites would be unlikely, however, woodland habitats outwith the Survey Area may offer some suitability. Signs of rabbits (wildcats main prey item) were also absent from the Site. As a result this species is not considered further in this ecological assessment.

7.3.9 Survey Results - Water Vole

Surveys for water vole were conducted in April 2012 across the Survey Area. The survey work was undertaken on methodology adapted from the 'Water vole conservation handbook' (Strachan and Moorhouse, 2006) with additional reference to recent publications (e.g. Ryland and Kemp, 2009). Active searches were conducted for water vole sign, including:

- Droppings;
- Burrows;
- Latrines;
- Feeding stations;
- Lawns; and
- Footprints and pathways.

As identified within the otter survey results, the watercourses surveyed were predominantly minor drains along field boundaries, set within a narrow field margin dominated by tall improved grassland or marshy grassland. Many of the drains were dry at the time of the survey and an extensive network of culverted drains is also known to be present although the location of these drains is unknown. Almost all drains were considered to be sub-optimal habitat for water vole due to the low to negligible water levels present, despite other suitable habitat for water vole such as earth banks for burrowing and vegetation for sources of food. In addition many of the drains were in the process of being cleared through mechanical excavation and although in the long run may provide improved water vole habitat, at the time of the survey newly excavated drains were unsuitable for supporting the species. The only good quality section of habitat was the short (200m) section of running water with tall herb and grassland dominated banks running from the reservoir in the north of the site. From the surveys no evidence of water vole was found along the any of these drains.

The lack of any conclusive evidence such as latrines or extensive networks of burrows of appropriate size and structure suggests that the watercourses on the Site presently do not support water vole populations. As a result this species is not considered further in this ecological assessment.

7.3.10 Survey Results - Badger

A badger survey was undertaken during March 2012 by a suitably experienced ecologist. The entire Survey Area was surveyed although effort was concentrated on identifying signs of badgers (especially setts) within 250m of proposed site infrastructure. The survey comprised a search for setts and other signs of badger activity, e.g. latrines, dung pits, pathways and foraging signs.

The Survey Area was dominated by a mixture of arable and pasture farmland with sections of woodland and connecting field boundaries which offers suitable habitat for foraging and denning badgers. The sloping land within the west of the Survey Area combined with small river valleys and woodland plantations also offer potential areas for sett construction. However, no evidence of badger activity in terms of setts, latrines or tracks was found within 250m of proposed infrastructure or across the wider Survey Area.

Although suitable habitat is present, the lack of field signs suggests that badger activity is very low or absent across the Site and no active setts are presently located within 250m of the proposed site infrastructure.

Although protected under the Protection of Badgers Act 1992, this protection is afforded the badger due to persecution rather than conservation status. Badgers are common throughout Scotland. As such, the badger population within the Survey Area is considered to have a less than local nature conservation value although it should be noted that were active badger setts confirmed at the time of construction, appropriate mitigation measures may be required to prevent disturbance or to avoid another breach of relevant legislation.

7.3.11 Survey Results - Red Squirrel

Red squirrel have been recorded in the local area, however, only very small pockets of suitable habitat were present within the Survey Area with larger suitable areas present immediately adjacent to the Site. Several sections of potentially suitable coniferous and mixed woodland were located around Nether Finlarg Farm. These areas of woodland were relatively isolated and unlikely to be large enough to support a self-sustaining squirrel population. Additional larger isolated areas of coniferous plantation were located within the northwest of the Survey Area covering approximately 2.9ha to 4.8ha each.

The suitability of these sections of woodland was generally low with sections of wind throw and areas of more open grassland. The trees were mature and cone production was assessed to be moderate for the age of plantation. Although a small number of cones with feeding damage were identified these could not be assigned to that of red squirrel as no other field signs such as hair (identifiable under a microscope) or sightings of individuals occurred. As recent records of red squirrel are present within the Site (NBN Gateway) it is likely that a small number of individuals could be present within these isolated blocks of forestry. Based upon these findings and in the absence of additional data it is assumed that red squirrel are present within the Survey Area but only very limited habitat is present within the Site, despite a record of the species from 2010. As a result red squirrel is assessed to be of less than local nature conservation value within the context of this Site.

7.3.12 Survey Results - Pine Marten

There are no recent records of pine marten in the local area and their distribution is more concentrated in the Highlands of Scotland. The habitat within the Site is considered to be sub-optimal for this species as it is open farmland. Sections of woodland within the Survey Area and wider area may offer some suitability but taking into account the general distribution of the species the presence of populations adjacent to the Site are thought to be unlikely. As a result this species is not considered further in this ecological assessment.

7.3.13 Survey Results - Reptiles

There are no recent records of any reptile species (last 20 years) in the local area. Despite this there were a number of areas that offer some degree of suitability for reptiles, primarily common lizard including a number of drystone walls and sections of field margins or small enclosures, where grasslands was more undisturbed by farming practices and grazing livestock. In addition the ditches and hedges offered suitable commuting and foraging routes along with tracks and periphery of short grazed grassland offering basking opportunities. The rough grassland within the west of the site bordering moorland habitats outwith the Site to the west may also offer some suitability for basking and foraging reptiles.

Despite all ecological and ornithological surveys being carried out within the active period for reptiles (April-September) no reptiles were observed at any location within the Site. However, it is recognised that herpetofauna is generally under recorded across Scotland and as a result of suitable habitat areas and records from the wider landscape, in the context of this Site it is considered that reptiles are of less than local nature conservation value.

7.3.14 Survey Results - Aquatic Ecology

No surveys for aquatic ecology were undertaken as part of the EcIA due to the distance to receiving water courses. Although the Survey Area supports a number of small areas of open water and sections of ditches and burns, the extent and impact of ongoing agricultural activities combined with the isolation of the majority of these areas due to extensive culverting suggest that the presence of species of conservation concern such as salmonids and lamprey are extremely unlikely. As a result the aquatic ecology of the Site is not considered further in this ecological assessment.

7.3.15 Summary of Ecological Evaluation

Table 7-7 summarises the key ecological receptors, their conservation importance, status on the Site and the determined receptor value.

Table 7-7: Summary of Values of Key Ecological Receptors

Receptor	Conservation Importance	Site Status	Ecological Receptor Value
Statutory and Non-Statutory Designated Sites			
River Tay SAC	International	2.8km to northeast of the Site.	International
Carrot Hill Meadow SSSI	National	4.5km to the east of the Site.	National
Gagie Marsh SSSI	National	4.5km to the southeast of the Site.	National
Auchterhouse Hill SSSI	National	5km to the west of the Site.	National
Whitehouse Den SSSI	National	1.5km to the southeast of the Site.	National
Whitehouse Den Local Wildlife Site	Local	1.5km to the southeast of the Site.	Local
Brighty Wood Local Wildlife Site	Local	4.5km to the southeast of the Site.	Local
Shielhill Local Wildlife Site	Local	4.6km to the southeast of the Site.	Local
Habitats			
Grassland			
Cultivated/disturbed land – arable	Local	Widespread across the Survey Area.	Negligible
Semi-improved – Neutral grassland	Local	Widespread across the northwest of the Survey Area.	Negligible
Semi-improved – Acid grassland	Local	Confined to two areas in the northwest of the Survey Area.	Less than local
Improved grassland	Local	Widespread across the Survey Area.	Negligible

Receptor	Conservation Importance	Site Status	Ecological Receptor Value
Cultivated/disturbed land - amenity grassland	Local	Very small area in garden at Nether Finlarg.	Negligible
Marsh/marshy grassland	Local	Confined to small patches in a few locations across the Survey Area.	Negligible
Woodland			
Coniferous	Less than local	Widespread across the Survey Area in plantations, shelter belts and as scattered trees.	Less than local
Broadleaved	Local	Mostly confined to around the two farms with some scattered trees across the southern part of the Survey Area.	Less than local
Mixed	Less than local	Mostly confined to around the two farms	Less than local
Other Habitats			
Scrub	Less than local	Larger areas on Finlarg Hill, small patches along field margins/corners.	Negligible
Bracken	Less than local	Confined to two small patches on Finlarg Hill.	Negligible
Tall ruderal	Less than local	Confined to one area around the northern pond.	Negligible
Buildings	Local	Two farms at Over Finlarg and Nether Finlarg.	Less than local
Boundaries	Local	Relevant to all field boundaries across the Survey Area.	Negligible
Quarry	Less than local	One small area to the north of the Survey Area.	Negligible
Marginal vegetation	Less than local	One very small area.	Negligible
Bare ground and tracks	Local	Spread across the Survey Area.	Negligible
GWDTEs	Local	A couple of small areas.	Negligible
Aquatic Habitats			
Standing water	Local	Confined to three ponds.	Less than local
Running water	Local	One small burn and a small number of wet ditches.	Less than local
Species			
Bats	International	Very low numbers using the Site in April; numbers increased through July and August. No evidence of roosts although suitable features are frequent across the Survey Area.	Local
Otter	International	No evidence of species being present and only very limited suitable foraging habitat.	Not considered further
Great crested newt	International	Considered to be absent from the Site based on lack of species records in Angus.	Not considered further

Receptor	Conservation Importance	Site Status	Ecological Receptor Value
Wildcat	International	Considered to be absent from the Site based on lack of recent species records in Angus.	Not considered further
Water vole	National	Only very limited and isolated suitable habitat with no signs of the species being present.	Not considered further
Badger	National	Good quality foraging habitat with sett building opportunities but lack of field signs and no sett present within Survey Area.	Less than local
Red squirrel	National	Some isolated and limited patches of suitable habitat with possible field signs although presence of species is not confirmed.	Less than local
Pine marten	National	Limited habitat and no signs of the species being present within the Survey Area.	Not considered further
Reptiles	National	Some areas of suitable habitat including hibernacular but no sightings and disturbance from agricultural activities likely to restrict distribution.	Less than local

7.4 Construction Impacts

Details of the Site infrastructure and construction methods are presented in Chapter 3. Construction activities are limited in their spatial and temporal extent with many of the impacts considered generic in nature and are typically associated with a development of this nature. Impacts on receptors are not limited to a single effect and may potentially be affected by a number of effects noted in Table 7-8. Impacts that are arising only during the construction phase are considered to be temporary with estimated construction taking approximately nine months. The impacts of decommissioning are difficult to predict, but are likely to be of a lesser magnitude and duration than the construction impacts.

Due to the distances between the Site and any nearby statutory and non-statutory designated sites, impacts as a result of construction activity on these sites are not expected. Table 7-8 provides a summary of the generic impacts on habitats and species expected within the construction phase of a small wind energy scheme.

Table 7-8: Generic Impacts of the Construction Phase on Habitats and Species

Generic Impacts	Effects on Habitat Features/Species on Site
Direct habitat loss	Construction of access track, turbine base, crane hardstanding, site compound and substation within undeveloped habitats would result in direct habitat loss. The maximum construction footprint of the proposed development is predicted to be 3.3ha (0.71%), including areas of existing track to be upgraded. This includes areas of permanent habitat loss associated with the turbine bases and access tracks and areas of temporary habitat loss, at the margins and in areas to be reinstated following construction. Impacts are reduced to some degree by maximising the use of

Generic Impacts	Effects on Habitat Features/Species on Site
	existing tracks.
Fragmentation of habitat areas	Direct habitat loss may result in habitat fragmentation due to the placement of a barrier, such as an access road bisecting habitat areas and potentially creating a barrier to the movement of species recorded present and affecting the integrity of the habitat.
Damage and disturbance to habitats and species	The construction of the proposed development has the potential to cause temporary damage and disturbance to nearby habitats and species for the duration of the works, as a direct result of activities such as vehicle movements and noise.
Displacement of species	The construction phase has the potential to displace species. During construction, the impacts will be primarily terrestrial, causing habitat loss and deterring species from entering the area.
Hydrological damage	The construction of the wind farm has the potential to cause direct hydrological damage. Although the watercourses on site already suffer from some degree of impact from agricultural activities additional impacts within this scheme from crossing of ditches or drains may result in surface run-off facilitating the transfer of sediments and other potential pollutants into the watercourse.
Dust deposition on sensitive habitats or sedimentation	During construction, the excavation works have the potential to cause additional dust deposition or sedimentation, which may affect sensitive habitats nearby (if any), depending in the direction of the prevailing winds and presence of watercourses /waterbodies and other sensitive habitats.
Light pollution of habitats used by species	The construction of the wind turbines may involve additional lighting such as around the site compound which could alter the behaviour of nocturnal species.

The impacts of the development on the ecological receptors; flora, fauna and habitats which have been valued as being of nature conservation value in the preceding section of this chapter are assessed in terms of their impact magnitude and overall impact significance using the matrices as detailed in Table 7-3 and Table 7-4.

7.4.1 Predicted Impact - Designated Sites

Due to the distance between the River Tay SAC (5.5km along watercourses) and taking into account existing pressure from present land use within the Site and wider landscape (including a variety of potential diffuse and point source pollution sources) no impact is anticipated assuming that standard construction techniques and precautions employed during wind farm construction are undertaken.

Whitehouse Den, Carrot Hill Meadow, Gagie Marsh and Auchterhouse Hill SSSI's are all situated at least 1.5km from the Site and are designated for their habitats and flora or geology as in the case of Whitehouse Den. Therefore due to the distance from the Site and designated features of these SSSI's this development is unlikely to have any impact on these SSSI's.

The Wildlife sites at Whitehouse Den, Brighty Wood and Shielhill are also at least 1.5km from the Site so this development is unlikely to have any impact on them.

This current application for a revised scheme would not change the predicted impact on the designated sites mentioned above.

7.4.2 Predicted Impact - Habitats

Predicted construction impacts on ecological receptors include the direct habitat loss from construction of infrastructure and temporary habitat disturbance associated with the construction footprint of the proposed development. The proposed infrastructure will result in permanent land take of 1.8ha with an additional 3.3ha temporarily lost during construction. Table 7-9 details the area of land take associated with site infrastructure with Table 7-10 showing the predicted habitat loss of habitat types within the Survey Area.

The calculations of habitat loss are based on the layout and dimensions of the wind farm components described in Chapter 3, which have then been used in GIS to apply 'infrastructure buffers' to calculate the appropriate areas of each habitat to be lost.

For the turbines, the permanent habitat loss has been calculated using a square footprint around the base of each turbine location of 15.5m to include all of the concrete foundation; the temporary habitat loss arising from the adjacent working area was calculated by extending the radius of the circular footprint by 5m.

Habitat loss associated with new access tracks was based on a permanent buffer 5m wide (2.5m either side of the track centre line) and a temporary buffer 10m wide (5m either side of the track).

Other infrastructure features such as areas of hardstanding, site compound, substation and the met mast were calculated based on the footprint of each structure as provided in the design layout. For each of these features a temporary working area extending to 5m beyond each feature was used to calculate the extent of temporary habitat loss.

For all the infrastructure features associated with the proposed development, the amount of habitat loss calculated is based on the proposed dimensions of the features, and provides an indicative assessment of the impact of the habitat loss likely to result from the construction of the proposed development.

Table 7-9: Area of Land Take Associated with Site Infrastructure and Temporary Buffers

Site Infrastructure	Permanent		Temporary	
	Area (ha)	% of Survey Area	Area (ha)	% of Survey Area
Turbine Foundation (15.5m x 15.5m, temporary 5m buffer)	0.096	0.02	0.13	0.03
Crane hardstanding (22m x 36m, temporary 5m buffer)	0.315	0.07	0.132	0.03
Onsite access track (new) (1,640m long and 5m wide, temporary 5m buffer)	0.707	0.15	1.333	0.29
Onsite access track (upgraded) (1,385m long and 5m wide, temporary 5m buffer)	0.691	0.15	1.371	0.30
Control building (4m x 8m, temporary 5m buffer)	0.003	<0.01	0.008	<0.01
Substation (4m x 4m, temporary 5m buffer)	0.002	<0.01	0.010	<0.01

Site Infrastructure	Permanent		Temporary	
	Area (ha)	% of Survey Area	Area (ha)	% of Survey Area
Met Mast (3m x 3m, temporary 5m buffer	<0.001	<0.01	0.011	<0.01
Construction compound (temporary 5m buffer)	N/A	N/A	0.287	0.06
Total	**1.81**	**0.39**	**3.28**	**0.71**

Table 7-10: Predicted Habitat Loss of Habitat Types Present in Survey Area

Habitat	Total Present in Survey Area (ha)	Permanent		Temporary	
		Area (ha)	% of Survey Area	Area (ha)	% of Survey Area
Grassland					
Cultivated/disturbed land - arable	251.50	0.63	0.14	1.97	0.42
Semi-improved Neutral grassland	99.07	0.00	0.00	0.00	0.00
Semi-improved Acid grassland	8.44	0.00	0.00	0.00	0.00
Improved grassland	73.85	0.68	0.15	0.97	0.21
Amenity grassland	0.31	0.00	0.00	0.00	0.00
Marsh/marshy grassland	1.83	<0.01	<0.01	0.02	<0.01
Woodland					
Coniferous woodland - plantation	8.59	0.02	0.01	0.22	0.05
Coniferous woodland – scattered trees	0.14	0.00	0.00	0.00	0.00
Broadleaved woodland - plantation	0.77	0.00	0.00	0.00	0.00
Mixed woodland - plantation	6.71	0.00	0.00	0.00	0.00
Mixed woodland – scattered trees	0.09	0.00	0.00	0.00	0.00
Other Habitat					
Scrub - scattered	4.50	0.00	0.00	0.00	0.00
Scrub - continuous	0.36	0.00	0.00	0.00	0.00
Bracken - scattered	1.52	0.00	0.00	0.00	0.00
Tall ruderal	0.35	0.00	0.00	0.00	0.00
Buildings	1.01	0.00	0.00	0.00	0.00
Boundaries/other habitat	0.07	0.00	0.00	0.00	0.00
Quarry	0.08	0.00	0.00	0.00	0.00
Marginal and inundation - marginal vegetation	0.05	0.00	0.00	0.00	0.00
Bare ground	2.09	<0.01	0.00	0.06	0.01
Track	2.14	0.48	0.10	0.04	0.01
Aquatic habitat					

Habitat	Total Present in Survey Area (ha)	Permanent		Temporary	
		Area (ha)	% of Survey Area	Area (ha)	% of Survey Area
Standing water	0.16	0.00	0.00	0.00	0.00
Running water	0.00	0.00	0.00	0.00	0.00
Total	**463.63**	**1.81**	**0.44**	**3.28**	**0.71**

Total land take during construction is estimated at 3.28ha or 0.71% of the total Survey Area. The main habitats affected by the construction of the wind farm would be arable land and improved grassland with very small areas of marshy grassland, coniferous plantation and existing farm tracks being used.

Habitats that remain unaffected by the proposed development will consequently be subject to no significant impacts.

Compared to the consented application this application would result in a decrease in both the permanent and temporary landtake and the increase in height of the four turbines would have no effect on the predicted habitat loss so there would be no further effect on the predicted impact on the habitats. .

Grassland and Arable

Cultivated/Disturbed Land - Arable

The greatest habitat lost during the construction of the proposed development infrastructure including the access track, turbines and construction compound would be to this habitat, 0.63ha permanent and 1.97ha temporary habitat loss. As this habitat offers negligible conservation value the magnitude of the construction impact is expected to be barely perceptible resulting in no significant impact.

The removal of Turbine 5 would result in a reduction in the permanent and temporary loss of this habitat type compared to the previously consented scheme and the increase in height of the four proposed turbines would have no effect on this habitat.

Improved Grassland

During construction this habitat would be affected by land take for the access track, turbines and substation with 0.68ha permanently lost and 0.97ha lost temporarily. However, as this habitat is of negligible nature conservation value the magnitude of impact is expected to be barely perceptible resulting in no significant impact.

The removal of Turbine 5 would result in a reduction in the permanent and temporary loss of this habitat type compared to the previously consented scheme and the increase in height of the four proposed turbines would have no effect on this habitat.

Marshy Grassland

There would be only one small area of this habitat affected by the construction of the access track, 0.02ha being lost temporarily and <0.01ha being lost permanently. As this habitat is considered to be of negligible nature conservation value the magnitude of impact is expected to be barely perceptible resulting in no significant impact.

Woodland

Coniferous Woodland - Plantation

Only a very small area, 0.22ha, of this habitat is predicted to be lost to the construction of the access track. As this habitat is considered to be of less than local nature conservation value the magnitude of impact is expected to be barely perceptible resulting in no significant impact.

Aquatic Habitats

Running Water

There will be no loss of running water as part of the proposed development. Development of the design now avoids the need for any watercourse crossings and, therefore, no impacts will result.

Other Habitats

Boundaries

The boundary features include stone walls and post and wire fences, as well as a few species poor hedges. They were assessed to be of negligible nature conservation due to the fact that they would provide only limited habitat for species such as bats, birds and reptiles. Some small sections of these features will have to be removed to construct the access track. This would result in a barely perceptible magnitude impact since on a small scale and is considered to result in no significant impact on these features.

Track

The current farm track will be upgraded as well as new track being laid as part of the construction of this development. Total track land take (including upgrade) will be 0.48ha with an additional temporary loss of 0.04ha due to disturbance. Since this habitat is already well used for farm vehicles the effects are considered to be of negligible nature conservation value and the magnitude of impact is expected to be barely perceptible resulting in no significant impact.

7.4.3 Predicted Impacts - Groundwater Dependent Terrestrial Ecosystems

Two areas were identified as supporting habitats that could potentially be GWDTEs, although in this case the areas were not considered to be dependent on groundwater within this setting and, therefore, were assessed to be an ecological receptor of negligible nature conservation interest in terms of their botanical assemblage. One of these areas is the marshy grassland around the sheep dipping area. This area will be slightly affected by the construction of the access track but since the area of land take will be very small (0.02ha temporarily lost) the impact magnitude would be barely perceptible on this ecological receptor of negligible value and would result in no significant impact.

It is concluded that the nature and magnitude of the predicted impacts associated with the revised scheme would not be materially different from the previously consented scheme and overall there be no likely significant effects on GWDTEs.

7.4.4 Predicted Impacts - Bats

Although the impacts of wind turbines on bats in the UK are not completely understood, guidance has been provided by Natural England (2009) and Bat Conservation Trust (Hundt, 2012). Potential construction impacts of wind farms on bats considered here include:

- Direct loss of foraging habitat and/or roosts; and
- Loss of flightlines.

Habitat Loss – Roost Habitat

A number of trees and buildings which offer suitable roosting habitat (moderate to high potential) are present within the Survey Area. Although no roosts were identified from the roost assessment surveys, a number of the trees and areas of the buildings were inaccessible for thorough searches of evidence of roosting bats. The results of the static detector surveys, although limited in their spatial coverage, suggest that there may be a roost located within the Over Finlarg Farm. It is also possible that this roost is a maternity roost as high levels of social calls were recorded throughout the night time activity period. As a result, following the precautionary principle it is assumed that a roost is located somewhere within the farm complex.

Direct Habitat Loss

The location of potential roost sites (Over Finlarg Farm and numerous trees throughout the Survey Area) are all situated in excess of 400m from proposed turbine locations and no direct impact on the potential roost locations are expected as part of the proposed scheme. Bats are assessed to be of local nature conservation value within the context of the Site and no significant impact on bat roosts at this Site location is anticipated. Nonetheless mitigation measures will be required to ensure that no impacts on these potential roost areas occur. If at any stage the removal or significant pruning of any mature trees, especially those highlighted as potential bat roosts (Figure 7-4) is required, pre-construction works checks will be required to assess whether the tree currently supports a bat roost. If a bat roost was confirmed at this stage, then a license would be required to ensure compliance with the legislation protecting bats.

Indirect Impacts

No infrastructure is proposed in proximity (closer than 80m) to potential bat roosts within trees or buildings and as such indirect impacts are not anticipated as a result of the construction of the development. It is possible that indirect impacts from increased disturbance throughout the site including disturbance to field boundaries for example could result in disruption of flight lines to and from a particular roost. However, as the areas being impacted upon do not form significant flightline features this is very unlikely. In addition, bright flood lighting should be avoided within close proximity of Over Finlarg Farm but if required the impact on bats can be minimised by the use of low pressure sodium lamps or high pressure sodium instead of mercury or metal halide lamps where glass glazing is preferred due to its ultra-violet filtration characteristics.

Lighting should be directed to where it is needed and light spillage avoided. This can be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvres and shields to direct the light to the intended area only. Planting can also be used as a barrier or manmade features that are required within the build can be positioned so as to form a barrier.

As a result a barely perceptible impact would be expected on bat roosts from indirect impacts at this location. However, if the design of the proposed wind farm was to change involving any impacts on trees or buildings highlighted as offering potential to roosting bats then this would need to be reassessed.

Habitat Loss – Foraging Habitat

The Site does not support extensive areas of suitable habitat with the majority of land under intensive agriculture which offers no significant foraging resource for local bat populations. The farm buildings are likely to provide the most suitable foraging areas with sheltered locations and presence of livestock likely to support a foraging resource. A small number of ditches and woodland blocks are likely to support some degree of connectivity although these are unlikely to provide significant foraging resources.

The very low levels of bat activity recorded to date suggest that the Site does not support extensive foraging especially in areas of the proposed turbines. With bats assessed to be of local nature conservation status within the Survey Area it is assessed that the construction phase of the proposed wind farm will result in a barely perceptible magnitude impact, which constitutes no significant impact as part of this EcIA.

Loss of Flightlines

The only impact expected from the proposed development will be removal of small sections of post and wire fencing and drystone walls. The post and wire fencing and drystone walls are unlikely to provide any significant flightline/navigational resources for local bats and this loss can be considered to be a non-significant impact. The current layout avoids the loss of species poor hedgerow to the north of turbine 3 and removes the potential to sever a flightline link close to the line of mature beech trees in the north of the Site.

Impacts on bat flightlines during construction are, therefore, assessed to be of low magnitude across the Site as a result of the wind farm development, resulting in no significant impact.

Summary of Potential Impacts on bats of the revised scheme

No significant effects on bats are predicted as a result of the revised scheme which is consistent with the impact assessment of the previously consented scheme. The reduction in the number of turbines through the removal of Turbine 5 is likely to reduce the potential loss of foraging habitat and potential interference with bat flight lines. Although an increase in blade length would result in a corresponding increase in swept area, the low levels of bat activity at the site, of species that are considered to be of ‘low risk’ from wind developments means that there would be no significant impacts associated with the risk of collision with turbines.

The turbines remain in locations which are not used extensively by bats, therefore, it is considered that the original results from the bat surveys would still be representative of turbines being placed within the site boundary and the impacts identified would be no greater than previously assessed.

7.4.5 Predicted Impacts - Badger

No evidence of badger was identified within the Survey Area. The extensive farmland habitats offered suitable habitat and the ditches and small areas of woodland, especially those located to the northwest of the Survey Area on sloping ground offered suitable sett building locations. As a result a precautionary approach was taken to this assessment considering the potential for badgers to be present on the Site in the future.

At present no badger setts are located within the areas to be affected by the proposed infrastructure (or wider Survey Area). As a result impacts are expected to be of barely perceptible magnitude on a receptor assessed as being of less than local nature conservation value, in terms of this Site, and overall would be assessed to be of no significant impact on badger. However, despite no significant impact badger are a transient species and, therefore, pre-construction checks and general mitigation measures are recommended. If at any point badger setts are identified appropriate mitigation measures may be required to prevent disturbance or to avoid breach of relevant legislation.

The impact assessment of the revised scheme on badgers is consistent with that provided for the previously consented scheme. The reduction in the number of turbines would result in a reduced level of habitat loss compared to the previously consented scheme, particularly of arable and improved grassland. Therefore there would be no significant impact on badgers.

7.4.6 Predicted Impacts - Red Squirrel

No definitive evidence of red squirrel was identified within the Survey Area although feeding remains were identified within coniferous woodland blocks to the northwest. These areas will remain unaffected by the proposed development and only very small sections of small isolated suitable woodland will be impacted upon due to Site infrastructure.

As a result barely perceptible magnitude impacts are anticipated on a receptor of less than local conservation value, resulting in no significant impact. However, despite no impact red squirrel are a transient species and, therefore, pre-construction checks on trees to be removed and general mitigation measures are recommended.

The impact assessment of the revised scheme on red squirrel is consistent with that provided for the previously consented scheme; no likely significant effects are predicted.

7.4.7 Predicted Impacts - Reptiles

Whilst no specific reptile surveys were undertaken in regard to the proposed development all other surveys paid attention to the presence of reptiles within the site. No reptiles were observed/identified during any of the surveys. However, suitable hibernacula and foraging resources are present within the Survey Area and Site. As a result a precautionary approach was taken to this assessment considering future presence of reptiles within the Site.

Construction of the proposed development is likely to require the removal of some of the drystone walls and this may result in the loss of hibernacula features used by reptiles. However given the above, the loss of suitable habitat related to the proposed development can be considered a low magnitude impact on a receptor assessed as being of less than local nature conservation value, in terms of this Site, and will be subject to no significant impact.

The impact assessment of the revised scheme on reptiles is consistent with that provided for the previously consented scheme; no likely significant effects are predicted.

7.4.8 Predicted Impacts – Other Protected Species

Otter

Otter were assessed to be absent from the Site at the time of surveys. However, it is possible that seasonal use of aquatic habitats may occur as otters will often seek out amphibians during the amphibian spring breeding period.

During the Site clearance and construction phase, particularly during access track construction, there will be temporary disturbance of, or damage to, habitats that are within the range of otter. However, most of the wind farm infrastructure is located well away from potential otter habitat and direct disturbance is very unlikely.

Impacts affecting small areas of habitat that do not represent a key part of any individual otter's range in an area such as this, can be considered as a barely perceptible magnitude impact on a receptor assessed as being of negligible nature conservation value, and would, therefore, have no significant impact on the otter population in this area. However, despite no significant impact otter are a transient species and, therefore, pre-construction checks and general mitigation measures are recommended.

The impact assessment of the revised scheme on otters is consistent with that provided for the previously consented scheme; no likely significant effects are predicted.

Water Vole

Water vole were also identified as being absent from the Site and only limited suitable habitat was recorded within the Survey Area. However, water voles are capable of colonising isolated habitat and as a result a precautionary approach was taken to this assessment considering future presence of water vole within the Site.

No infrastructure is proposed in proximity to the drainage channel in the north of the Site (identified as the most suitable area for water vole) and, therefore, no disturbance is likely. No significant impact on water vole is therefore predicted. Despite no significant impact, water vole are a transient species and, therefore, pre-construction checks and general mitigation measures are recommended.

The impact assessment of the revised scheme on water voles is consistent with that provided for the previously consented scheme; no likely significant effects are predicted.

Aquatic Ecology

No surveys were undertaken to assess the value of the aquatic ecology receptors as these were assessed to be of negligible nature conservation value. The Survey Area lies within the catchment of a SAC which supports a number of protected species including salmonids and lamprey, the watercourses on Site are heavily managed with the majority culverted underground, therefore, morphologically altered and no longer of natural condition. In addition all watercourses were very small in size and offered no suitable habitat for species such as salmonids. Nonetheless there is potential for some impacts from the proposed development in the form of culvert crossings and run-off of sediments from track/foundation construction. As a result the additional impacts from the proposed development can be considered to be low magnitude on a receptor assessed as being of negligible nature conservation value, in terms of this Site, and will be subject to no significant impact.

The impact assessment of the revised scheme on the aquatic ecology of the site is consistent with that provided for the previously consented scheme; no likely significant effects are predicted.

7.4.9 Summary of Construction Impact Assessment

The construction impacts predicted as a result of the wind farm are summarised in Table 7-11.

Table 7-11: Impact Summary Table

Receptor	Evaluation	Nature of Impact	Impact Magnitude	Impact Significance
Designated Sites				
River Tay SAC	International	No impact	No impact	No impact
Gagie Marsh SSSI	National	No Impact	No Impact	No Impact
Carrot Hill Meadow SSSI	National	No Impact	No Impact	No Impact
Auchterhouse Hill SSSI	National	No Impact	No Impact	No Impact
Whitehouse Den SSSI	National	No Impact	No Impact	No Impact
Whitehouse Den Local Wildlife Site	Local	No Impact	No Impact	No Impact
Brighty Wood Local Wildlife Site	Local	No Impact	No Impact	No Impact
Shielhill Local Wildlife Site	Local	No Impact	No Impact	No Impact
Grassland Habitat				
Cultivated/disturbed land – arable	Local	Loss of habitat	Barely perceptible	No significant impact
Semi-improved – Neutral grassland	Local	No impact	No Impact	No Impact
Semi-improved – Acid grassland	Local	No Impact	No Impact	No Impact
Improved grassland	Local	Loss of habitat	Barely perceptible	No significant impact
Cultivated/disturbed land - amenity grassland	Local	No Impact	No Impact	No Impact
Marsh/marshy grassland	Local	Loss of habitat	Barely perceptible	No significant impact
Woodland Habitat				
Coniferous	Less than local	Loss of habitat	Barely perceptible	No significant impact
Broadleaved	Local	No Impact	No Impact	No Impact
Mixed	Less than local	No Impact	No Impact	No significant impact
Other Habitat				
Scrub	Less than local	No Impact	No Impact	No Impact

Receptor	Evaluation	Nature of Impact	Impact Magnitude	Impact Significance
Bracken	Less than local	No Impact	No Impact	No Impact
Tall ruderal	Less than local	No Impact	No Impact	No Impact
Buildings	Local	No Impact	No Impact	No Impact
Boundaries	Local	Temporary loss of habitat	Barely perceptible	No significant impact
Quarry	Less than local	No Impact	No Impact	No Impact
Marginal vegetation	Less than local	No Impact	No Impact	No significant impact
Bare ground	Local	No Impact	No Impact	No Impact
Tracks	Less than local	Loss of habitat	Barely perceptible	No significant impact
GWDTE	Local	Loss of habitat	Barely perceptible	No significant impact
Aquatic Habitats				
Standing water	Local	No Impact	No Impact	No Impact
Running water	Local	No Impact	No Impact	No Impact
Fauna				
Bats	Local	Roost habitat loss Foraging habitat loss Loss of flightlines	Barely perceptible Barely perceptible Low	No significant Impact No significant Impact No significant Impact
Badger	Less than local	Loss of Habitat	Barely perceptible	No significant Impact
Red squirrel	Less than local	Loss of Habitat	Barely perceptible	No significant Impact
Reptiles	Less than local	Disturbance during construction Loss of Habitat	Low Low	No significant Impact
Other Protected Species	Negligible	Disruption/loss of habitat if colonisation of site occurs prior to construction	Low	No significant Impact

7.4.10 Mitigation Measures

In the absence of mitigation, all ecological construction impacts are considered not to be significant. However, as a matter of good practice, a range of measures are proposed to ensure adequate consideration of ecological interests on and around the Site, and to explore opportunities to enhance the biodiversity value of the Site through sensitive design (Table 7-12).

Table 7-12: Mitigation Measures Proposed for the Construction Phase

Generic Impacts	Mitigation Measures
Direct habitat loss	The development footprint is small and the vast majority of areas to be affected support heavily managed agricultural habitats. Despite this the extent of habitat loss will be kept to a minimum with all unnecessary

Generic Impacts	Mitigation Measures
	habitat disturbance avoided. Within all areas disturbed temporarily, restoration and reinstatement works will be undertaken to minimise the overall footprint of the development. Track verges will be reinstated with appropriate vegetation.
Ecological Mitigation Strategy	It is recommended that all mitigation measures are incorporated into a site-specific Ecological Mitigation Strategy (EMS) that would be developed to reflect the seasonality of the ecological receptors present at the Site and the eventual development programme, including pre-construction or enabling works, the construction phase, and the operational phase. The EMS would include all works required to prevent or reduce potentially adverse impacts on ecological receptors, as well as a schedule for any ecological monitoring required at the Site. In addition, the EMS would provide the framework for the provision of the Project Ecologist/Ecological Clerk of Works (ECoW), and other recommendations that reflect environmental best practice in the construction of wind farms (Scottish Renewables et al., 2010). Any mitigation strategies should be agreed with the developer, the Ecologist, Angus Council, SEPA and SNH prior to the commencement of works and would be incorporated into the scheme-specific Ecological Mitigation Strategy. The EMS would clearly set out the lines of communication between the Project Manager for DWE, the Contractor's Project Manager and the Ecologist(s), and in particular set out the roles and responsibilities of the various parties to instruct site-based staff in the event that a matter of legislative compliance arises on-site unexpectedly, e.g. if during works a protected species is found at a location where it had not previously been anticipated to be. Good construction site management will be implemented to avoid/minimise generation of litter, dust, noise and vibration. This will be controlled and monitored through the Contractor's Construction Environmental Management Plan.
Pollution and sedimentation	The construction process has the potential to cause surface run off facilitating the transport of sediments or pollutants. This may then in turn have an indirect effect on adjacent habitats and/or dependent species. Although the Tay SAC is over 4km from the Site following the flow of watercourses ensuring no negative impacts on the designated Site is paramount. As a result it will be important to put in place an appropriate Pollution Prevention Plan (PPP) and maintain the 50m buffer in relation to watercourses. This PPP will also detail method statements on all aspects of the construction process that may affect the Site's ecology (e.g. fuel storage, need for spill kits, storage of materials etc.)
Dust deposition on sensitive habitats	In the context of the proposed development and the existing land use across the Site, no additional negative impacts from dust deposition due to the development are anticipated.

Habitats

The habitats which will be affected by the construction of the wind farm have either local or less than local ecological conservation value (Table 7-11) and the impact on these habitats is expected to be not significant. However, where habitat loss is unavoidable working areas adjacent to any of these habitats should be clearly defined by pegging out the footprint of the scheme prior to the commencement of works. The aim of this is to restrict the footprint of the scheme to a minimum and to reduce the risk of unnecessary damage to these habitats.

Where vegetation loss is necessary sensitive track design should be adopted in accordance with SNH guidance (SNH, 2005). Cut and fill construction will be employed in areas of shallow topsoil, and the vegetation will be removed according to a construction method statement which will be agreed with SNH prior to implementation. Cut batters will be formed on either side of the track-ways and shall have a bank angle of 30 degrees or less and will be designed to be re-vegetated as soon as possible following reinstatement post-construction.

Management of excavated soil and subsequent restoration of vegetation will be detailed in a Construction Method Statement (CMS).

Grassland and Arable

The main habitats affected by this development would be arable land and improved grassland, with a very small area of marshy grassland. The loss of this habitat cannot be avoided so general good construction site management should be applied to avoid pollution, minimise disturbance and prevent silt runoff (Table 7-11).

Woodland

Coniferous Woodland - Plantation

The proportion of coniferous woodland which would be lost to the access track would be small, 0.05% of the Survey Area. These are mature trees which are densely planted so might benefit from being thinned out slightly. The loss of these trees could provide an opportunity to enhance the habitats on the Site by planting other trees, particularly native broadleaved trees. This would increase the diversity of the species on the Site and provide better habitat for species such as bats, invertebrates and birds.

It is possible that red squirrel could be present in this plantation so a check for dreys and signs of feeding should be carried out prior to felling before construction starts. Any trees which are removed should be left in piles to create habitat for invertebrates.

Other Habitat

Boundaries

Some of the boundaries including stone walls and hedges will be removed for constructing the access track. Where possible these should be replaced by species rich hedges to increase species diversity on the Site and to provide shelter and food resources for birds, small mammals and invertebrates, amphibians and reptiles. Before any boundaries are removed particularly stone walls a check for reptiles should be carried out.

All habitat clearance works should be undertaken with due care and attention and in accordance with a Construction Method Statements (CMS) produced by the site ecologist in consultation with the Principal Contractor and SNH, supplemented, if necessary, by specific on the ground advice from an Ecological Clerk of Works (ECoW).

Protected Species

Bats

Despite the non-significant impacts, mitigation is proposed to ensure effects on bats are minimised as far as possible. Although the majority of impacts are identified as being of no significant impact, a number of recommendations are made.

Trees with roosting potential should be avoided in the first instance or checked by a licensed bat worker prior to felling or substantial pruning. If a bat roost was confirmed at this stage, then a license would be required to ensure compliance with the legislation protecting bats. If the wind farm design changes and potential impacts are identified, further surveys may be required.

Measures shall be implemented to reduce the potential for disturbance from artificial lighting. This is particularly the case near potential foraging, commuting or roosting areas. At all times downward-directed lighting should be used to light the working area only and reduce 'light leakage' that may temporarily affect bat flightlines.

Otter and Water Vole

A final pre-construction check for the presence of protected species will be conducted prior to the commencement of the site clearance phase. This will include a survey for otter holts and couches to ensure legal compliance with Conservation (Natural Habitats, &c.) Regulations 1994, as amended. In addition, this visit will also serve to check that water vole have not taken up occupation of the Site.

Any drains and ditches within 250m of proposed wind farm infrastructure will be surveyed to ensure that no otter holts or couches are present.

No in-channel obstructions (floodlighting, fencing or diversions) will be permitted within any watercourse location unless specifically authorised in writing by a suitably experienced ecologist. No materials shall be stored within 50m of any watercourse, any pipes shall be stored upright, or have covers fitted to the ends to prevent entrapment and all excavations shall be covered and/or provisions made to allow mammals which have inadvertently fallen into an excavation over night to escape by themselves.

Where vegetation has to be cleared to facilitate the installation of access track and/or a culvert in a watercourse, this will be undertaken using a strimmer to avoid disturbing ground prior to excavation.

In the unlikely event that a previously undiscovered large mammal burrow is confirmed as a holt following discovery during vegetation clearance, works shall stop immediately until a safe working area has been determined (e.g. >30m) and/or a way forward has been identified between SNH and the suitably qualified Ecologist. If the holt has been identified to be within 30m of the proposed access track or crossing point, and rerouting is not possible, then liaison would be held with SNH and that in all likelihood a licence from the SNH would be required before works would be allowed to proceed.

Badger

A final check for badger setts within approximately 50m of working areas will be conducted prior to the commencement of the site clearance phase, preferably within the spring or autumn periods, to ensure legal compliance with the Protection of Badgers Act 1992, as amended.

All excavations shall be covered and/or provisions made to allow mammals which have inadvertently fallen into an excavation over night to escape by themselves.

Where dense vegetation/scrub has to be cleared to facilitate the installation of access track, clearance will be undertaken using a strimmer/hand saws to avoid disturbing ground prior to excavation.

If a previously undiscovered mammal burrow was confirmed as a sett following discovery during vegetation clearance then works would stop immediately within 30m of it. If the sett has been identified to be within 30m of the proposed access track and rerouting is not possible, then a licence from SNH would be likely to be required before works could lawfully proceed.

Red Squirrel

Although the Site offers only very small areas of suitable habitat for red squirrel during the felling of any trees along the existing Over Finlarg access track (or elsewhere on Site) should be conducted using best practice guidance (Forestry Commission Scotland, 2006) with operators instructed to look for dreys as they work. Forked trees should be treated with extra caution as these are favoured drey trees. If suspected active red squirrel dreys are encountered during operations, then consultation with SNH would likely be required before works could lawfully proceed.

Reptiles

Reptiles may be present within the Site as there are pockets of suitable habitat. As a result the removal of any sections of dry stone wall or hedges should be kept to a minimum, undertaken using manual techniques and outside the recognised reptile hibernation period. If any reptiles are discovered then a suitably qualified ecologist (ECoW) should relocate the individuals to a suitable section of similar habitat outwith the construction area. If at any time hibernating reptiles are identified all construction activity within 30m should stop and consultation should be sought from SNH regarding a way forward. It is likely that the section of wall or hedge containing hibernating reptiles would be required to be excluded from disturbance until April.

7.4.11 Predicted Residual Impact

The nature and significance of residual impacts i.e. impacts following mitigation, are summarised in Table 7-13. Given the small scale of the proposal and with the mitigation measures proposed, the residual impacts of the construction are considered to have no significant impacts on the habitats and species present on site.

Table 7-13: Residual Impacts on Ecological Receptors

Receptor	Impact Without Mitigation	Mitigation Measures	Residual Impact
Habitats			
Arable	No significant impact	• Sensitive track design	No significant impact
Semi-improved – neutral grassland	No significant impact	• Sensitive track design	No significant impact
Improved grassland	No significant impact	• Sensitive track design	No significant impact
Marshy grassland	No significant impact	• Sensitive track design	No significant impact
Coniferous plantation	No significant impact	• Sensitive track design • Planting native broadleaves • Creating log piles from felled trees • Tree inspection prior to felling (for bats and red squirrels)	No significant impact

Receptor	Impact Without Mitigation	Mitigation Measures	Residual Impact
Mixed plantation	No significant impact	• Sensitive track design • Planting native broadleaves and conifers • Creating log piles from felled trees • Tree inspection prior to felling (for bats and red squirrels)	No significant impact
Marginal vegetation	No significant impact	• Sensitive track design	No significant impact
Boundary features	No significant impact	• Sensitive track design • Creation of rock piles • ECoW • Planting species rich hedgerows	No significant impact
Fauna			
Bats	No significant impact	• Lighting directed only on working areas • Pre-construction survey of trees to be felled	No significant impact
Badger	No significant impact	• Pre-construction mammal survey to check within 50m of working areas preferably in spring or autumn • Vegetation clearance by hand strimmer where hidden setts are a potential • Work to stop and consultation with SNH if sett found within 30m buffer and works cannot be re-routed • Excavations will be covered	No significant impact
Red squirrel	No Significant Impact	• If unidentified dreys are subsequently disturbed during the construction process there may be the need for drey relocation in consultation with SNH and a suitably qualified ecologist.	No significant impact
Reptiles	No Significant Impact	• ECoW • Manual destruction of the dry stone wall and removal of hedge using hand held machinery outside of hibernation period. • Re-instatement of the dry stone wall/creation of rock piles to improve reptile habitat.	No significant impact
Other protected Species	No significant impact	• Pre-construction mammal survey to check for signs within 250m of turbine locations and tracks • No in-channel obstructions permitted • CMS to include measures to maintain water quality • Vegetation clearance by hand strimmer where hidden places of shelter are a potential • Work to stop and consultation with SNH if evidence of protected species found within 30m buffer • Excavations will be covered • No materials to be left within 50m of watercourse • Pipes to be stored upright, or capped	No significant impact

7.5 Permanent and Operational Impacts

7.5.1 Predicted Impact – Designated Sites

Due to the distance between the Site and any nearby statutory and non-statutory designated sites, operational impacts on these sites is not expected.

7.5.2 Predicted Impact – Generic

Table 7-14 summarises the predicted permanent and operational impacts of the proposed development on habitats and non-avian species present on and near the site.

Table 7-14: Generic Impacts of the Operation Phase on Habitats and Species

Generic Impacts	Effects on Habitat Features/Species on Site
Direct habitat loss	Although habitat loss occurs during the construction period, the habitat effectively remains unavailable for the lifetime of the development. Construction of infrastructure components results in direct habitat loss. The impacts of this habitat loss are addressed within Section 7.4, but the 1.8ha of permanent habitat loss is also included within this section. Excluded are areas of temporary habitat loss, at the margins and in areas which are reinstated following construction.
Displacement of species	The operational phase also has the potential to displace species. During operation, the surrounding terrestrial habitats have been restored; however the operational wind development may displace local bat species.
Collision risk	The presence of the moving rotors of the wind turbines in operation may present a risk of collision to bats flying over the area.

7.5.3 Predicted Impact – Habitats

The habitats which would be permanently affected by the operation of the proposed development would include arable land, improved grassland, marshy grassland and coniferous plantation. The majority of the habitat lost would be associated with the arable and improved grassland. The details of land take associated with the proposed infrastructure are presented in Section 7.4.2.

Grassland and Arable

Cultivated/Disturbed Land - Arable

The operation of the proposed development would result in permanent loss of 0.63ha of this habitat. As this habitat offers negligible conservation value the magnitude of the construction impact is expected to be barely perceptible resulting in no significant impact.

The impact assessment of the revised scheme on the arable habitat of the site is consistent with that provided for the previously consented scheme; no likely significant effects are predicted.

Improved Grassland

During the operation of this development 0.63ha of this habitat would be lost due to the turbines, tracks, substation and met mast. This land was generally used for grazing and was assessed to be of negligible nature conservation value. The magnitude of impact is expected to be low resulting in no significant impact.

The impact assessment of the revised scheme on the improved grassland habitat of the site is consistent with that provided for the previously consented scheme; no likely significant effects are predicted.

Marshy Grassland

There would be only one small area of this habitat affected by the construction of the access track, with <0.01ha being lost permanently. As this habitat is considered to be of negligible nature conservation value the magnitude of impact is expected to be barely perceptible resulting in no significant impact.

Woodland

Coniferous Woodland - Plantation

The operation of this development would result in the permanent loss of 0.02ha of coniferous plantation. This would be due to the felling of some trees along the access track. As these are mature trees and this habitat considered to be of less than local nature conservation value the magnitude of impact is expected to be barely perceptible resulting in no significant impact.

Protected Species

Bats

According to Natural England's TIN 051 guidance (adopted by SNH), although individual common and soprano pipistrelle bats are at medium risk of collision with wind turbines, populations of these species are considered to be at a low risk of threat from wind turbines. This is due to the relative population sizes and common status of these species across the UK. Myotis bats are all identified as having a low risk from wind turbines both in terms of individuals and populations.

Within wind energy developments there is the potential to impact upon local bat populations. The design process of the wind development has taken bat habitat into account and followed best practice guidance (Natural England, 2012) in siting of turbines away from optimal bat habitat features in order to minimise potential impacts on local bat populations. As a result the proposed turbine locations are all in excess of 50m plus rotor diameter from any potential foraging habitat significantly reducing the potential for bat collisions (Natural England, 2012). Proposed turbines have a hub height of 57m and blade length of 35.5m, with hedge height approximately 2m, to maintain minimum distances as per guidance this results in a minimum distance of requirement of 40.3m.

Results from static detectors identified that the sampled turbine locations (layout as for Application 12/00577/EIAL Figure 3-1 Site Design Iterations A (layout d)) supported very little activity. Areas of focused bat activity were all limited to detectors in excess of 500m from turbine locations. This survey information is restricted to static detector locations only and as such significant areas of the Survey Area do not have long term monitoring information. However, all previously proposed turbine locations (layout d) supported extremely low levels of bat activity with a total of 69 passes across the four static detectors throughout the 19 survey nights. This results in an average activity of 0.1 calls hour^{-1} at each of the four monitored turbines. This is in comparison to static detectors at habitat locations (away from proposed turbines) identifying an average of 4.2 calls hour^{-1} at each of the four monitored turbines.

Given the above, it is considered that the impact of the operational phase of the development on bat populations, assessed as being of local nature conservation value, would most likely result in, a barely perceptible impact, which constitutes no significant impact as part of this EcIA.

No significant effects on bats are predicted as a result of the revised scheme which is consistent with the impact assessment of the previously consented scheme. The reduction in the number of turbines through the removal of Turbine 5 is likely to reduce the potential loss of foraging habitat and potential interference with bat flight lines. Although an increase in blade length would result in a corresponding increase in swept area, the low levels of bat activity at the site, of species that are considered to be of 'low risk' from wind developments means that there would be no significant impacts associated with the risk of collision with turbines.

Other Protected Species

No other significant impacts on terrestrial or aquatic ecology are anticipated during the operational phase of the proposed scheme.

The revised scheme would result in in no significant impacts on terrestrial or aquatic ecology which is consistent with the impact of the previously consented scheme. The reduction in the number of turbines would increase the available foraging habitat for badgers and cover for reptiles and other small mammals.

7.5.4 Mitigation Measures

Table 7-15: Mitigation Measures during Operation

Generic Impacts	Mitigation of Effects on Habitat Features/Species on Site
Direct habitat loss	Although direct habitat loss is generally associated with the construction stage, the overall increase in areas of hardstanding will remain for the life-span of the project. Mitigation for this loss is not required, but enhancement could be in the form of increasing areas of semi-natural habitat within the Site. An appropriate enhancement strategy would be to plant native broadleaved trees to compensate for the felling of any conifers and to replace the lost boundaries with locally provident species rich hedgerows.
Displacement of species	The presence of a wind farm at the proposed site is unlikely to cause any displacement of species. The area supports very low bat populations which will remain unaffected. The species present on the Site are not considered to be particularly sensitive to wind turbines. Hence no mitigation is required.
Collision risk	If micrositing allowances allow, turbines should not be moved closer to bat habitat features and ideally distances from such features should be maximised. Based on existing data the risk of bat collisions is negligible.

Habitats

No specific mitigation measures are recommended with respect to habitats as all loss is required and permanent through the lifetime of the development. However, the loss of hedgerows and marshy grassland could be compensated for through the replacement of fencelines with species rich hedgerows or planting small areas of broadleaved woodland. The purpose of this would be to minimise the loss of semi-natural habitats during the development and to increase the biodiversity of the Site.

7.5.5 Predicted Residual Impact

Given the relatively small scale of the proposed development, siting within an area of intensive agriculture and the mitigation measures proposed above, the residual impacts of the operational phase are considered to have no significant impacts on the habitats and species present on site. The revised scheme would not result in any changes to the predicted residual impact assessment of the previously consented scheme.

7.6 Cumulative Impacts

There may be cumulative impacts of wind farms on flora and fauna, with the greatest theoretical risk being of significant impacts arising on species and habitats of national or international importance resulting from a number of wind farms being present in a relatively small area (e.g. Landscape Design Associates, 2003). Current guidance suggests that the highest priority for cumulative impact assessment is for species and habitats that are declining and/or not in favourable conservation status and that species and habitats of very high conservation importance or those vulnerable to wind farms may be targeted for cumulative assessments (SNH, 2005).

At this site, there are no habitats of international importance present within the study area, or species of international/national conservation value that are likely to suffer from cumulative impacts.

Due to the assessment that the wind energy development is expected to have no significant impact on the species and habitats present within the site, and the lack of species and habitats of international or national conservation importance, cumulative impacts are not anticipated.

The revised scheme would not result in any changes to the cumulative impacts anticipated of the previously consented scheme, no cumulative impacts are anticipated.

7.7 Summary

The Site is not situated within or immediately adjacent to any designated sites with ecological interest. The closest designated sites are Tay SAC located approximately 2.8km (5.5km downstream), Gagie Marsh and Carrot Hill Meadow SSSI located 4.5km southeast and east respectively. No impacts are expected on these or any other designated site.

The development site for the Frawney Wind Farm supports primarily intensive agricultural habitats although a small number of more semi-natural habitats and valuable biodiversity features are present.

The hydrology of the Site is presently highly managed due to agricultural operations and no semi-natural watercourses are present on Site. Although the drainage of the Site ultimately flows into the Tay SAC, this is approximately 5.5km downstream of the Site boundary. Impacts on the drainage ditches and small burns will be managed and impacts minimised resulting in no significant impacts expected due to the proposed development.

Very few protected species are identified as being present with low bat activity and the potential presence of red squirrels across the wider Survey Area. Impacts due to the proposed development are not predicted to be significant.

The possibility of otter and badger being present within the Site for purposes of hunting/foraging cannot be ruled out but impacts on these species are assessed as not being significant.

However, it will be important to undertake pre-construction checks for otters and other protected species prior to construction with some degree of monitoring during the construction process to avoid any potential breach in legislation.

A series of mitigation measures have been proposed to protect the ecological receptors on Site throughout the development.

7.8 References

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Ryland, K. and Kemp, B (2009). Using field signs to identify water voles - are we getting it wrong? In Practice, Bulletin of the Institute of Ecology and Environmental Management. No. 63, March 2009 (pp. 23-25).

Scottish Natural Heritage. (2010). Scottish Wildlife Series: Otters and Development. Scottish Natural Heritage. Accessed October 2010 – http://www.snh.org.uk/publications/on-line/wildlife/otters/default.asp

Strachan, R. and Moorhouse, T. (2006). Water Vole Conservation Handbook (2nd edition). Wildlife Conservation Research Unit, University of Oxford.

8 Ornithology

8.1 Introduction

This chapter, produced by Atmos Consulting, presents the results of an ornithological impact assessment of the proposed development. The methodology used in this chapter is based on best practice guidelines (IEEM, 2006). The purpose of this chapter is to provide independent advice on the potential effects of the proposed development on the ornithological interest of the application site and its immediate environs.

For the purpose of this chapter the proposed ornithological survey area, hereafter, referred to as the 'Site', corresponds to the landownership boundary and a 500m buffer around it as presented in Figure 8-1. It should be noted that the ornithological survey boundary does not represent the application boundary.

The proposed development consists of four wind turbines and associated infrastructure (access track, electrical cable, control building and construction compound). This is a revision to the consented wind farm (13/00532/EIAL) which was for five turbines of 80m tip height and 56m hub height. This EcIA relates to the revised scheme of four turbines of 92.5m tip height and 57m hub height.

The original Survey Area was designed to encompass the proposed turbine locations of layout d (Figure 3-1 Site Design Iterations A), as applied for in application 12/00577/EIAL and the associated infrastructure. This application was subsequently withdrawn and a new planning application 13/00532/EIAL for five turbines was consented in February 2014 layout h (Figure 3-1 Site Design Iterations B). Under this current application (Figure 3-2 Site Layout) the layout of the turbines remains the same as in the consented application (13/00532/EIAL) but with the removal of Turbine 5 and a slight increase in tip and hub height of the remaining four turbines. Further description of the Site and details of the development can be found in Chapter 3 The Development.

Assessment within this chapter is supported by the baseline information contained in Appendix 8-1.

8.2 Methodology and Approach

8.2.1 Information Sources

Several sources of information were used to inform this chapter. Information on statutory sites was obtained from the website of the statutory agency SNH via the "Site Link Portal" (http://www.snh.org.uk/snhi/). A search was also conducted for protected species records within the NM26 10km Grid Square on the National Biodiversity Network (NBN) Gateway website (http://www.searchnbn.net/) to inform which surveys might be necessary at the Site.

Aerial photography of the Site was examined using photography available in the public domain on the www.bingmaps.co.uk web page.

The following sources of information were used:

- Results of internet searches as detailed above;
- Consultation results;

- Survey results of extended Phase 1 surveys, winter walkover surveys, breeding bird surveys and Vantage Point surveys, completed by Atmos Consulting staff and specialist subcontractors.

8.2.2 Consultation

Table 8-1 summarises the main aspects and outcomes of consultations undertaken, whether these comments are relevant to the specifics of the site and, if relevant, where in the document the comments are addressed.

Table 8-1: Consultation Responses

Consultee	Response	Comment
RSPB (2008)	Recommended relevant moorland bird surveys due to moorland habitats nearby.	Breeding Bird Surveys followed Common Bird Census Methodology as the Site was dominated by farmland habitats.
RSPB (2012)	Provided a data search for the Site the surrounding areas.	Results presented in summary in Appendix 8-1.
RSPB (2012)	RSPB responded to application 12/00577/EIAL with no comments or concerns.	
SNH (2008)	Highlighted vicinity of Whitehouse Den SSSI but held no bird data. No further comments.	
SNH (2012)	Ornithological surveys should follow SNH guidance documents (SNH 1005, updated 2012). Recommended the use of SNHi and NBN webpages for ornithological data.	Findings of SNHi presented in Appendix 8-1 (Appendix Ornithology)
SNH (2012)	Survey work for wintering geese at Frawney highlight that although geese do overfly the site, few of these flights were at collision risk height and they do not use the area to forage. It is therefore likely that the risk of turbine collision mortality is lower in this locality and should pose little risk to SPA populations from the following sites; • Loch of Kinnordy • Loch of Lintrathen • Firth of Tay and Eden Estuary We consider the risk to wintering geese to be extremely low and there will be no likely significant effect on these SPAs. It is unlikely that the proposal will have a significant effect on the qualifying interests of nearby goose Special Protection Areas (SPA) either directly or indirectly. An appropriate assessment is therefore not required.	The revised and current proposals will not result in any greater impacts than those identified in ES 2012 and, therefore, it is considered that an appropriate assessment is still not required.
SNH (2013)	17/07/2013 - Response to application 13/00532/EIAL: We consider that the situation at Frawney and the surrounding area has not changed such that our advice would alter from our previous response.	
Tayside	No response received.	

Consultee	Response	Comment
Raptor Study Group (TRSG) (2008)		
TRSG (2012)	None undertaken.	

8.2.3 Overall Approach

A number of documents have been published by SNH to provide guidance on the survey requirements for the assessments of the avian assemblage of wind farm sites and potential impacts of this proposal.

In 2002, SNH produced guidance on survey methods to be used to assess impacts of wind developments on upland bird communities. This guidance was designed to provide information on the survey effort and types of surveys required to ensure sufficient information on bird interests at proposed wind development sites was collected to allow impact assessments to be completed. The guidance was updated and replaced by more detailed guidelines on survey methods for onshore wind farm bird surveys in 2005 (SNH, 2005) and revised again in 2010.

SNH has also provided guidance on methods for assessing the collision risk of bird species with wind turbine blades using a simple model (SNH, 2000).

SNH has produced updated guidance on assessing the significance of impacts from onshore wind farms on birds at sites outwith designated areas (SNH, 2006, updated 2012). This guidance identifies species that may be particularly at risk from wind development impacts.

8.2.4 Nature Conservation Legislation

National legislation for the special protection of selected species is provided in the Wildlife and Countryside Act 1981, as amended (WCA). Under Section 1(1) and 1(2), all British bird species, their nests and eggs, excluding some pest and game species, are protected from intentional killing, injury or damage. Under Sections 1(4) and 1(5), special penalties are applied to bird species included in Schedule 1 of the Act and protection is extended for these species.

The Nature Conservation (Scotland) Act 2004 (NCSA) sets out a series of measures designed to conserve, protect and enhance the biological and geological natural heritage of Scotland. Among these measures is a requirement to establish a list of species considered by the Scottish Government to be "*of principal importance for the conservation of biological diversity in Scotland*". This list is as set out in the Scottish Biodiversity Strategy (Scottish Executive, 2004).

The Birds Directive is more formally known as Council Directive 2009/147/EC on the conservation of wild birds. It is a European Union directive which was adopted in 2009, replacing Council Directive 79/409/EEC of 1979 on the conservation of wild birds which was modified several times. It aims to protect all European wild birds and the habitats of listed species, in particular through the identification and classification of SPAs for rare or vulnerable species listed in Annex I of the Directive. It also protects all regularly occurring migratory species, with particular attention to the protection of wetlands of international importance (Article 4). Together with Special Areas of Conservation

(SACs) which are designated under the Habitats Directive, SPAs form a network of European protected areas known as Natura 2000.

Sites of Special Scientific Interest (SSSI) are sites of national importance for nature conservation, and can be notified for their ecological interest. The Wildlife and Countryside Act 1981 (as amended in Scotland) provides for the protection of SSSIs.

Biodiversity Action Plans (BAPs) are part of the British government's strategy for the implementation of the 1992 Convention on Biological Diversity, to which it is a signatory. BAPs have been developed for the UK and devolved to local levels (LBAPs), to protect a number of rare species and habitats and reverse the decline of more widespread, but declining, species and habitats. As with the Scottish Biodiversity List, LBAPs also include species which are not rare or declining, but are considered important to the local public. Under the NCSA, the Scottish Government and other bodies exercising a public function have a duty to give due regard to the conservation of biodiversity. The UKBAP and the Tayside LBAP are, therefore, relevant to this chapter.

8.2.5 Evaluation of Ornithological Significance

The criteria applied to assess the nature conservation value of the ornithological receptors are as per Section 7.2.5 and Table 7-2 in Chapter 7 (Ecology). Tables 7-3 and 7-4 define the impact magnitude and Significance applied in this assessment.

8.2.6 Survey Methodologies

The survey methodologies, survey timings and results are presented in detail in Appendix 8-1. The following surveys were completed:

- Diurnal Vantage Point (VP) surveys from three VPs: a total of 234 survey hours over 12 months from October 2008 to September 2009 (Figure 8-1 presents the viewsheds for the three VPs);
- Dawn and dusk VP surveys from one VP: a total of 54 survey hours between October 2009 and May 2009;
- Winter walkover surveys: six visits between October 2008 and March 2009;
- Common Bird Census (CBC): three visits between April and June 2009; and
- Barn owl survey: one visit in July 2009.

Whilst the survey data was collected five years ago, the habitats on the site and farming operations have not changed during this period and, therefore, the data are considered to provide a robust baseline on which to base the ornithological assessment.

8.2.7 Assessment Methods

The methodology adopted in this assessment has involved the following key stages:

- Determine baselines;
- Review development for impacts;
- Evaluate significance;
- Identify mitigation; and
- Assess residual impacts.

8.3 Baseline Conditions

8.3.1 Designated Sites

There are no designated sites within or immediately adjacent to the Site. Three designated sites are present within 5km, and an additional six designated nature conservation sites within 10km of the Site, the locations of these are illustrated on Figure 7-1. Only sites designated for their ornithological interest will be considered in this chapter.

Firth of Tay and Eden Estuary SPA

The Firth of Tay and Eden Estuary SPA lies 9.5km to the south of the Site and extends to approximately 6,925ha. The SPA includes extensive sand flats and mudflats, saltmarsh, sand dunes, shingle and marsh habitats. It qualifies for designation as a SPA under Articles 4.1 and 4.2 of the Birds Directive.

Under Article 4.1, the qualifying breeding Annex 1 species that occur within the European marine site are:

- Marsh harrier *Circus aeruginosus*, 2.5% of the breeding population (Great Britain GB); and
- Little tern *Sterna albifrons*, 1% of the population (GB).

The site further qualifies under Article 4.1 by regularly supporting an overwintering population of European importance of the following Annex 1 species:

- Bar-tailed godwit *Limosa lapponica*, 4.6% of the population (GB).

The SPA also qualifies under Article 4.2 of the Birds Directive, in that over winter it regularly supports populations of European and international importance of the following migratory species:

- Greylag goose *Anser anser*, 1.2% of the population (Iceland/UK/Ireland);
- Pink-footed goose *Anser brachyrhynchus*, 1.2% of the population (Iceland/Greenland/UK); and
- Redshank *Tringa totanus*, 1% of the population (Eastern Atlantic – wintering).

The SPA further qualifies under Article 4.2 in that it supports an assemblage of birds of European importance, based on the fact that over winter it regularly supports 48,000 waterfowl. This assemblage includes nationally important wintering populations of cormorant *Phalacrocorax carbo*, shelduck *Tadorna tadorna*, eider *Somateria mollissima*, long-tailed duck *Clangula hyemalis,* common scoter *Melanitta nigra*, velvet scoter *Melanitta fusca*, goldeneye *Bucephala clangula*, red-breasted merganser *Mergus serrator*, goosander *Mergus merganser*, oystercatcher *Haematopus ostralegus*, grey plover *Pluvialis squatarola*, sanderling *Calidris alba*, dunlin *Calidris alpina* and black-tailed godwit *Limosa limosa*. This site is recognised as being of International conservation value.

Firth of Tay and Eden Estuary Ramsar Site

The Firth of Tay and Eden Estuary are also designated as a Ramsar site, recognising the complex of coastal habitats, which include extensive invertebrate-rich intertidal mudflats and sandflats created by the sediment load deposited by the River Tay. Also present are large areas of reedbed and sand-dune and a small amount of saltmarsh. This site is recognised as being of International conservation value.

The site qualifies for designation under criteria 5 and 6 of the Ramsar Convention. Under criterion 5, it qualifies for the internationally important assemblage of wintering waterfowl, where it supports >27,000 waterfowl.

Under Criterion 6, species or populations of birds occur at levels of international importance, where the qualifying species with peak counts in spring and autumn are:

- Common redshank Tringa *totanus totanus*, 1.8% of the population.

Species with peak counts in winter are:

- Pink-footed goose *Anser brachyrhynchus*, 2% of the population;
- Greylag goose *Anser anser*, 2.1% of the population; and
- Bar-tailed godwit *Limosa lapponica*, 1.5% of the population.

Subsequent to designation, a number of species/populations have been identified for possible future consideration under criterion 6. These include:

- Species with peak counts in spring/autumn: Goosander *Mergus merganser merganser*, 1.6% of the population.

None of these sites are designated for their ornithological interest. Any impacts on these sites will have been addressed in Chapter 7 Ecology.

8.3.2 Desktop Study and Consultations

The results of the desktop study, consultations and search for existing data and information on the avian interest of the Site are presented in detail in Appendix 8-1.

Aerial photography showed that the Site was dominated by arable land and pasture with some areas of heathland located in the 500m buffer zone in the west and south.

In summary, the avian assemblage at Frawney appeared to be typical for lowland farmland habitats. No previous records of wintering geese or swans in the area were found. Information on breeding raptors was scarce. However, a goshawk territory was confirmed in the plantation woodland to the southeast of the Site, outwith the survey area, and an osprey territory was reported from the Glamis Estate, approximately 5km northwest of the Site. Lowland waders had been reported breeding near the Site in the past and were likely to still do so.

8.3.3 Survey Results

Vantage Point Survey Results

During the VP survey a total of nine species were recorded with 28 flightlines, involving 1117 individuals. Table 8-2 summarises the number of flights per species, minimum, maximum and median flock size as well as the total flight time and flight time at collision risk height. Table 8-2 presents the species in order of conservation concern with qualifying species of the nearby SPA and SSSIs first, followed by Annex I and Schedule 1 species and then species of lower conservation concern. A complete species list with details on the conservation concern of all species is included in Appendix 8-1.

Marked in bold are those species for which flight activity at collision risk height was large enough to carry out collision risk modelling. Flight activity was considered large enough when over 1000 flight seconds at risk height were recorded. For at risk flight durations lower than 1000, the calculated annual collision risk does not exceed 0.06 collisions per year which would only result in a maximum of one collision over the life time of the wind farm. Results of the CRM are presented in the operational impact Section 8.6.1.

Table 8-2: Summary Flight Data for Target Species from Vantage Point Surveys

Species	No. of Flights	Minimum No. of Birds	Maximum No. of Birds	Median No. of Birds	Total Bird Seconds	At Risk Bird Seconds
Greylag goose	1	48	48	115	5520	0
Pink-footed goose	6	37	221	95	48580	0
Oystercatcher	1	2	2	2	250	0
Golden plover	**5**	**15**	**104**	**28**	**5884**	**5355**
Peregrine	2	1	1	1	40	0
Whooper swan	3	4	24	17	1972	268
Barn owl	1	1	1	1	105	0
Curlew	**3**	**2**	**31**	**3**	**3257**	**3257**
Lapwing	**6**	**2**	**47**	**32**	**11649**	**11499**

Of the SPA qualifying species, greylag and pink-footed geese were recorded with a total of seven flights for both species. None of the flights were recorded at collision risk height. Three ground registrations were reported for greylag geese, all of these were approximately 1km from the Site boundary to the west. One oystercatcher flight with two individuals was recorded in June 2009.

A total of three Annex I species were recorded during the VP surveys (golden plover, peregrine and whooper swan). Schedule 1 species included golden plover, peregrine, whooper swan and barn owl.

A total of six species considered by SNH to be at risk from wind farm developments (SNH 2006) were recorded during the VP surveys including greylag and pink-footed geese, golden plover, whooper swan, peregrine and curlew.

Figure 8-2 presents the raptor flights (peregrine and barn owl) and Figure 8-3 presents the flightlines for waterfowl and waders.

Golden plover flocks were present on Site between August and November 2008 with a total of five flocks recorded in flight and two ground registrations. Flock sizes varied between three and 104 birds. Most of the flight activity was recorded at collision risk height.

Two peregrine flights were recorded, both above collision risk height; one in October 2008 and one in January 2009.

Whooper swan flights were recorded on three occasions in November, December and March with four to 24 birds. Only the flight with four individuals was recorded at collision risk height.

One barn owl flight flying below risk height was noted in March 2009 northwest of Nether Finlarg cottages.

Three flocks of curlews were recorded at collision risk height: three and 31 birds in March and two birds in June. Additionally there was also one ground record of a flock of 14 birds noted in August 2009.

Lapwing flocks of 15 to 47 birds were noted in October 2008, March 2009 and August 2009 and flock of 64 birds was noted on the ground in September 2009.

Further details on species activity are presented in Appendix 8-1.

Winter Walkover Surveys

SPA qualifying geese were recorded only during the winter walkover visit in October 2008: one flock of 12 greylag geese and one flock of 74 pink-footed geese were reported flying over the Site in southerly directions. The only other SPA qualifying species recorded during the winter walkovers was oystercatcher with sightings of up to three birds in February and March some of which considered to be breeding on the Site.

During the winter walkover, two Annex I species, peregrine and golden plover, were recorded. One adult male peregrine was recorded flying over the Site in October 2008. Golden plover were noted during the October and November 2008 visits with flocks of between eight and 27 individuals.

Five Schedule 1 species were recorded during the winter walkovers including peregrine, goshawk, barn owl, common crossbill and redwing. A female goshawk was recorded during the October 2008 visit in the woodland at the southeastern corner of the survey area and a female bird was observed displaying over the triangular plantation in the northwest of the Site during the March visit. A barn owl in flight was recorded in October 2008 and January 2009 south of Muirside House. During the October 2008 visit, a small flock of five common crossbills was recorded near the small square plantation in the northwest corner of the Site.

A small flock of four redwings was recorded during the December 2008 visit. However as redwing is only protected as a breeding species, redwings will not be considered further in this assessment.

A total of 48 species were recorded during the winter walkovers, 17 of which are listed as Scottish priority species and 14 as UKBAP species. Overall, the assemblage of bird species during the winter months included typical farmland species in low numbers with only few larger flocks of seed-eating farmland bird such as finches and buntings. Corvids such as carrion crows, rook and jackdaws were abundant as were wood pigeons and starlings.

The survey results are presented in detail in Appendix 8-1.

CBC Survey Results

During the 2009 breeding season, a total of 50 species were recorded during the CBC survey. Of these, 33 species were confirmed or probably breeding within the survey area. A further four species were possibly breeding on Site. A total of 18 Scottish Priority Species, 18 UK BAP species, 13 red and 15 amber listed species were recorded during the surveys.

Oystercatcher, which is one of the qualifying species of the SPA, was found to be breeding on Site with an estimated three to four pairs. Other lowland wader species breeding within the study area included one to two pairs of curlew, one to two pairs of lapwing and three to four pairs of oystercatcher.

The breeding bird assemblage was diverse and included typical farmland passerines such as skylark, linnet, reed bunting, starling, house sparrow, grey partridge and yellowhammer. Also noted was a common gull colony to the south of the site at the gas installation station and a rookery near Govals cottage to the north of the Site.

Two flocks of 85 and 33 golden plovers were recorded flying over the Site during the April 2009 visit. This was the only Annex I species noted during the CBC surveys. Schedule 1 species included common crossbills with one flock of six birds recorded in the plantation woodland in the southeastern area of the 500m survey buffer. Also of note was the record of one pair and a single corn bunting during the April 2009 visit. However, this species was not recorded during any of the following visits and, therefore, not considered to be breeding on the Site.

A complete list of all species recorded during the CBC and the breeding status are presented in Appendix 8-1.

Barn Owl Surveys

No signs of breeding barn owl were identified during the survey, however a roost site was detected in a derelict building in the northeast of the 500m buffer area. The species is considered to be present on Site all year and it is likely that barn owls are breeding nearby.

8.3.4 Evaluation of Ornithological Receptors

Based on the results of the surveys, consultation and desktop study and considering the conservation status of the observed species, the following sections present the evaluation of the ornithological receptors.

Research identifies 35 ornithological species to be at risk of impacts from onshore wind farms (SNH, 2006; Bright et al 2006). Of these, seven species were recorded during surveys undertaken over the study period: curlew, golden plover, goshawk, peregrine, greylag goose and pink-footed goose. Impacts on these species are, therefore, considered in detail, including assessment of collision risk where appropriate, following the methodology recommended by SNH (SNH, 2000b).

Two species of goose, greylag and pink-footed goose and one wader, oystercatcher, listed as part of the Firth of Tay and Eden Estuary SPA were recorded during ornithological surveys at the proposed Frawney wind farm. Three Annex I species were recorded: golden plover, peregrine and whooper swan. Three Schedule 1 species, barn owl, goshawk and common crossbill were noted during the surveys as well as curlew, a species considered to be at risk from wind developments (SNH 2006).

Lapwing a UKBAP species was also recorded and was considered as a target species.

Greylag Goose

Greylag geese recorded at Frawney were considered to be part of the qualifying interest of the Firth of Tay and Eden Estuary SPA. During the surveys, one greylag goose flightline with 48 individuals above collision risk height was recorded during the VP watches. Three ground registrations of greylag geese were reported in December 2008 and January 2009 with flocks between 94 and 288 birds approximately 1km to the west of the Site (Figure 8-3). One additional observation was made during the October 2008 winter walkover visit when one flock of twelve greylag geese was recorded flying south over the Site.

Greylag goose is a species of International conservation importance as a qualifying feature of the Firth of Tay and Eden Estuary SPA. The Site and its vicinity were only occasionally used by wintering greylag geese over the winter months and flights across the Site were recorded infrequently. For these reasons, greylag geese at Frawney are considered to be of less than local conservation value.

Pink-footed Goose

Pink-footed geese recorded at Frawney were also considered to be part of the qualifying interest of the Firth of Tay and Eden Estuary SPA. During the survey period six flights of pink-footed goose were recorded during the VP watches in November 2008 and March 2009. These flights were of flocks ranging from 37 to 221 with a mean flock size of 95 individuals. All flights were recorded above collision risk height. During the winter walkovers in October 2008, one flock of 74 pink-footed geese was recorded. No ground registrations of foraging geese were reported.

Pink-footed goose is a species of International conservation importance as a qualifying interest of the Firth of Tay and Eden Estuary SPA. The Site and its vicinity were only occasionally used by wintering pink-footed geese over the winter months with infrequent flights across the Site. For these reasons, pink-footed geese at Frawney are considered to be of less than local conservation value.

Oystercatcher

Wintering oystercatcher is a qualifying species of the Firth of Tay and Eden Estuary SPA and amber-listed. Oystercatcher was identified breeding on Site and one flight of two individuals was recorded during the VP surveys in June 2009. Oystercatcher was not recorded on Site during the winter months. The first records of single individuals or groups of two or three birds were made in February 2009 and March 2009, indicating the return of the local breeding population of three to four pairs.

The birds breeding at Frawney could be part of the wintering population of the Firth of Tay and Eden Estuary SPA, which was reported with 5100 individuals in February 2000. With no oystercatchers wintering on the Site, the SPA population will not be affected during the winter months. Up to eight individuals of the wintering population could be affected by the Frawney wind farm proposal, if they were breeding at the Site.

As a qualifying feature of the Firth of Tay and Eden Estuary SPA, oystercatcher is a species of International conservation importance. The Site and its vicinity were not used by wintering oystercatcher. Due to the small number of breeding oystercatchers on Site, oystercatcher at Frawney is considered to be of less than local conservation value.

Golden Plover

During the study, five golden plover flights were recorded in October 2008 and November 2008 with flock sizes of between 15 and 104. Most flights were recorded at collision risk height. Golden plover were also recorded during the winter walkover surveys in October 2008 and November 2008 with flocks of 15 and 33 individuals and two flocks of 33 and 85 golden plovers during the April 2009 breeding bird visit.

Golden plover were not breeding on Site and no further records were made for this species during any of the surveys. Golden plover is an Annex 1 species, therefore, of International conservation importance. With no breeding population on the Site and low flight activity over the Site during the migration period, golden plover at Frawney is considered to be of less than local conservation value.

Peregrine

Peregrine was observed on three occasions during surveys with two flights above collision risk height recorded in the autumn and winter and one record of an adult bird during the November 2008 winter walkover survey. The closest peregrine breeding location is not known and this species was not recorded during the breeding season.

Peregrine is a species of International conservation importance due to its Annex 1 status. However, with only three observations over the study period and no breeding known to occur in the vicinity of the Site, peregrine at Frawney is considered to be of negligible conservation value.

Whooper Swan

Whooper swan flights across the Site were recorded over the winter months with a total of three flights noted in November 2008, December 2008 and March 2009. Flocks were small with four to 24 birds. Only one flight was recorded at collision risk height and no foraging whooper swans were noted on the Site or in its vicinity.

Whooper swan is a species of international conservation value due to its Annex I status. Due to the low activity levels of this species over the Site, whooper swan at Frawney is considered to be negligible conservation value.

Goshawk

No goshawk flights were recorded during the VP surveys. An adult female was recorded twice during the winter walkover surveys in October 2008 and March 2009 with display flights recorded in March over the Site. No further records of this species were collected. A nest site was reported by the Tayside Raptor Study group in the woodland adjacent to the Site in the southeast.

Goshawk is a species of national conservation importance due to its Schedule 1 status. A nest site was reported close to the Site but activity levels over the proposal area were very low. Therefore, goshawk at Frawney is considered to be of local conservation value.

Curlew

Curlew flight activity over the Site was low with only three flights recorded in March 2009 and June 2009. Two flights in March 2009 were of flocks of three and 31 individuals and two birds were recorded June. All flights were recorded at collision risk height. One or two pairs of curlew were found breeding on the moorland habitats within the northwestern area of the 500m survey buffer.

Curlew is an UKBAP and Scottish Priority species, amber-listed and considered to be at risk from onshore wind farms (SNH, 2006), therefore, is considered to be of regional conservation value. Given the low numbers recorded on the Site, curlew at Frawney is considered to be of less than local conservation value.

Lapwing

Six lapwing flights were recorded at Frawney during the VP watches with flock sizes between 15 and 47 birds. Flights were recorded in autumn and spring and were considered to be of migrating birds. The majority of flights were recorded at collision risk height. Lapwing was also recorded during the March 2009 visits of the winter walkovers and during the CBC survey. Lapwings were identified as probably breeding on Site with one or two pairs.

Lapwing is a Scottish Priority and UKBAP species as well as red-listed and are, therefore, considered to be of regional conservation value. Due to the small numbers observed on Site, lapwings at Frawney are considered to be of negligible conservation value.

Avian Assemblage

Despite the presence of suitable foraging habitats for wintering waterfowl, no foraging geese or swans were recorded within the Site boundary or the surveyed buffer zones. Occasional flights of geese and swans were recorded during the migration and winter periods but did not indicate the presence of a regularly used flight route across the Site or in the vicinity. No important foraging or roosting areas were identified at or near the Site.

The avian assemblage at Frawney included few breeding raptor species such as goshawk and buzzard as well as probably barn owl in the wider area. Other raptor species, in particular those of elevated conservation concern were only recorded infrequently and did not appear to regularly use the Site to hunt or breed.

Other birds breeding on the Site included a variety of typical farmland species with finches, buntings and sparrows as well as lowland and farmland waders. This included numerous Scottish Priority and UKBAP species such as grey partridge, lapwing, curlew, linnet, skylark, house sparrow, starling, reed bunting and yellowhammer. However, the number of pairs on Site was low with only one or two for most species apart from skylark, yellowhammer and probably linnet. Over the winter months, starling was only species to be encountered regularly in flocks of several hundreds of birds with most other finches and bunting only occurring in smaller mixed flocks.

Other species associated with the woodland habitats on or near the Site included song thrush, bullfinch, siskin, cuckoo and lesser redpoll, most of which were confirmed or possible breeders.

Overall, the avian assemblage at Frawney is diverse and species rich, representing a typical farmland species assemblage with some woodland and heathland species also present, reflecting the proximity of these habitats to the Site. Despite the diverse habitats and diverse assemblage of passerines, waders and corvids, the number of raptors using the Site appears to be limited to two species. Although superficially suitable, the area appears not to be of any value to wintering and migrating waterfowl despite the vicinity of the coast and Firth of Tay and Eden Estuary SPA.

Numerous UKBAP and Scottish Priority species are using at the Site as part of the avian assemblage. However, due to the low numbers of most of the species, the conservation value of the avian assemblage at Frawney is considered to be of local conservation value.

All Other Species

All other species recorded during the surveys were considered to be of negligible conservation value in relation to the site due to their low abundance, unsuitability of habitat and/or their limited use of the survey area.

Table 8-3 summarises the key ornithological receptors, their conservation importance, status on the Site and the determined receptor value.

Table 8-3: Summary of Values of Key Ornithological Receptors

Species	Conservation Importance	Status at Frawney	Ecological Receptor Value
Greylag goose	International	Passage migrant; medium sized to small flocks occasionally moving over the Site.	Less than local
Pink-footed Goose	International	Passage migrant; medium sized to small flocks occasionally moving over the Site.	Less than local
Oystercatcher	International	Not recorded as wintering species but up to four pairs breeding on Site.	Less than local
Golden plover	International	Passage migrant; medium sized to small flocks occasionally moving over the Site.	Less than local
Peregrine	International	Only four records during VP and winter walkover surveys, not breeding in the vicinity, not regularly using the Site.	Negligible
Whooper swan	International	Passage migrant; small flocks occasionally moving over the Site.	Negligible
Goshawk	National	Not recorded during VP watches but two records during the winter walkovers including one display flight. Nest location reported in the woodland southeast of the Site.	Local
Curlew	Regional	Four observations recorded, not breeding in close vicinity, not regularly using the Site.	Less than local
Lapwing	National	Five observations recorded, not breeding in close vicinity, not regularly using the Site.	Negligible
Avian assemblage	Regional	Breeding, foraging and wintering on Site.	Local
All other species	County/ Local / Less than Local/Negligible	Flying, foraging over, breeding & or potentially breeding on Site.	Negligible

8.4 Construction Impacts

8.4.1 Predicted Impact

Some of the impacts predicted as a result of the construction of the proposed Frawney Wind Farm can be considered generic impacts which are typically associated with a development of this nature. A receptor may be affected by each of these generic impacts or just one. A summary description of these impacts is presented in Table 8-7. Impacts that are arising only during the construction phase are considered to be temporary, with estimated construction taking three to four months. The impacts of decommissioning are difficult to predict, but are likely to be of a lesser magnitude and duration than the construction impacts.

It is concluded that the nature and magnitude of the predicted impacts associated with the revised scheme would not be materially different from the previously consented scheme and would have no effect on the generic impacts of the construction of the wind farm other than decreasing the area of landtake slightly.

Table 8-4: Generic Impacts of the Construction of a Wind Farm on Bird Species

Generic Impacts	Effects on Species on Site
Direct habitat loss	The proposed wind farm will involve the construction of access tracks, turbine bases, crane hardstandings, site compound and substation within undeveloped habitats, resulting in direct habitat loss. The maximum area of this permanent loss is predicted to be 1.1ha (not including upgrading of existing access track), with some areas at the margins experiencing temporary loss followed by re-vegetation.
Disturbance to species	The construction of the proposed development has the potential to cause temporary disturbance to nearby habitats and species for the duration of the works, as a direct result of activities such as vehicle movements, noise and increased human activity.
Displacement of species and indirect habitat loss	The construction of the wind farm has the potential to displace species. During construction, the impacts will be primarily terrestrial, causing habitat loss and deterring species from entering the area.

Impacts on Designated Sites

Due to the distance between the Site and Firth of Tay and Eden Estuary SPA and Ramsar site, there will be no direct habitat loss or disturbance to any qualifying species within the site as a result of the construction of the proposed wind farm.

Disturbance or displacement impacts and any impacts as a result of indirect habitat loss to any of the SPA qualifying features are discussed in detail in Section 8.5.

The revised scheme would not result in any changes to the impacts on the Firth of Tay and Eden Estuary SPA and Ramsar site.

Impacts on SPA Qualifying Species

Greylag geese, pink-footed geese and oystercatcher are part of the qualifying interest of the Firth of Tay and Eden Estuary. All three species only use the SPA over the winter months and any impacts on the SPA population would, therefore, have to occur during this time. However over the winter months, all three species were rarely recorded at the Site. Frawney was not used by foraging or roosting geese or oystercatchers. Therefore, no disturbance, displacement or habitat loss as a result of construction activities would affect any of these species. It is concluded that the construction of the proposal would not have a likely significant effect on the SPA qualifying features or the SPA itself.

The revised scheme would result in in no significant impacts on the qualifying features of the SPA which is consistent with the impact of the previously consented scheme.

Impacts on Other Ornithological Receptors

If construction was to take place during the breeding season, all birds breeding within the wind farm footprint or in the vicinity of construction activity could be affected. All nesting birds are protected under the Wildlife and Countryside Act 1981 and, therefore, all species need to be taken into consideration during any construction activities that may be carried out during the breeding season (March to July inclusive).

Ornithological receptors at the Site, present during the breeding season include most farmland species. If construction activities were to take place during the breeding season, some breeding and foraging habitat could be lost indirectly due to disturbance and displacement in addition to the direct loss of the habitats itself. However, as most of the access tracks will be located on existing farm tracks with only short sections being added to reach the turbine bases, any impacts as a result of track construction and habitat loss are expected to be of barely perceptible to low magnitude and would not be altered by the changes due to this revised scheme.

With a breeding assemblage of local conservation value, any potential impacts as a result of direct habitat loss or disturbance are considered to be not significant which is consistent with the impact of the previously consented scheme.

8.4.2 Mitigation Measures

The development of a wind farm could affect breeding birds. To protect the breeding birds on the Site, it would be beneficial for the track construction work to be completed before the start of the breeding season. Vegetation should be cleared before breeding birds occupy their territories or well after young birds have fledged.

The potential impacts of the proposal were considered to be low to no impact magnitude for all species with the magnitude of impacts not exceeding minor to no significant impacts. No further mitigation measures are recommended.

8.4.3 Predicted Residual Impact

The overall construction impacts of the proposed wind farm for all bird species encountered at the Site are considered to be not significant which is consistent with the impact of the previously consented scheme.

8.5 Permanent and Operational impacts

8.5.1 Predicted Impact

Some of the impacts predicted as a result of the operation of the proposed Frawney Wind Farm can be considered generic impacts which are typically associated with a development of this nature. A receptor may be affected by each of these generic impacts or just one. A summary description of these impacts is presented in Table 8-8. Impacts that are arising during the operation phase are considered to be permanent.

Table 8-5: Generic Impacts of the Operation of a Wind Farm on Bird Species

Generic Impacts	Effects on Species on Site
Direct habitat loss	The proposed wind farm will involve the construction of access tracks, turbine bases, crane hardstandings, site compound and substation within undeveloped habitats, resulting in direct habitat loss. The maximum area of this permanent loss is predicted to be 1.1ha, with some areas at the margins experiencing temporary loss followed by re-vegetation.
Disturbance to species	The operation of the proposed development has the potential to cause disturbance to species, as a direct result of the presence of the turbines and associated activities such as vehicle movements, noise and increased human activity.
Displacement	The operation of the wind farm has the potential to displace species. During

Generic Impacts	Effects on Species on Site
of species and indirect habitat loss	operation, the surrounding terrestrial habitats will be restored; however the operational wind turbine may displace avian species.
Collision risk	The presence of the moving rotors of the wind turbines in operation may present a risk of collision to fauna flying over the area.

The collision risk has been calculated for golden plover, curlew and lapwing as flight activity levels for these species were high enough to return meaningful results. Random collision risk modelling was completed for all three species as the flightline figures suggested that the flight activity was unpredictable, using most of the Site. Results are presented in Table 8-6 and 8-7 and details on the calculation of the model and worked examples are presented in Appendix 8-1. The results show a slight increase in collision risk compared to the results from the consented wind farm (Ref: 13/00532/EIAL) due to the small increase in the height of the turbines.

Table 8-6: Collision Risk Modelling Results for current application of four turbines

Species	Annual collision risk	Years per collision	Collisions over 25 years
Golden plover	0.026	37.13	0.673
Curlew	0.030	33.15	0.754
Lapwing	0.122	8.21	3.046

Table 8-7: Collision Risk Modelling Results for application 13/00532/EIAL of five turbines

Species	Annual collision risk	Years per collision	Collisions over 25 years
Golden plover	0.021	48.50	0.515
Curlew	0.021	48.60	0.514
Lapwing	0.094	10.67	2.342

Impacts on Designated Sites

Due to the distance between the Site and the Firth of Tay and Eden Estuary SPA and Ramsar site, there will be no direct habitat loss or disturbance to any qualifying species within the site as a result of the operation of the proposed wind farm. The revised scheme would result in no changes to the predicted impacts on the SPA and Ramsar in terms of direct habitat loss, disturbance or displacement of the qualifying species.

Disturbance or displacement impacts, collision risk and any other impacts to any of the SPA or SSSI qualifying features are discussed in detail in the next section.

Impacts on SPA Qualifying Species

As greylag and pink-footed geese as well as oystercatcher of the wintering SPA population were not found to be using the Site to roost or forage, no indirect impacts such as disturbance or displacement are expected.

Flight activity levels of greylag and pink-footed geese as well as oystercatcher over the Site were very low with the majority of the few recorded flights noted above or below collision risk height. Therefore, the collision risk for these three species is considered to be of a magnitude of barely perceptible to no impact.

Overall, the operation of the wind farm is not considered to result in a significant impact on the SPA or its qualifying features.

As the SPA qualifying birds were found not to be using the Site to roost or forage the revised scheme would result in no changes to the impacts of the operation of the wind farm on the SPA qualifying species, which is consistent with the impact of the previously consented scheme. Due to the increase in height of the turbines in this revised scheme there could be a slight increase in the impact of the operation of the wind farm but as the flights of the SPA qualifying birds are mostly outwith the collision risk height there would be no change to the impact of the previously consented scheme.

Impacts on Other Ornithological Receptors

Disturbance and displacement as a result of the operational wind farm could affect all species using the Site during the year, in particular those considered to be at risk from wind turbines. Although a number of species of conservation importance were recorded on the Site, most of these are not known to be sensitive to the presence of wind turbines. Curlew was the only species potentially at risk from wind turbines but the two breeding territories were identified over 1km from the nearest proposed turbines. Therefore, no disturbance or displacement of breeding curlew is expected. Any impacts as a result of direct or indirect habitat loss, disturbance or displacement as a result of the operational wind farm are considered to be of a magnitude of no impact.

The revised scheme would result in the reduction of landtake but this would not change the predicted impacts of the operation of the wind farm as the curlew breeding territories are over 1km from the Site and other species of conservation concern are not at risk from wind turbines.

Flight activity of three wader species, golden plover, curlew and lapwing was high enough over the Site to allow collision risk calculations. These resulted in an estimated annual collision risk of 0.026 for golden plover, 0.030 for curlew and 0.122 for lapwing. Although these levels are slightly higher than those predicted for the consented wind farm (Ref: 13/00532/EIAL) they are still considered to be so small that no impacts are expected for the breeding or wintering populations of the three species.

8.5.2 Mitigation Measures

No specific mitigation measures are proposed for the operational phase of the wind farm.

8.5.3 Predicted Residual Impact

The overall operational impacts of the proposed wind farm for all bird species encountered at the Site are considered to be not significant.

8.6 Cumulative Impacts

There may be cumulative impacts of wind farms on flora and fauna, with the greatest theoretical risk being of significant impacts arising on species of national or international importance resulting from a number of wind farms being present in a relatively small area (e.g. Landscape Design Associates, 2003). Current guidance suggests that the highest priority for cumulative impact assessment is for species that are declining and/or not in favourable conservation status and that species of very high conservation importance or those vulnerable to wind farms may be targeted for cumulative assessments (SNH, 2012).

To assess cumulative impacts on ornithological receptors, a search for wind farm schemes in the Natural Heritage Zone (NHZ) 16, the Eastern Lowlands was carried out. Over 100 wind farms were identified in the scoping, planning, approved or operational stages. Due to the large number of wind farms within the NHZ16 area, only operational or approved schemes will be taken into account, to assess cumulative impacts on ornithological receptors.

There is one small operational turbine of 25m tip height currently installed at the Nether Finlarg Farm, directly east of the proposed development, but no other operational wind farms are located within a 5km radius of the Frawney site. Arkhill Wind Farm comprising of eight turbines is now operational 6km west of the proposed site. Chapter 6 (Landscape & Visual Impact) considers all wind farms known to be operational, consented and in planning within 60km of the proposed development. Figure 6-28 presents an overview of these wind farms.

Notwithstanding this impact assessment, in undertaking an appropriate assessment of the proposed development on the SPAs, the competent authority would also need to include the potential effects of the proposal 'in combination' with other developments that may affect the integrity of the SPAs. SNH confirmed in their response to planning application 12/00577/EIAL that they considered no appropriate assessment to be necessary for this site although detail to inform and review this opinion is provided here for completeness.

Only five operational wind farms (Lochelbank with 12 turbines, Arkhill with eight turbines, Michelin Tyre Factory with two turbines, Scotston Hill with one turbine and Methil Docks with one turbine) were located within 20km of the SPA. This is the maximum distance where connectivity between a SPA designated for wintering waterfowl (in particular goose species) and a wind farm is assumed. Cumulative impacts on the Firth of Tay and Eden Estuary SPA would, therefore, be limited to these proposals.

It was not possible to obtain copies of the full ES's for these nearby schemes but non-technical summaries (NTS's) were available for three of the schemes. For Arkhill, the NTS notes that no significant impacts are predicted upon birds from the scheme and in particular, it is considered that there would be no threat to wintering geese flights patterns. Arkhill is surrounded by farmland habitat that could be suitable for wintering waterfowl although the site itself is elevated in rough grassland of the Sidlaw Hills.

The predicted impact of the other wind farm schemes on the SPA populations is not known but the information available in the NTS's was used to deduct any potential impacts. The largest scheme, Lochelbank is located on upland pasture, moorland and woodland. The Michelin Tyre turbines are in the outskirts of Dundee in an industrial setting, similar to the Methil dock turbine. As such, these areas are unlikely to be of significant value to wintering waterfowl. Only the Scotston Hill turbine is located in farmland habitats that could be suitable for any of the SPA species. However, for this scheme an ornithological report was submitted based on which SNH and RSPB raised no concerns regarding this turbine.

Based on the information available, the individual schemes would appear to be located in areas of no or limited value to wintering geese so that the impact of every wind farm individually is not likely to be significant. Cumulatively, the Firth of Tay and Eden Estuary SPA and its qualifying interest is not considered to be affected by the present wind farm schemes within a 20km connectivity distance. As Frawney does not represent an area of importance to wintering geese and swans either, no cumulative impacts are expected.

8.7 Summary

Twelve months of ornithological survey work was completed for the proposed wind farm during 2008 and 2009. Surveys included 12 months of VP survey work from three VP locations with dawn, diurnal and dusk watches, winter walkover, breeding bird and barn owl surveys. Whilst the survey data was collected four years ago, the habitats on the site and farming operations have not changed during this period and, therefore, the data is considered to provide a robust baseline on which to base the ornithological assessment.

The Firth of Tay and Eden Estuary SPA is located approximately 10km to the south of the proposed development. The SPA is designated for its wintering populations of greylag and pink-footed geese, bar-tailed godwit, redshank and the wintering waterfowl assemblage including species of ducks and waders such as oystercatcher. The SPA is also designated for its breeding populations of marsh harrier and little tern.

Of the SPA qualifying species, only greylag and pink-footed geese and oystercatcher were recorded over the winter months but records for all three species were infrequent and no patterns of roosting, foraging or regular flight paths could be identified at or near the Site. The overall construction and operational impacts on the wintering SPA population was considered to have no likely significant effect on the SPA and its qualifying features.

Other species of conservation concern included peregrine, golden plover, whooper swan, goshawk, barn owl, curlew and lapwing. None of these species were recorded in large numbers or frequently using the Site to forage, breed or roost. Goshawk was the only species of elevated conservation concern breeding close to the Site. However, goshawk flight activity over the Site was recorded only infrequently. The avian assemblage on the Site was considered to represent a typical, diverse farmland bird assemblage with low numbers of breeding pairs for most species.

The proposed changes to the consented wind farm (Ref: 13/00532/EIAL) i.e. the removal of turbine 5 and the increase in height of the four remaining turbines would result in no changes to the predicted impacts which might occur during the construction and operation of the proposed wind farm.

Collision risk calculations (using the random model) were completed for golden plover, curlew and lapwing. Flight activity of all these species was low to infrequent. The predicted annual collision risk for all species was very low with a maximum value of 0.122 birds per year for lapwing. Overall, the potential collision risk to bird species at Frawney was considered to be not significant for any of the species encountered.

Recommended mitigation measures include construction programmed outwith the breeding bird season to protect any breeding birds present.

With no significant adverse impacts expected for any of the bird species encountered at the Site, no significant cumulative impacts are expected from the Frawney development in combination with other wind farm schemes in the NHZ Eastern Lowlands.

8.8 References

Natural Heritage (2000). Windfarms and birds: calculating a theoretical collision risk assuming no avoidance action. SNH Guidance Note Series. SNH, Battleby.

Scottish Natural Heritage (2005, revised 2010). Survey methods for use in assessing the impacts of onshore windfarms on bird communities. SNH Guidance. SNH, Battleby.

Scottish Natural Heritage (2006, updated 2012). Assessing significance of impacts from onshore windfarms on birds outwith designated areas. SNH Guidance, SNH, Battleby.

Scottish Natural Heritage (2012). Cumulative effect of windfarms. Version 2 Revised. SNH Guidance, SNH, Battleby.

9 Hydrology, Hydrogeology and Soils

9.1 Introduction

This chapter undertaken by Atmos Consulting addresses the assessment of the potential impacts of the proposed development on the surface water and groundwater environment in terms of both quality and quantity. In addition, the chapter addresses the potential impact of the development proposals on soil and geology, both on the site and its immediate surroundings.

The assessment is primarily concerned with the proposed four wind turbines and associated infrastructure (access track, electrical cable, control building and construction compound) referred to as the development area and covers a study area of up to 1km from the turbines and infrastructure. However, where a hydrological connection deems it necessary, the assessment has considered locations beyond 2km. The assessment also takes account of the potential for cumulative effects with other developments.

This chapter is supported by the following Technical Appendices:

- Appendix 9-1: Inventory of Water Features; and
- Appendix 9-2: Water Supply Locations and Details.

9.2 Methodology and Approach

9.2.1 Information Sources

The following sources of information, presented in Table 9-1, were used in the completion of this chapter.

Table 9-3: Information Sources

Topic	Source of Data and Information
Climate Rainfall	Centre of Ecology and Hydrology (CEH) National River Gauge Archive Data Weather Underground, wunderground.com – local weather stations
Topography Elevation, Relief	Ordnance Survey Mapping Google Maps aerial images
Geology Solid and Drift	British Geological Society (BGS) Solid Edition Mapping (Scale 1:50,000), Sheet 49 Arbroath (1984) British Geological Society (BGS) Drift Edition Mapping (Scale 1:50,000), Sheet 49 Arbroath (1984) SNH website (www.snh.org.uk)
Soil Soil Type	Macaulay Institute Soil Survey Map (Scale 1:63,360) Sheets 57 Forfar (1961)
Groundwater Hydrogeology, Aquifer Properties, Source Protection Zones and Groundwater Levels	SEPA - Consultation and published sources on their website (www.sepa.org.uk) SEPA groundwater monitoring sites Hydrogeological Map of Scotland (Scale 1:625,000) (Institute of Geological Sciences, 1988) Scottish Aquifer Properties Interim Report (BGS, NERC and Sniffer, June 2006).

Topic	Source of Data and Information
	A GIS of aquifer productivity in Scotland explanatory notes (BGS, 2004). Groundwater Vulnerability Map of Scotland (http://data.gov.uk/dataset/groundwater-vulnerability-map-of-scotland)
Surface Water Surface Water Features, Flood Risk, Water Quality, Recreational Waters and Fisheries	Angus Council - Consultation SEPA - Consultation and published sources on their website (www.sepa.org.uk) Scotland Drinking Water Protected Area for surface water, Scottish Government Website Maps, Map 11
Water Resources Private Water Supplies, Licensed Abstractions, Impoundment Licenses And Discharge Consents	Angus Council - Consultation SEPA - Consultation and published sources on their website (www.sepa.org.uk) Public consultation, interview and questionnaires
Water Authority Assets	Scottish Water – Consultation

9.2.2 Consultation

Before undertaking the assessment, key consultees with a specific interest in the water environment were contacted. These included SEPA, Scottish Water and Angus Council (Table 9-2). SNH also commented on the water environment during scoping in 2009.

Table 9-4: Consultation Responses

Consultee	Response	Comment
Angus Council	Scoping response, Dave Scott 02/04/2009	The hydrological and hydrogeological assessment should identify the impact of the proposal on the hydrology and hydrogeology of the area and assess any possible impact on private water supplies. It should assess the level and significance of any impact and detail any mitigation.
	Hydrological information request, sent 04/01/2012, responses received from Lyn Simpson (19/01/2012) and Angela Murray (23/01/2012), Economic Development and Environmental and Consumer Protection	Cognisance should be taken of the comments provided by SEPA in its letter dated 16 January 2009. Angus Council provided a list of all properties within Angus known to be on private water supplies (PWS). Information was noted not to be comprehensive and missing some grid references and source types. The data related to properties only. Further details on the sources (where known) was provided on 23/01/2012 for the properties identified to be within hydraulic catchment and 2km of the study area.
SEPA	Scoping response received 16/01/2009 from Julia Garnett, Acting Senior Officer	All potential sources of pollution should be identified and mitigation measures should be detailed within the ES. Key areas of pollution related to a wind farm development are siltation of surface runoff, erosion of access tracks, fuel storage and management and foul effluent disposal. Surface water management should be through the use of SUDS principles. All private water supplies within the catchment should be identified and measures taken to ensure the protection of these supplies from pollutions. Contact should be made with Angus Council Environmental Health Department

Consultee	Response	Comment
		regarding this issue. Potential impacts to hydrology must be addressed within the ES including impacts to watercourse and flood risk.
	Hydrological information request received 16/03/2012	Confirmed SEPA does not have any rain gauges in the requested area. However, SEPA provided monthly rainfall totals and the Long Term Average for the nearest observer read gauge located in the Forfar (NGR 3443 7503). The data has not been quality controlled. There is no SEPA flow data available within or adjacent to the development area. SEPA provided no information on historical flooding, water quality or licensed abstractions or discharges.
	Response to planning application 12/00577/EIAL	SEPA's principal area of concern is centred on construction activities and the creation of access roads and consider that the production of a Construction Method Statement (CMS) is essential, to be fully implemented by all operators on site. SEPA has no objection subject to a planning condition being attached to any consent ensuring that no development can commence until a full site specific Environmental Management Plan (EMP) incorporating a Construction Method Statement (CMS) and a Site Waste Management Plan (SWMP) is submitted at least one month prior to commencement of development and approved by the planning authority, in consultation with SEPA and other agencies such as SNH. Detailed guidance on the content of the CMS is also provided by SEPA. It is unclear from the application whether the developer intends to utilise borrow pits. It should be noted that should infilling the borrow pit use waste materials like peat, shrubbery, fencing materials or any imported 3rd party waste, as part of the works, is regarded as a waste disposal activity and therefore requires SEPA authorisation. SEPA request confirmation as to whether borrow pits are intended. Should the developer wish to import inert wastes to assist the formation and construction of the access roads they would be required to submit a Paragraph 19 Waste Management Licence exemption for "relevant work". SEPA does not have any concerns regarding the ecological impacts of this proposal as long as SEPA Pollution Prevention Guidelines are followed, appropriate licences are in place and suitable mitigation measures are employed. Impacts on Private Water Supplies (PWS) have been assessed by the developer. From the data provided it is considered unlikely that the proposed development will have an adverse impact on PWS in the area.
Scottish Government Environmental quality	Response to planning application 12/00577/EIAL	No objection to application 12/00577/EIAL

Consultee	Response	Comment
Scottish Water	Asset information request sent 04/01/2012 received 05/01/2012	The nearest Scottish Water infrastructure to the development is located approximately 0.4km from the development area to the northwest of the A90. Scottish Water infrastructure is presented on Hydrological Features Figure 9-1.
	Response to planning application 12/00577/EIAL	No objection to application 12/00577/EIAL
SNH	Scoping response received 27/01/2009	Soil and water to be included in the EIA. The Dean Water is part of the River Tay SAC which extends up to Inverarity, approximately 6km downstream from the proposed development. At this distance, SNH considers that the proposed wind farm is sufficiently far from the SAC for significant effects to be unlikely (effects considered include release of sediment and other pollutants from the proposed wind farm site into watercourses). No comments on water environment in response to planning application 12/00577/EIAL.

9.2.3 Overall Approach

The assessment has been undertaken primarily using a qualitative assessment based on professional judgement and statutory and general guidance. It assesses potential impacts during the construction and operation of the proposed development and outlines mitigation measures to control the predicted effects of the proposal. It incorporates:

- A review of the relevant legislation, guidelines and policy;
- Consultation with both statutory consultees and private water supply users;
- A desk study to identify existing information;
- Site visits to determine baseline conditions;
- Constraints on the development associated with the hydrology, hydrogeology, geology and soils, so that the most sensitive areas can be avoided or protected;
- The prediction of likely impacts on hydrology, hydrogeology and hydro-ecology from the proposal;
- The assessment of the likely significance (as described in the EIA regulations) and predicted magnitudes of impacts and the sensitivities of receiving environments;
- Identify mitigation measures to avoid, remediate or reduce the identified effects; and
- Identify residual effects of the development and their significance after implementation of the recommended mitigation measures.

9.2.4 Potential Effects of Wind Farm Development

Potential hydrological/hydrogeological effects resulting from the construction, operation and decommissioning of wind farms relate to four main factors:

Erosion and Sediment Transport

Unmanaged erosion/sediment deposition and suspended solids generated from ground disturbance could travel directly by surface runoff or cause modification to stream channel morphology, with resulting smothering of habitats/ impact on both terrestrial and aquatic flora and fauna, especially fish. Unacceptable levels of sediment could also affect water abstracted for drinking supply.

Potential Polluting Events Affecting Groundwater and Surface Water Quality

Oil, fuel and chemical pollution (from accidental spillage, incorrect transport, storage during concrete preparation and refuelling procedures, leaching of concrete from turbine bases and installations etc.) could impact both terrestrial and aquatic flora and fauna and also on human activities such as water abstracted for drinking supply.

Alteration of Natural Drainage Patterns/Runoff Volumes and Rates

Any alteration of natural drainage could disturb natural surface and subsurface water flows to either water dependent habitats or to water supply abstraction points, unless properly managed. Tracks and other hardstanding areas could provide new preferential pathways that interfere with the retention of flows within catchments. Inappropriate water crossings could result in blockages and flooding, with the potential to exacerbate erosion.

Increase in the Magnitude or Frequency of Flood Events

The construction of bridges or alteration of flood plains area may result in flood waters extending further or deeper elsewhere and/or increase the frequency of such events. This could result in risk to human life/ health, damage to infrastructure and property, and changes to ecological systems.

9.2.5 Guidance and Legislation

The assessment has been undertaken in accordance with statutory and general guidance and environmental legislation relating to the water environment including:

Statutory and General Guidance

- Scottish Planning Policy (SPP), Scottish Government (2010);
- Pollution Prevention and Control (Scotland) Regulations (2000);
- Pollution Prevention Guidelines (PPGs);
- Planning Advice Notes (PANs), Scottish Government;
- CIRIA publications;
- C532 Control of water pollution from construction sites (2001);
- C650 Environmental good practice on site (2005);
- DEFRA draft Code of Practice for the sustainable use of soils on construction sites;
- DEFRA Good practice guide for handling soil (MAFF 2000);
- DEFRA UK (UKCP09) climate projections (2009);
- SEPA Land Use Planning System Guidance Note 4, LUPS-GU4 (March 2012);
- Forestry Commission, Forest and Water Guidelines, Fourth Edition (2003); and
- SNH Good Practice during Wind Farm Construction (2010).

Legislation

- The Water Environment (Controlled Activities) Regulations, 2011 (as amended in 2013)(CAR);
- Control of Pollution Act 1974;
- Environmental Protection Act 1990;
- Environment Act 1995;
- Groundwater Regulations 1998;
- The Flood Risk Management (Scotland) Act 2009
- Water Environment and Water Services (Scotland) Act 2003 (WEWS Act);
- Water Framework Directive (WFD), 2000;
- Private Water Supplies (Scotland) Regulations, 2006;
- EC Freshwater Fish Directive (2006/44/EC);
- Waste Management Licensing Regulations 1994, (SI 1994); and
- Environmental Liability (Scotland) Regulations 2009.

9.2.6 Assessment Methods

Significance Criteria

There are no published guidelines or criteria for assessing and evaluating effects on hydrology, hydrogeology, geology or soil within the context of an EIA. The assessment is, therefore, based on a methodology derived from generic EIA regulation guidance, IEMA guidance and SNH publication 'A Handbook on Environmental Impact Assessment'. The methodology is also based upon relevant SEPA guidance including 'Assigning Groundwater Assessment Criteria for Pollutant Inputs' (SEPA, 2010). The assessment method approach as set out within Chapter 2 has been used within this assessment.

9.3 Baseline Conditions

This section describes the existing baseline conditions at the proposed development and its immediate surroundings.

9.3.1 Site Visit

A site visit was undertaken on the 23rd January 2012 by a qualified hydrologist and EIA Project Manager. Key issues and features were identified, including surface water features, dominant soil types and other land use characteristics likely to influence hydrological processes. Weather conditions during the site walkover were dry, sunny and cold.

An inventory of the main surface water features identified within the area of the development is presented within Appendix 9-1.

9.3.2 Topography, Land Use and Climate

The proposed development occupies an area of arable and pastural fields on the southeastern slope of Finlarg Hill between 200m and 250m AOD. Elevations of the hydrological study area decrease from the summit of Finlarg Hill at 336m AOD to approximately 180m AOD at Nether Finlarg Farm in the east. Slopes within the area are relatively low to medium gradient and surface water runoff is expected to be low to medium.

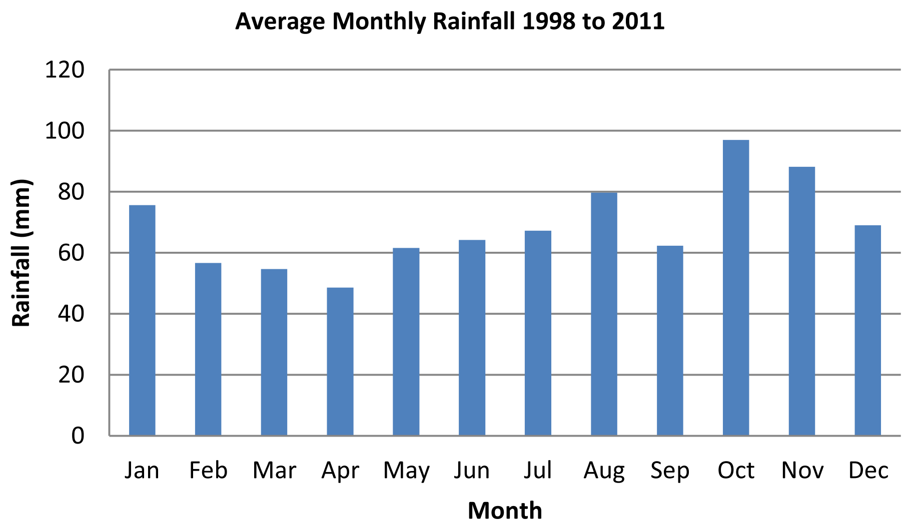
Existing farm tracks are present linking Over Finlarg Farm with the fields towards the lower reaches of Finlarg Hill. The structure of these tracks generally comprises a gravel build up and some less used tracks were observed without any significant build up. The gravel tracks where present comprised local dark red sandstone or dark grey dolerite type imported gravel.

The proposed access track for the wind farm development uses some of the existing tracks and follows the lines of existing field boundaries where possible.

Average annual catchment rainfall for the Dean Water catchment is approximately 823mm (data obtained from the CEH the 1961 to 1990 National River Flow Archive data), indicating a relatively dry climate compared to the rest of Scotland.

Rainfall data from SEPA's nearest observer read gauge located in the Forfar (NGR 344300, 750300) provided data for monthly average rainfall calculations. Monthly average rainfall is present in Chart 9-1.

Chart 9-1 Average Monthly Rainfall



9.3.3 Soils

The distribution of soils over the proposed area is generally controlled by the underlying geology, the topography and the drainage regime. The Soil Survey Map of Scotland (1:50,000) sheet 57 indicates that the majority of the development area is underlain by the Balrownie Association. The Balrownie Association is an intermediate freely to imperfectly draining iron podzols to brown forest soils derived from till from Lower Old Red Sandstone sediments and water sorted material overlying the till. The Balrownie Series brown forest soils are located on the lower flanks of the slope and the Aldbar iron podzols are mainly located on the upper slopes of Finlarg Hill.

Soils observed during the site walkover were recorded to be a dark reddish brown sandy soil with occasional sub-angular to sub-rounded sandstone fragments.

There are no peat deposits shown in the development area or in the vicinity of the development area.

Soils comprise primarily of natural soil deposits with the exception of three localised areas of made ground as described below:

1. A recent borrow pit extraction area (NGR 341360, 742630) partially infilled with soil, rock, wood and fencing materials located to the northwest of the development area, west of the pylons, adjacent to the channel of the watercourse.
2. A small area of hydrocarbon staining in the northwestern section of the development area (approximate NGR 341610, 742640) caused by an oil spill adjacent to the water supply pumping house at the open air reservoir. Some attempt had been made to prevent the oil from leaching into the watercourse in the form of a hay bale bund down gradient of the stained area.
3. A recent area of disturbed ground within the central section of the development area (approximate NGR 341595, 742070) adjacent to the ruin and sheep wash area. The landowner indicated this area had been recently cleared to install new drainage from the former pond up gradient. Evidence of a section of this area being used for the burning of materials was observed.

Overall, the development area has been used for rural agricultural practices and other than the areas listed above, no evidence of contamination or contaminative uses was observed. Therefore, there is unlikely to be a presence of any significant contamination at the site.

9.3.4 Drift Deposits

The drift geology map indicates the majority of the development area is covered by glacial till drift deposits comprising compact sandy clay containing clasts of local rocks and far travelled erratics. To the south of the main development area glacial meltwater deposits comprising sand and gravel often giving rise to a hummocky topography. Areas of higher topography, towards the summit of Finlarg Hill, are shown to have no drift deposits overlying the bedrock. This was confirmed by bedrock being very close to the surface on Finlarg Hill.

The drift geology, where present, within the development area is considered to be of low sensitivity as a result of its relatively impermeable and localised nature.

9.3.5 Solid Deposits

The development area is underlain by the Arbroath Sandstone, part of the Dundee Flagstone Formation and Garvock Group of the Lower Devonian Old Red Sandstone. The Arbroath Sandstone comprises mainly of cross bedded sandstone varying from red to purple with some limestone detritus.

Sandstone outcrops were present on higher ground in the northwestern section of the development area. The sandstone was observed to be a dark red to greyish brown fine to medium grained sandstone with a flaggy structure in places. Many of the existing drystone walls or dykes along the field boundaries are constructed of this local red flaggy sandstone.

No known geological faults are known within the development area.

There are no publically available BGS borehole logs available within 1km of the development to provide further information on the geological setting. Several confidential boreholes are noted in the area, mainly located adjacent to properties, for example Nether Finlarg, Kierton Farm Cottage, Dunrobin Cottage and along the A90 trunk road.

The BGS provided information on an existing record from a hydrogeology study in the area, however, the exact location is unknown and it is unclear if records refer to a spring or borehole. This BGS record recorded up to 33m thick of undifferentiated drift deposits underlain by a Lower Old Red Sandstone.

The solid geology is considered to be of low sensitivity.

9.3.6 Mining and Quarrying

No visible evidence of mining or quarrying within the development area was noted during the site walkover or on review of OS mapping with the exception of one area adjacent to a watercourse to the northwest of the development area. Aerial imagery showed a lumpy ground surface within the northwestern section of the development area which were identified as most likely being former borrow pit excavations. During the site reconnaissance a small recent borrow pit partially infilled was observed on the southern side of the watercourse. The fresh rock exposed within the borrow pit was observed to comprise dark red fine to medium grained flaggy sandstone. Additional small heaps of rocks were noted to the north of this watercourse at higher topographical heights.

Four disused stone quarries are shown on OS mapping to the west of the proposed development area in the region of Lumleyden. The quarry areas were observed to be borrow pits overgrown with vegetation with some spoil being exposed. The most southeasterly excavation area is currently a pond.

No borrow pits are currently proposed on site; it is anticipated that aggregate would be transported to the site from local quarries.

9.3.7 Hydrogeology

The Lower Old Red Sandstone is considered to be a locally important aquifer of moderate permeability in which flow is dominantly in fissures and other discontinuities with the potential for some intrinsic flow.

The SEPA web based interactive map indicates the development area to be located within the Forfar bedrock and localised sands and gravels area, part of a SEPA Drinking Water Protected Area (DWPA) and a nitrate vulnerable zone. It should be noted that the whole of Scotland is classified as a groundwater DWPA.

The groundwater in the Forfar bedrock and localised sands and gravels area is classified as good for quantity and poor for quality as a result of diffuse nitrate pollution from arable farming. The SEPA River Basin Management Plan objective for this groundwater body is to be classified as good by 2015.

The underlying geology has the potential to contain groundwater in locally exploitable quantities, for private water supplies and potentially public water supplies. Groundwater may also be important for base flow supply to surface water bodies. Overall, the groundwater is considered to be of medium sensitivity.

9.3.8 Groundwater Vulnerability

Any groundwater potentially present is anticipated to have flow dominated by local structural features, fissures, discontinuities and the topographical regime as the bedrock is generally considered moderately permeable. Where there is less than 1m of drift deposit the soil porosity is used to map the groundwater vulnerability. The underlying bedrock is likely to be moderately permeable and there is assumed to be some attenuation capacity of the bedrock below the low permeability drift deposits.

The BGS classifies the vulnerability of the groundwater under the site as class 4 equating to groundwater being vulnerable to pollutants not readily absorbed or transformed and that pollution incidents will have a rapid travel time. It should be noted that the BGS vulnerability is assessed on a large scale and, therefore, may not fully represent the vulnerability of the localised Old Red Sandstone bedrock.

9.3.9 Hydrology

The development area generally sheds runoff to the east through un-named drains and the Gallowfauld Burn into the Corbie Burn approximately 3km east of the proposed development. The Corbie Burn joins the Kerbet Water approximately 5.5km down gradient of the proposed development. The Kerbet Water then flows east and northwest into the Dean Water approximately 13.5km down gradient of the development area to the northwest. The Dean Water flows to the northwest into the River Isla, which joins the River Tay at Mains of Cargill approximately 25km to the west of the proposed development. The River Tay ultimately discharges to the Firth of Tay at Perth. The approximate sub-catchment boundary of the development area is shown on Figure 9-1.

The nearest named surface water body to be shown on a 1:50,000 scale OS mapping is the Gallowfauld Burn to the east of the development area. The Gallowfield Burn was noted to be a morphologically altered burn that has been historically redirected underground, around Nether Finlarg Farm as part of a historical mill lead, and appears at the surface as a stone lined ditch along the road by Nether Finlarg to the east of the proposed development.

The majority of the natural watercourses that would have flowed through the development area flow underground within culverts originally installed for land gain and directing water to former mills that were located at Over Finlarg and Nether Finlarg. Both these farms had small dammed reservoirs feeding the mills located behind their properties. The approximate route of the culverts has been interpreted by review of aerial images, historical maps, the position of topographical low areas, consultation with the landowners and on site observations.

The indicative culvert locations are illustrated on the hydrological features Figure 9-1.

The 1:25,000 scale OS mapping shows several wells and springs located within and adjacent to the development area:

- A well is shown adjacent to the sheep wash area and former ponded area within the central area of the site (NGR 314567, 742085). No evidence of this well was observed during the site visit and the landowner indicated that there was no well currently used in this location.
- A well within a small fenced boundary containing the Frawney ruin is shown in the northern section of the site (NGR 341925, 742603). No evidence of the well was

observed during the site walkover and the area is currently being used as a small plantation area.

- A spring is shown to the northwest of the development area (NGR 341587, 742652). Observations made whilst on site indicated that this spring is a piped or culverted supply along the base of a former stream valley that originates further up gradient on the hillside. The valley is currently a dry valley as runoff is likely to be collecting into the underground culvert/drain discharging into the open air man-made reservoir. This water source is known to be a source of water supply for nearby properties.
- To the southwest of the development area, a well and two springs are shown adjacent to the ponded/former quarry area at Lumleyden. No visible evidence of a well or water supply infrastructure was recorded at this location to the south of the pond, however, presence of a pond indicates there must a water supply nearby.

The site visit confirmed the presence of an open air reservoir in the northwestern section of the development area (NGR 341570, 742660). The reservoir was approximately 25m in length by 10m in width, by between 0.3m to approximately 1.5m in depth lined with black plastic lining material. The lining material was noted to be creased and wrinkled in areas and there were several large air bubbles below the lining material causing the lining to rise. The reservoir is a basic open air water collection structure with an abstraction taken from the central to lower end. To the east, down gradient of the reservoir was a small hut or pump house that pumped water from the reservoir to several underground holding tanks.

OS mapping and aerial imagery showed two covered reservoirs; one down gradient to the open air reservoir and one to the south and up gradient of the covered reservoir. During the site visit these features marked as reservoirs were confirmed to be underground water storage tanks. The tanks to the south of the reservoir are of concrete construction hidden under vegetation that supplies water to Nether Finlarg Farm and Cottages. To the south of the reservoir two underground storage tanks were observed. One of concrete and brick construction that was observed to be empty and another more modern tank of fibre glass construction immediately adjacent to the older tank.

OS mapping showed a small pond adjacent to the sheep wash area towards the centre of the site (NGR 341540, 742130). Observations during the site visit recorded this pond area / topographical dip to contain no standing water but it is clear from the lack of vegetation that this area has contained water in the past. Evidence of earthworks was present down gradient of the former ponded area and the landowner indicated that he had been upgrading the drainage in this area.

During the site visit, the development area comprised generally dry arable fields with no significant boggy areas recorded. A slightly wet area was recorded in the northern section of the site within the field corner (approximate NGR 341805, 742560). At this location the small watercourse flowing east becomes a more diffuse flow through vegetation before flowing into a man-made drainage ditch which leads to an underground culvert. This watercourse reappears at the surface adjacent to the road to the southeast of the development area.

The hydrological features on and adjacent to the development area are presented on Figure 9-1 and an inventory of the main water features is presented in Appendix 9-1.

Further information on the private water supplies is presented in Section 9.3.13 and Appendix 9-2.

9.3.10 Water Quality

SEPA has introduced water monitoring and classification systems that will provide the data to support the aim of the WFD (2000/60/EC): "that all water bodies are of good ecological status, or similar objective, by 2015".

The classification system covers all rivers, lochs, transitional, coastal and groundwater bodies, and is based on a new ecological classification system with five quality classes (High, Good, Moderate, Poor and Bad). The classification system has been devised following EU and UK guidance and is underpinned by a range of biological quality elements, supported by measurements of chemistry, hydrology (changes to levels and flows) and morphology (changes to the shape and function of water bodies). Small water bodies (rivers with <10km^2 catchment, lochs <0.5km^2) are not classified under the WFD and, therefore, do not have target objectives under the River Basin Management Plan. SEPA's interactive River Basin Management Plan (RBMP) Interactive Map was consulted to identify the status of the waters within and adjacent to the study area.

The un-named drains and Gallowfauld Burn have a catchment less than 10km2 and, therefore, have not been monitored by SEPA under the RBMP, as such no recent water quality data is available.

The Kerbet Water to the northeast of the development area has been monitored and classified by SEPA under the RBMP. The Kerbet Water is classified by SEPA as being of poor ecological status as a result of diffuse and point source pollution from arable farming and sewage, and morphological changes changing habitats and abstractions.

The Kerbet Water flows easterly and then northwesterly to join the Dean Water. The Dean Water is classified by SEPA as being of bad ecological status as a result of diffuse pollution source, abstractions and morphological alterations associated with farming activities.

The Dean Water is ultimately part of the River Tay catchment. The River Tay catchment is classified as a SAC for Brook lamprey, Sea Lamprey, River Lamprey, Atlantic salmon, otter and clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels. The SAC designation boundary begins where the Corbie Burn joins the Kerbet Water approximately 5.5km down gradient of the development area.

The River Isla and River Tay are classified by SEPA as being of moderate ecological status and a chemical status of pass. The moderate ecological status is recorded as being as a result of point source pollution from sewage disposal and morphological alterations. The River Tay catchment is a nitrate vulnerable zone, a freshwater fish protected area and an Urban Waste Water Treatment Directive (UWWTD) sensitive area.

Field water quality measurements for the reservoir were taken in situ using a Hanna multi-parameter probe. The results, which represent slightly alkaline water, are presented in Table 9-3.

Table 9-5: Water Quality Measurements

Location	pH	Conductivity (µS/cm3)	Total Dissolved Solids (ppm)	Temperature (°C)	Dissolved Oxygen (mg/l)
Open air reservoir	7.97	167	84	7.5	31.9

The development area is not located within a Scotland Drinking Water Protected Area for surface water according to the Scottish Government Website Maps (Map 11).

The sensitivity of the water quality in the catchment is considered to be medium as the development is within the catchment of the River Tay, however, there are no rapid, direct pathways between the development area and the SAC 5.5km down gradient.

9.3.11 Flood Risk

The proposed development is not located within or in proximity to a SEPA flood risk area. The nearest flood risk area is associated with the Corbie Burn, approximately 1.1km east and greater than 35m altitude down gradient, of the development area. This flood risk area has a 0.5% probability (1 in 200 chance) of flooding. No known flood defences are in place in these areas and no known properties are at risk of flooding along the Corbie Burn within 2km of the proposed development. Flood risk sensitivity is considered to be low.

9.3.12 Designated Sites and Water Dependent Habitats

There are no designated sites on or within 1km of the proposed development. The nearest designated site in relation to hydrology is the River Tay catchment SAC beginning where the Corbie Burn meets the Kerbet Water approximately 5.5km down gradient of the development area.

No groundwater dependent habitats were identified within the proposed development area during the site visits.

Chapter 7 (Ecology) provides further detail on the habitats present on and adjacent to the development area.

9.3.13 Water Resources

Public Water Supplies

Scottish Water has confirmed they do not have any water supply or sewer infrastructure, or other assets within the proposed development area. The nearest Scottish Water mains water supply piping is along the public road and A90 main road approximately 0.35km to the southeast of the proposed development area. This mains pipeline supplies the properties near the A90 main road including West Tarbrax, South Tarbrax, Tarbrax House and North Tarbrax.

There is no Scottish Water infrastructure and no known public water supply sources within 2km of the proposed development area.

Licensed Abstractions

In Scotland water abstractions between 10 m3/day and 50m3/day require to be registered. Abstractions that have the potential to cause a significant impact or larger abstractions require an abstraction licence.

Consultation with SEPA did not identify any known licensed water abstractions within 2km of the proposed development area.

Licensed Discharge Consents

Consultation with SEPA did not provide any details of discharge consents within 2km of the development. However, as a result of the rural nature of the development area it is likely that there are discharges of septic tank effluent to drains or soakaways associated with each property and potential additional discharges associated with farming activities, such as sheep wash areas.

Evidence of a septic tank was observed during the site visit immediately south of the boundary wall of Over Finlarg Farmhouse.

The position of known discharges is presented on Figure 9-1.

Private Water Supplies

OS mapping showed two covered reservoirs, a spring and two wells within the development area. The site walkover and consultation with the local landowners indicated that the two OS mapping marked wells are no longer used or obsolete as there are no longer inhabited properties at these locations requiring a water supply.

The two covered reservoirs marked on OS mapping were confirmed to be underground holding tanks for private water supplies (PWS), supplying Nether Finlarg and Nether Finlarg Cottages (four properties) and historically supplying the Over Finlarg properties (five) from the open air reservoir below the OS marked spring. The site walkover identified the spring to be channelled below the ground to surface at the head of the open air reservoir rather than a clear spring source.

Consultation with Lyn Simpson and Angela Murray from Angus Council (January 2012) provided a list of potential properties across the whole of Angus that may be reliant on PWS and where possible indicated the type of supply. Properties on PWS within 2km of the development included: Lumleyden, Over Finlarg, Nether Finlarg, Nether Finlarg Cottages, Govals, Tarbrax, Gallowfauld and Washingdales. Angus Council indicated that they do not have a comprehensive up to date database of PWS and there may be more that are currently unrecorded or PWSs that may have transferred to mains supply. The council PWS data has been supplemented by enquiries and questionnaires at individual properties.

Consultation with the owner of Over Finlarg Farm indicated that the Over Finlarg properties are currently supplied by a borehole northeast of Over Finlarg (NGR 341560, 741445; Figure 9-1). The groundwater from this borehole is pumped up-hill to a new holding tank immediately adjacent to the old holding tank and the natural head of the water allows a good pressure of supply to the Over Finlarg properties.

Consultation with the owner of Nether Finlarg Farm indicated that to the west of Nether Finlarg Farm is a borehole (NGR 342605, 741815; Figure 9-1) that supplies water to Nether Finlarg Farm and numbers 3 and 4 Nether Finlarg Farm Cottages (both owned by the landowner of Nether Finlarg Farm). These three properties also have an alternative supply from the open air reservoir which may be used if there is a power cut etc.

It is understood that number 1 Nether Finlarg Farm Cottage and number 2 Nether Finlarg Farm Cottage (also known as May Cottage) are reliant on the open air reservoir and northern most holding tank (or underground reservoir) for their water supply.

PWS questionnaires were issued with a stamped addressed envelope for responses in January and April 2012. Questionnaires were provided to Lumleyden, Govals Farm, number 1 Nether Finlarg Farm Cottage and number 2 (May Cottage) Nether Finlarg Farm Cottage to gather further information on the PWS sources. Responses were received only from number 1 and number 2 (May Cottage) Nether Finlarg Farm Cottages in April and May 2012.

The questionnaire responses indicated that both number 1 and number 2 (May Cottage) Nether Finlarg Farm Cottages, are reliant on a PWS sourced at the open air reservoir that is in turn sourced by the underground culvert up gradient of their properties.

The known PWS features identified within 2km of the development area are presented on Figure 9-1 and in Appendices 9-1 and 9-2.

The wind turbines have been positioned to avoid water features as far as possible, maintaining a minimum 50m buffer around watercourses and a 250m buffer around PWS sources including springs and boreholes. The access tracks have been designed to follow existing access tracks where possible, maintaining a minimum 100m buffer from PWS sources. The current proposed design results in infrastructure being positioned further away from water features than that proposed in the original application 12/00577/EIAL (layout d, Figure 3-1).

Abstractions have been considered not to be hydraulically connected to the infrastructure where they either:

1. Are located in catchments with no wind turbine and infrastructure activity;
2. Take water at elevated locations of the sub-catchment compared to the wind farm infrastructure and are, therefore, highly unlikely to receive groundwater recharge or surface water originating from the infrastructure area; and/or
3. Are located more than 0.25km from the infrastructure and are considered to be far enough away not to be impacted by the proposals with appropriate controls in place.

One identified PWS source is considered to be potentially in hydraulic continuity with the proposed wind farm infrastructure. This is the borehole supplying the Over Finlarg properties. The borehole is located over 0.5km from the nearest proposed wind turbine, however, a section of access track is within 0.5km of this PWS. The nearest section of access track is 137m down gradient of the borehole. This section of access track is greater than 100m from the PWS source in accordance with LUPS-GU4 guidance. The owner of Over Finlarg Farm has a financial interest in the wind farm development.

All other identified PWS are considered not to be in hydraulic continuity with the wind farm development as supply sources are located greater than 0.25km from the turbines and infrastructure, located up gradient of wind farm infrastructure and/or within separate sub-catchments. Justification for each PWS is further detailed in Appendix 9-2.

No PWS sources were identified within 250m of a proposed turbine or 100m of access tracks, therefore, no further quantitative hydrogeological assessment is required in accordance with LUPS GU4 Appendix 2 (March 2012).

PWS are highly sensitive receptors, however, no PWSs have been identified as being hydraulically connected to the wind turbines and associated infrastructure other than the borehole at Over Finlarg located over 0.5km from turbines and over 0.1km from the access tracks. Risks to this private water supply are considered to be low.

9.3.14 Watercourse Crossings and Diversions

The wind farm development has been designed to minimise watercourse crossings or diversions. Where possible the proposed access track runs parallel with existing field boundaries and uses existing tracks.

The wind farm development will require two new crossings of an existing underground culvert within the southern section of the development area to the southeast and east of Over Finlarg Farm.

No other watercourse crossings or diversions of water bodies are proposed as part of this development.

9.3.15 Site Sensitivity

Hydrologically sensitive receptors for this site, as discussed above, are considered to be:

- PWS in close proximity of the development area and PWS infrastructure within the development area – High sensitivity;
- Surface water catchment ultimately draining into the highly sensitive River Tay catchment down gradient – Medium sensitivity receptor; and
- Groundwater, moderate aquifer below the site may have medium residence times and provide base flow to local surface water bodies – Medium sensitivity receptor.

9.4 Construction Impacts

9.4.1 Predicted Impact

This Section provides a summary of the potential risks of the proposed development, based on an assessment of activities that will occur during the construction of the four wind turbines and associated infrastructure, prior to the inclusion of mitigation measures (Table 9-4). An assessment of these risks determines the need for mitigation measures, which are discussed in detail in Section 9.4.2. Residual effects (post-mitigation) are outlined in Section 9.4.3 and Table 9-5.

The potential impacts from the construction of the proposed wind farm development are:

- Potential risk to surface water from the introduction of sediment into surface water run-off following activities such as access track construction, turbine excavation and the dewatering of excavations;
- Impacts on hydrogeology as a result of dewatering of foundation excavations;
- Potential risks to surface water and groundwater resulting from the use and storage of fuels, oils and other potentially polluting substances;
- Potential risks to surface water and groundwater resulting from the batching, transporting and pouring of concrete for turbine foundations;
- Potential risk to PWS infrastructure in the vicinity of the development area;
- Loss and sterilisation of soils due to the construction of access tracks and turbine footings; and
- Slight increase in impermeable areas due to crane pads and access tracks.

Table 9-6: Potential Impacts (Pre-Mitigation) During the Construction and Decommissioning Phase

Activity	Potential Impact	Sensitivity of Impact	Magnitude of Potential Impact	Significance of Potential Impact	Comment
Excavation and construction of buildings, foundations, hardstandings construction compound and access tracks within the site	Spillages of concrete during foundation construction could enter the surface water bodies, or groundwater.	Medium/ Regional	Medium	Moderate	Mitigation is required to control concrete pouring activities. A mitigation strategy will be introduced which will prevent spills from entering any water body. Concrete will be of high grade to prevent leaching.
	Generation of turbid runoff which could enter the surface water bodies.	Medium/ Regional	Low	Minor	There will need to be controls on construction activities to ensure any earthworks and hardcore placement do not generate turbid water and affect water quality or ecological conditions.
	Disturbance of PWS	High/ National	Low	Minor	Care will be required when excavating within the catchment of a PWS. The exact location of PWS piping will be carefully investigated prior to full scale earthworks. Monitoring of the PWSs will be undertaken before, during and after construction.
	Changes in surface water runoff patterns which could result in a flooding risk	Low/ Local	Low	Negligible	Best practice track drainage provisions to be part of the access track design.
Dewatering of excavations	Discharge of potentially sediment laden runoff or groundwater into surface water bodies following dewatering or excavation.	Medium/ Regional	Low	Minor	Mitigation measures will include catch pits and appropriate bunding around excavations. Measures will be formalised within a Construction Environmental Method Plan (CEMP) and will be based on SEPA PPG guidelines.

Activity	Potential Impact	Sensitivity of Impact	Magnitude of Potential Impact	Significance of Potential Impact	Comment
	Disruption to groundwater due to dewatering of excavations	Medium/ Regional	Low	Minor	Any muds and fluids excavated will be contained within a bunded area to ensure there is no runoff into nearby ditches or water bodies. Fluids will percolate back into the surrounding soil. Any effect on the soil water table would, therefore, be neutral.
Traffic movement and creation of fugitive dust	Fugitive dust migration. Exposure of construction workers to dust.	Low/ Local	Low	Negligible	Small development, unlikely that traffic movement will be high. Dampening down of access tracks in dry conditions can be undertaken. Ensure excess water is not used so excess sediment laden runoff is not produced.
Electric cables	Could act as small drainage channels and lead to turbid water entering surface water.	Medium/ Regional	Low	Minor	Gradients on the site are generally relatively small so it is unlikely that cable trenches will act as drainage channels, and, therefore, no turbid water would develop. Cables will be routed along the access tracks to avoid additional ground disturbance.
Site activities such as the storage of fuel and oil, toilet facilities	Spillages and leakages of oil, fuel, and other potentially polluting substances e.g. oil spills, could enter the surface water bodies or groundwater.	Medium/ Regional	Low	Minor	Good site management practices will be adopted to reduce the potential for any spillages or leakages of potentially polluting substances. A mitigation strategy will be introduced which will prevent spills and leakages from entering the drains and tributaries of the Gallowfield Burn and Corbie Burn.

9.4.2 Mitigation Measures

This section outlines the proposed mitigation measures designed to address the potential impacts described in Table 9-4. If appropriate mitigation measures or enhancements are incorporated into the construction phase then the risk of construction activities having the potential to cause pollution of the water environment is minimised.

During the contractor tendering process for the construction works, environmental specifications and objectives shall be included in the tender documents so that all contractors can allow for mitigation measures in their tender costs. In addition, the use of the construction contract conditions as recommended by 'SEPA Special Requirements for Civil Engineering Contracts for the Prevention of Pollution V2' (2006) shall be applied.

The conditions to prevent pollution will be addressed within a CEMP, to be prepared in consultation with SEPA and to be submitted at least one month prior to the commencement of development. This CEMP shall systematically identify the pollution risks associated with each operation, and will include:

- A DMP detailing proposed surface drainage measures to treat and deal with all the surface runoff from the site, to be designed in accordance with SUDS principals;
- As part of the DMP a Pollution Prevention Plan (PPP) shall be produced to detail the embedded mitigation measures as identified within this ES and any supplementary statements, to address each of the identified pollution risks;
- An Accident Management Plan (AMP) to detail emergency contingency and spillage plans;
- Details of any monitoring proposals including a Water Quality Monitoring Plan (WQMP), to monitor amongst other parameters pH and turbidity, to be implemented by a designated appointed person on-site;
- Any requirement for waste storage shall be detailed and implemented through a Waste Management Plan (WMP);
- A location map of all areas of disturbance with the potential to generate silt-laden run-off, with details of the proposed mitigation at each point as recommended by CIRIA guidance documents;
- A location map of all potential chemical contamination sources, including all fuel, oil and chemical storage areas, vehicle compounds, refuelling sites, waste depots and on-site sewage systems;
- Procedures for dealing with water contaminated from cement and the excavations into which the cement is to be poured; and
- Timing of works, including a programme of works which takes into consideration and avoids working during high rainfall events.

Access Tracks

Construction of access tracks and continued use during the remainder of the construction phase will potentially generate turbid runoff. Measures described in SEPA PPG notes, CIRIA guidance and Forest and Water Guidelines will be formalised within a sediment management plan for the site, which the contractors will be required to comply with.

The access track layout is illustrated on Figure 3-2 and typical track designs are illustrated on Figure 3-6. The layout is designed to use existing tracks where possible and minimise land take.

Construction will be dependent on substrate and gradient. As bedrock is considered to be relatively shallow, tracks will be stone-based and possess a camber to ensure rapid drainage (to avoid ponding and rutting which generates turbid water). Drainage will be collected and directed by strip drains to either infiltration drains or to areas of sufficient vegetation to promote the infiltration of the track runoff. Such measures will be based on best practice guidance outlined above and will lead to minimal changes on surface water regime.

Any silty water generated on site will ideally be settled out as much as possible through drainage mitigation measures (silt traps etc.) and channelled into vegetated areas at least 20m from any water body to allow the settlement of suspended solids. Silt traps, gravel, sand bags, silt fencing and anchored straw bales may be required at the discharge points in order to prevent erosion at the outlet, alleviate flow and aid in flow dispersion across a wider area of vegetation to prevent potential scour and remobilisation of deposited silt.

Discharge points will be located a sufficient distance from any water body to allow adequate infiltration or settlement of suspended solids to prevent any discharged surface runoff potentially entering the water bodies. Direct discharge of untreated water to water bodies or culverts will not be permitted.

Particular care will be required on the section of new track in the central section of the development area with steeper gradients to prevent the track from becoming a preferential pathway for surface water runoff, eroding and allowing the migration potentially laden with sediment towards existing drains. Grips or cross drains are likely to be required in this track section to prevent sediment laden drainage draining into existing drains. Drainage from the track downslope will be managed and minimised through SUDs systems to prevent erosion of the surface soils and sediment laden water reaching existing drains.

Flood Risk

The crane pads and the track will effectively be semi-permeable structures that do not require deep foundations. The length of the new track has been kept to a minimum. The construction of new track and the turbine foundations will result in a negligible increase in impermeable area when compared to the whole site or catchment area. The limited development of land within the site and the well-drained nature of the site results in only minor changes from the baseline condition in terms of surface water runoff. Changes to flood risk across the site are assessed to be negligible and, therefore, no flood risk mitigation is deemed necessary.

Watercourse Crossings

There are two new crossings of an existing underground culvert. These crossings are likely to comprise of plating to distribute loads over a wider area. Watercourse crossings will be over engineered to allow for high rainfall events and regularly maintained to prevent blockages.

Private Water Supplies

Although, the turbines are not considered to be hydraulically connected to the proposed development, additional mitigation or enhancement measures will be undertaken in order to protect the PWS sources as a precautionary measure which will comply with Conditions 25 of the planning consent. Measures will include:

- The foundation excavation will be undertaken with care, assessing for water ingress and the degree of bedrock fracturing and weathering;
- Should shallow groundwater be encountered during excavation the foundation excavations will be sealed with a geotextile membrane prior to concrete pouring to prevent concrete migration into shallow groundwater;
- Concrete type used will be of an appropriate quick setting and non-leachable specification to prevent concrete migration into the groundwater;
- Any excavation and construction works will avoid periods of heavy rainfall and will be undertaken and restored within as short a period as possible;
- Where groundwater is encountered, it is recommended that dewatering should be kept to a minimum to prevent altering the water table by drawdown. Where dewatering is required, the water should be pumped to a small holding sump or designated infiltration area to allow removal of suspended sediment. Once the solids have been removed, groundwater should either be discharged direct to surrounding vegetation or a small down slope trench allowing infiltration back into the ground. Any discharge should be in agreement with SEPA and be in accordance with CAR 2011 (as amended 2013). Any untreated discharge should be directed away from water bodies; and
- An Environmental Management Plan and drainage plan will be submitted to SEPA for approval two months prior to any works as per Condition 2 (v) of the planning consent.

Mitigation measures to prevent the disturbance of PWS piping should be put in place, including careful excavation to confirm the location of the piping and appropriate plating to distribute heavy loading over private water supply piping crossings.

No PWSs have been identified as being significantly at risk from the wind farm development, however, water piping for the PWSs passes through the proposed development area. The indicative route of this piping is illustrated on Figure 9-1.

The exact location and condition of the water supply piping should be carefully investigated prior to construction operations and mitigation measures to prevent the disturbance of water supply should be put in place. Mitigation measures will require appropriate protection of the section of piping for example by use of a geotextile membranes, grids or plating to evenly distribute the loads crossing the pipe or potential replacement of the pipe section and trench in stronger loading bearing materials. Should any replacement of the piping be required, an alternative temporary water supply (e.g. water bowsers) to the reliant properties (potentially 1 and 2 Nether Finlarg Farm Cottages and all the properties at Over Finlarg) will be provided for the duration of the works, which will be kept to a minimum.

The PWS piping is considered to be a sensitive receptor. Disruption to the supply of water in the piping would have a medium magnitude impact, however, with the mitigation above the disruption to the PWS is considered to be unlikely and any disruption will be short term and restorable. Therefore, the potential impact is deemed to be not significant.

Water quality monitoring of the borehole supply at Over Finlarg and the piped supply to Nether Finlarg Farm Cottages 1 and 2 (May Cottage) will be undertaken prior to construction works to establish a baseline condition, during construction to monitoring any effects of construction activities and post construction to confirm conditions are similar to the original baseline.

Wind Turbine and Crane Pad

Construction mitigation and enhancement measures detailed below will ensure risks are minimised during the construction of the wind turbines and crane pads.

Turbine foundations will be formed through the pouring of concrete. Without controls on this process, concrete spillages could potentially result in pollutants coming into contact with local groundwater or surface water. Temporary bunds should be placed around pouring operations to contain concrete spillages and a spill response protocol should be developed for use by contractors.

As detailed in the baseline description the geology underlying the development area has the potential to be permeable through structures and discontinuities with some intrinsic flow and, therefore, has the potential to be a locally important aquifer.

The foundation excavation will be undertaken with care, assessing for water ingress and the degree of bedrock fracturing and weathering.

A protective geotextile liner will be used within the excavation to ensure liquid concrete does not come into contact with underlying strata and groundwater. A geotextile liner together with the use of an appropriate fast setting non leachable specification concrete would restrict any potential flow of concrete into the surrounding groundwater. This would only be necessary if there was evidence of significant fracturing and groundwater flow. Given the nature of the geology, it is considered that the likelihood of encountering groundwater is moderate and encountering significant groundwater is unlikely unless at a significant depth.

Should shallow groundwater be encountered during construction of the turbine foundations, any dewatering required should be pumped to a small holding sump or designated settlement area to allow removal of suspended sediment. Once the solids have been removed, groundwater should either be discharged direct to surrounding vegetation or a small down slope trench allowing infiltration back into the ground. Any discharge should be in agreement with SEPA and be in accordance with CAR 2011(as amended 2013). Any untreated discharge should be directed away from water bodies.

Any excavation and construction works will avoid periods of heavy rainfall and will be undertaken and restored within as short a period as possible.

Site Activities

Good working practices will be adopted throughout the construction works to protect the water environment, ecology and human health. The storage of oil, fuel and other substances will be within the designated construction area. SEPA's General Binding Rules dictate that oil and fuel will be stored within impervious storage bunds (or double skinned tanks) with 110% capacity of the largest tank or 25% of the total storage capacity, whichever is the greater, so that any spillages or leaks are contained. All tanks, whilst designed to provide more storage volume than needed, will be fitted with alarms to warn site workers if the volume exceeds a specified level. Machinery should be routinely checked to ensure they are in good working order and spill kits should be on site in case of a spill.

Best working practices incorporating measures to protect the water environment, particularly SEPA PPG recommendations should be adopted throughout the construction phase.

As part of a site wide CEMP there should be a plan for controlling sediment generation and handling of pollutants close to water bodies.

9.4.3 Predicted Residual Impact

This assessment describes likely residual effects following incorporation of mitigation measures, i.e. real effects that may potentially occur as a result of the development.

Effects on Surface Water

Adherence to the recommended mitigation and enhancement measures will ensure that the likely potential impacts will be controlled. Impacts such as the generation of sediment from the construction works will be controlled through the use of good practice. Good practice legislation and guidance notes provide clear guidance on the measures to be adopted when working near to watercourses. Method Statements will also be prepared in response to any license requirements. It is predicted that should any sediment input to surrounding water bodies occur it would be small in volume and would occur over a short period only.

Whilst good practice measures will be in place, there is inevitably the potential for accidental incidents to occur. Response to such events will be managed through the CEMP, such that all spills will be contained. Occurrences of this nature are expected to be low in magnitude and intermittent or infrequent in nature. Overall the residual effect is considered to be not significant.

Effects on Groundwater

The baseline description indicates that there is potential for local groundwater flow to occur within the more permeable Old Red Sandstone discontinuities with some potential for intrinsic flow. The development has been designed to avoid the fault zones.

PWSs were identified within 1km of the infrastructure, however, these were considered not to be hydraulically connected to the wind farm infrastructure with the exception of the borehole at Over Finlarg of which the owner is financially involved in the development and the closest wind farm infrastructure is the upgrade of an existing access track over 100m from the source. Full details on mitigation measures for the PWS are detailed in Section 9.4.2.

Measures to control concrete pouring of the turbine base structure and to limit groundwater contact with concrete are likely to significantly restrict the pathway for groundwater impacts.

Accordingly, any residual effects to groundwater features are considered to be minor or unlikely to be of significance.

Table 9-7: Residual Effects during the Construction and Decommissioning Phase

Effect	Type of Effect	Probability of Effect	Sensitivity of Effect	Magnitude of Effect	Significance	
					Ranking	Rationale
Effects on surface water features – drainage ditches and water bodies	Negative	Unlikely	Regional	Low	Minor	Risks controlled through sediment management and treatment of dewatered groundwater if encountered.
Effects on groundwater features – Base flow to drainage ditches	Negative	Unlikely	Regional	Low	Minor	Careful management of turbine excavation to contain concrete pouring. Effective management and storage of polluting substances such as fuel and oils.
Effects to PWS – Disturbance to supply	Negative	Unlikely	Regional/ National	Low	Minor	Risks controlled through careful excavation, management of dewatering, sediment control measures and management of concrete pouring.

9.5 Permanent and Operational Impacts

9.5.1 Predicted Impact

This Section provides a summary of the potential risks of the proposed development, based on an assessment of activities that will occur during the operational phase of the five wind turbines and associated infrastructure, prior to the inclusion of mitigation measures (Table 9-6). An assessment of these risks determines any requirement for mitigation measures.

The potential impacts from the operation of the proposed development are summarised below:

- Potential increase in surface water run-off from the site, particularly along new and upgraded access tracks;
- Potential for surface water discharges to cause pollution of local watercourses;
- Potential increase in suspended sediments entering watercourses due to the erosion of access tracks; and
- Potential for the leakage and spillage of polluting substances from the turbine and turbine transformer.

As shown in Table 9-6 all predicted impacts are considered to be minor. As such no specific mitigation measures are deemed to be required as the impacts are considered to be not significant.

Table 9-8: Potential Impacts (Pre-Mitigation) during the Operational Phase

Activity	Potential Impact	Sensitivity of Potential	Magnitude of Impact	Significance of Potential Impact	Comment
Access Tracks	Changes in surface water runoff patterns which could change supply to water bodies.	Medium/ regional	Low	Minor	Very few changes in site runoff regime expected.
	Generation of turbid runoff which could enter water bodies.	Medium/ regional	Low	Minor	Mitigation will be incorporated into the access track design to ensure suspended sediments within runoff are controlled.
Watercourse Crossings	Changes in flow regime of watercourses.	Medium/ regional	Low	Minor	Watercourse crossings will be over engineered to allow for spate flows and regularly maintained.
Site activities	Spillages and leakages of oils, fuels, and other potentially polluting substances which could enter water bodies.	Medium/ regional	Low	Minor	Best site management practices would be adopted to reduce the potential for any spillages or leakages of potentially polluting substances.

9.5.2 Additional Enhancement

Although no specific hydrology mitigation is identified to be required during operation of the wind farm additional enhancement measures have been following commission of the wind farm to further minimise effects on the water environment and soils. Apart from the operation and upkeep of turbines and access tracks there will be relatively little on-site activity during the operational phase. However, potential exists for any activity to affect the site hydrology and surrounding water features. This requires a long term strategy for sustainable mitigation that will be on-going.

Access Tracks

Mitigation measures for access tracks described in the construction of access tracks section will be sufficient to protect local hydrological features during the operational phase. However, routine maintenance should help to further reduce potential for runoff onto the public road and increased suspended sediment levels within drainage ditches. Sediment management will continue to be a focus of the development where required and drainage ditches and grips will be regularly inspected for blockages.

Site Activities

Routine maintenance of the wind turbine and associated infrastructure will require access by maintenance crews. Such activities may involve the use of oils, greases and other substances with associated potential for accidental spillages. However any spillages are likely to be very small and, given the limited site drainage, risk to downstream watercourses is not considered to be significant.

Operational practices will incorporate measures to protect the water environment. All vehicles visiting the site will be equipped with sand trays to place below any oil or fuel filling activities and should be equipped with emergency oil spillage kits.

9.5.3 Predicted Residual Impact

There are unlikely to be any residual effects to surface water or groundwater resources during the operational phase. Activities on-site will be few and will be controlled through best site management practices. The risk of accidental spillages reaching any receptors is remote.

Table 9-9: Residual Effects during the Operation Phase

Effect	Type of Effect	Probability of Effect	Sensitivity of Effect	Magnitude of Effect	Significance	
					Ranking	Rationale
Effects on surface water features – water bodies.	Negative	Unlikely	Regional	Low	Minor	Few activities will be on going Sediment management will continue to be a focus of the site management.
Effects on groundwater features – Base flow to water bodies.	Negative	Unlikely	Regional	Low	Minor	No predicted impacts on groundwater are expected during the operation of the site.
Effects to PWS – Disturbance to supply	Negative	Unlikely	Regional/ National	Low	Minor	Spillage risks controlled through maintenance and spill kits.

9.6 Cumulative Impacts

The existing 25m wind turbine at Nether Finlarg is located approximately 0.68km southeast of the proposed development. A second 25m turbine has been consented adjacent to this existing turbine. These two turbines fall with the same hydrological catchment as the proposed development, however, the overall proportion of land take and increase of semi-impermeable surfaces within the catchment is very low in comparison to the catchment area and is, therefore, unlikely to significantly affect runoff rates.

The proposed wind farm development to the north of the Frawney Wind Farm at Govals Farm (six turbines) was refused at planning committee in May 2013 however, the Govals Wind Farm was approved on appeal on the 7th January 2014. The consented Govals Wind Farm falls within a separate sub-catchment to the Frawney Wind Farm separated by a hill spur, therefore, there is unlikely to be any significant cumulative effects on the localised water environment. Although within separate sub-catchments, both wind farm developments are within the catchment of the Kerbet Water. The proportion of land take within the Kerbet Water catchment is very low (2.0ha for Frawney Wind Farm and an estimated 4.0ha for Govals Wind Farm) by comparison to the whole catchment area (approximately 6,000ha). Overall, this equates to less than 1% of the catchment area and, therefore, is not deemed to be significant. In any event, a five turbine scheme has been consented on the Frawney site.

The assessment for the consented scheme of the potential effects to surface water and groundwater during the operational phase of the Frawney Wind Farm, show their significance to be low to negligible. For the proposed development, there will be no additional impact from the consented scheme. There is a potential for minor cumulative effects from the adjacent proposed wind turbines in the form of slightly increasing runoff rates. However, the cumulative impacts are minor and, therefore, deemed to be insignificant.

9.7 Summary

The assessment has identified areas of activity, particularly during the construction phase that have the potential to impact upon the hydrological receptors at the site. It has already been acknowledged that these potential impacts can be managed through suitable mitigation and enforcement of the conditions of the consented scheme. The principle of the wind energy development at the site has already been established. Sensitive receptors identified include:

- PWSs and associated infrastructure for the Nether Finlarg properties and Over Finlarg properties, however the owners of Over Finlarg Farm are financially involved in the development. Nether Finlarg and Nether Finlarg Cottages are not financially involved in the development and are reliant on a borehole at Nether Finlarg and the open air reservoir as a PWS;
- Several other PWS sources were identified in the area. Owing to their distance from the development infrastructure and hydrogeological regime, these PWSs are unlikely to be affected by the proposal;
- Groundwater, a locally important aquifer potentially providing local base flow to water bodies; and
- Surface water catchment as a result of the River Tay freshwater fish protected catchment and a SAC for Atlantic Salmon, Lamprey, trout and otters.

The potential for the proposed revised scheme to affect geological, hydrogeological and hydrological features has been mitigated to acceptable levels through the original consented developments constraints based approach to the site layout and design (e.g. mitigation by avoidance and using existing tracks), and by adopting best practice mitigation measures. These mitigation measures focus on reducing and controlling runoff from the access track (to reduce potential for increasing suspended solids within water bodies), preventing/managing spills, leaks or concrete contamination of groundwater and surface water and protecting PWS piping.

With the implementation of best practice mitigation, the residual effects of the proposed development from the consented scheme on the geology, hydrogeology and hydrology will be Minor or lower and therefore not deemed to be significant. The proposed development will comply with all relevant conditions imposed on the consented scheme (13/00532/EIAL).

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10 Cultural Heritage

10.1 Introduction

This chapter, undertaken by ARCHAS Cultural Heritage Ltd, considers the likely change of effects on the historic environment of the construction, operation and decommissioning of the proposed development in comparison to the consented wind farm at the site.

10.2 Methodology and Approach

10.2.1 Information Sources

For the purposes of this study, available sources of data on the historic environment were acquired from information held by the relevant heritage bodies including:

- The Scheduled Monuments (SMs), the Statutory List of Buildings of Special Architectural or Historic Interest and the Inventory of GDLs, maintained by Historic Scotland;
- The Royal Commission for Ancient and Historic Monuments of Scotland (RCAHMS);
- Local Sites and Monuments Record (SMR) held by Aberdeenshire Council Archaeology Service (ACAS);
- Aerial photographs held by the RCAHMS; and
- All relevant historic maps held by the Map Library of the National Library of Scotland including superseded Ordnance Survey maps and pre-Ordnance Survey maps.

10.2.2 Planning and Legislative Context

The United Kingdom government is party to the 'Valetta Convention', the European convention on the protection of archaeological heritage. Article 2 notes that States must have a legal system for the protection of the archaeological heritage, on land and underwater. Article 4 requires provision for the "*the conservation and maintenance of the archaeological heritage preferably in situ*." Indirect impacts caused by wind turbines are assumed to be adverse i.e. the introduction of a turbine is at best, negligible with regard to the impact upon the setting of cultural heritage.

In Scotland, the relevant legislation relating to the historic environment includes:

- Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997;
- Ancient Monuments and Archaeological Areas Act 1979;
- Town and Country Planning (Scotland) Act 1997;
- Planning etc. (Scotland) Act 2006;
- Protection of Wrecks Act 1973; and
- Protection of Military Remains Act 1986.

The Scottish Government's policy on the historic environment is set out in Scottish Historic Environment Policy (SHEP) (Historic Scotland, 2011) and described in Scottish Planning Policy (SPP, 2010). Historic Scotland has also published a series of guidance notes: 'Managing Change in the Historic Environment', intended to explain how to apply the policies contained in the SHEP (2011) and the SPP (2010).

Definition of the Historic Environment

The SPP notes that *"the historic environment includes ancient monuments, archaeological sites and landscape, historic buildings, townscapes, parks, gardens, designed landscapes and other features. It comprises both statutory and non-statutory designations. The location of historic features in the landscape and the patterns of past use are part of the historic environment"* (SPP 2010, Section 111).

Protection of the Historic Environment

A key principal of the SHEP states that *"there should be a presumption in favour of protection of individual historic assets and also the pattern of the wider historic environment; no historic asset should be lost or radically changed without adequate consideration of its significance and of all the means available to manage and conserve it"* (SHEP 1.14 b).

10.2.3 Study Areas

Cultural heritage sites have been identified and assessed within three distinct areas:

- An inner study area (development area) measuring approximately 2.2km by 2.2km. Information was subsequently collected on all known and newly identified sites (Figure 10-1).
- A middle study area extending for approximately 5km beyond the approximate centre of the development area boundary encompassing most of the sites identified by Historic Scotland as requiring assessment. Information was subsequently collated for all Nationally Important cultural heritage sites (archaeological or built heritage) including Scheduled Monuments (SMs), Category A and Category B Listed buildings and Gardens and Designed Landscapes (GDLs) with potential inter-visibility with the turbine and five sites were identified.
- An outer study area extended beyond the inner study area up to 20km. Records were collated for all Nationally Important cultural heritage sites (archaeological or built heritage) including SMs, Category A Listed Buildings Conservation Areas and GDLs with potential inter-visibility with the wind turbine. A search was then carried out within this list for those cultural heritage sites with the potential for negative effects upon their settings and no sites were identified.

10.2.4 Field Survey

An archaeological field survey was undertaken on 21st March 2012 to provide additional information on features of interest identified from the above sources within the development area and to assess the potential for the presence of further archaeological sites. Eight previously unknown sites were identified during the field survey.

10.2.5 Consultation

Scoping and consultation responses were sought from a number of authorities and organisations. These are outlined in Table 10-1.

Table 10-1: Consultation Responses

Consultee	Response	Comment
Historic Scotland	28/03/2012 - Historic Scotland confirmed that no SMs, Listed Buildings or GDLs are present within the development area. However, it was noted that designated sites lie within the vicinity of the proposed development. In particular, attention should be given to assessing the impacts upon Glamis Castle and GDL. Impact on setting should be considered for Arniefoul, Huntingfauds and Carlunie Hill Cairns (SMs). In addition, HS requested that wireframes be prepared for visualisations of these sites. It was also requested that detailed information was sought from Aberdeenshire Archaeological Service (AAS) on the archaeological potential of the study area.	Assessment of ZTV and wireframes has enabled the indirect impacts upon the heritage assets identified by HS and AAS to be assessed (if present) as requested by HS. All possible impacts suggested by HS have been carefully assessed within this chapter.
	23/10/2012 - No objection to application 12/00577/EIAL – consider that effects on Glamis Castle will not be significant due to the lack of views as a result of intervening topography from ground floor and the viewing platform (at 42m height) of the castle.	The scheme comprised five turbines of 80m tip height, 20m less than the previous application and, therefore, no impacts will result on Glamis Castle.
	27/06/2013 – No objection	Comments on the previous application advised that we were content that there would be no significant impacts on the site or setting of any heritage assets within our remit, and we consider that this continues to be the case with the amended proposals.
Aberdeenshire Archaeological Service (AAS)	10/04/2012 - AAS noted sites of archaeological interest within the site boundary need to be considered in the environmental assessment. In addition, AAS noted that based on the known records there is potential for unknown archaeological remains at a sub-surface level and requested that during access track and turbine base construction that Archaeological Monitoring be undertaken. In the wider area there are a number of archaeological sites, however, consideration of impacts upon setting need to be reported in the ES.	No direct or indirect impacts upon any of the sites identified by AAS are expected. However, they have requested that a watching brief be undertaken during ground-breaking operations during construction.
	09/07/2012 - No objection to application 12/00577/EIAL - The proposed mitigation measures outlined in the ES (an Archaeological Watching-Brief on all ground-breaking works under the umbrella of a Written Scheme of Investigation) is acceptable. The visual impact assessments within Chapter 10 are acceptable and there are no other additional requirements for these. The proposed mitigation measures can be secured by a planning condition.	The proposed mitigation measures are as per the previous application and therefore can be secured by planning condition.

10.2.6 Overall Approach

The specific objectives of this study are to:

- Identify the archaeological baseline of the proposed wind turbines development area and their immediate vicinity;
- Assess the predicted and potential direct impacts of the construction and operation of the wind turbines upon the cultural heritage resource within the development boundary;
- Propose measures, where possible to mitigate adverse direct impacts;
- Identify key cultural heritage receptors in the wider historic landscape whose setting could be affected by the proposed development; and
- Assess the predicted and potential impacts of the proposed wind turbine upon the settings of key receptors within the wider historic landscape.

10.2.7 Assessment Methods

Direct Effects

Significance of direct effects on cultural heritage (e.g. damage or severance) was determined with respect to the sensitivity of the baseline conditions and the predicted magnitude of effect as detailed in Chapter 2.

Many sites of cultural heritage importance are not currently afforded any statutory protection through designation. For the purposes of assessment, these undesignated sites were assigned a level of importance using professional judgement supported by review of the following guidance:

- Criteria used in Scottish Historic Environment Policy (SHEP 23) for the designation of SMs (Historic Scotland, 2009); and
- Non-statutory criteria used in the designation of Listed Building categories (Memorandum of Guidance on Listed Buildings and Conservation Areas; Historic Scotland, 1998 and SHEP 23).

Indirect Effects (Setting)

Significance of indirect effects (i.e. changes to cultural heritage setting owing to visual intrusion) is assessed similarly to landscape and visual impacts.

Many archaeological sites are not visible, or barely visible, from ground level. Such sites will not usually be vulnerable to visual effects i.e. effects on setting. However, some invisible or partially visible sites may be located in an area where the immediate topography and landscape is important to an understanding of the site, and consequently the setting and location might be more sensitive.

A selection process was undertaken to identify cultural heritage sites that may receive/have indirect setting effects arising from/as a result of the proposed development. Their sensitivity to indirect visual effects [on their setting] was separately determined according to the definitions in Table 10-3.

Table 10-2: Sensitivity of Cultural Heritage Sites to Effects on Setting

Sensitivity of Receptor	Definition
High	Sites of national importance that are visually prominent and whose setting contributes significantly to their importance; invisible or partially visible sites of national importance whose location and topographical context aid our understanding of their form and function.
Medium	Sites of regional importance that are visually prominent and whose setting contributes significantly to their importance; invisible or partially visible sites of regional importance whose location and topographical context aid our understanding of their form and function.
Low	Sites of local importance whose landscape setting contributes significantly to their importance. Sites of local importance whose landscape setting contributes significantly to their importance.
Negligible	Sites whose landscape setting is of negligible importance

The magnitude of effects on the setting of cultural heritage sites was assessed according to established principles and criteria set out in published guidance (Memorandum of Guidance Historic Scotland 1993 and Guidelines for Landscape and Visual Effect Assessment (LI/IEMA, 2002). These criteria were also used in the assessment of overall visual effects, and are described in more detail in Chapter 6 (Landscape and Visual). The application of the criteria leads to a determination of the magnitude of effect for each viewpoint on a four-point scale of 'Dominant', 'Prominent', 'Present' or 'Negligible'. Each viewpoint was selected and identified as the most appropriate location for assessment of inter-visibility. This process was undertaken using the 'best' views to and from the monument allied to its landscape setting and the topography as it relates to the site and any other associated sites in the general landscape. Any inter-visibility with the proposed development was then assessed from this location.

Effects on setting were assessed using ZTV mapping and wireframes to indicate the potential views of the wind turbines. This represents worst-case assessment, as it assumes no intervening ground cover screening such as woodland or other buildings.

As with direct effects, the significance of effects on setting was determined taking into account the importance of the archaeological resource affected and the magnitude of effect. For each site, the viewpoint taken into consideration was the one with the greatest magnitude of effect. Table 10-3 illustrates the matrix of importance used to determine the significance of effect on setting.

Table 10-3: Determination of Significance of Effects on Setting

Magnitude / Sensitivity	Dominant	Prominent	Present	Negligible
High	Substantial	Substantial	Moderate	Slight
Medium	Moderate	Moderate	Slight	Negligible
Low	Slight	Negligible/Slight	Negligible	Negligible

In respect of both direct effects and effects on setting, effects assessed as Moderate or greater are generally considered significant in the context of EIA Regulations.

10.3 Baseline Conditions

A complete gazetteer of cultural heritage features considered as part of this assessment is included in Appendix 10-1 (Gazetteer of Cultural Heritage Features). Note that owing to the size of this appendix it is available as a separate CD on request (refer to Chapter 1 for details).

10.3.1 Archaeological Sites within Inner Study Area

The field survey and desk-based assessment identified a total of 14 sites of archaeological and historical interest located within the inner study area, the majority of which are post medieval and agricultural in date and origin. The identified sites are listed in Table 10-4 and shown on Figure 10-1.

Table 10-4: Known Archaeological Sites within Inner Study Area

Site No.	Site Name	Site Type	Designation	Importance
1	Over Finlarg Farmhouse	Farmhouse	Category C (s)	Local
2	Frawney Steading	Steading	None	Local
3	Frawney Steading	Steading	None	Local
4	Tarbrax School	School	None	Local
5	Lumleyden	Burials (poss)	None	Local
6	Nether Finlarg	Mill Dam/Sluice	None	Local
7	Nether Finlarg	Smithy	None	Local
8	Govals Quarry	Quarry	None	Local
9	Govals	Souterrain (poss)	None	Local
10	Govals	Mound (poss structure)	None	Local
11	Govals	Quarries	None	Local
12	Nether Finlarg	Quarry	None	Local
13	Lumleyden	Boundary (stones)	None	Local
14	South Tarbrax	Inn	Category B Listed	Regional

Site 1 comprises Over Finlarg, a farm with a Category C (s) Listed farmhouse. The listing document (HB NUM 17455) describes the farmhouse as circa 1800 and a good unaltered example of an early 19th century farmhouse. Listed items include boundary walls, gate-piers, gateposts, terrace Wall and steps. The farm and farmhouse are depicted on the OS 1st edition Ordnance Survey map (Forfarshire, Sheet XLIV 1865) which shows a Mill Dam and Sluice to the west of the farm with a spring and well to the south of the main farm buildings comprising two large, U shaped in plan outbuildings. Field survey revealed that the farm buildings are still upstanding but now much altered while the mill dam and sluice are no longer present.

Site 2, Frawney Steading is depicted on the 1865 1st edition OS map (Forfarshire, Sheet XLIV 1865). The map shows a large L shaped in plan farmhouse with a horse gin attached on the northeast side with a mill dam to the west and two smaller rectangular buildings to the south. A well and gardens are also indicated. Field Survey revealed that the larger L shaped farmhouse is largely ruined but upstanding in places to a height of 3m. The mill dam and the two ruined buildings also remain. The well was located at NGR 341540, 742103 surviving as a circle of large stones with flat slabs covering the central part of the well.

Site 3 (Frewney Steading) is depicted on the 1st edition OS map (Forfarshire, Sheet XLIV 1865) as "*Frewney*". A large barn (still extant) and a smaller house, well and track (no longer visible) are depicted. Field Survey revealed that the barn was still standing within a fenced off area but no other features were visible.

Site 4, (Tarbrax School) is depicted on the 1st edition OS map (Forfarshire, Sheet XLIV 1865) as a rectangular building oriented northwest-southeast with a garden area on the east side and annotated as a school (now destroyed). Field survey revealed no trace of the building.

Site 5, (Lumleyden) is recorded by the NMRS (SMR No: NO 44 SW 13) and local SMR (NO 44 SW 0013) as Lumleyden findspot and is recorded as the location of numerous burials presumed to be the remains of robbers summarily executed (*pers comm*). This information was given to the OS by C W Philips in 1954 and has not been verified.

Site 6, (Nether Finlarg) is depicted on the 1st edition OS map (Forfarshire, Sheet XLIV 1865) as a mill dam and sluice located to the rear of the upstanding farmhouse. Field survey revealed no trace of the features.

Site 7, (Nether Finlarg) is a small building depicted on the 1st edition OS map (Forfarshire, Sheet XLIV 1865) as a "*smithy*". The site of the building is immediately to the north of the current Nether Finlarg Farm Cottages as depicted on the current OS 1:10,000 map coverage. Field survey revealed no trace of the building.

Site 8, (Govals Quarry) comprises a large scooped quarry revealed during field survey measuring approximately 25m by 30m in plan with a steep side on the west measuring 2-3m in height. The quarry was located in a wooded area.

Site 9, (Govals possible Souterrain) comprises a deposit of large stones slightly curving that measured 33m in length by 4m wide. At the southeast end (NGR 341387, 743014) there were large flat stones visible that may comprise capstones. Bearing many similarities to a souterrain in plan and construction, this deposit of stones may also be simply be a deposit of stones cleared from the cultivated field. It may also be the site of a souterrain now used as a place for the deposition of stone clearance.

Site 10, (Govals Mound/Structure) comprises a small, elliptical mound measuring 10m east to west by 8m north to south. Three large upright and inline stones respecting the downslope side of the mound suggest that the remains of a stone built structure survive here.

Site 11, (Govals Quarries) comprises an area of what appear to be spoil heaps and quarry scoops and excavated hollows. Study of the OS 1st and 2nd editions reveal no depiction of such activity. It is considered that the quarrying predates the OS 1st edition.

Site 12, (Nether Finlarg, Quarry) comprises a quarry depicted on the OS map (Forfarshire, Sheet XLIV 1865) as a quarry and as an "*old gravel pit*" on the 2nd edition OS map (Forfarshire, Sheet XLIV.SW1903).

Site 13, (Lumleyden Boundary Stones) comprise a series of boundary stones as depicted on the OS map (Forfarshire, Sheet XLIV 1865) and as recorded by the NMRS, NO 44 SW 19-24 and located along the Glamis/Tealing Parish Boundary on the southwest shoulder of Finlarg Hill.

Site 14, (South Tarbrax, Inn Category B Listed Building) comprises a former inn as depicted on the Ordnance Survey map (Forfarshire, Sheet XLIV 1865) as "*South*

Tarbrax". The Historic Scotland Listing Document (HB NUM 10991) describes the site as a "*Two-storey house with single-storey wing and byre, white-washed rubble and slate. 18th cent. Former inn*".

Unknown Archaeological Sites

The study area comprises predominantly pasture and arable fields. The archaeological potential of such an area is generally considered to be good.

10.3.2 Designated Sites / Sites of National Importance within 1km

There are no designated sites or sites of National importance within 1km of the wind turbines (such as SMs, Listed Buildings, or GDLs).

10.3.3 Designated Sites of National / Regional Importance within 5km

Within 5km of the turbines, there are three SMs, no Category A Listed Buildings and no GDLs (Figure 10-2). There is one Nationally Important and one designated site (Site 14, South Tarbrax Category B Listed Building and Site 17 Huntingfaulds Cairn Scheduled Monument) within 5km of the turbines with possible effects on its setting as a result of the proposed development.

Table 10-5: Known sites of National/Regional Importance within 5km

Site No	Site Name	Site Type	Designation	Importance	Figure No
14	South Tarbrax	Inn (c.18th)	Category B Listed Building	Regional	Figure 10-1
15*	Arniefoul Cairn	Chambered cairn	Scheduled Monument	National	Figure 10-3
16*	Huntingfaulds Cairn	Chambered Cairn	Scheduled Monument	National	Figure 10-4
17*	Carlunie Hill	Chambered Cairn	Scheduled Monument	National	Figure 10-5

Sites identified by * are those identified by Historic Scotland for specific assessment.

10.3.4 Designated and NSR Sites within 25km

The significance matrix (Table 10-3) indicates that any site of local importance whose setting contributes to their importance will have at worst a slight significance of effect on their setting if the wind turbines are a dominant feature within the landscape. As views of the proposed turbines were not assessed as dominant for any features of local importance, only sites of national importance are considered further within this assessment. One site, (Sites 18 Glamis Castle GDL and Category A Listed Building) have been assessed within this study.

NSR sites are cultural heritage sites that are presently not designated, however, have been deemed by the local SMR to be of schedulable quality and are, therefore, regarded as such in relation to potential direct or indirect effect on setting.

In total, there are 486 Scheduled Monuments, 271 Category A Listed Buildings, 20 GDLS and 44 Conservation Areas within 25km of the proposed development site. For most of these, the significance of effect on their setting is negligible at best. A list of all of these sites is available as an appendix on a CD.

10.4 Construction Impacts

10.4.1 Predicted Impacts

Potential effects on the cultural heritage resource considered are:

- Direct: Physical damage to or destruction of features occurring during construction. Activities presenting a risk during construction include top-soil stripping, foundation excavation, bunding, machine movement over vulnerable soft ground and temporary soil and construction material storage. The greatest potential for unexpected discoveries within the area of construction is of buried Prehistoric features and objects. The evidence would indicate that these are likely to be isolated features, very possibly having a burial/ceremonial association, and that they are probably already damaged as a result of agricultural impact.
- Effects on Setting: Visual changes affecting the setting of cultural heritage features. Other possible indirect effects include disturbance from vibration during construction, de-watering or changes in hydrology as a result of the installation of the wind turbines and associated engineering and ancillary equipment.

The physical impact of construction activity arising from turbine construction has the potential to destroy whole or parts of archaeological deposits, monuments and historic structures; and to alter the burial environment of archaeological deposits which may result in accelerated rates of deterioration and consequential destruction of deposits.

Direct impacts upon the cultural heritage resource caused by construction activities have the potential to be substantial and adverse unless effectively mitigated.

10.4.2 Mitigation Measures

The site layout has been developed taking into account environmental sensitivities and constraints. In this way, direct effects on identified and known cultural heritage sites have been avoided as far as possible by careful location of the turbine access tracks and infrastructure.

Where effective mitigation is implemented, cultural heritage assets will be preserved *in situ* or properly recorded. Positive outcomes of mitigation can result in improved understanding and interpretation of the asset; previously unavailable information being made available to a wider audience; and increased public understanding and enjoyment of cultural heritage.

Mitigation of Effects on Unknown Archaeology

The known baseline is such that there is some potential for buried archaeological deposits to be encountered within the development boundary, with Prehistoric remains being the most likely. Since the landscape context of particularly the Prehistoric period has entirely gone, there is very little to help predict the possible location of such remains. In addition the most likely character of such remains is of widely dispersed discrete features. Together, these factors mean that they may not be readily identified through evaluation. Given the limited land take of the new development it is recommended and requested by the council archaeology service that the most effective strategy of identifying, recording unknown buried archaeology is to make provision for the archaeological monitoring of all areas of soil stripping related to construction (turbine base, crane pads, connecting trackways, site compounds and storage areas), and provision for the excavation and recording of any archaeological deposit revealed. An agreed Written Scheme of Investigation should stipulate that the construction timetable accommodates sufficient time between the soil strip and construction to allow for appropriate treatment of any remains encountered.

10.4.3 Predicted Residual Impact

Figure 10-1 shows the locations of known sites in the context of the proposed site layout, and indicates that the majority of these are not directly affected by the proposed turbines or associated infrastructure (such as access tracks). No residual impact is predicted.

10.5 Permanent and Operational Impacts

10.5.1 Predicted Impact

The indirect impact of wind turbines as new features in the landscape has the potential to affect the setting of cultural heritage assets. The archaeological/historical context, visual appearance and the aesthetic qualities of a site's surroundings are important to the intrinsic value of certain cultural heritage features and to our modern perceptions and experience of some sites. The alteration of those qualities would impact negatively upon site character and value. As a wind farm has been consented at the site, a precedent has been set that considers wind farm development at this site acceptable. The revised scheme which is proposed in this application will have a reduced impact than the consented application as the baseline now includes a wind farm.

As noted above, no sites within the 25km outer study area are considered to have effects on setting based on a review of inter-visibility with the proposed development. Of the four cultural heritage features of National and Regional Importance identified within the 5km middle study area (Table 10-6), the setting of one site only (Site 14, Category B Listed Building) was considered to be potentially affected. Based on a review of inter-visibility with the proposed development (using the ZTV and wireframes; Figures 10-2 to 10-7) and consideration of their sensitivity to effects on setting, the residual effect of the proposed development on the setting of each identified feature has been assessed (Table 10-6). This has taken into account both the views of the feature and views from the feature.

Table 10-6: Potential Effects on Cultural Heritage Setting

Site	Importance	Distance from site	Percentage of turbines visible	Sensitivity	Magnitude	Significance
14 South Tarbrax Inn	Regional	1.5km	100	Medium	Dominant	Moderate
15 Arniefoul Cairn (Figure 10-3)	National	2.65km	0	High	None	None
16 Huntingfaulds Cairn (Figure 10-4)	National	2.12km	0	High	None	None

Site	Importance	Distance from site	Percentage of turbines visible	Sensitivity	Magnitude	Significance
17 Carlunie Hill (Figure 10-5)	National	4.80km	15	High	Negligible	Slight
18 Glamis Castle (illustrated on Figure 10-6 at 42m height for the viewing platform; Figure 10-7 presents view from GDL)	National	7.4km	0	High	None	None

All of the sites assessed as having potential sensitivity to the wind turbines are between 1km and 8km from the proposed development.

Site 14 (Tarbrax c.18th Inn) is a Category B Listed Building. Located approximately 2.1km to the southwest of the proposed turbines, the site comprises a two-storey house with a single-storey wing and byre, constructed from white-washed rubble and slate. There are views to and from the proposed turbines and most of the turbines are inter-visible. The turbines are dominant in views to the site, while the principal views are to the southeast from the Listed complex. However, the turbines are visible and it is, therefore, considered that the effect on the setting of the consented development is of Dominant magnitude, resulting in an overall effect of Moderate significance on setting. This was considered acceptable for the consented scheme. The difference in impact between the consented scheme and the proposed will be negligible.

Site 17 Carlunie Hill, comprises a Chambered Cairn, on the summit of Carlunie Hill that measures 14m in diameter and 2m in height. The wireframe (Figure 10-5) indicates that one turbine hub and three turbine tips would be inter-visible with the Scheduled Cairn and owing to the distance (4.8km) and proportion visible, a minor feature on the horizon. It is, therefore, considered that the effect on setting from the consented scheme will be of negligible magnitude, resulting in a Slight significance of effect on setting. Again, this was considered acceptable for the consented scheme. There will be minimal difference in impact between the consented scheme and the current proposed development. Any increase in height will be offset by the reduction in turbine numbers from five to four.

Unknown Archaeology

The archaeological potential of the proposed development area is generally considered to be good. While unknown features of cultural heritage importance may be present, such features would almost certainly consist of buried archaeological features not visible above ground level, and would, therefore, not be sensitive to visual effects on setting during the operation of the wind turbines.

10.5.2 Mitigation Measures

As explained in Chapter 3, views of the wind turbines have been taken into account as part of the design process, to reduce visual effects and improve fit within the landscape context.

Mitigation of the operational impact of the wind turbines has, therefore, been embedded within the design process, and no further specific mitigation of the effects on the setting of designated heritage is proposed.

10.5.3 Predicted Residual Impact

Since no mitigation is proposed for the indirect effects on setting, the predicted impacts will be as described in Section 10.5.1.

10.6 Cumulative Impacts

Potential effects on cultural heritage features are determined through consideration of the effect on each individual historical site. A cumulative effect would arise where several historical sites within a region were affected by more than one development proposal.

There is one consented wind farm on the Frawney site (13/00532/EIAL) and one wind farm adjacent to the proposed site at Govals Farm. Analysis of the cumulative ZTV (Figure 6-32) for the development was undertaken. As the ZTVs also demonstrate, the zones of visibility will remain largely the same as the consented application (13/00532/EIAL) with no new areas of notable visibility. The only potential for indirect impact was identified on the Carlunie Hill Cairn Scheduled Monument. Inter-visibility was identified with turbines at Frawney and Govals Farm, however, the 5km distance is considered to reduce the impact, as well as only small sections of blade tip and turbines being visible. As a result no significant cumulative impacts are predicted.

10.7 Summary

An effect of Moderate significance on the setting of one site, the Tarbrax Inn, a Category B Listed building has been assessed and identified. The turbines are inter-visible with this building. The remaining sites that have inter-visibility with the turbines all have a Slight significance of effect as views are generally restricted to blade tips and one turbine hub. The impact of the consented scheme was considered acceptable and the proposed revised scheme will not create any additional impact. The increased height of the proposed wind turbines will not have any increased impact. Any increased impact due to the height of the turbines will be offset by the reduced number of the proposed development. However, planning consent is sought for 25 years and any effects, although long term, will not be a permanent modification to the setting of the features identified.

10.8 References

Historic Scotland (1998). Memorandum of Guidance on Listed Buildings and Conservation Areas.

Historic Scotland (2011). Scottish Historic Environment Policy (SHEP 23).

HMSO (1979). Ancient Monuments and Archaeological Areas Act.

HMSO (1997). Planning (Listed Buildings and Conservation Areas) (Scotland) Act.

LI/IEMA (2002). Guidelines for Landscape and Visual Impact Assessment.

Cartographic

County	Date	Ordnance Survey Sheet	Scale
Forfarshire	1st Edition 1865	XLIV	1:10560
Forfarshire	2nd Edition 1903	XLIV (SW)	

11 Transport and Access

11.1 Introduction

This chapter evaluates the effects of the proposed development on the road network and associated receptors. The site is located 10km north of Dundee, to the west of the A90 trunk road. This assessment identifies the potential effects of increased road traffic on the local road network including the A90 as a result of the proposed development and assesses their significance against identified criteria suggesting suitable mitigation where possible.

11.2 Methodology and Approach

11.2.1 Legislation and Guidance

This assessment takes account of the following planning advice and guidance documents described in more detail below:

- Scottish Planning Policy (SPP);
- Planning Advice Note (PAN) 75: Planning for Transport;
- Guidelines for the Environmental Assessment of Road Traffic, Institute of Environmental Management and Assessment (IEA, now IEMA), 1993; and
- Angus Local Plan Review, Adopted 2009.

Scottish Planning Policy: Transport

Paragraph 168 of SPP notes: "*A transport assessment should be carried out where a change of use or new development is likely to result in an increase in the number of trips. The output of traffic assessments can also identify potential cumulative effects of development which need to be addressed*."

Once operational, wind farms are generally considered to have no impact on the number of trips made, therefore, this assessment concentrates on the potential impacts during the construction phase.

Planning Advice Note (PAN) 75: Planning for Transport

Paragraphs 40 and 41 of PAN 75 state that: "*SPP17 requires a transport assessment to be produced for significant travel generating developments. Transport assessment is a tool that enables delivery of policy aiming to integrate transport and land use planning*", and that "*All planning applications that involve the generation of person trips should provide information which cover the transport implications of the development. The level of detail will be proportionate to the complexity and scale of impact of the proposal…*"

The advice note focuses on the number of person trips, however, the more significant elements of the wind farm construction will be in the abnormal load transportation and the Heavy Good Vehicles (HGV) construction traffic. The assessment, therefore, concentrates on these elements.

Guidelines for the Environmental Assessment of Road Traffic, IEA 1993

The 'Guidelines for the Environmental Assessment of Road Traffic' produced by the IEA (1993) (the IEA Guidelines) are referred to throughout this assessment. The IEA Guidelines suggest two broad rules can be used as a screening process to identify the appropriate extent of the assessment area. These rules are:

- Rule 1: Include road links where traffic flows increase by more than 30% (or the number of HGV's would increase by more than 30%); and
- Rule 2: Include any other specifically sensitive areas where traffic flows would increase by 10% or more.

These guidelines are intended for the assessment of the environmental effects of road traffic associated with major new developments.

PAN75 principally relates to developments that generate significant increases in travel as a direct consequence of their function, e.g. retail parks. Therefore, a formal transport assessment is not required for the proposed development. However, in providing the information required to be presented in an ES (as per IEA guidelines) this chapter addresses the local traffic impacts of the development during construction, operation and decommissioning and, therefore, addresses the issues that would be assessed within a transport assessment.

The general approach to the assessment of effects as required by the EIA Regulations has been followed.

Angus Local Plan Review

The Angus Local Plan Review which was adopted in 2009 states that proposals for all forms of renewable energy developments will be supported in principle if access for construction and maintenance traffic can be achieved without compromising road safety or causing unacceptable permanent and significant change to the environmental and landscape.

11.2.2 Consultation

Table 11-1 summarises the consultation responses with regards to transport received during this process.

Two potential transportation routes of abnormal loads: from Dundee and Grangemouth; were selected for the consultation process so opinions could be sought and a preferred route selected.

Table 11-1: Consultation Reponses

Consultee	Date of Response	Summary of Comments and Requirements
Angus Council – Roads Department	10/05/2012	• Commented that Angus Council were not responsible for maintaining the A90. • Noted that the planning application should consider associated development traffic, potential impact on the route to site and site access details.
	16/07/2012	• No objection to application 12/00577/EIAL subject to a Construction Traffic Management Plan being secured by planning condition.
BEAR Scotland	09/03/2012	• Could not foresee any problems with the proposed routes for abnormal loads.

Consultee	Date of Response	Summary of Comments and Requirements
		• Confirmed that the transportation routes had been used in the past to transport similar loads without any difficulties and none of the structures on either route are subject to any weight restrictions. • Commented that they would prefer the turbines to be landed at Dundee as it would reduce the distance to be travelled and hence disruption to traffic.
Network Rail	13/03/2012	• Commented that it appears that both of the proposed transportation routes do not affect any Network Rail owned rail bridges and, therefore, have no objection to either of the proposed routes.
Tayside Police	13/03/2012	• Once the local authority roads department have processed the application, the Tayside Police will respond in turn.
Transport Scotland	09/03/2012	• Commented that they would be prepared to authorise the proposed movements. • Recommended a suitable route to travel through Dundee.
	05/07/2012	• No comments to application 12/00577/EIAL given the minimal impact upon trunk road traffic.

11.2.3 Overall Approach

Baseline conditions at the site were established through desktop assessment of the proposed route. The potential effects of the development were then identified and assessed and where possible mitigation measures suggested.

Baseline traffic flow for the A90 and A928 were obtained from the Transport Scotland website (Transport Scotland, 2011) and Angus Council and reviewed in order to consider the effect of construction vehicles on road capacity and road safety.

The methodology used in the assessment adheres to that set out in the IEA Guidelines (1993) and, therefore, focuses on:

- potential effects on land uses and environmental resources fronting those roads, including the relevant occupiers and users; and
- potential effects on local roads and the users of those roads.

Sensitivity of a road can be defined by the user groups such as school children and the elderly. For the purposes of this assessment sensitivity is defined as high, medium or low and has been determined by professional judgement based on the known characteristics of the road. Examples of characterisation are:

- High sensitivity: road would be adjacent to facilities used by sensitive user groups e.g. schools, nursing homes or where pedestrian activity is high and, therefore, users would be very sensitive to high traffic flows.
- Medium sensitivity: road where residential properties or shopping areas have roadside frontage or the roads have narrow footpaths or cycleways, and, therefore, users would be moderately sensitive to high traffic flows.
- Low sensitivity: already busy roads, dual carriageways, without pedestrian access or segregated footpath provision, located away from junctions and access points and, therefore, users would not be sensitive to high traffic flows.

11.2.4 Assessment Methods

The assessment methods used are in accordance with IEA Guidelines (1993) and the magnitude of potential impact is defined in Table 11-2.

Table 11-2: Magnitude of Potential Impacts

Magnitude	Change in Predicted Traffic Flow
Major	Greater than 90 % (Greater than 70% where considered sensitive)
Moderate	60 – 90 % (40 – 70 % where considered sensitive)
Minor	30 – 60 % (10 – 40 % where considered sensitive)
Negligible	Less than 30 % (Less than 10 % where considered sensitive)

It should be noted that increases in traffic flows below 10% are not considered to be significant given that daily variations in background traffic flow may fluctuate by this amount. The sensitivity of each receptor and magnitude of potential change were compared to determine the overall significance of effect, as outlined in Table 11-3. Effects classified as major or moderate significance are considered to be significant.

Table 11-3: Significance of Potential Effects

	Magnitude			
Sensitivity	Major	Moderate	Minor	Negligible
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible

11.2.5 Assessment Methods

The methodology adopted in this assessment has involved the following key stages:

- Determine baseline;
- Review development for impacts;
- Evaluate significance;
- Identify mitigation; and
- Assess residual impacts.

11.3 Baseline Conditions

11.3.1 Study Area

The transportation study area comprises the proposed transportation route to site required to transport wind farm components as well as the onsite access arrangements. Traffic impacts on the A90 and through Dundee were considered as part of the assessment. The transportation route to site is shown on Figure 11-1.

Site Access Location

The Frawney Wind Farm site will be accessed from the public road network (A928) located to the south of the site, via an existing private road entrance at NGR 341489, 740654. The route to site including the site access location is shown on Figure 11-1. This site access location will remain the same for the construction, operation and decommissioning of the project and is the same as the consented development.

Proposed Route to Site for Wind Turbine Components

The proposed transportation route to the site for wind turbine components is from the Port of Dundee approximately 12km south of the site entrance which was considered acceptable for the consented scheme. The 'Water Preferred Policy Guidelines for the Movement of Abnormal Indivisible Abnormal Loads' (Highway Agency, 2008) advises that *"In order to reduce the distance that abnormal loads move by road, coastal waters will continue to be the preferred transport mode over longer distances. This means taking the load by road to the nearest coastal port unless there is a nearer suitable abnormal load landing facility."* The Port of Dundee was identified as a suitable landing port for wind turbine components during the consultation process.

The transportation route is outlined below and illustrated on Figure 11-1.

- Components landed at the Port of Dundee;
- Exit docks and turn right onto A92/East Dock Road;
- Continue along A92 until reaching junction with A972;
- Travel A972 until junction with A90 and turn right;
- Continue on A90 for approximately 7.5km;
- Turn left onto A928 for 1km until reaching site access point.

Proposed Route for HGV's to Access Site

There are a number of quarries within a 20km radius of the site, one of which will be used to source concrete and aggregate as required. The associated HGV traffic will mainly use the A90 and A928 to transport the materials to site.

Upgrades to the Public Road System

The same bell mouth which was proposed and agreed for the consented scheme will be used which will provide access off the A928.

On-Site Access

The on-site access track will use the same tracks as proposed and consented in the permitted application (2013/00532/EIAL). There will be less access track required due to the reduction in turbine numbers. Construction detailing will be agreed as per the planning conditions issued with the planning consent for the previous scheme.

11.3.2 Baseline Traffic Count

Traffic count information was available for the A972, A90 and A928 from Transport Scotland and Angus Council and is presented in Table 11-4. These traffic count locations are used in the traffic flow assessment in Section 11.5.4.

Table 11-4: Traffic Count Data

Road	Transport Scotland Identifier	NGR	Site Name	2011 Average Daily Flow
1. A972	ATC03117	343000, 731800	A972 Kingsway East – North of A92	25691
2. A972	ATCPT030	342720, 732050	A972 Kingsway East – South of Longtown Road	27579
3. A972	ATCPT031	342380, 732180	A972 Kingsway East – East of	29423

Road	Transport Scotland Identifier	NGR	Site Name	2011 Average Daily Flow
			Pitkerro Road	
4. A972	ATCPT032	341710, 732310	A972 Kingsway East – East of Forfar	25521
5. A90	ATC00013	341575, 733432	A90 Dundee; Forfar Road	31081
6. A90	JTC00064	341887, 735747	A90 Powrie – North of Duntrane Road (Dundee)	25645
7. A928	-	339006, 743040	A928 at Meikle Kilmundie	1215

The earliest anticipated start date for construction of the proposed development is 2015. The construction programme estimates the duration of construction activity to be approximately nine months. To enable the likely impacts during construction to be assessed, base year traffic flows for 2015 have been calculated by applying growth factors from the Department for Transport (DfT) TEMPRO software to the base traffic flow shown above. Table 11-5 outlines the growth factor and the projected 2014 base year traffic flow.

Table 11-5: Predicted Baseline Traffic Growth

Road	Location	Survey Year	Growth Factor	Predicted AADT Vehicles (2015)
1. A972	A972 Kingsway East – North of A92	2011	1.008	25896
2. A972	A972 Kingsway East – South of Longtown Road	2011	1.008	27799
3. A972	A972 Kingsway East – East of Pitkerro Road	2011	1.008	29658
4. A972	A972 Kingsway East – East of Forfar	2011	1.008	25725
5. A90	A90 Dundee; Forfar Road	2011	1.008	31082
6. A90	A90 Powrie – North of Duntrane Road (Dundee)	2011	1.008	25850
7. A928	A928 at Meikle Kilmundie	2011	1.008	1224

11.4 Identification of Sensitive Receptors

Sensitive receptors within the study area were identified during consultation and desk based study including schools, residential areas, town centres, trunk roads, footpaths and cycle routes. The settlements identified within the study area have been considered to be the main sensitive receptors as typically individual sensitive receptors, schools, hospitals and residential areas are located within them.

The only major settlement within the study area is Dundee. The transportation route from the port through Dundee passes residential areas, business, junctions and schools.

The following roads have been considered as sensitive receptors within this assessment:

- A972 trunk road;
- A90 trunk road; and
- A928.

It is important to note that the settlements located along the A972 and A90 are located on a trunk road which is designed for and used to high levels of freight traffic and HGVs in particular. As such any traffic increases associated with the Frawney Wind Farm on these receptors would be minimal and related effects would likely not be significant. However, the increase traffic on the A972 and A90 has been quantified and assessed in this chapter.

11.5 Construction Impacts

The likely increases in traffic volumes as a result of the wind farm construction have been predicted. The construction programme estimates the duration of construction activity to be approximately nine months. The predicted traffic flows take into account specific construction activities and associated HGV trip generation.

11.5.1 Abnormal Loads during Construction

An abnormal load movement is defined on the DfT website "*as a vehicle in excess of 80 tonnes in weight, 3m in width and 18.75m in length*" (DfT, 2011). The hub, nacelle and foundation plate of the candidate turbine (Enercon E48) would be transported on articulated vehicles up to 30m in length and 4.5m (nacelle diameter) in width.

The major turbine components would be transported to the site as abnormal loads of varying tonnage and length. The number of these has been included within the assessment of general construction traffic to ensure a robust assessment including all vehicles. It is important to consider the effect of these particular vehicles in isolation, as the effects are quite different to those attributed to general construction traffic.

The vehicles used to transport turbine components would constitute abnormal loads only on the delivery phase of the journey since the extendible trailers are retracted to the size of a standard articulated vehicle (16.5m) during the return leg. Each delivery of turbine components, therefore, consists of one abnormal load movement on the inbound journey to site and one HGV movement on the return journey.

It is likely to take approximately two months to erect the turbines at the proposed development site. During this period, up to 32 abnormal loads of wind turbine components) would be delivered to the site, eight fewer than the consented scheme, although the blade lengths will be longer but should not have any additional impact on the highway. These include:

- up to 12 tower sections;
- four nacelles;
- 12 turbine blades; and
- four generator and hub loads.

In addition, two heavy lift cranes would access the site, which are also considered to be abnormal for the purposes of this assessment. Other wind loads such as foundation plates and ancillary items would also be delivered during this period.

11.5.2 Potential HGV Loads during Construction

Table 11-6 outlines the estimated HGV trip generation in line with the construction programme, including abnormal load deliveries.

Table 11-6: Construction Programme and Associated Predicted Vehicle Movements (Note: all figures are approximate)

Component	Material	Total no. of deliveries	M1	M2	M3	M4	M5	M6	M7	M8	M9
Site access tracks	Aggregate	**346**	173	173							
Crane hardstanding	Aggregate	**105**				35	35	35			
Control building	Pre-mix concrete and steel	**98**							49	49	
Construction compound	Blocks, sand, timber etc.	**166**	83	83							
Wind turbine foundations	Pre-mix concrete and steel	**183**			61	61	61				
Commissioning	Fuel etc.	**4**									4
Final works	Various	**6**									6
Misc. (fuels etc.)	Cables, sand etc.	**18**	2	2	2	2	2	2	2	2	2
Cabins and amenities	Turbine components	**8**	4								4
Cabling kit (sand etc.)	Sand, cable etc.	**105**						35	35	35	
Additional plant (excavators, dumpers etc.)	Excavators, dumpers, etc.	**12**	6								6
Turbine delivery/erection		**34**					34				
Switchgear		**3**									3
Total		**1088**									
Total deliveries per month			**268**	**258**	**63**	**98**	**132**	**72**	**86**	**86**	**25**
Total deliveries per day			**13**	**13**	**3**	**5**	**7**	**4**	**4**	**4**	**1**
Total movements per day			**26**	**26**	**6**	**10**	**14**	**8**	**8**	**8**	**1**
Average movements per month		**120**									
Average movements per day		**6**									

A number of additional HGV loads will be required during the construction of the wind farm including low loaders for transporting plant to site and 21 tonne trucks for the delivery of construction materials e.g. aggregates and concrete.

HGV traffic is typically slow moving and can, therefore, cause delays to normal traffic movements particularly on smaller roads. It can be difficult to ascertain the maximum number of vehicles per day during the construction period as different activities may be scheduled concurrently while most activities must happen in sequence.

It is estimated that approximately 1088 (2176 movements, to and from site) HGV deliveries would occur during the construction of the project. These would include 34 abnormal loads to the site and 183 (366 movements, to and from site) HGV deliveries associated with the construction of the wind turbine foundations. Table 11-6 also includes aggregate deliveries for the access tracks, hardstandings and construction compound and concrete and steel for the substation, turbine and mast foundations.

Table 11-6 shows that over the entire construction period, it is estimated that on average six HGV deliveries (12 movements, to and from site) would be made each day. Certain concrete pouring operations require a continuous delivery of materials. The turbine foundations will be cast over consecutive days during months three to five of continuous pours with up to 28 deliveries of concrete per day for each pour. This could result in peak loads of concrete arriving at the site during certain periods of the day, assumed to be up to a maximum of six loads per hour.

Table 11-6 identifies that the most intense period of construction would be months one and two, during which construction of the access track and construction compound would be undertaken concurrently. During this period, assuming an equal spread of deliveries throughout the month, 13 HGV deliveries (26 movements, to and from site) on average would occur each day.

11.5.3 Construction Personnel

For the purposes of estimating traffic generation it is assumed that the construction phase would require an average workforce of ten persons on site per day throughout the construction phase. This figure would require an average of five vehicles per working day based on occupancy of two personnel per vehicle (DfT, 2006), giving ten movements per day. This number of vehicle movements is considered to be worst-case, as a number of construction personnel would likely arrive to site in vehicles already accounted for in the assessment, such as HGV's being used to transport material.

11.5.4 Traffic Flows

Table 11-7 summarises the average and peak traffic increases predicted to occur during construction at the assessment locations identified by Transport Scotland (in consultation) and describes their significance in terms of the potential increase in traffic volumes.

The A90 and A928 have been identified as having low sensitivity as they are A-class roads, constructed to accommodate significant HGV composition.

Table 11-7: Predicted Percentage Increases in Traffic at Assessment Locations (2015)

Road	Location	Baseline Average Daily Traffic Forecast (ADTF) 2016	Predicted % Increase HGV+LGV 2 way movements		Magnitude	Significance
			Average (22 vehicles)	Peak (36 vehicles)		
1. A972	A972 Kingsway East – North of A92	25896	0.08%	0.14%	Negligible	Negligible
2. A972	A972 Kingsway East – South of Longtown	27799	0.08%	0.13%	Negligible	Negligible

Road	Location	Baseline Average Daily Traffic Forecast (ADTF) 2016	Predicted % Increase HGV+LGV 2 way movements		Magnitude	Significance
			Average (22 vehicles)	Peak (36 vehicles)		
	Road					
3. A972	A972 Kingsway East – East of Pitkerro Road	29658	0.07%	0.12%	Negligible	Negligible
4. A972	A972 Kingsway East – East of Forfar	25725	0.09%	0.14%	Negligible	Negligible
5. A90	A90 Dundee; Forfar Road	31082	0.07%	0.12%	Negligible	Negligible
6. A90	A90 Powrie – North of Duntrane Road (Dundee)	25850	0.09%	0.14%	Negligible	Negligible
7. A928	A928 at Meikle Kilmundie	1224	1.8%	2.9%	Negligible	Negligible

HGVs and construction personnel vehicles would respectively average 12 and ten movements per day. In comparison to the projected base traffic flows at the assessment locations, this would represent average daily increases in traffic movements on the A928 of up to 1.8%.

Table 11-7 also shows that the peak daily increase during the busiest periods (months one and two) of 26 HGV and ten personnel movements would result in temporary traffic increases of up to 2.9%.

In terms of the thresholds outlined by the IEA Guidelines, Table 11-7 illustrates that the construction traffic is predicted to have a negligible effect on the A972, A90 and A928.

11.5.5 On Site Access Tracks

New site tracks and hardstanding areas will be created to the specification of the turbine manufacturer. Existing site tracks will be improved wherever possible with replacement and re-grading of running surface in degraded areas.

11.5.6 Predicted Impact

The increases in HGV traffic have the potential to result in the following environmental impacts:

- Traffic Noise and Vibration – the potential traffic noise impact on residential receptors in the vicinity of the site would be temporary in nature. Construction noise impacts are discussed further in Chapter 5.
- Disruption and Driver Delay – the effects of delay to other road users would mainly be apparent during the movement of abnormal loads as a result of their large size and low speed rather than their numbers. This could be significant without appropriate mitigation and planning. Mitigation measures are outlined in Section 11.5.7 to reduce any effects.

- Increased risk of accidents – any increases in traffic numbers has the theoretical potential to increase the risk of accidents. Ordinarily, marginal increases in vehicle numbers would be considered to have a negligible effect on safety since the increases are within average day to day variation in traffic levels. However, there is a potential for impacts on safety as a consequence of driver frustration related to the movement of abnormal loads. Measures to control and improve the potential for issues of driver frustration to arise are described below.
- Severance – severance is the perceived division that can occur within a community when it becomes separated by a major traffic artery. It may result from the difficulty of crossing a heavily trafficked existing road for example, or as a result of a physical barrier created by the road itself. The only major urban area within the study area which has the potential to be subject to severance impacts along the route will be Dundee. However, the IEA guidelines suggest that only changes in traffic flow of 10% or more are likely to produce changes in severance. Due to the low proportion of increased traffic flow, temporary nature of the effects and the relatively short duration of transportation of turbines, the severance effect on all roads within the study area is not considered to be significant.
- Pedestrian Delay – changes in the volume, composition or speed of traffic may affect the ability of people to cross roads. In general terms, increases in traffic levels are likely to lead to greater increases in delay. However, given the range of local factors and conditions which can influence pedestrian delay, IEA does not recommend that thresholds be used as a means to establish the significance of pedestrian delay. While some delay to pedestrians may occur due to the increased traffic levels, it is unlikely that during peak construction times, when traffic is heaviest, that the estimated six HGVs per hour at peak times would have an impact on pedestrian delay. Therefore the potential effect is not considered to be significant.
- Pedestrian Amenity – pedestrian amenity is broadly defined as the relative pleasantness of a journey and is considered to be affected by traffic flow, traffic composition and pavement width/separation from traffic. The IEA guidelines note that changes in pedestrian amenity may be considered to be significant where the traffic is halved or doubled. An additional six HGVs per hour equating to one every 10 minutes is unlikely to impact on pedestrian amenity during deliveries. The potential effect is not considered to be significant.
- Dust and Dirt – HGVs have the potential to distribute dust and dirt from the construction site onto the local road network. These effects would be most pronounced at the site access junction with the A928.
- Visual Effects – the movements of high-sided vehicles could be considered visually intrusive. This effect would be short-term and only occur during the construction period.
- Fear and Intimidation – the scale of fear and intimidation experienced by pedestrians is dependent on the volume of traffic, its HGV composition, its proximity to people or the lack of protection caused by such factors as narrow pavement widths. However, this impact is subjective and there are no commonly agreed thresholds by which to determine the significance of the effects. The predicted increases in traffic are such that any change in level of fear and intimidation may only be minor. This effect is not considered to be significant.
- Accidents and Safety – due to the numerous local causation factors involved in personal injury accidents, the IEA guidelines do not recommend the use of

thresholds to determine significance. Given that the changes predicted are temporary in that they relate only to the worst-case months and less than six additional HGVs per hour are predicted, the potential effects related to accidents and safety are not considered to be significant.

11.5.7 Mitigation Measures

The potential effects associated with the construction traffic on site will be reduced through the use whenever possible of existing access tracks within the site.

The abnormal loads movements of the turbine components will be programmed to avoid peak periods of traffic, pedestrian activity through Dundee and outwith school hours to reduce the impact and sensitivity of the A972, A90 and A928. It is proposed that the abnormal loads are transported outside times when traffic is highest.

The implementation of a traffic management plan (TMP) and routing strategy will aim to reduce the movement of construction vehicles during the morning and evening peak traffic hours when the road network is typically at its busiest.

Prior to construction of the wind farm, a draft TMP would be prepared and submitted to Angus Council for consideration. The developer and appointed contractor will develop this TMP with Angus Council and adhere to its details during the construction of the wind farm. The TMP will typically include consideration of the following:

- Appropriate police or contractor escort to accompany movement of turbine components from the port of entry, at times to be agreed with the local authorities and police where appropriate;
- Advanced notification to the general public warning of turbine component transport movements;
- Informative road signage warning other users of forthcoming turbine component transport and construction traffic movements;
- Arrangements for regular road maintenance and cleaning, e.g. road sweeping in the vicinity of the site access point as necessary;
- Specific routing of abnormal loads to avoid peak seasonal traffic along the route;
- Specific timing of deliveries outside of peak traffic hours;
- Drivers to be briefed on pulling over to the side of the road at suitably safe locations to allow other road users to overtake safely;
- Wheel cleaning/dirt control arrangements at key stages of construction; and
- Provision of temporary signs and traffic control where necessary.

To mitigate specific impacts on residents and recreational users of the A928 the following measures are proposed:

- Notify local residents of proposed timings for abnormal load deliveries and predicted days of elevated construction traffic will help to avoid a high level of impact where possible;
- Signage to be provided to warn recreational users at construction traffic crossing points; and
- Arrangements for regular road maintenance and cleaning, e.g. road sweeping in the vicinity of the site access point as necessary.

In order to reduce traffic impacts associated with the construction of the proposed wind farm development, construction personnel will be encouraged to car-share or use company shuttles where practicable.

11.5.8 Predicted Residual Impact

The mitigation measures described above and the short-term nature of the increase in traffic would result in minimal residual environmental effects in terms of traffic and transport. This conclusion is justified by:

- A routing agreement will reduce impacts during both construction and decommissioning;
- All traffic and access related conditions imposed on the consented scheme will be adhered to in the proposed development; and
- The abnormal loads movements of the turbine components will be programmed at night which would result in a negligible effect.

11.6 Permanent and Operational Impacts

11.6.1 Predicted Impact

It is predicted that during the operational phase there would be an increase in traffic of no more than two vehicle movements per month. This would principally constitute two movements of light vehicles for maintenance and two additional movements for servicing every six months with very occasional abnormal loads associated with replacement blades and gearboxes. These traffic movements associated with the operational phase of the proposed development are not considered to be significant.

11.6.2 Mitigation Measures

No mitigation measures are anticipated to be required for transport during operation of the proposed development due to the low numbers of operational vehicle movements. If replacement turbine components were required, transport arrangements for abnormal loads and appropriate mitigation would be agreed with the relevant local authorities in advance.

11.6.3 Predicted Residual Impact

None of the identified effects associated with traffic in the operational phase would be significant.

11.6.4 Decommissioning

Current baseline data collected for the purposes of this assessment will not be valid at the year of decommissioning. As it is unlikely that baseline traffic figures on local roads will reduce appreciably over the next 25 years, it is considered that the percentage increase in traffic due to decommissioning would be low and that overall, the effects of decommissioning would be less than those of the construction phase. A TMP will be implemented to reduce the movement of vehicles associated with decommissioning during the morning and evening peak traffic hours when the road network is typically at its busiest.

11.7 Cumulative Impacts

Operational wind farm sites are considered to have no cumulative traffic impact and are, therefore, not considered.

Information gained from research and the relevant wind farm databases indicates that as of April 2014, within the transport study area of the site there is one operational wind farm (Ark Hill), one consented wind farm on the Frawney site and one consented wind farm nearby (Govals Farm).

The proposed development is been progressed in place of the consented scheme at Frawney so will not be constructed together. Assuming a worst-case scenario, that Frawney and Govals Farm were consented and developed at the same time; and turbine components landed at the same port during the same time period; there would be negligible cumulative abnormal load or HGV impact on the busy and well maintained A972 and A90. It is, however, considered unlikely that all projects within the local area would be constructed at the same time. The other wind farm sites would not use the A928 required for the Frawney Wind Farm access route and, therefore, no cumulative impacts are predicted on this road.

11.8 Summary

The potential effects of abnormal load movements and other construction traffic deliveries have been assessed in this chapter.

There will be reduced numbers of traffic required for the proposed development compared to the consented scheme due to the reduced number of turbines and therefore amount of access track required.

Although the abnormal loads will be longer for the turbine blades than the consented scheme, the road network will be able to accommodate them.

All transport related conditions imposed on the consented scheme will be adhered to for the proposed scheme should it be consented.

Extensive consultation was undertaken to ensure the views of all stakeholders could be taken into account in defining the proposed transportation route to site for abnormal loads: from the Port of Dundee onto the A92/East Dock Street, A972, A90 north and A928 to the site access location. Abnormal loads would be scheduled to occur during off-peak periods, at time to be agreed with Tayside Police and Angus Council in order to minimise delays to other road users. The timing of deliveries will also be planned with Transport Scotland so that it does not coincide with any major traffic works along the proposed routes.

The construction of the proposed development would result in a temporary increase in traffic levels on sections of the A972, A90 and A928. In accordance with the IEA Guidelines significance criteria, these increases are considered to be negligible.

Traffic generated during operation and maintenance of the proposed development would be minimal and would not result in any significant effects.

Traffic generated during decommissioning of the wind turbine is likely to be lower than the levels associated with its construction. Decommissioning would be the subject of a further traffic assessment and management plan at the appropriate time. The effects are not expected to be significant.

No significant cumulative traffic effects are envisaged due to the capacity of the road network to accommodate the predicted additional temporary traffic and the likelihood that some of the considered projects will be constructed within different time periods to the proposed development.

11.9 References

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12 Socio-economics and Recreation

12.1 Introduction

This chapter, written by Grangeston Economics, provides an assessment of the effects of the proposed development on socio-economic activity and recreation during construction and operation of the wind farm.

A range of socio-economic impacts may result from the project locally, regionally and nationally. The proposed development would contribute to the climate change agenda through the generation of clean electricity and the displacement of fossil fuel emissions. The wind farm also has the potential to contribute to sustainable development both nationally by contributing to security of energy supply and more locally by economic diversification and development.

The specific socio-economic effects considered are those affecting tourism, recreation and employment created through the construction process; the operation and maintenance of the wind farm; and any community trust expenditure. In addition, the project may have an impact on existing land uses at, and close to, the site and on property values.

The reporter for the appeal (13/00532/EIAL) agreed with Angus Councils' summary that there is no persuasive evidence to support claims that wind farms have a socio-economic impact, particularly on tourism and also that there is no compelling evidence that the development of a wind farm at the site would be harmful to tourism. The council and reporter also noted the developments potential for employment creation.

12.2 Methodology and Approach

The methodology used for this socio-economic assessment is based on best practice for undertaking economic impact assessment and expert knowledge of renewable energy developments and specifically of wind farm projects.

The assessment addresses the following issues:

- Baseline analysis of local economy;
- Construction impacts of development of the wind farm;
- Impacts of operation of the wind farm;
- Impacts associated with expenditures of the community trust;
- Potential impacts on visitor market and tourism issues; and
- Impacts on property.

The following sources of information were used in the completion of this chapter:

- General Register Office for Scotland;
- ONS (Business Register Employment Survey);
- ONS (NOMIS);
- Scottish Government; and
- Scottish Neighbourhood Statistics.

For potential impacts on recreation, reference can be made to the assessment of access to the outdoors within SNH's Handbook on EIA, Appendix 5 (SNH, 2006). SNH note that wind turbines can change the perception and amenity of both area and linear access facilities through visual and noise impacts; access tracks can interfere with/or facilitate public access; and wind turbines can act as a general deterrent or result as an attractor, depending on perception.

The criteria employed to assess the significance of effects on recreation has been based on whether there will be a permanent or long term change to access facilities, or where proposals affect recreational resources that have more than local use or importance. The assessment has been based on a professional judgement of the degree of change resulting from the proposals.

12.3 Baseline Conditions

12.3.1 Population

Angus is located on the northeast coast of Scotland and covers an area of 2,182km^2 which accounts for approximately 2.8% of Scotland's total land area. In 2012, Angus had an estimated mid-year population of 116,210, equivalent to 2.2% of Scotland's population. Angus' gender split at 49% (male) to 51% (female) is almost identical for Scotland as a whole.

Table 12-1: Population Estimates (mid-2012)

	Angus	Scotland
Male	48.6%	48.5%
Female	51.4%	51.5%
Total	116,210	5,313,600

Since 2000 the population of Angus has increased at a similar rate as Scotland as a whole (1.6% compared to 3.1%).

Table 12-2: Population Change 2001-2012

	Angus	Scotland
2000	108,850	5,062,940
2012	116,210	5,222,100
Percentage Change	6.8%	5%

Angus has a population density of 51 persons per km^2 making it the 12th least densely populated of Scotland's 32 local authority areas.

Table 12-3: Age Profile (mid-2012)

	Median Age	Under 16 years	Working Age	Pensionable Age
Angus	44 years	18%	58%	24%
Scotland	41 years	17%	63%	20%

Angus like many rural areas, has an older median age (7% older than Scotland as a whole) and a smaller working age population (8% lower than the relative share for Scotland as a whole). The percentage of Angus' population that is of pensionable age is 20% greater than that for Scotland as a whole.

Despite Angus being categorised as 'rural', over 70% of the population live in the seven main settlements of: Arbroath, Forfar, Montrose, Carnoustie, Monifieth, Brechin and Kirriemuir.

Table 12-4: Population Estimates by Settlement (mid-2008)

Settlement	Population	% of Angus Population
Arbroath	22,110	20.0
Forfar	13,430	12.2
Montrose	11,050	10.0
Carnoustie	10,780	9.8
Monifieth	8,220	7.5
Brechin	7,070	6.4
Kirriemuir	5,750	5.2
Sub-total	**78,410**	**71.1**
Angus	110,310	100

12.3.2 Industrial Structure

There are over 32,000 employees in employment in Angus. This does not include the self-employed which at the 2001 census was estimated at around 8% of people of working age and is largely accounted for by the primary sector

Table 12-5: Employees in Employment by Sector: Structure 2010

Sector	Angus	Scotland
	%	%
Primary Sector	**0.6**	**1.6**
Agriculture, forestry & fishing	0.6	1.6
Production & Construction Industries	**21.4**	**15.5**
Mining, quarrying & utilities	0.9	2.8
Manufacturing	14.6	7.5
Construction	5.9	5.3
Service Industries	**78.3**	**82.9**
Motor trades	2.8	1.9
Wholesale	2.8	3.0
Retail	11.8	10.2
Transport & storage (inc postal)	3.4	4.0
Accommodation & food services	7.8	7.1
Information & communication	0.9	2.7
Financial & insurance	0.9	3.7
Property	0.9	1.0
Professional, scientific & technical	5.9	5.9
Business administration & support services	4.7	7.5
Public administration & defence	5.3	6.8
Education	6.8	8.4
Health	18.6	16.4

Sector	Angus	Scotland
Other services	5.6	4.4
Total (%)	**100**	**100**
Total (nos)	**32,200**	**2,311,100**

Compared to Scotland as a whole, Angus has over one-fifth of its employees within the production and construction sectors compared to less than one-sixth in Scotland. The difference is particularly noticeable in manufacturing where Angus supports double the share of employment in manufacturing compared to Scotland (14.6% to 7.5%). Angus supports strong engineering, textiles and food processing sectors, as well as oil and gas related activities, digital media and pharmaceuticals.

Angus has a smaller proportion of employment in service industries, most noticeably in the information and communication, financial and insurance, and business administration and support services sectors.

Between 2008 (at the point of the financial crisis and subsequent recession) and 2010 (latest available data), employees in employment fell by 7.5% in Angus compared to a 6.2% reduction for Scotland as a whole. Angus appears to have suffered a relatively larger reduction in employment in the production and construction industries. In terms of the absolute numbers, 11 of the 18 subsectors experienced a reduction in employment and of these, three (manufacturing, construction and education) accounted for 48% of the reduction.

Table 12-6: Employees in Employment by Sector: Change 2008-2010

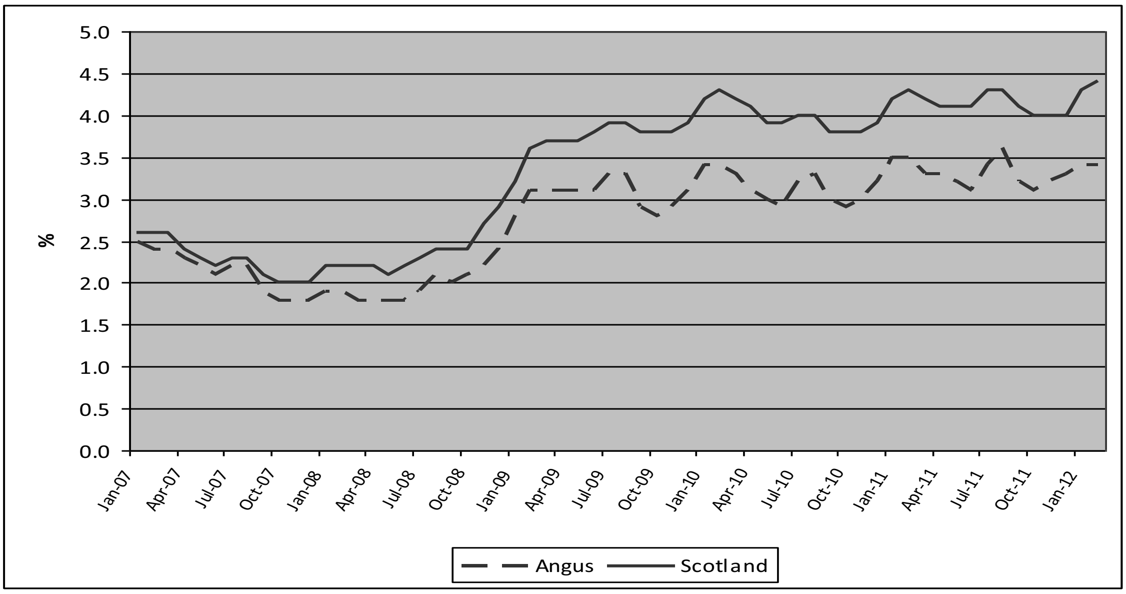
Sector	Angus	Scotland
	%	%
Primary Sector	**0.0**	**+1.7**
Agriculture, forestry & fishing	0.0	+1.7
Production & Construction Industries	**-14.8**	**-13.5**
Mining, quarrying & utilities	-25.0	+10.3
Manufacturing	-9.6	-14.1
Construction	-20.8	-21.6
Service Industries	**-4.9**	**-4.8**
Motor trades	+50.0	+14.2
Wholesale	-18.2	-11.7
Retail	-5.0	-5.9
Transport & storage (inc postal)	-8.3	-9.2
Accommodation & food services	-7.4	-7.7
Information & communication	0.0	+3.3
Financial & insurance	-40.0	-17.6
Property	0.0	-18.4
Professional, scientific & technical	+18.8	-3.4
Business administration & support services	0.0	-4.2
Public administration & defence	0.0	+5.0
Education	-18.5	-7.9
Health	-3.2	+0.1

Sector	Angus	Scotland
Other services	-18.2	-11.0
Total (%)	**-7.5**	**-6.2**
Total (nos)	**-2,600**	**-151,700**

12.3.3 Unemployment

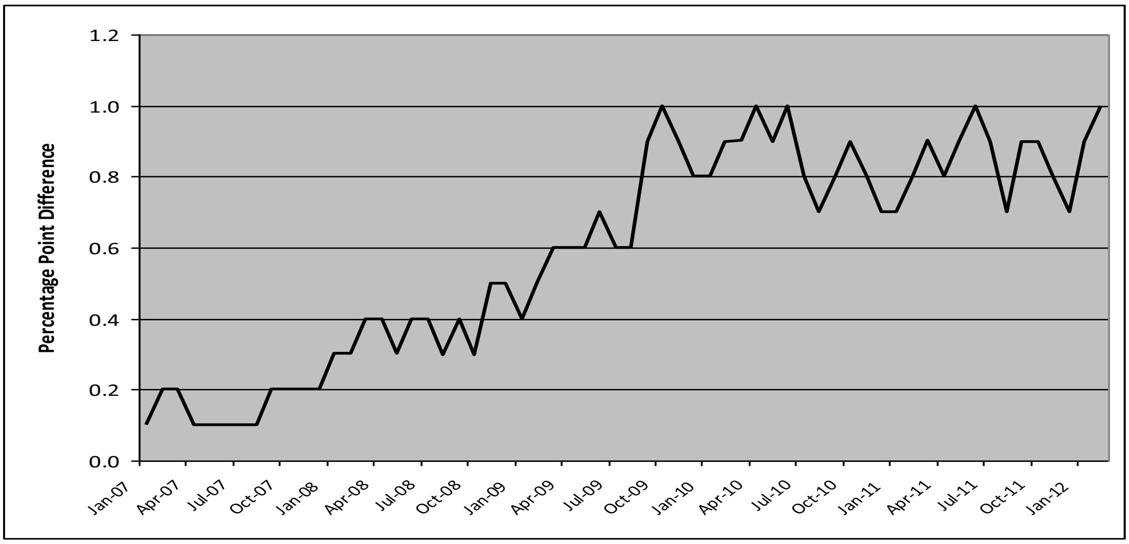
Unemployment in Angus over the past five years has tended to be lower than that for Scotland as a whole, currently (data from February 2012) standing at 3.4% compared to 4.4% for Scotland. The unemployment rate was falling (to a low of around 1.8%) until August/September 2008 when unemployment generally began to increase with the global banking crisis and subsequent recessions starting in 2009.

Figure 12-1: Unemployment Rates for Scotland and Angus (2007-2012)



However, based on the unemployment data, it appears that relative to Scotland as a whole, Angus has not experienced such a large increase in unemployment and in fact the gap between Angus' and Scotland's unemployment rates has widened. Throughout 2007 the gap was no more than 0.2 percentage points. During 2008 the differential was between 0.3 and 0.4 percentage points and by October 2009 the Scottish unemployment rate was 1.0 percentage points above Angus. Since then the differential has ranged between 0.7 and 1.0 percentage points.

Figure 12-2: Unemployment Rates for Scotland and Angus (2007-2012)



12.3.4 Recreation

There are no rights of way or core paths in proximity to the proposed development although there are a number of recreational routes such as rights of way, core paths and National Cycle Network Route 1 within the wider area. Visual effects form some of these key routes are considered within Chapter 6 Landscape and Visual Impact Assessment.

12.4 Construction Impacts

The total costs of the development and construction of the wind farm are estimated to be approximately £14.8 million. Of this approximately £11 million is accounted for by the manufacture, transport and erection of the wind turbines which it is understood will be sourced in Germany. The balance of the construction costs, approximately £3 million, relates to the grid connection, construction management, contingency and balance of plant which typically includes the civil and electrical works not included in the turbine supply contract, e.g. access roads, crane pads and laydown areas, turbine foundations, turbine transformers and control building. Consideration of decommissioning will be included in this stage of the assessment.

Table 12-7 provides a summary of construction cost elements and where they are likely to be sourced.

Table 12-7: Summary of Construction Costs by Source (£)

Category	Scotland (including Angus)	Angus	Elsewhere	Total
Turbines	-	-	£9,000,000	£9,000,000
Grid Connection	£800,000	£320,000	£800,000	£1,920,000
Balance of Plant	£1,875,000	£750,000	-	£2,625,000
Construction Mgt	£312,500	-	-	£312,500
Contingency	-	-	£937,500	£937,500
Total	**£2,987,500**	**£1,070,000**	**£10,737,500**	**£14,795,000**

It is expected that a significant proportion of these activities, excluding the manufacture of towers, nacelles and blades, will accrue to companies based in Scotland and benefit both the Scottish and local economies. Based on O'Herlihy & Co Ltd (2006) it is assumed that 100% of the expenditure associated with balance of plant and construction management and 50% of expenditures associated with grid connection will benefit companies in Scotland.

The extent to which the local (Angus Council area) economy will benefit from these expenditures will depend on the range of companies operating locally and their capacity and relevant experience. For this appraisal the 'local portions' as identified by O'Herlihy & Co Ltd (2006) are used. It is assumed that 40% of the expenditures associated with balance of plant and 20% of expenditures associated with grid connection will benefit companies in Angus. In total, just under £3 million could be spent within Scotland, of which just over £1 million could be sourced in Angus.

Tables 12-8 and 12-9 report the estimated employment at the Scottish and local (Angus) levels arising from these expenditures.

Table 12-8: Scottish Employment Generated Through Construction (Permanent FTE[1])

Activity	Direct	Indirect[2]	Induced[2]	Total
Construction[3]	1.53	1.22	0.60	3.35
Power Collection	0.50	0.17	0.15	0.82
Total	**2.03**	**1.39**	**0.75**	**4.17**

Note 1: Construction jobs are estimated in man years. These are converted into full time equivalent permanent jobs on the basis that 1 FTE job is equivalent to 10 man years.
Note 2: Scottish level multipliers from Scottish Input-Output Tables.
Note 3: Balance of Plant and Construction Management.

It is estimated that the construction of the wind farm will create approximately 2.0 permanent direct FTE jobs in Scotland (this is equivalent to 20 man years of work). Taking into account indirect and induced impacts, the construction of the wind farm will support almost 4.2 permanent FTE jobs in Scotland.

Table 12-9: Local Employment Generated Through Construction (Permanent FTE[1])

Activity	Direct	Indirect[2]	Induced[2]	Total
Construction[3]	0.52	0.10	0.05	0.67
Power Collection	0.20	0.02	0.02	0.24
Total	**0.72**	**0.12**	**0.07**	**0.91**

Note 1: Construction jobs are estimated in man years. These are converted into full time equivalent permanent jobs on the basis that 1 FTE job is equivalent to 10 man years.
Note 2: Local multipliers based on O'Herlihy & Co Ltd (2006);
Note 3: Balance of Plant.

It is estimated that the construction of the wind farm will create approximately 0.7 permanent direct FTE jobs in Angus. Taking into account indirect and induced impacts, it will support 0.9 permanent FTE jobs in the local area. Indirect impacts arise from the purchase of goods and services required for the construction of the wind farm. They are the impacts associated with the supply chain. Induced impacts arise from the household expenditures of the wages and salaries earned by the direct and indirect employees.

Tables 12-10 and 12-11 report the estimated income (wages and salaries) that will be generated by the construction phase of the wind farm.

Table 12-10: Scottish Income Generated Through Construction (£)

Activity	Direct	Indirect[1]	Induced[1]	Total
Construction[2]	£422,809	£338,247	£118,387	£879,443
Power Collection	£154,162	£50,873	£32,374	£237,409
Total	**£576,971**	**£389,120**	**£150,761**	**£1,116,852**

Note 1: Scottish level multipliers from Scottish Input-Output Tables.
Note 2: Balance of Plant and Construction Management.

It is estimated that the construction of the wind farm will generate total direct incomes in Scotland of £577,000. Taking into account indirect and induced impacts, the construction of the wind farm will generate a total income of £1.1 million in Scotland.

Table 12-11: Local Income Generated Through Construction (£)

Activity	Direct	Indirect[1]	Induced[1]	Total
Construction[2]	£144,963	£28,993	£10,824	£184,780
Power Collection	£61,665	£5,087	£4,216	£70,968
Total	**£206,628**	**£34,080**	**£15,040**	**£255,748**

Note 1: Local multipliers based on O'Herlihy & Co Ltd (2006).
Note 2: Balance of Plant.

It is estimated that the construction of the wind farm will generate total direct incomes in Angus of £207,000. Taking into account indirect and induced impacts, the construction of the wind farm could generate a total income of £256,000 locally.

Indirect and induced income at the local level includes expenditures by local people within the local economy as well as by expenditures by non-local construction workers in the local economy, for example, at B&Bs, shops and hotels.

Tables 12-12 and 12-13 report the Gross Value Added (GVA) generated during the construction phase of the wind farm. GVA is the difference between the value of goods and services produced and the cost of raw materials and other non-labour inputs that are used up in production and provides a measure of the value created.

Table 12-12: Scottish GVA Generated Through Construction (£)

Activity	Direct	Indirect[1]	Induced[1]	Total
Construction[2]	£895,092	£716,074	£304,331	£1,915,497
Power Collection	£259,559	£101,228	£77,868	£438,655
Total	**£1,154,651**	**£817,302**	**£382,199**	**£2,354,152**

Note 1: Scottish level multipliers from Scottish Input-Output Tables.
Note 2: Balance of Plant and Construction Management.

It is estimated that the construction of the wind farm will create total direct GVA of £1.2 million in Scotland. Taking into account indirect and induced impacts, the construction of the wind farm will generate total GVA of £2.4 million in Scotland.

Table 12-13: Local GVA Generated Through Construction (£)

Activity	Direct	Indirect[1]	Induced[1]	Total
Construction[2]	£306,889	£61,378	£27,825	£396,092
Power Collection	£103,824	£10,123	£9,837	£123,784
Total	**£410,713**	**£71,501**	**£37,662**	**£519,876**

Note 1: Local multipliers based on O'Herlihy & Co Ltd (2006).
Note 2: Balance of Plant.

It is estimated that the construction of the wind farm will generate total direct GVA in Angus of £411,000. Taking into account indirect and induced impacts, the construction of the wind farm could generate total GVA of £520,000 locally.

Indirect and induced income at the local level includes expenditure by local people within the local economy as well as by expenditures by non-local construction workers in the local economy, for example, at B&Bs, shops and hotels.

Overall, the construction of the proposed development will create short-term benefits for the local area through employment creation and business opportunities, both directly on the site and on the local supply chain. In the longer term this phase of the project will not result in any fundamental change in population, local services, employment or overall structure of the local economy.

In conclusion, the socio-economic impacts of the construction phase of the project are considered to be positive but short-term and localised.

12.5 Operational Impacts

The operational phase of the wind farm will generate economic impacts through the following activities:

- Turbine maintenance and repair;
- Civil maintenance;
- Electrical maintenance;
- Operational management and monitoring;
- Company administration; and
- Impacts associated with community funding (Section 12.6).

Based on information provided by the developer, the estimated annual operational expenditure is estimated to be approximately £583,400 (Table 12-14).

Table 12-14: Annual Operating Costs (£)

Item	Cost (pa)	Total (pa)
Turbine operational expenditure	£22,000 / MW	£202,400
Direct operational expenditure (yrs 1-5)	£25,000 / MW	
Direct operational expenditure (yrs 6-10)	£30,000 / MW	£368,000[1]
Direct operational expenditure (yrs 11-25)	£35,000 / MW	
Environmental studies	£5,000	£5,000
Site management	£8,000	£8,000
Total		**£583,400**

Note 1: Arithmetic average over 25 year operational life of wind farm.

Based on O'Herlihy & Co Ltd (2006), it is assumed that two-thirds (66%) of the annual operating costs will benefit companies in Scotland. The extent to which the local (Angus) economy will benefit from these expenditures will depend on the range of companies operating locally and their capacity and relevant experience. In this appraisal, based on O'Herlihy & Co Ltd (2006), it is assumed that 46% of the operational expenditures could benefit companies in Angus.

In the region of £385,000 could, therefore, be spent annually in Scotland, of which £268,000 could be sourced within Angus.

Tables 12-15 and 12-16 report the estimated impacts on employment, income and GVA in Scotland and Angus arising from the operation of the wind farm.

Table 12-15: Scotland Operational Impacts

Activity	Direct	Indirect[1]	Induced[1]	Total
Employment	1.66	0.76	0.5	**2.9**
Income	£47,190	£18,876	£10,381	**£76,448**
GVA	£89,363	£35,745	£25,809	**£151,917**

Note 1: Scottish level multipliers from Scottish Input-Output Tables.

Table 12-16: Local Operational Impacts

Activity	Direct	Indirect[1]	Induced[1]	Total
Employment	1.16	0.13	0.11	**1.4**
Income	£32,890	£3,289	£2,274	**£38,452**
GVA	£62,283	£6,228	£5872	**£74,384**

Note 1: Local multipliers based on O'Herlihy & Co Ltd (2006).

It is estimated that the wind farm will, over its 25 year life, directly support approximately 1.6 FTE jobs in Scotland, of which 1.1 could be based in Angus. In total (direct, indirect and induced) the wind farm will support 2.9 FTE jobs in Scotland, of which 1.4 could be based in Angus.

The operation of the wind farm will also generate total (direct, indirect and induced) annual earnings (wages and salaries) of £76,500 in Scotland, of which £38,500 could be in Angus, and create GVA of £152,000 in Scotland, of which £74,000 could be created in Angus.

Over the 25 year operational life of the project the total earnings (discounted at the Treasury discount rate of 3.5% generated in Scotland by the operation of the wind farm is estimated at £1.3 million (£0.66 million in Angus). The total GVA generated is estimated at £2.5 million (£1.2 million in Angus).

12.6 Community Trust Expenditures

The developers are proposing a community benefit package of £46,000 per annum (£5,000 per MW) over the 25 year life of the project.

The economic impacts arising from the activities of the community will depend on the manner in which their available funds are spent/invested and on the balance between economic and social/community development activities.

A study, 'Impact of Community Benefit Payments from Two Major Wind Farms in the Western Isles', estimates that in the case of the Western Isles Development Trust (WIDT), 77 FTE (direct, indirect and induced) jobs will be created by each £10 million of expenditure. While the WIDT is an independent trust established to promote sustainable economic social and environmental activity across the Outer Hebrides, the local community that will benefit from the proposed development may be more locally focussed and possibly less focussed on economic development activities as such. It has, therefore, been assumed that the employment impact of the activities of the local community trust per £ of expenditure will be 50% of that expected for WIDT, that is 38.5 FTE (direct, indirect and induced) jobs will be created by each £10 million of expenditure.

On the basis of these assumptions, an expenditure of £46,000 per annum over the 25 year operational life of the wind farm will have the potential to create 1.4 FTE (direct, indirect and induced) over the operational life of the wind farm.

12.7 Summary of Economic Impacts

Table 12-17: Economic Impacts of the Proposed Development

Operational Costs	Total
Total Capital Cost of Project	£14,795,000
Total Operating Costs	£14,585,000
Operating Costs Sourced in Scotland	£962,500
Construction & Operations	
Scottish Level Employment	4.2 FTE
Local Level Employment	0.9 FTE
Community Trust Employment	1.4 FTE
Scottish Level Income	£1,116,000
Local Level Income	£255,000
Scottish Level GVA	£2,354,000
Local Level GVA	£520,000

Notes:

1. Total operating costs is the estimated annual operating cost of the wind farm discounted at the Treasury test discount rate of 3.5% over the 25 year project life.
2. Income and GVA are discounted over the 25 year life of the project at the Treasury test discount rate of 3.5%pa.
3. The estimate of potential employment generation arising from the activities of the community trust is only indicative and will depend crucially on how the community decide to invest their income. As this employment is generated over the 25 year operational life of the wind farm these jobs have been discounted at the Treasury test discount rate of 3.5%.
4. No allowance has been made for decommissioning impacts.

12.8 Tourism and Recreation

Tourism is an important generator of revenue for the Scottish economy. The most recently available figures (2010) show that Angus and Dundee attracted 510,000 trips from UK tourists, staying for around 2.13 million nights and spending £87 million. Overseas visitors made 70,000 trips, staying for 730,000 nights and spending £43 million.

Compared to Scotland as a whole, Angus and Dundee have a smaller percentage of visitors who are on holiday (60% compared to 66% for UK visitors and 39% compared to 52% for overseas tourists). In contrast they have a much larger share of tourists who are visiting friends and relatives (21% compared to 11% for UK tourists and 43% compared to 29% for overseas tourists). It is likely that tourists who are visiting friends and relatives will be less adversely affected by the existence of wind farms compared to visitors who are there primarily for a holiday.

The potential impact of the proposed development on tourism and recreation is closely related to public attitudes towards wind turbines in the landscape and is, therefore, linked with the landscape and visual assessment of the proposal.

Key studies published in 2002 and 2008 have assessed the effect of wind farms on tourism in Scotland. These studies provide some evidence that wind farms do not substantially detract from the visitor experience of the area. The main findings are reported in Table 12-18. More recently a poll commissioned by Scottish Renewables (April 2012) has revealed that 71% of people in Scotland support wind power as part of the energy mix. The 'YouGov' poll which surveyed 1041 people in Scotland found that 59% disagreed with the statement that "*wind turbines are ugly monstrosities and* *horrendous machines"*. As the original wind farm application at the Frawney site has been consented, the principle of a wind energy development has been established.

Table 12-18: Publications on the Effects of Wind Farms on Tourism

Tourist Attitudes Towards Wind Farms, MORI Scotland (2002)
• Survey was based on detailed interviews with approximately 300 visitors. • Over 90% of visitors would return to Scotland for a holiday whether or not there were wind farms in the area. • Of those that had seen wind farms whilst on holiday, only 8% had come away with a negative impression. • 80% said they would go to a wind farm information/visitor centre during their stay.
Investigation into the Potential Impact of Wind Farms on Tourism in Scotland, Visit Scotland (2002)
• 75% of visitors were either positive or neutral towards wind farm development in general, although less positive about specific visual impacts. • The attitude of those who had actually experienced a wind farm tended to be more positive than those who had not. • The majority said it would make no difference to their decision to holiday in Scotland if the number of wind farms increased.
The Economic Impacts of Wind Farms on Scottish Tourism, Glasgow Caledonian University, Moffat Centre and Cogentsi (2008)
• Three-quarters of tourists felt wind farms had a positive or neutral impact on the landscape. • Overseas visitors seem to be more positive about wind farms than domestic tourists. • Importantly, respondents that had seen a wind farm were less hostile than those who had not. • The vast majority (93%-99%) of tourists that had seen a wind farm in the local area suggested that the experience would not have any effect on their decision to return to that area, or to Scotland as a whole. • If the renewables target is met via substantial wind farm development, Scottish tourism revenues in 2015 are forecast to be 0.18% lower than they would have been if there were no wind farms in Scotland. • The overall conclusion of this research was that the Scottish Government should be able to meet commitments to generate at least 50% of Scotland's electricity from renewable sources by 2020 with minimal impact on the tourism industry's ambition to grow revenues by over £2 billion in real terms over the period 2005-2015.

Based on the evidence from previous surveys and reports it is likely that the majority of general tourists will not be adversely affected by the proposed development, although there is likely to be some reduction in their amenity value during the construction phase.

No direct impacts on recreation will result from the proposed development due to the lack of recreational facilities within the development site. Visual effects on recreational users in the wider area are considered in Chapter 6.

The reporter for the appeal for the consented scheme agreed with Angus Council that a wind farm development at the Frawney site would not have a negative impact on tourism in the area.

12.9 Impacts on Property

There are a limited number of properties in close proximity to the wind farm development area. A common concern for local residents, especially those in close proximity to wind farms is the impact of the development on property prices. As a wind farm has already been consented at the site, this application to increase the height of four of the turbines will not create any additional impact. To further support this point there is a significant body of research on the impact of wind farms on property prices. The most relevant are:

What is the impact of wind farms on house prices? (RICS, 2007) which concluded that "*despite initial evidence that there was an effect when they investigated more closely there were generally other factors which were more significant than the presence of the wind farm. Insofar as there was any impact on prices the results seem to show that it is most noticeable for terraced and semi-detached houses, with there being a significant impact on properties located within a mile of the wind farm. The effect seems much less marked, if at all, for detached houses*." The study also concluded that "*beyond the one mile zone no clear linear relationship between physical distance to the wind farm and transaction price was observed*."

Impact of wind farms on residential property prices-Crystal Rig Case Study. (Edinburgh Solicitors Property Centre (ESPC), 2007) which found no evidence of a negative impact on the price of property in nearby areas. The ESPC found that prices in the town of Dunbar had risen from below to above the regional average over the past four years, during the time the Crystal Rig wind farm was built and that since the wind farm began operating property price inflation has continued to exceed that achieved across East Lothian.

The very wide ranging US project **The Effect of Wind Development on Local Property Values** (REPP2003) found that "*for the great majority of projects the property values actually rose more quickly in the 'view shed' (i.e. within 5 miles of the wind farm) than they did in the comparable community. Moreover values increased faster in the view shed after the projects came on-line than they did before*."

The Impact of Wind Power Projects on Residential Property Values in the United States (Berkeley National Laboratory, 2009) was based on data collected on almost 7,500 sales of single family homes situated within 10 miles of 24 existing wind facilities in nine different U.S. states. The conclusions of the study were drawn from eight different hedonic pricing models, as well as both repeat sales and sales volume models. "*The various analyses are strongly consistent in that none of the models uncovers conclusive evidence of the existence of any widespread property value impacts that might be present in communities surrounding wind energy facilities. Specifically, neither the view of the wind facilities nor the distance of the home to those facilities is found to have any consistent, measurable, and statistically significant effect on home sales prices. Although the analysis cannot dismiss the possibility that individual homes or small numbers of homes have been or could be negatively impacted, it finds that if these impacts do exist, they are either too small and/or too infrequent to result in any widespread, statistically observable impact*".

The overall conclusion from these studies appears to be that once constructed and operational, wind farms do not adversely impact on the local property market and that other factors such as quality of the stock and proximity to facilities are much more significant.

12.10 Summary

Benefits from the proposed development are identified for the Scottish economy and the local community including full time jobs, increased income and GVA. The total costs for the development and construction of the wind farm is £14.8 million. Of this, £9 million is for the purchase of the turbines that will be sourced from continental

Europe. Of the balance of the construction costs, it is expected that in the region of £3 million could be spent within Scotland, of which £1 million could be sourced within Angus.

In the region of £385,000 is predicted to be spent annually in Scotland from operational expenditure, of which £268,000 could be sourced within Angus.

The local community trust could benefit from an income of £46,000 per annum (£5,000 per MW) which could be invested to generate positive local economic and community impacts.

Whilst some tourists and visitors to Angus may experience a perception that their amenity value would decrease due to the proposed development, research suggests that the majority would not perceive a negative effect on their enjoyment of their visit to the area.

12.11 References

Berkeley National Laboratory (2009). The Impact of Wind Power Projects on Residential Property Values in the United States.

ESPC (2007). Impact of Wind Farms on Residential Property Prices – Crystal Rig Case Study, Edinburgh Solicitors Property Centre.

Glasgow Caledonian University, Moffat Centre and CogentSI (2008). The Economic Impacts of Wind Farms on Scottish Tourism.

MORI Scotland (2002). Tourist Attitudes Towards Wind Farms.

O'Herlihy & Co Ltd (2006): Windfarm Construction: Economic Impact Appraisal. A Final Report to Scottish Enterprise.

Renewable Energy Policy Project (2003). The Effect of Wind Development on Local Property Values.

RICS (2007). What is the Impact of Wind Farms on House Prices?

VisitScotland (2002). Investigation into the Potential Impact of Wind Farms on Tourism in Scotland.

Westbrook (2005). Impact of Community Benefit Payments from Two Major Wind Farms in the Western Isles.

YouGov (2012). YouGov Poll on Attitudes to Wind Power in Scotland 12th - 17th April 2012. Available at: http://www.scottishrenewables.com/publications/yougov-poll-attitudes-wind-power-Scotland/

13 Infrastructure, Aviation and Safety

13.1 Introduction

This chapter produced by Atmos Consulting addresses issues associated with infrastructure, aviation and safety in respect of the proposed changes to the consented scheme. In addition to the main environmental effects of the proposed Frawney Wind Farm site, there are several smaller issues of potential relevance to the proposed development namely:

- Potential telecommunication and television impacts;
- Aviation and radar implications;
- Health and Safety; and
- Shadow Flicker and reflected light.

13.2 Methodology and Approach

13.2.1 Information Sources

The following sources of information were used in the completion of this chapter:

- OS Maps;
- Databases;
- Windfarmer Software;
- Consultation responses;
- Publications; and
- Websites.

13.3 Consultation

A number of organisations whose operations could be potentially impacted on by the construction and operation of the proposed development have been consulted. This has allowed for a number of potential issues to be identified at an early stage in the development design process. Table 13-1 summarises the main aspects and outcomes of consultations undertaken which helped to inform the design of the proposed development.

Table 13-1: Consultation Responses

Consultee	Date	Response
Telecommunications		
Atkins	Email 13/10/2011	No objection to the proposed development.
	Application Response 03/07/2012 and 24/06/2013	Confirmed no objections in relation to UHF Radio Scanning Telemetry communication in response to application 12/00577/EIAL and to 13/00532/EIAL.
Arqiva Limited and Arqiva	Email 02/08/2011	Three links were identified which require 100m minimum clearance from blade tip to the link:

Consultee	Date	Response
Services Limited		• 0469751/1 (from NGR 339492 740779 to NGR 376431 789943); • 0466836/1 (from NGR 339492 740779 to NGR 366316 753531); and • 047655/2 (from NGR 339492 740779 to NGR 348250 740912).
	Application Response 09/07/2013 and 08/08/2013	Confirmed no objection to application 12/00577/EIAL and 13/00532/EIAL.
BT	Email 02/08/2011	Three links were identified by Ofcom and an additional six by BT making a total of nine links (ID's below as provided by BT): • 906585; 11235; 5773; 7773; 9345; 8185; 10832; 903508; and 902738.
	Application Response 02/07/2012 and 28/06/2013	Confirmed no objection to application 12/00577/EIAL and 13/00532/EIAL.
Cable & Wireless	Email 02/08/2011	Three links were identified which require 100m minimum clearance from blade tip to the link: • 0436047/2 (from NGR 358950 757950 to NGR 337690 739960); • 0436051/2 (from NGR 358950 757951 to NGR 337690 739961); and • 0436047/4 (from NGR 358950 757952 to NGR 337690 739962).
Ericsson (including Hutchison 3G UK Limited)	Email 04/08/2011	Four links were identified: • 0425806/2 (Craigowl Hill NR Dundee Tays NGR 337700 740000 to MCL Brechin, Angus NGR 359000 758000); • 0425807/2 (Craigowl Hill NR Dundee Tays NGR 337700 740000 to MCL Brechin, Angus NGR 358800 758000); • 0493997/1 (Petterden Junction Dundee Tayside NGR 342410 740080 to Baldovie NTL NGR 347800 733370); and • 0492256/2 (South Powrie Farm NGR 341845 735085 to Petterden NGR 342420 740060).
Everything Everywhere	Email 12/01/2012	Four links were identified which require 140m minimum clearance (corresponds to 100m + blade radius) from blade tip to the link path: • 0477617/1; 0415447/1; 0468752/1; and 0466750/1.
	Application Response 15/08/2013	In response to application 12/00577/EIAL confirmed no Orange microwave links affected by the proposal.
Joint Radio Company Limited (JRC)	Email 29/07/2011	The proposed development is located within the co-ordination zone (1km) of three protected links managed by JRC. The affected links are: • Arbroath (NGR 362200 740300) to Craigowl Tealing Dundee (NGR 337700 739900) JRC manages this link on behalf of SSE; • Rossie Farm (NGR 366300 753500) to Craigowl Tealing Dundee (NGR 337700 739900) JRC manages this link on behalf of SSE; and • Dunnichen Hill RS Tays (NGR 350800 749700) to Craigowl Hill NR Dundee Tays (NGR 337700 740000).
	Application	In response to application 12/00577/EIAL and 13/00532, cleared

Consultee	Date	Response
	Response 10/07/2013	with respect to radio link infrastructure operated by Scottish Hydro (Scottish & Southern Energy) and Scotia Gas Networks.
Ofcom	Email 27/07/2011	23 links were identified: • Arqiva Ltd: 0469751/1, 0466836/1; • Arqiva Services Ltd: 0472655/2; • BT: 0497479/1, 0526485/1 and 0396035/1; • Cable & Wireless Worldwide PLC: 0436047/2, 0436051/2 and 0429548/2; • Everything Everywhere (Orange) : 0477617/1, 0415447/1, 0468752/1, and 0466750/1; • Everything Everywhere (Ericsson) : 0425806/2, 0425807/2, 0492256/2; • Hutchison 3G UK Limited: 0493997/1; • Scottish Ambulance Service NHS Trust: 0404458/1 and 0415333/1; • Scottish and Southern Energy Plc: 0403780/1, 0403775/2 and 0403778/1;and • Tayside Police: 0827574/1.
Scottish Ambulance Service	Email 05/10/2011	Two links were identified: • 0404458/1; and • 0415333/1. A new radio system has been put in place and the proposed wind farm development will have no effect on the old system.
Scottish and Southern Energy	Email 15/07/2008 and 29/07/2011 (from JRC)	Two links were identified which are managed by JRC: • Craigowl (NGR 337740 740020) to Rossie Farm (NGR 366300 753500); and • Craigowl (NGR 337740 740020) to Arbroath (NGR 362230 740330). JRC objects to the development as a result of the SSE links above.
Tayside Police	Email 17/07/2008	One link was identified in 2008: • 0465563/1 (Craigowl Hill NGR 337700 740100 to Cairnconnon Hill NGR 356900 745500) Tayside Police were re-consulted on 02/08/2011 - no response has been received to date.
Aviation		
CAA	Letter 02/09/2008	Response to layout (a) (Figure 3-1), recent consultations have been made but the CAA will not be responding due to recent changes in policy. No issues were raised in response to layout (a).
	Application response 23/07/2013	No objection in response to application 13/00532/EIAL.
Dundee Airport	Email 13/03/2012	Calculations show that, at the given position and height, this development is unlikely to infringe the safeguarding surfaces for Dundee Airport. However, due to its height and position, a red obstacle light will be required to be fitted at the hub height of the turbine. Provided that this condition is met Dundee Airport Limited would not object to this proposal.
	Application response 04/07/2012	With reference to 12/00577/EIAL and 13/00532/EIAL, this development would not infringe the safeguarding surfaces for Dundee Airport. Aviation lighting will be required.

Consultee	Date	Response
	and 26/07/2013	
MOD	Letters: 26/03/2009 and 19/08/2009 based on layouts (a) and (b) (Figure 3-1)	The turbines will be in line of sight to the Air Traffic Control (ATC) radar at Royal Air force (RAF) Leuchars. Recent consultations on layout (c) (Figure 3-1) were undertaken in September 2011, although no response has been received to date. Telephone conversation with Louise Dale, MOD (27/02/2012) confirmed that no further response would be issued pre-submission due to lack of resources within the MOD.
	Application response 24/07/2012 & 23/10/2012	The MOD initially objected due to unacceptable interference to the ATC radar at RAF Leuchars. They also stated if the developer is able to overcome the issues associated with RAF Leuchars Radar, they will require that all turbines be fitted with 25 candela omni-directional red lighting or infrared lighting with an optimised flash pattern of 60 flashes per minute of 200ms to 500ms duration at the highest practicable point. The MOD has been working with the applicant and their technical consultants to agree a scheme to mitigate the unacceptable effects of the turbines on the ATC radar at RAF Leuchars. MOD has confirmed that their technical and operational assessors have approved in principle a radar mitigation strategy and the MOD are prepared to remove their objection subject to the imposition of a planning condition.
	Application response 18/07/2013	In response to application 13/00532/EIAL, confirmed that the MOD would raise no objection to the revised application subject to the inclusion of the planning conditions.
	Reconsulted on 25/03/2014	Reconsulted regarding the proposed height extension to the conseted turbines. Response awaited.
Public Safety		
Scotways	Letter 27/01/2012	Information on access rights within the local area and advice on the positioning of turbines in proximity to rights of way was provided, citing Welsh Assembly Government's Technical Advice Note on Renewable Energy TAN 8.

13.4 Electromagnetic Interference

13.4.1 Telecommunications

The moving rotors of wind turbines have the potential to impact on telecommunication 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'.

A number of organisations which may have an interest in telecommunications were contacted as part of the EIA. Responses received are outlined in Table13-1. Twenty three fixed communication links were identified by Ofcom within a 1.5km radius of the site centre, most of which were associated with the mast at Craigowl Hill. Individual link operators were contacted to provide details of the links identified by Ofcom. These link details were plotted on the constraints map (Figure 3-9) which formed part of the iterative design process described in Chapter 3. For the majority of the links minimum buffers of 100m either side of the link paths were adopted to enable design away from the links to avoid any direct effects on any of the communications links identified.

For the JRC operated links, a standard 100m buffer is not usually accepted and any turbine sited within 1km would receive an initial objection until further investigation can be undertaken. As noted in Table 13-1, JRC has identified three links within a 1km radius of the site and an initial objection to the proposed development was received pending further assessment.

A detailed assessment was commissioned by the applicant for proposed layout d (Figure 3-1 and Table 3-2) in order to further assess any potential impacts on the links caused by the proposed turbines. A response and detailed assessment report was received from JRC on 11th May 2012. This assessment is confidential and cannot be appended to this ES; however a brief summary of the conclusion and recommendations is presented as follows:

- The proposal meets the recommended criteria for operating and assigned point to point links with digital modulation. Confidence in the predicted effects come as a result of research into the influence of wind turbines on UHF telemetry and microwave links.
- The recommendations of the detailed assessment include:
  - Liaison with SSE and JRC should continue during the planning of the proposed Frawney development to ensure that any planned future radio systems that may be affected by the proposed development will be taken into account;
  - Based on the turbine locations (layout 01d), micrositing allowance (50m) and dimensions (60m hub height; 100m tip height) provided for the assessment, JRC should consider removing their earlier objection which was given prior to having detailed information about the proposed development; and
  - The JRC assessment report should be shared with SSE for their opinion on the methodology and data used and the assumptions made by JRC in arriving at the conclusions. The final decision regarding the outstanding objection and potential mitigation strategies ultimately reside with SSE.

On 10 July 2012, in response to application 12/00577/EIAL, JRC cleared the proposed development (layout d) with respect to radio link infrastructure operated by Scottish Hydro (Scottish & Southern Energy) and Scotia Gas Networks.

In response to the consented application, 13/00532/EIAL, JRC stated that it does not foresee any potential problems based on known interference scnearios and the data provided. The proposed turbines will be sited within the existing red line boundary and will be one less than the consented, therefore, occupying a smaller area. All turbines will be a greater distance from the JRC links than those assessed in the previous report. It is, therefore, anticipated that the proposed development would still comply with the conclusions of the response issued in response to the previous consented application and that there would be no unacceptable impacts on the links.

13.4.2 Television Reception

Wind turbines have the potential to adversely affect domestic television reception through either physical blocking of the transmitted signal or, more commonly, by introducing multi-path interference where some of the signal is reflected through different routes. Multi path interference to television signals can cause 'ghosting' on older analogue transmissions where an object in the picture appear several times in different positions. This effect rarely extends beyond 2km from a turbine between the receiver and transmitter.

In areas where several turbines are sited in close proximity, the interactions of the interference mechanisms are complex and can be difficult to predict. There are, however, a number of measures that can be taken to reduce or overcome any interference effects including:

- The provision of a more sensitive receiver antenna for affected households;
- Re-positioning of the antennae to receive signals from a different transmitter;
- Installation of a local community re-broadcast facility; and
- An alternative means of transmission, such as a satellite or cable.

The proposed development is located in an area which has been served by a digital transmitter since August 2010 and, therefore, is unlikely to be affected by the development of the wind farm as digital signals are rarely affected. In the unlikely event that television signals are affected by the proposed development, the mitigation measures discussed above will be considered by the applicant.

13.4.3 Aviation and Radar

Wind turbines have the ability to reflect radio waves and, therefore, have the potential to interfere with radar systems. Reflections from the rotating wind turbine blades may show up on radar as 'clutter'. Wind turbines can also reflect away some of the emitted radar signal and the 'echo' from aircraft in a line of sight from the radar, beyond the turbines. Such effects could have an adverse impact on aircraft safety.

Consultation has been carried out with all aviation stakeholders as presented in Table 13-1. It is acknowledged that there may be aviation/radar issues associated with the location of the proposed development and potential solutions for coexistence of the development and aviation operations are outlined below as explored by specialist consultants Spaven Consulting in 2009 (Report Ref: 09/200/ME/2 presented in Appendix 13-1) and Aveillant Ltd in 2012 (Appendix 13-3).

CAA

Initial consultations with the CAA in 2008 based on layout (a) (Figure 3-1) identified that there may be issues related to en route navigational facilities managed by National Air Traffic Services (NATS). Further information on NATS is presented below.

Consultations (29 February 2012) have been made with the CAA based on layout (d) (Figure 3-1), however, due to a policy change in December 2010 regarding responding to pre-planning applications, no further response will be received until the planning application has been submitted.

CAA did not raise any concern in their response to the consented application 13/00532/EIAL.

Dundee Airport

Consultations have been made with the Dundee Airport and based on the response received on 13 March 2012 the development is considered unlikely to infringe the safeguarding surfaces for Dundee Airport. However, due to the height and position of the proposed turbines, a red obstacle light fitted at the hub height of the turbine has been requested. A detailed report on aviation issues surrounding the proposed development suggests that the installation of obstacle lighting on the turbines is unlikely to provide any measurable benefit to pilots flying in the area at low level at night (Spaven, 2009).

In response to application 13/00532/EIAL, Dundee Airport confirmed that the development would not infringe on their safeguarding surfaces.

MOD

The proposed development site is located within a low priority military low flying area. A standard industry consultation proforma was submitted to the MOD (Defence Estates) in October 2008 for layout (a) (Figure 3-1), located within the same boundary as the current proposed development. Defence Estates issued a response letter on 26 March 2009 noting that the turbines will be 20km from and in line of sight to the Air Traffic Control (ATC) radar at Royal Air Force (RAF) Leuchars causing unacceptable interference to the radar. Following discussions with the MOD it is understood that their principal concern relates to the provision of air traffic radar services to aircraft departing from runway 09 at RAF Leuchars under the Instrument Flight Rules along a standard instrument departure route known as SID 4. SID 4 passes approximately one nautical mile (nm) southwest of the proposed wind farm site.

Following receipt of the objection, Spaven Consulting was commissioned to engage with the MOD to assess the basis for their objection and to explore the potential for mitigation of any effects. The full reported results of this commission are presented in Appendix 13-1. In summary, the following conclusions were made:

- The proposed development would be clear of all published instrument approach procedures to RAF Leuchars;
- In the event of a Leuchars controller seeking to provide 5nm separation from radar returns generated by the Frawney turbines to an aircraft on a Deconfliction Service, flying on SID 4, alternative routes to the east and southwest of the wind farm could be used;
- The MOD approved a two turbine development at the Michelin Tyre Factory in 2005, which is closer to RAF Leuchars and to its instrument departure routes than the proposed development. Aircraft are not routed away from these turbines;
- The airspace in the vicinity of the proposed development is relatively lightly used and a high proportion of air traffic in the area is known to Leuchars controllers and/or not in receipt of a radar service;
- The area surrounding the proposed development is already an obstacle-rich environment, with TV masts up to 803 feet above ground level, power lines greater than 200 feet above ground level crossing the site, and multiple masts on Craigowl Hill;
- The stated MOD policy on provision of air traffic services in the vicinity does not accord with known ATC practice in relation to the Michelin turbines;

- There are additional operational mitigation measures available to controllers which are in everyday use at all ATC radar units in the UK providing services outside controlled airspace;
- The proposed development is amenable to being treated in the same way as the Michelin turbines, using proven and approved operational mitigation measures;
- The Drumderg (built), Tealing (approved) and Mountboy (refused on residential amenity grounds) turbines are further examples of wind energy projects visible to the RAF Leuchars radar which have been found to be acceptable to the MOD;
- Previous consultations with the MOD for a potential development at the site for 100m turbines raised no objection once suitable mitigation could be agreed;
- There are numerous examples of radar-equipped military airfields elsewhere in the UK co-existing with wind farms; and
- The proposed development will have no impact on the minimum altitudes for aircraft flying on instruments in the vicinity.

As reported in Chapter 3, the current design layout (Figure 3-2) is more contained than the previous turbine layouts (Figure 3-1) responded to by the MOD in 2009. The current layout is sited within the same boundary and, therefore, the assessment undertaken by Spaven Consulting 2009 is still relevant. It is likely that the more contained five turbine layout will reduce the frequency with which the turbines generate returns on the Leuchars radar.

Of further note is the current status of the RAF Leuchars radar and air base. In July 2011, it was announced in the press that RAF Leuchars will become an army base, with its Typhoon aircraft leaving for Lossiemouth in 2013. Whilst it is currently not clear whether the radar at Leuchars will remain operational on the army base, the departure of the Typhoon aircraft is likely to considerably reduce the level of aircraft using the SID 4 route.

Further consultations for the proposed development were made with the MOD on 26 September 2011 with follow up emails on 29 February 2012 based on layout (d) (Figure 3-1). No response was received prior to the submission of planning application 12/00577/EIAL.

Since 2009, technological advances have identified radar mitigation solutions for certain proposed wind farm developments including proposed developments within Angus which are also visible to the Leuchars radar (e.g. Corse Hill 21.6km from the turbines).

The MOD initially objected to Frawney planning application 12/00577/EIAL on 24 July 2012 due to unacceptable interference to the ATC radar at RAF Leuchars. They also stated if the developer is able to overcome the issues associated with RAF Leuchars Radar, they will require that all turbines be fitted with 25 candela omni-directional red lighting or infrared lighting with an optimised flash pattern of 60 flashes per minute of 200ms to 500ms duration at the highest practicable point.

Further consultation was undertaken with the MOD through 2012 to agree a scheme to mitigate the unacceptable effects of the turbines on the ATC radar at RAF Leuchars. On 23 October 2012 the MOD confirmed that their technical and operational assessors approved in principle a radar mitigation strategy (as proposed by the applicant) and the MOD were prepared to remove their objection subject to the imposition of an appropriate planning condition for five 100m tip turbines.

The radar mitigation strategy proposed is the Aveillant radar system using Holographic Radar technology that is designed specifically to remove the unacceptable effects of wind turbines on Air Traffic Control Radar. Appendix 13-3 presents a letter from Aveillant confirming their commitment to the mitigation solution and objective to deployment of the Holographic radar for approval by RAF Leuchars in the first half of 2014. It is, therefore, anticipated that the MOD could approve the operation of the radar mitigation scheme by the end of 2014.

The MOD was consulted on the consented layout h (Figures 3-1, 3-2 and Table 3-2) on 17 May 2013. In their response to application 13/00532/EIAL, the MOD accepted the proposed mitigation proposal and would not raise an objection subject to the inclusion of planning conditions.

Condition 5 of the planning consent requires an Air Traffic Control Radar Mitigation Scheme to be submitted and approved by the planning authority. The proposed development will adhere to this condition as well as condition 6 which requires the turbines to have suitable lighting.

The proposed layout is reduced in geographical spread from the previous applications (12/00577/EIAL and 13/00532/EIAL) and the turbines will be sited within the existing red line boundary having less separation distances between them, therefore, occupying a smaller area and presenting less profile to the RAF Leuchars Radar. It is, therefore, anticipated that the proposed development would still comply with the conclusions of the letter issued by MOD on 26 October 2012 and that the Aveillant mitigation solution would remain acceptable in this instance, subject to condition 5 of the planning consent for application 13/00532/EIAL .

NATS En-Route Ltd (NERL)

NERL produce self-assessment maps to assist in determining whether further detailed assessments need to be carried out in relation to primary surveillance radars based on a radar line of sight assessment. These assessment maps have been applied to the dimensions of the turbine being considered and indicate that some interference would be expected. The proposed turbines will be in line of sight to the ATC radar at Leuchars.

An assessment of the impact of the proposed development on NATS Craigowl Hill transmitter/receiver facilities was carried out by Spaven Consulting in September 2009 (Appendix 13-2) based on layout (b) (Figure 3-1). The assessment reported that the proposed development turbine blade tips are lower than ground level at the Craigowl Hill site and are well beyond the recommended 2km radius horizontal distance from the facility.

13.5 Health and Safety

A number of health and safety considerations have been taken into account during the EIA process and design of the proposed development. These include:

- Public roads;
- Overhead power lines;
- General turbine safety;
- Right of way;
- Extreme weather such as lightening and ice throw;

- Public safety and access; and
- Health and safety during construction.

13.5.1 Public Roads

There are several tracks and roads on and around the site. Appropriate buffers have been applied to ensure that the proposed turbines are located sufficiently far from existing road infrastructure. A minimum buffer of 100m from roads was adopted although the turbines will be sited over 700m from any public road.

13.5.2 Overhead Power Lines

There are two overhead power lines dividing the site into three areas crossing the site boundary from the southwest to northeast. Appropriate buffers determined through consultation with SSE, have been applied to ensure that the turbines are located sufficiently far from the power lines not to cause any effects on the operation of the power lines or wind turbines. As advised by SSE, a minimum buffer of 156.7m from the power lines has been adopted equivalent to 1.5 times the height of the turbine measured from the blade tip at its highest position to normal ground level, i.e. 150m; and the distance from centre line of towers to the outermost (middle phase) conductor i.e. 6.7m in this instance.

13.5.3 General Turbine Safety

Wind farms have a proven track record of safety. A small number of wind turbines have been known to lose parts of the rotor assembly through accidental damage due to lightening, mechanical failure or extreme gale force winds. However, no member of the public has ever been injured during the normal operation of a wind turbine (Renewable UK, 2010c).

The safe operation of the turbines is ensured through a combination of design, quality control and manufacture to high safety standards. The developer will require that the selected wind turbine model will have certification from an internationally recognised authority and have a proven track record of safe operation. The wind turbine installed at the site will comply with BS EN 61400-1: 'Wind turbine generator systems - safety requirements'.

It is not anticipated that there will be much on-site activity once the wind farm is fully installed and operational. The primary safety systems at the site will include a computerised central control system housed within the substation building. This system will continually monitor the operational status and safe working of key components for each turbine and will allow the operator to remotely monitor the turbines via a modem. Any problems that cannot be resolved by the internal computer will be referred to the operator via the computer's modem link and addressed as soon as possible.

13.5.4 Rights of Way

Consultation with Scotways confirms that there are no known rights of way in the vicinity of the proposed development and, therefore, no effects are anticipated.

There is a known right of way (TA45) outside of and to the south of the proposed site boundary, to the south of the A928, however, since this is sufficiently far from the proposed turbine locations, no issues are anticipated. The TA45 right of way is routed from Tealing House to the A928 Kirriemuir road formerly referred to as TCI 6 prior to local government re-organisation in 1996.

13.5.5 Extreme Weather

Lightning Strike

Wind turbines can be susceptible to lightning strike due to their height and appropriate measures are taken into account in the design of turbines to conduct lightning strikes down to earth and minimise the risk of damage to turbines. Occasionally however, lightning can strike and damage a wind turbine blade. Modern wind turbine blades are manufactured from a glass-fibre or wood-epoxy composite in a mould, such that the reinforcement runs predominantly along the length of the blade. This means that blades will usually stay attached to the turbine if damaged by lightning and in all cases turbines will automatically shut down if damaged by lightning.

Ice Throw

Ice build-up on blade surfaces occurs in cold weather conditions. Wind turbines can continue to operate with a very thin accumulation of snow or ice, but will shut down automatically as soon as there is a sufficient build up to cause aerodynamic or physical imbalance of the rotor assembly. Potential icing conditions affecting turbines can be expected 2-7 days per year (light icing) in Scotland (WECO, 1999).

The potential for ice throw to occur after start up following a turbine shut down during conditions suitable for ice formation is high. There are monitoring systems and protocols in place to ensure that turbines that have been stationary during icing conditions are restarted in a controlled manner to ensure public safety. The risk to public safety is considered to be very low due to the few likely occurrences of these conditions along with the particular circumstances that can cause ice throw. Despite the recent winters of 2009/2010 and 2010/2011 being unusually icy, there were no recorded incidences of ice throw injury to the public or the operational staff at any wind turbine site in UK.

13.5.6 Public Safety and Access

The Renewable UK Health and Safety Guidelines state that *"it is the responsibility of wind farm designers to ensure that the wind turbines and associated equipment are designed to avoid or, where this is not entirely possible, to minimise risks to health and safety whilst they are being assembled, constructed, installed, operated, maintained and decommissioned"* (Renewable UK, 2010a). The guidance stipulates the need to ensure potential risks to non-industry personnel i.e. members of the public, are addressed throughout the life phases of projects and that residual risks are acceptable when compared with people's expectations of day to day risk exposure (Renewable UK, 2010a).

Site security and access during the construction period will be governed under Health and Safety at Work Act 1974 and associated legislation. There will be no public access to the site during construction. Once the construction period and commissioning of the wind farm is complete, no special restriction on access is proposed.

The site is not identified as an area used for formal recreation. However, the Land Reform (Scotland) Act (2003) which came into effect in February 2005 establishes statutory rights of responsible access on and over most land. The legislation offers a general framework of responsible conduct for both those exercising rights of access and for landowners. Informal recreational access would benefit from the presence of the turbines within the site by providing a feature of interest.

Appropriate warning signs will be installed concerning restricted areas such as transformers, switchgear and metering systems. All on site electrical cables will be buried underground with relevant signage.

13.5.7 Health and Safety during Construction

A number of activities outlined in Chapter 3, during the construction phase of the project have potential to injure workers and members of the public. All site work will comply with the following relevant regulations:

- The construction (Design and Management) Regulations 2007 approved code of practice;
- The Health and Safety and Work Act 1974;
- The Management of Health and Safety at Work Regulations 1999;
- Provision and Use of Work Equipment Regulations 1998;
- The Works at Heights Regulations 2005; and
- Control of substances hazardous to Health 1999.

The essence of this legislation is to ensure the safe operation of the construction site and the health and safety of all employees, contractors, visitors, self-employed people and members of the public who may have access to the site. Construction activities will also take account of the Renewable UK Guidelines for Health & Safety in the Wind Energy Industry Sector (Renewable UK, 2010a) and the Management of Health and Safety at work Regulations 1999.

Renewable UK has also produced the Wind Turbine Safety Rules (WTSR) which clearly specify actions and procedures which have to be followed in order that persons working on wind turbines are safeguarded from inherent dangers that exist from the installed electrical and mechanical equipment in wind turbines (Renewable UK, 2010b). All construction activities and other site works will comply with these rules.

A construction Health and Safety Plan will be developed to manage safety during construction. Angus Council will require all contractors to provide a copy of their Health and Safety policy prior to commencing work at the site.

When not in use potentially hazardous machinery will be stored in the secure construction compound to prevent use by unauthorised persons. Normal site safety procedures will be strictly enforced including displaying the appropriate signage concerning restricted areas.

Detailed information on construction site access and issues associated with highway safety are included in Chapter 11.

13.6 Shadow Flicker

Shadow flicker can arise from the passing of the moving shadow of a wind turbine rotor over a narrow opening such as the window of a nearby residence. A similar effect can also occur when the gloss blades of a rotating turbine reflect the sun causing a flashing light. Shadow flicker only happens 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; and
- The proportion of sunny weather during the months when flicker can occur.

The extent of the effect is also dependent on the size, shape and orientation of any windows or doors of neighbouring properties.

The flickering effect may have the potential to cause disturbance and annoyance to residents. It is, however, not possible for turbines to cause photosensitive epilepsy. People with photosensitive epilepsy are usually sensitive to flickering light between 16-25 Hertz (Hz), although some people may be sensitive to rates as low as 3Hz and as high as 60Hz (Epilepsy Action, 2011). Modern wind turbines are designed to operate at a frequency of less than 1Hz and are, therefore, well below the frequencies known to trigger photosensitive epilepsy (Epilepsy Action, 2011).

13.6.1 Policy and Guidance

The web based guidance which supersedes PAN 45 only provides limited advice on shadow flicker stating that *"shadow flicker can only occur within buildings where the flicker effects appear through a narrow window opening. The seasonal duration of this effect can be calculated from the geometry of the machine and the latitude of the potential site"* and further that *"the effect diminished with distance and that flicker effects are likely only to occur within ten rotor diameters of a turbine"* (Scottish Government, 2011).

A recent report by consultants Parson's Brinkerhoff for the Department of Energy and Climate Change (DECC, 2011) reviewed the UK evidence base on shadow flicker by carrying out a review of international guidance, literature review and investigation of current assessment methodologies employed by developers. This report concluded that the assumption of ten rotor diameters as a suitable area for investigation and 130 degrees either side of north was acceptable. Furthermore the study concluded that there is a need to address 'worst-case' and what is realistic in shadow flicker assessments.

Planning for Renewable Energy: A Companion Guide to PPS 22 (2004) considers the issue of shadow flicker in paragraphs 73-78, the key points are:

- Shadows may be cast from wind turbines over neighbouring properties under certain conditions as the sun may pass behind the rotors of a wind turbine;
- When the blades rotate, the shadow flicks on and off; the effect is known as 'shadow flicker';
- Shadow flicker only occurs inside buildings where the flicker appears through a narrow window opening;
- It can be calculated from the geometry of the machine and the latitude of the site and the likelihood of it happening depends upon a number of factors such as the time of year; cloud cover and prevailing wind direction;

- Only properties within 130 degrees either side of north, relative to the turbines in the UK can be affected;
- The further the observer is from the turbine the less pronounced the effect will be; and
- Flicker effects have been proven to occur only within ten rotor diameters of a turbine.

There is no national planning policy or guidance in Scotland which deals with 'exposure' to shadow flicker effects in terms of acceptable periods for duration. There is, however, guidance in Northern Ireland which recommends that shadow flicker at neighbouring offices and dwellings within 500m should not exceed 30 hours per year or 30 minutes per day (DOENI 2009). This is based on research by Predac, a European Union sponsored organisation promoting best practice in energy use and supply which draws on experience from Belgium, Denmark, France, the Netherlands and Germany.

13.6.2 Assessment Methodology

A shadow flicker assessment has been undertaken for the proposed development. The potential effects of shadow flicker were modelled using WindFarmer software (v5.1.11.0, Garrad Hassan). The software creates a mathematical model of the development and its surroundings based on:

- Turbine locations, hub height and rotor diameter;
- Topography based on Ordnance Survey 50m DTM data; and
- Latitude and longitude of the development (used in calculating the position of the sun in relation to time of day and year).

The calculation is run for a worst-case scenario which includes the following assumptions:

- Weather conditions are such that shadows are cast during every day of the year, i.e. bright sunshine every day;
- The turbine rotor will always be facing directly towards a given window, maximising the size of the shadow and hence frequency and duration of the effect;
- The turbine are always rotating; and
- There will not be intervening structures or vegetation (other than topography) that may restrict the visibility of a turbine, preventing or reducing the effect.

When the factors above are accounted for, the likely actual incidence of shadow flicker will be substantially less than that predicted based on the worst-case scenario.

13.6.3 Assessment Results

Of the surrounding residential dwellings, two properties lie within 10 rotor diameters (maximum of 710m for the turbine size under consideration) and within the potential area of shadow casting from the turbine (130 degrees either side of north). This assessment is based on the maximum proposed turbine dimensions with a rotor diameter of 71m and, therefore, a cut-off distance of 710m from the turbine location has been applied.

There are three properties within 710m of the proposed turbines, these are Over Finalrg Farm bungalow, Over Finlarg Old Farmhouse and Over Finlarg New Farmhouse. The three properties lie due south of the proposed turbines so are not within 130 degrees either side of north and therefore would not be susceptible to shadow flicker.

13.7 Summary

There is an approved wind farm at the Frawney site and this application is a variation of this consented scheme. The proposed four turbines will be in the same locations as the consented scheme with turbine five removed. Organisations with an interest in telecommunications, television, aviation, safety, defence and infrastructure in the vicinity of the site were consulted to ascertain potential interference from the proposed development. Responses to the current proposed development layout are still awaited from the MOD, however, a solution to any aviation and radar issues has been identified and the MOD stated in their response to the consented scheme at the site, that subject to a suitable mitigation proposal and the implementation of conditions they would have no issue. Interference to their operations are therefore, not envisaged.

Twenty-three EMI links have been identified within a 1.5km radius of the site and the potential effects on these have been taken into consideration in the site design process. Three JRC links are identified in close proximity to the proposed turbine locations although detailed assessment undertaken by JRC for the previous layout d confirmed that the current turbine layout is acceptable and will not interfere with the link operations. Due to a more compact layout with the proposed turbines located further away from the links, it is anticipated that the current proposed layout will also not interfere with the link operations.

The potential for shadow flicker has been assessed and this has been considered to pose no major problems for the surrounding properties.

No potential impacts on television signals are anticipated due to the digital switch over which took place in August 2010. However, in the unlikely event that reception may be affected, there are several mitigation measures that will be put in place.

A construction Health and Safety Plan will be developed to manage safety during construction. PEP's will require all contractors to provide a copy of their Health and Safety policy prior to commencing work at the site. This will help ensure that health and safety will be of the highest standard.

The safe operation of the turbines is ensured through a combination of design, quality control and manufacture to high standards. The developer will require that the selected wind turbine model will have certification from an internationally recognised authority and have a proven track record of safe operation. The wind turbines installed at the site will comply with BS EN 61400-1; 2005 'Wind Turbines. Design requirements'.

Public access to the site is currently limited and this is unlikely to change during the operational life of the wind farm.

13.8 References

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Appendices

Appendix 2-1: Scoping Response

Our Ref: N.1.5/DS/IAL

Your Ref:

2 April 2009

Atmos Consulting
In Business Centre
Stadium Business Park
24 Longman Drive
Inverness
IV1 1SU

Ask for: Dave Scott
Direct Line: 01307-473335

Dear Sirs

TOWN AND COUNTRY PLANNING (SCOTLAND) ACT 1997
ENVIRONMENTAL IMPACT ASSESSMENT (SCOTLAND) REGULATIONS 1999
SCOPING OPINION – WIND FARM DEVELOPMENT AT FRAWNEY NETHER FINLARG, ANGUS

I refer to the above and enclose for your attention a copy of my Council's scoping opinion for the above proposal.

Yours faithfully

DAVE SCOTT
SENIOR PLANNING OFFICER

Encl

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ANGUS COUNCIL

ENVIRONMENTAL IMPACT ASSESSMENT (SCOTLAND) REGULATIONS 1999

SCOPING OPINION
WIND FARM DEVELOPMENT – MOUNT BOY, ROSSIE MOOR, MONTROSE

Angus Council will require any Environmental Statement to comply with the requirements of Schedule 4 of the Environmental Impact Assessment (Scotland) Regulations 1999.

Key issues to be addressed by any Environmental Impact Assessment are considered to be:-

- Site Selection – Consideration of alternatives in terms of site location and design is a statutory requirement of an ES. As such, the EIA should include an assessment of alternative sites in the surrounding area and identify the criteria used in the final site selection and the limiting factors existing in areas that also meet the selection criteria. The ES should include a summary of this assessment and a full justification for why this particular site was selected over other options.

- Description of Project –

    - Description and detailed specification of turbines proposed;
    - Construction program
    - Pollution control measures
    - Access track specifications;
    - Identification of the source of materials for the construction of access tracks, including definition of extraction/operational areas, extent and re-instatement of borrow pits and timing of works;
    - Methods for disposal and/or storage of excavated material;
    - Land take implications, on or off site, and vehicle movements during construction and operational phases;
    - Location, design and colour of any substations, transformers and permanent offices;
    - Location of cables (underground and overground). An indication of the depths and/or heights at which cables will be located and associated installation works should be included;
    - Details of all likely grid connection routes;
    - Extent and location of construction site huts, vehicle equipment and materials compound and an outline of the proposals for construction site staff facilities.
    - Operational lifespan of the windfarm and associated infrastructure, including access tracks and operational details (e.g. site visits and maintenance).
    - Future expansion requirements
    - Timing, duration and phasing details of construction work.
    - Timing and phasing details of decommissioning works for both the windfarm and its associated infrastructure.
    - Full site restoration and re-instatement details at both post-windfarm construction and decommissioning stages. We would expect the ES to also examine the options for decommissioning any redundant structures present on the site which are associated with previous land uses.

    The Environmental Impact Assessment should fully consider the impacts of each component part of the development in relation to the issues identified below.

- The Environmental Impact Assessment should be undertaken in accordance with the relevant methodologies identified in the 'Frawney Wind Farm Scoping Report', Atmos Consulting, November 2008 unless otherwise indicated in this scoping opinion.

- Landscape and Visual Assessment – This should be undertaken in accordance with the "Guidelines for Landscape and Visual Impact Assessment (LI-IEMA, 2002). It should address the impact of the proposal on the local and wider landscape and on locally designated sites. It should also address the impact of the proposal on local properties particularly in relation to visual dominance. Final selection of viewpoints should be agreed in consultation with Angus Council's Planning and Transport Division and the proposed list in the scoping report should be extended and progressed in accordance with the guidance given at the meeting held with Atmos, SNH and Angus Council at the meeting on 3 March 2009. The Assessment should consider the guidance on the location of wind farm development provided in the Tayside Landscape Character Assessment (SNH, 1999) and should have regard to relevant SNH publications including Visual Analysis of Windfarms, Good Practice Guidance 2007". The potential impact of the development on Historic Gardens and Designed Landscapes should be considered.

- An assessment should be made of the sensitivity of the landscape to change in terms of landscape character and its components. This should include consideration of the impact on the character and perception of adjacent character types and how the windfarm is seen in relation to other character types. Reference should be made to Tayside Landscape Character Assessment (SNH review no 122, by Land Use Consultants, 1999), and an Inventory of Gardens and Designed Landscapes in Scotland Vol 4 Tayside, Central and Fife, a report by Landuse Consultants to Countryside Commission for Scotland and Historic Buildings and Monuments Directorate, Scottish Development Department 1988. Consideration should also be given to any sites which it is proposed may be added to the Inventory. The potential impact of the development on Historic Gardens and Designed Landscapes including Glamis, Drumkilbo, The Guynd, Airlie Castle, Cortachy Castle, Guthrie Castle and Rossie Priory should be adressed.

Architecture and Design Scotland advocates that all windfarms be designed to an overall design strategy that is capable of producing a clear and comprehensive layout. The ADS therefore continues to recommend that design professionals be appointed from the outset to advise on, explain and test suitable design strategies.

The ES should contain a full explanation of the design concept that has been developed and alternative layouts that have been considered. It should describe the finalised layout, including the turbines, ancillary buildings and access tracks and explain how this responds to the overall design concept.

Cognisance should be had of the comments provided by Scottish Natural Heritage in its letter dated 27 January 2009 a copy of which is attached.

- Noise Assessment – this should provide background noise level readings for all neighbouring noise sensitive properties and should be undertaken in accordance with ETSU-R-97 and other relevant guidance as identified in the Scoping Report. It should identify the noise characteristics of the proposed turbines and provide predictions of anticipated noise levels including details of any mitigation. It is recommended by ETSU-R-97 that background noise monitoring locations are agreed with the Planning Authority prior to commencement of works. 3 noise monitoring locations have been proposed in the scoping report however there is no supporting information as to how the 3 proposed noise monitoring locations have been chosen. The process for selection of noise monitoring locations should identify groups of properties that would be subject to similar derived noise limits which should then inform the number and location of background noise monitoring locations. Without the aforementioned information the proposed monitoring locations cannot be agreed at this stage. The overall methodology for undertaking the assessment should be agreed in consultation with Angus Council's Planning & Transport and Environmental and Consumer Protection Divisions. The proposed methodology should provide that the duration of any noise monitoring period be sufficient to obtain a representative spread of data (2 week minimum period) with any data obtained during periods of heavy rainfall excluded. Noise limits between 3-12 m/s wind speed are normally imposed and if the full range of wind speeds are not covered during the monitoring period then alternative options should be agreed in consultation with Angus Council's Planning & Transport and Environmental and Consumer Protection Divisions.

- Ecological Assessment – this should provide baseline information on flora and fauna (an extended Phase 1 habitat survey may be acceptable for most of the site. The application site would be surveyed for the presence of protected species and it is acknowledged that additional protected species habitat surveys and botanical surveys in accordance with National Vegetation

Classification (NVC) level survey are likely to be required for areas as informed by the assessment of the baseline information. Target notes could be employed to enhance the survey should any identified vegetation community be too small to map or prove to be worthy of special note. As well as undertaking a survey of these areas, it will also be necessary to locate any rare or nationally scarce higher and lower plant species within the survey area identified. The ES should contain full details of the methods employed and timing of the survey work. Survey results should be presented in terms of presence, numbers and distribution of any protected species.

Particular attention should be given to geese and swan flight lines between significant feeding areas in agricultural fields and roosting locations. As noted in the scoping report Montrose Basin and the Tay and Fife Estuaries are RAMSAR and SPA sites. The Assessment should consider the level and significance of any impact and detail any mitigation.

Cognisance should be taken of the comments provided by Scottish Natural Heritage in its letter dated 27 January 2009 a copy of which is attached.

- Cultural Heritage – this should identify designated sites within the vicinity of the proposal and address the impact of the development on any sites. It should assess the level and significance of any impact and detail any mitigation.

- Hydrological and Hydrogeological Assessment – this should identify the impact of the proposal on the hydrology and hydrogeology of the area and assess any possible impact on private water supplies. It should assess the level and significance of any impact and detail any mitigation.

  Cognisance should be taken of the comments provided by SEPA in its letter dated 16 January 2006 of which a copy is attached.

- Transportation and Access – this should assess the impact of the proposal on the road network, including trunk roads, during both construction and operation. It should identify the preferred route options for delivering the turbines and for other construction traffic. Secondary environmental impacts as a consequence of any improvements to access roads/tracks should be fully examined and quantified.

- Electromagnetic Interference / air traffic safety – this should address the potential impact of the proposed development on television and radio reception, microwave communications and air traffic/radio installations. The potential impact should be assessed and quantified and details of any mitigation provided.

- Socio-economic Assessment – this should address the possible impact of the proposal on the socio-economic environment of the area. The assessment should consider issues of safety as well as impact on tourism/ recreation, public access, farming etc. It should identify, assess and quantify both positive and negative impacts.

- Cumulative Impact Assessment – this should consider the potential cumulative impact of the development in respect of all relevant subject areas identified in this scoping opinion for any site within an initial search distance of 70km that are either subject to a planning or Section 36 application/ permission or at screening/ scoping opinion stage. A list of current wind farm proposals was provided electronically in spreadsheet form on 6 March 2009.

  Cumulative effects should be separated into:

  - Effects in combination - where two or more features are seen together at the same time from the same place, in the same arc of view, where their visual effects are combined.
  - Effects in succession - where two or more features are present in views from the same viewpoint but cannot be seen at the same time together, because the observer has to turn to see the other features in succession. In effect, this means that windfarms 50km apart will be assessed, if their ZTVs overlap at one key viewpoint.
  - Effects in sequence - where two or more features are not present in views from the same viewpoint and the observer therefore has to move to another viewpoint to see the second or more of them, so they will then appear in sequence

The applicant should check with relevant Authorities to ascertain if there are other proposals within 70km of the proposed application site that should be considered as part of any cumulative assessment. Any cumulative impact assessment should take cognisance of the published SNH guidance on cumulative effect of windfarms.

The Statement should provide baseline information for each of the areas identified above and will be expected to assess and quantify direct and indirect, positive and negative impacts and where appropriate detail any proposed mitigation.

The following bodies have been sent a copy of this proposed opinion and have been advised that in terms of Regulation 12 of the 1999 Regulations they are required, if requested, to make available any relevant information in their possession:-

- Scottish Natural Heritage, West Lodge, Airlie, by Kirriemuir, DD8 5NP
- Scotland Water, Bullion House, Invergowrie, DD2 5BB
- Scottish Environment Protection Agency, 7 Whitefriars Street, Perth, PH2 0PA
- Health & Safety Executive, Belford House, 59 Belford Road, Edinburgh, EH4 3EU
- Scottish Executive, 2-H Victoria Quay, Edinburgh, EH6 6QQ

For any impact predictions made in the assessment it would be helpful if you could indicate whether effects are:-

Temporary/permanent
Adverse/beneficial
Direct/indirect
Duration/over project life span etc.
(Ir)reversible
Probable/improbable

It would also be used to indicate:-

Confidence in prediction/basis for prediction (case studies) etc.
Quantify impacts
Description of remedies to avoid or reduce negative impacts
Estimate of type and quantity of expected residues and emissions

It should be noted that Angus Council reserves its right under Regulation 19 to request additional information as may be required.

AC33

Dave Scott
Angus Council
Planning & Transport
County Buildings
Market Street
Forfar
Angus
DD8 3LG

Tayside & Clackmannanshire

direct dial 01738 - 458665
email Catriona.Gall@snh.gov.uk
our ref CNS REN WF FRAWNEY
your ref N.1.5/DS/KW
date 27 January 2009

For the attention of: Dave Scott

Dear Sirs,

TOWN & COUNTRY PLANNING (SCOTLAND) ACT 1997
ENVIRONMENTAL IMPACT ASSESSMENT (SCOTLAND) REGULATIONS 1999

SNH SCOPING ADVICE FOR A PROPOSED 7 TURBINE WINDFARM, AT FRAWNEY, NETHER FINLARG, ANGUS

Thank you for your letter of 12 December 2008 requesting the scoping opinion of Scottish Natural Heritage (SNH) for the above proposal. We appreciate the extension to our consultation period for this request.

Description of the Proposal

The proposal is located in Angus roughly 4.5km southeast of Glamis and 2.5km north of Tealing. It comprises 7 turbines of height up to 110m to blade tip, and associated ancillary development including a temporary construction compound, borrow pits, permanent anemometers, new on-site tracks, substation, transformers and control building, and a connection to the grid.

SNH's Comments on Issues to be Included in Environmental Impact Assessment

This scoping response highlights SNH's key areas of concern which we consider should be scoped into any Environmental Impact Assessment (EIA) for this windfarm proposal. In this response we address:

1. SNH's Strategic Locational Guidance

2. Nature Conservation Designations

3. Landscape and Visual Assessment

4. Ecology (excluding birds)

5. Bird Ecology

6. Soil And Water

7. Recreation And Tourism

We provide these comments in Appendix A which is sub-divided according to the above headings. We provide further information on Landscape and Visual Assessment in Appendix B which gives our general guidance on *Scoping Issues For Wind Farm EIA*. And in Appendix C we provide information on the legislative requirements for European Protected Species.

SNH's Consideration of the Planning Application

While SNH is supportive of the principle of renewable energy, our advice is given without prejudice to a full and detailed consideration of the impacts of the proposal when it is submitted for formal consultation.

For further information or advice from SNH in connection with this proposal, please contact me at the address above, or alternatively contact Shona Hill (Area Officer) in our Airlie office (telephone. 01575 530333).

Yours sincerely

Catriona Gall
Renewable Energy Casework Adviser
SNH Policy and Advice

Enc.

APPENDIX A

SNH'S ADVICE ON ISSUES TO BE SCOPED INTO ENVIRONMENTAL IMPACT ASSESSMENT, INCLUDING SPECIFIC COMMENTS ON THE SCOPING REPORT

1. SNH'S STRATEGIC LOCATIONAL GUIDANCE

SNH's "Strategic Locational Guidance" (SLG) is available from our website on the following page: http://www.snh.org.uk/strategy/renewable/sr-re01.asp

The location of the Frawney windfarm proposal is within Zone 1 of the SLG – an area of low natural heritage sensitivity. In such areas, SNH considers that there is 'the greatest opportunity for development' so long as proposals are 'undertaken sensitively and with due regard to cumulative impact.'

For bird interests, the RSPB has undertaken sensitivity mapping which indicates the area as being of 'low' interest. This bird sensitivity mapping – part-funded by SNH and available from http://www.rspb.org.uk/Images/sensitivitymapreport_tcm9-157990.pdf – is more up-to-date and has been carried out at a finer level of detail than that of the SLG.

2. NATURE CONSERVATION DESIGNATIONS

2i. Sites of European Importance

The Dean Water is part of the River Tay Special Area of Conservation (SAC) and the SAC extends up to Inverarity, about 6km downstream from the proposed Frawney windfarm site. At this distance, SNH considers that the proposed windfarm is sufficiently far from the SAC for significant effects to be unlikely. The effects that we have considered include release of sediment and other pollutants from the proposed windfarm site into watercourses, and we have formed our view from our experience of advising on sites in the construction stage of windfarm development, and in providing other planning responses requiring consideration of riverine SACs. For information only, we provide you with the legislative requirements for European sites (see Appendix C); our advice on the River Tay SAC is given within this context.

The proposed Frawney windfarm site is more than 20km from the Montrose Basin Special Protection Area (SPA), partly designated for its wintering populations of pink-footed geese and other wildfowl. At this distance, roughly 29.5km from the SPA, the proposed windfarm site is further than we consider geese are able to forage in a day. Also the proposed windfarm site is in close proximity to a double row of powerlines which are likely to make the location unattractive for foraging geese. Therefore SNH advises that there is no connectivity between the development proposal and the SPA and the applicant does not need to consider this issue further.

2ii. Sites of National Importance

SNH confirms that there are no Sites of Special Scientific Interest (SSSIs) in vicinty of this windfarm proposal that could be directly or indirectly affected by it.

3. LANDSCAPE AND VISUAL IMPACT ASSESSMENT (LVIA)

3i. Introduction

An assessment of the likely **effects on the landscape resource** includes consideration of likely changes to:

- individual elements – trees, hedges, buildings;
- characteristics – elements or combinations of elements (physical as well as perceptual) which make a particular contribution to the character of an area;

- character – distinct and recognisable pattern of elements (key characteristics) which create a particular sense of place; and
- landscape value – as described by statutory landscape designations, locally valued landscapes; condition and rarity of landscape elements.

An assessment of **visual effects** describes:

- likely changes in the available views resulting from the development; and
- changes in the visual amenity of the visual receptors.

3ii. Available Guidance

The following guidance presents good practice for the design and siting of windfarm development, and for carrying out a Landscape and Visual Impact Assessment (LVIA).

- Visual Analysis of Windfarms Good Practice Guidance (available from SNH website: http://www.snh.org.uk/strategy/renewable/sr-we00.asp).
- Cumulative Effects of Windfarms, SNH Guidance Note (also available on SNH website).
- Guidelines on the Environmental Impact of Windfarms and Small Scale Hydroelectric Schemes (SNH, 2001) – NB. to be replaced later this year by new publication: "Designing Windfarms in the Landscape" (consultation document available on SNH website, link as above).
- Tayside Landscape Character Assessment (LUC, 1999).
- PAN 45 – Renewable Energy Technologies.
- PAN 68 – Design Statements.

Appendix B provides a **draft** scoping note produced by SNH's Landscape Group and it identifies most of the key issues which a Landscape and Visual Impact Assessment (LVIA) should address.

SNH supports the use of the The **Tayside Landscape Character Assessment** (TLCA) and other landscape character assessments, however, we do consider that certain sections of the TLCA are now out-of-date. All statements in the TLCA regarding wind energy generation are based upon mid/late 1990s technology. Paragraph 4.60 of the TLCA refers to turbines with 30-35m hubs and rotor diameters of 30-35m which gives a maximum to tip height of 52.5m. This is roughly half the height of today's machines which, in addition, have a greater blade length:hub height ratio (approx 1:1.5 as opposed to 1:2 in the 1990s) and thus a potentially greater landscape and visual impact. All statements referring to sensitivity to wind farm development in the 1999 TLCA should be (re)considered in the light of today's technology.

3iii. Specific Issues for the LVIA to Address

SNH highlights the following landscape and visual matters as requiring particular attention:

Cumulative effects.
The cumulative LVIA should include, and specifically should distinguish between the following, as defined in the guidance:

- Cumulative landscape effects.
- Cumulative visual effects.
- Static combined effects.
- Static successive effects.
- Sequential effects. Routes to be assessed should be selected and verified following consideration of the cumulative ZVIs.

See Appendix D of SNH's guidance on the "Cumulative Effects of Windfarms" for our recommended approach to considering likely cumulative effects upon landscape and upon views and visual amenity. This guidance is available from the SNH website – http://www.snh.org.uk/strategy/renewable/sr-we00.asp – as indicated above.

For reference, to help provide a national overview of windfarm development in Scotland, SNH produces a quarterly windfarm footprint map. Recent versions of the map are available to download from http://www.snh.org.uk/strategy/renewable/sr-rt01.asp Please note that the windfarm footprint map provides an overview only; we endeavour to keep the map as up to date as possible but please be aware of the provisos listed on our website.

Effects on designated landscapes.
The site does not lie *within* any areas designated for landscape value such as National Scenic Areas (NSAs) or Inventory-listed Gardens and Designed Landscapes (GDLs). It is, however, within 20km of the following GDLs:

- Glamis (about 4.7km)
- Drumkilbo (about 11.5km)
- The Guynd (about 13.5km)
- Airlie Castle (about 14.2km)
- Cortachy Castle (about 15.5km)
- Guthrie Castle (about 16.0km)
- Rossie Priory (about 17.7km)

Following an amendment (made 1 April 2007) to the General Development Procedure Order Historic Scotland – http://www.historic-scotland.gov.uk – are now the statutory consultee in respect of GDLs and can be contacted for further advice.

Effects of the grid connection.
The assessment should consider the impacts of constructing, installing and operating the following infrastructure components associated with the grid connection:

- Substation.
- Cabling (Underground).
- Cabling (Overhead).
- Monitoring and control centre.

3iv. SNH's comment on the landscape and visual section of the Scoping Report

We broadly agree with the approach to LVIA as proposed within the Frawney Wind Farm Scoping Report. We welcome and strongly support the proposed design iteration approach which is recommended in The EIA Regs. We would expect the on-going landscape and visual assessment to inform the design development of all aspects of the wind farm development proposals (as also encouraged in PAN 68 Design Statements).

In respect of the **cumulative assessment** indicated in the scoping report, we advise that initial consideration of a 35km study area is too limited. Current thinking suggests that a study area taking the ZTV radius and an additional 15kms distance (to reflect potential significant **static and sequential** visual impacts to other wind farms) is likely to encompass any significant cumulative impacts. This would create an initial CLVIA study area of 50km distance. From a more detailed consideration of impacts in discussion with Angus Council and SNH, this CLVIA study area may then be redefined and reduced if appropriate given current pressures and patterns of wind energy development.

As noted within the scoping report the **turbine layout** is at a preliminary stage. As part of the iterative process for landscape and visual assessment, SNH would expect to see due consideration of whether this site is suitable for a development of this scale – both in terms of the heights and number of turbines (maximum 7 turbines at 110m to blade tip) and their detailed positions. The initial proposal locates turbines at elevations ranging between 190m AOD and 265m AOD, and indicates turbines both on the flatter agricultural landscape and on the west facing slopes of Finlarg Hill and the adjacent unnamed hill.

SNH would welcome further consideration of the proposed layout to improve the wind farm composition by producing a more contained and compact grouping, thereby mitigating landscape and visual impacts. We recognise that the site is immediately constrained by the location of the two pylon lines and their associated wayleave considerations.

SNH agrees with the proposed range and location of **viewpoints** detailed within the scoping report. We would also suggest the following viewpoints as additional/alternative options, with some justification for their inclusion.

Scoping Report Viewpoint	SNH suggested viewpoint	GR Location	Justification
13. Auchterhouse Hill	Alternative option - adjacent Balkello Hill	362 395	Panoramic views from formally constructed cairn with seating and a view indicator. Panoramic view symbol indicated as such on OS maps and www.walkscotland.com (route11).
-	Addition option – Carrot Hill minor road	464 408	Relatively close proximity views from east across Corbie Burn valley, from minor road. 180º panoramic view symbol looking west towards site indicated on OS map.
-	Addition option – A90 north of Claverhouse, Dundee	approx. 418 353	Wide panoramic elevated view over Angus farmland gained from ascending localised hill to north of Dundee. Significant 'gateway' view entering/leaving Dundee.
22. A90	Alternative option – A90 Newlands	approx. 448 473	Elevated views south over Angus farmland and direct to south.

** NB for clarity in respect of the suggestions made in the table overleaf, we have used the numbering as detailed on the figure in the scoping report indicating draft VPs overlaying the ZTV (no figure number) as there was some slight discrepancy between numbers of viewpoints between this figure (23 vps) and table 2 (24 vps).

The assessment of **visual effects** should consider both **static and sequential views** and assessment of impact. In particular from main transport corridors, including but not exclusive to, the A90, A928 and A94. Further to this any popular recreational routes should also be considered for assessment where appropriate.

The assessment of **sequential effects** should also be undertaken for potential cumulative impacts. SNH are concerned about the sequential and successional impact and experience of multiple wind farms on travellers along the A90 corridor. In particular, cumulative impacts where the addition of the Frawney windfarm proposal may visually link existing and proposed wind farms to the north and south due to the proximity of the site adjacent to the A90.

4. ECOLOGY

4.1 Sites of European Importance

The ES should assess all possible impacts, both direct and indirect, on features of European importance (for European sites see Section 2 above, in respect of European Protected Species see Section 4.4 below).

4.2 Desk Study

SNH recommends the applicant contacts the NBN Gateway for any animal and plant species records that there might be for this area: http://www.nbn.org.uk/

4.3 Impacts on Vegetation/Habitats

An EIA for the proposal would require a Phase 1 habitat survey of the site alongside a National Vegetation Classification (NVC) survey of any important semi-natural habitats encountered on the development site. Any rare or nationally scarce higher and lower plant species within the survey area should be identified and proposals presented for any necessary mitigation. It is important to ensure that vegetation survey is carried out at the right time of year.

If peatland vegetation / areas of remnant peatland habitat are recorded for this site, then further consideration should be given to the underlying depth of peat on the site, as indicated in Section 6 below.

Any secondary effects on vegetation interests should be considered, assessed and any mitigation proposals presented in the ES. This includes any changes to land management practice resulting from the presence of a windfarm, for example, changes in grazing, sporting or muirburn practice.

The *presentation* of vegetation survey results is important; work should be presented clearly and transparently. It is important to ensure that vegetation survey is carried out at the right time of year. It is also helpful if the maps that present vegetation recorded on-site are also marked with the finalised layout of the windfarm proposal, including turbines and tracks.

4.4 Impacts on Species

Note: Birds are considered in the next section (Section 5) below.

Mammal surveys should be conducted to record the distribution of protected animal species, including species listed on Annex IV of the Habitats Directive (European Protected Species, or 'EPS') and species listed on Schedule 5 of the Wildlife and Countryside Act (1981). Mitigation of impacts, where these occur, should be addressed for species of note. It is possible that otters – an EPS – could be present on the proposed development site and SNH advises that these are included as a "key" species. Appendix C provides further advice on the legislative requirements put in place for EPS.

Any UK Biodiversity Action Plan (BAP) species that are recorded during the mammal survey should be given consideration in relation to proposals. A key species here may be water vole.

Overall, regarding mammals, the ES should present:

- Likely "key" species which may be adversely affected by the development proposal.
- Possible reasons why the species may be affected by the development.
- Indicative timescale for proposed fieldwork, identifying the timings of surveys (months).
- Outline survey methodology for each species.

The *presentation* of mammal survey results in the ES is important; work should be presented clearly and transparently. It is important to ensure that mammal surveys are carried out at the right time of year. Should information be gathered regarding species sensitive to disturbance, SNH would be willing to advise on an appropriate format for dissemination of this information.

5. BIRD ECOLOGY

5.1 SNH Bird Guidance

Bird survey work should follow the methodology outlined in the guidance note "Survey Methods for use in Assessment of the Impacts of Proposed Onshore Windfarms on Bird Communities" (http://www.snh.org.uk/pdfs/strategy/renewable/bird_survey.pdf).

SNH's bird guidance should be followed regarding survey requirements, survey methodology, any collision risk analysis and also regarding the *presentation* of this work in any submitted ES. It is essential that the record of the survey work which has been undertaken is presented clearly and in a transparent manner. Likewise the full workings of any collision risk analysis should be presented clearly in an ES. Maps should be clearly laid out, and it is helpful for flight-line maps and for maps recording the locations of breeding birds to be also marked with the finalised windfarm layout.

Should information be gathered regarding bird species sensitive to disturbance, SNH would be willing to advise on an appropriate format for dissemination of this information.

6. SOIL AND WATER

It may be that there are remnant areas of peatland on this proposed site, or that there are underlying peat soils. Any such peatland must be clearly mapped (depth, nature, hydrology and condition) as this should inform routing of proposed tracks (whether excavated or floated), and siting of turbines and other infrastructure – this should allow for the development to avoid deep peat areas.

Although it is not a Section 36 proposal, we recommend that you check the Scottish Government guidance in respect of peat slide hazard risk assessment:

http://www.scotland.gov.uk/Publications/2006/12/21162303/1

If significant levels of peat are recorded across the site then it may be necessary to undertake a peat slide hazard risk assessment.

We recommend that you contact the Scottish Environment Protection Agency (SEPA) in respect of freshwater issues. SEPA will advise on the adequacy of any hydrological work that is undertaken as part of EIA for this windfarm proposal. As indicated in Section 2i, we consider that the River Tay SAC is sufficiently far downstream of the windfarm proposal for there not to be any significant effects on this designated site.

7. RECREATION AND TOURISM

SNH recommends that the following matters are given consideration in the ES:

- The effect on the enjoyment of any strategic access routes in the area.
- The use of boundary features and essential access controls to ensure that these are not a barrier to the general right of access.
- Any increase in noise and other changes in experience of the area from its present character.

The EIA should deal with the temporary and permanent effects of the proposals on recreation and access. SNH would expect that an assessment will be made of how current and future recreational use are likely to be affected during construction and subsequent operation of the windfarm.

SNH SCOPING ADVICE ON LANDSCAPE and VISUAL MATTERS for WIND FARM EIA

4 th draft September 2006

Contents

1.0 Background

1.1 This note provides general guidance on the landscape and visual aspects to be covered at pre-scoping and scoping stages. It deals with both the simple and complex issues that need to be considered by a landscape and visual impact assessment within an Environmental Statement, in the interests of developing and achieving best practice. This note should be read in conjunction with the scoping checklist in the published SNH guidance on the impacts of windfarms1 it does not replace it.

1.2 The nature and scale of windfarm development and its landscape context varies considerably. It may, therefore be, that the emphasis to be placed on individual aspects varies from case to case. However, the aspects to be considered are likely to include landform, open-ness, scale, landscape character & features, visibility, designations, and cumulative impacts.

2.0 Scoping – landscape and visual impact assessment general

2.1 The approach described in the “Guidelines for Landscape and Visual Impact Assessment” (LI-IEMA, 2002) should be used. Assessments need to be rigorously documented and explained, as well as being integrated and objective. Their presentation should be logical, clear and well-structured.

2.2 The site selection process should be explained in the ES. The likely effect on all landscape and visual resources and sensitivities (including landscape character, landscape designations and visibility) should be addressed in the site selection process in balance with other considerations. Likely significant impacts on relevant designated areas – national, regional, and local – should be assessed even where the site lies outwith the boundary of such areas.

2.3 Landscape and visual impact assessment should make use of the appropriate Landscape Character Assessments, National Scenic Area descriptions and all other relevant landscape and planning documents. This should include good practice and policy guidance, including PAN 45 and NPPGs (especially numbers 13 & 14), SNH Visual Analysis of Windfarms, Good Practice Guidance, (DRAFT) 2005, (VAW GPG), SNH renewables and wild land policies, siting and design guidance, and so on. There should

[1] Scottish Natural Heritage (2001) “Guidelines on Environmental Impacts of Windfarms & Small Scale Hydroelectric Schemes”. Battleby.

be links to other sections of the Environmental Statement such as tourism, recreation, cultural heritage, and transportation. These links should be clearly cross-referenced.

2.4 Chartered Landscape Architects, preferably a team of at least two, should carry out the landscape and visual impact assessment part of an ES.

2.5 Cumulative effects and the accumulation of windfarm projects should be considered and assessed whenever relevant. Sequential impacts as well as intervisibility should be considered.

2.6 It is emphasised that one of the main purposes of the EIA process is its iterative nature in influencing and improving design. The design sequence and key changes through the process should be made clear in the ES.

2.7 As with any planning application, material post-assessment changes should be re-assessed, re-visualised and re-evaluated. This may require a re-submission of documents.

3.0 Scoping – content of landscape and visual impact assessment

3.1 The basis upon which all aspects of the landscape and visual impact assessment have been assessed, especially judgements of magnitude, sensitivity and significance should be defined and made clear and distinct. Measures of magnitude should distinguish between the scale, nature, and duration of effects. The limitations of the assessment (e.g. the scale or accuracy of topographical information) should be clearly stated.

3.2 The landscape and visual impact assessment should include a separate assessment of the effects on both landscape and visual resources. The study area should normally cover an area, which is at least equal to the area of the agreed Zone of Theoretical Visibility (ZTV; see section 4 below) unless otherwise decreed by the planning authority in consultation with SNH.

3.3 The landscape and visual impact assessment should include the following:

a) Assessment of potential impacts from fixed locations as well as along road corridors and other routes (to include consideration of the sequential experience of the windfarm);

b) Assessment of all stages: construction, operation, maintenance and decommissioning;

c) Details and assessment of **all** elements of the scheme, whether existing or proposed, permanent or temporary, including: turbines, grid connections, on site tracks, access routes, buildings, plant, substation, anemometer, fences, storage areas, compounds, turning areas, hardstanding, car parks, lighting, borrow pits, and off-site implications e.g. quarrying. Methods of working should be detailed. All significant elements should be illustrated in visualisations, i.e. tracks, sub-stations, borrow-pits and so on, not just the wind turbines;

d) Assessment of alternative types of turbine and the implications of these alternatives on the overall effects of the windfarm, for example the external or internal locating of transformers. Off-site impacts may also be relevant, for example the transportation of different lengths of turbine blades;

e) Assessment of effect upon amenity, including access and recreation and wild land[2], cross referring to information in the tourism section of the EIA as necessary;

f) Assessment of any indirect effects on land use, e.g. how a proposal within a forest may affect the scope for future restructuring or removal;

g) Proposals for mitigation and assessment of residual impacts;

[2] NPPG 14 defines wild land as "*uninhabited and often relatively inaccessible countryside where the influence of human activity on the character and quality of the environment has been minimal*".

h) Proposals for reinstatement, including method statements;

i) Assessment of potential cumulative effects (including sequential impacts) with other windfarms developments. This will include windfarms beyond the ZVI for the proposed development, as directed by the planning authority.

3.4 Assessment should include consideration of the likely effects upon the following:

a) The key landscape characteristics of the site that make it distinctive and the particular relationship of the components of the windfarm to these (with reference to the relevant LCAs);

b) Physical landscape features (e.g. loss of field boundaries, woodland or other landcover etc.);

c) The character and experience of the landscape, including the effect on the experience of wildness;

d) And any recognised landscape or amenity values or visual resources, e.g. designations.

4.0 Zones of Theoretical visibility

4.1 ZTVs are intended to help assess likely landscape and visual impacts by indicating the extent of theoretical visibility. They should not be regarded as a measure of impact in themselves.

4.2 Zones of Theoretical Visibility (ZTV) diagrams need to be clear and legible. This means it is generally most appropriate superimposed on an Ordnance Survey base map at 1:50,000 scale, copied at either 1:50000 or 1:100000, printed in greyscale and of a high quality resolution. Although there may be some circumstances where a more detailed base map is required or, conversely, where it can be shown at 1:100,000 scale beyond the inner 15km of the ZTV, if agreed by the planning authority. This should be presented as either an A1 sheet or as separate A3 sections (with minimum 1km overlaps). An overview ZTV map at 1:250000 scale, based on 1:250000 OS base map, should also be produced. Turbine locations, viewpoint locations and the ZTV radii should all be shown on the ZTV. Cumulative ZTVs (see section 8) can be shown at another scale if agreed by the planning authority. A draft ZTV should be produced at an early stage in the visual assessment process in order to inform the initial choice of viewpoints (see section 5 below). It is recommended that this is produced prior to the scoping meeting.

4.3 The data used to calculate the ZTV, its inherent limitations and the methods of calculation should always be described (Note OS Landform Profile (10m) is the recommended preference. It provides a more precise representation of the topography compared with the Landform Panorama (50m) which is only considered acceptable if the landform is simple).

4.4 The existence of error should always be acknowledged. If possible the errors should be assessed and discussed.

4.5 A (computer generated) ZTV should always be tested and verified by desk and field study and the results of those tests should be described. AND / OR The visibility within the ZTV should be tested using wireframes. This can be used to check for local obstructions and to guide viewpoint location selection. 4.6 Radii for Zones of Visual Influence should be based on the recommendations in Table 1. However, these may need to be adjusted on a site-by-site basis, taking into account the predominant environmental conditions, nature and scale of development and its landscape context. For example where the extent of visibility is particularly high; such as in open, flat, moorland conditions. The radii for ZTVs will be agreed beforehand with the planning authority in consultation with SNH.

Table 1: Recommendations for ZTV radius in relation to height of turbines[3].

Height of turbines (total including rotors) (m)	Recommended ZTV radius (km)
Up to 50	15
51 - 70	20
71 - 85	25
86-100	30
101-130	35

NB. The recommended radius may vary dependent on the specific environmental conditions, landscape context and the nature and scale of the proposed development.

4.7 The distance will need to be increased to take account of any cumulative effects with other windfarms. See cumulative impacts section (8).

4.8 The ZTV should be 'bare ground', i.e. showing the worst case. If agreed, computer modelling of built and other landscape elements (such as forestry) should be included as an additional and separate ZTV.

4.9 The ZTV should assess the degree of visibility based on the numbers of turbines visible, for both total height to nacelle/hub height and on total height to blade tip. Therefore, ideally, at least two ZTVs should be produced for each windfarm assessment. In specific, sensitive situations, ZTV should also show proportion of turbines visible and/ or numbers upon the skyline.

4.10 Individual turbines or groups, as required by the planning authority or SNH, should be numbered on plans and wirelines and possibly other visualisations. This is in order to indicate which turbines would be visible from particular viewpoints.

4.11 For development of 5 turbines or less, the ZTV can be calculated from the centre of the site. For larger windfarms, or those that due to their layout span large distances of more than approximately 2 km, it will be necessary to apply the distances in table 1 from the outermost turbines, not the centre. Should the wind farm be designed as two or more distinct groups of turbines, separate and combined ZTVs may be required.

4.12 It is recommended that the ZTV (overlay) should extend to the edge of the map base that includes the recommended ZTV distance (See VAW p31, para 55).

4.13 A ZTV for access tracks and / or the grid connection should be included if these are likely to form a significant element. This should be agreed beforehand with the planning authority in consultation with SNH.

(For more information on ZTVs, see VAW GPG, Ch 2, p21, and Good Practice Guidance Summary pp41-2)

5.0 Viewpoint selection and assessment

5.1 Viewpoints should be selected in negotiation with statutory consultees, principally the Local Planning Authority and SNH. Viewpoints selected by the planning authority may include additional residences and public buildings, as local authorities have other interests in addition to those of SNH. It may be that a lengthy initial list becomes shortened as it becomes obvious which are the viewpoints that best illustrate the most significant likely impacts or help most with design iteration.

3 University of Newcastle (2002) Visual Assessment of Windfarms Best Practice. Scottish Natural Heritage Commissioned Report F01AA303A.

5.2 Public consultation on viewpoint selection is recommended and has been found to be helpful, at public meetings, to display any indicative visualisations at eye level and to show the correct viewing distance for them. Marking tape on the floor or some other method can do this.

5.3 The selection of viewpoints and the direction of views selected should be based on the identification of potentially sensitive receptors (people, places and activities) and potentially significant views, locations or landscapes, taking into account the likely impacts of the windfarm.

5.4 The choice of **all** viewpoints should be informed by the cumulative ZTV as well as the individual ZTV. Although it is possible to add supplementary viewpoints as part of a cumulative VIA, it is preferable to use all or some of the same viewpoints for both the individual and cumulative VIA.

5.1 View type

Viewpoints should be selected in order to show:

a) Areas of high landscape or scenic value; both designated and non designated. For example NSA's, AGLV's, GDL's, search areas for wild land, tourist routes and local amenity spaces;

b) A full representation of views from a range of distances, aspects, landscape character types and visual receptors;

c) All aspects of the proposed development, i.e. illustrate it "in the round" to help in the design development and assessment processes. This will also enable assessment a range of light conditions e.g. side-lit, back-lit and front-lit;

d) Visual composition. For example focussed or panoramic views, simple or complex landscape pattern;

e) The variety of images that the windfarm will present in the landscape, including, for example, where all the turbines are visible as well as places where partial views of turbines occur;

f) A range of distances;

g) A range of elevations;

h) Sequential along specific routes;

i) The full range of different types of views, e.g. popular hilltops, footpaths and other recreational routes, key transport routes (on and offshore where relevant), minor roads where the windfarm will be the focus of the view, individual houses in close proximity, settlements, cultural and recreational foci, and so on;

j) And views of other windfarms if cumulative impacts are being assessed.

5.2 Viewer Type

k) The full range of receptor groups, e.g. residential, work, road users and other travellers, walkers, other recreational users, etc.;

l) Various modes of movement. For example those moving through the landscape or stationary

In addition to representative viewpoints , specific viewpoints that are already important vantage points within the landscape, are also important to consider. For example, local visitor attractions, scenic routes, or places with cultural landscape associations.

The developer should be aware that further or alternative viewpoints may need to be considered throughout the VIA process.

5.4 The local planning authority may have additional considerations regarding viewpoint selection. Viewpoints in close proximity (less than 10 km) are particularly useful in determining the preferred windfarm layout and design. Precise adjustment of the viewpoint location should be made to avoid underestimation of the visual effect by, for example, the judicious positioning of screening objects.

5.5 The precise location of the viewpoint (including 12 figure OS grid reference and a brief description), viewpoint height (mAOD), nature of view (width of view in degrees and bearing of key foci within view) and conditions of assessment should be given. This should give details of the orientation to and distance from the proposed development, date, time of day and weather conditions and visual range, when the photographs were taken and the assessment made. It is helpful if a small insert map (based on a 1:50000 OS base map) showing the viewpoint's detailed location and direction is given alongside each visualisation.

5.6 All viewpoint information listed in 5.5above should be presented in a table and cross-referred to a ZTV map on which all of the numbered viewpoints are plotted.

5.7 The characteristics visible from each viewpoint that are sensitive to windfarm development should be described and assessed, particularly in relation to the changes the development would cause. Factors such as season, weather, air clarity, movement, orientation to prevailing winds, elevation of the windfarm in relation to the viewer, and any screening elements may be relevant. The design and layout of the turbines and other components of the windfarm, as it would appear from each viewpoint, should also be described and assessed.

5.8 Details of the types of receptors, and an assessment of their sensitivity, should be included.

(For further detailed information on Viewpoints, see VAW GPG, Ch 3, p43, and Good Practice Guidance Summary pp55-6)

6.0 Visualisations (See p111, GPG summary)

6.1 Early selection of viewpoints for wireline diagrams and photomontages should be based on the draft ZTVs, draft cumulative ZTVs, and site assessment. These visualisations should be used in the process of refining the siting and design of the development. Subsequent selection of important and / or typical viewpoints should determine the visualisations to be included in the landscape and visual impact assessment. This should be an iterative process, as should selection of those viewpoints to be illustrated by photomontages as well as wirelines. Generally, there is likely to be little gained by using photomontages for viewpoints more than, approximately, 15km away from the development. However, it can also be important to see the context of the view even beyond 15km.For example where the windfarm is likely to appear as a prominent landscape feature within a very open and simple setting. The final decision should rest with the planning authority, possibly in consultation with SNH.

6.2 Visualisations should be accurately scaled and show all of the main elements of the windfarm, including turbines, tracks, borrow pits, grid connection, anemometers, buildings, and other windfarms, etc.

6.3 Visualisations should show the "worst case scenario" of all turbine blades either facing the same direction, but this varying between viewpoints so that the ones in the centre face forwards towards the viewpoint or the blades arrangement under prevailing wind conditions at each viewpoint, that is "face on" to the viewer. It is recommended that turbines are always shown with one blade positioned straight upwards for wirelines. Photomontages as illustrations, can alternatively show turbines at varying positions in their rotation; provided all visible turbines can be seen in the image.

6.4 Wireline images should be used in an appropriate combination with photographs and photomontage, as both working and presentation tools. The combination of a photograph of the existing landscape and a wireline diagram of the proposed view should be provided for as the minimum requirement for all viewpoints. All wirelines used during the assessment process should be included in the ES, possibly in an appendix, including those used to appraise alternative turbine layouts or windfarm designs. This is because photomontages can imply a false realism and a wireline diagram in the landscape and visual impact assessment should therefore, always accompany them.

6.5 The camera type, lens, focal length, film speed, shutter speed and aperture, frame numbers, spacing between the frames and bearings to distinctive elements in the view should be recorded at each photograph location in addition to the viewpoint information (5.5). This should be clearly stated in the landscape and visual impact assessment. The field of view and the central point of the photograph should be determined by the professional assessor.

6.6 An SLR camera for 35mm film or Digital SLR with fixed focal length lenses are recommended. Compact zoom digital cameras are not recommended. Use of a 50mm focal length lens or a lens giving similar field of view for digital should be used. Zoom lens is not appropriate. Other specifications may be appropriate in very specific circumstances eg telephoto lens (see para 129) in addition to the 50mm panorama view. Film speed ISO 200 or less is recommended.

6.7 Panoramas require levelled photographs using tripod and spirit level. Panoramas should be produced by splicing standard photographs manually in order to minimise distortion. Aim to provide an overlap of frames of between one quarter and one half of the frame width. Manually set the exposure setting to ensure good lighting over the entire panorama; but particularly the site and key characteristics of the area. Where splicing is used, the number of photographs taken should be stated.

(For more information on Visualisations, see VAW GPG, Ch 4, p57, and Good Practice Guidance Summary pp111-114)

7.0 Photomontages

7.1 The limitations of photomontage should be recognised and acknowledged in the ES. A comfortable viewing distance of 30-50 cm should dictate the technical detail of their production. In any event, the depictions should be as realistic as possible to ensure that the general public and decision-makers are suitably informed. A full image size of A4,A3 or even greater (VAW GPG, p101, Table 11) for a single frame picture, giving an image height of approximately 20 cm (min 14cm), is required to give a realistic impression[4]. See VAW GPG pp99-114 for further guidance on the presentation of visualisations.

7.2 The quality of photographs and photomontages is very important. Photographic work should be carried out in good weather conditions, offering clear visibility and no 'haziness'. Photographs should ideally be taken to be front or side lit; not directly into the sun. All images used should be correctly exposed and sharp, with a satisfactory level of brightness and contrast.

7.3 The worst-case scenario of turbines seen against a strongly contrasting sky (e.g. bright blue or dark grey) should always be shown. If it is desired to illustrate possible views in other, e.g. cloudy, weather conditions then these should be additional to, and not instead of, those photomontages with a contrasting sky in the background. In any event, photographs must be able to clearly show the proposed windfarm site and its context and, if to be used for photomontage, should be able to have wind turbines clearly illustrated upon them. Turbines must be shown in a colour that shows up clearly against both the sky and the background landscape as appropriate.

4 A recent, helpful presentation showed for each viewpoint the current situation photograph, wireline and photomontage based on 50mm lens on one A3 page; then a full page photomontage with 70mm lens length on the next page.

7.4 The applicant is required to submit a paper copy of the full ES to the statutory authorities and consultees. CD's or electronic copies are not an acceptable substitute.

7.5 The use of videomontages or computer generated moving images may be useful to represent blade movement from key locations. This may be particularly beneficial in showing the effects of movement in certain circumstances such as blade tips rotating over a skyline. A videomontage may also be required to show the effect of the turbines from viewpoints where the current absence of unnatural movement is a particularly sought-after and valued aspect of the landscape experience.

(For more information on Photomontages, see VAW GPG, Ch 4, p84, and Good Practice Guidance Summary pp111-114)

8.0 Assessment of Cumulative Impacts

8.1 Introduction / General

8.1.1 It is established planning practice that the cumulative impacts likely to arise from the proposal in conjunction with other developments approved and / or in the planning system, should be assessed. The local planning authority should confirm which other developments and proposals should be considered in an assessment of cumulative impacts. SNH guidance for this aspect of assessment is available on our website; (http://www.snh.org.uk/pdfs/strategy/cumulativeeffectsonwindfarms.pdf. The following points should be considered as initial advice on methodology.

8.1.2 The methodology used to assess cumulative impacts should be clearly explained. It should be based on the GLVIA and, whether it follows the draft guidance here or not, the reasoning behind judgements should be made clear. This is because, as noted in section 8.2 below, there is more than one type of cumulative impact and their assessment quickly becomes complicated.

8.1.3 The purpose of a cumulative assessment is not to find whether any one of the proposals is "right" or "wrong" individually. Instead, it should be focused on the additional impact of another windfarm, assuming that the previous developments have been built. As with individual assessments, analysis of cumulative impacts should be an iterative process that informs the design of the proposed windfarm. As a generalisation, new developments should be designed to integrate with the preceding one(s), provided the initial developments correspond reasonably well to their surroundings.

8.2 Types of Cumulative Impacts

8.2.1 Cumulative effects on visual amenity consist of combined visibility and sequential effects. In more detail:-

- Combined visibility occurs where the observer is able to see two or more developments from one viewpoint, without moving his or her head.
- Successive or repetitive visibility occurs where the observer is able to see two or more windfarms from one viewpoint but has to move his or her head to do so.
- Sequential effects occur when the observer has to move to another viewpoint to see other developments, or a different view of the same development. The occurrence of sequential effects may range from frequent (the features appear regularly and / or with short time lapses between them, depending on speed of travel and distance); to occasional (long time lapses between appearances because the observer is moving slowly and / or there are large distances between the viewpoints). It may also be that sequential impacts tend to be greater where windfarms are seen from a single route, even where there are considerable distances between them, or if the windfarms are within the same landscape character type.

8.3 Zones of Theoretical Visibility

8.3.1 Where cumulative impacts need to be assessed, Zones of Theoretical Visibility should be produced for each windfarm and overlain with each other; preferably on one map but this may not be practicable or legible if too many windfarms are being assessed. The visibility of each windfarm should be clearly distinguished on the map(s). The base maps should be OS 1:50,000 scale or as otherwise decreed by the planning authority, possibly in consultation with SNH. See also Section 4 above on ZVI.

8.3.2 The radius for cumulative Zones of Theoretical Visibility should be agreed with the planning authority in consultation with SNH. An initial area of search for cumulative impacts should be twice the radius of the ZVI for the proposed single windfarm. Within this area the study area for cumulative impacts will be determined by consideration of factors such as important viewpoints; transport routes, recreational foci etc. This should indicate how the landscape is likely to be experienced and, thereby, the area within which cumulative impacts will probably be significant.

8.4 Scale and Duration of impacts

Scale of proposal

8.4.1 The extent of key views that the windfarms will seem to occupy needs to be made clear by, say, giving an indication of the proportion of the whole view or skyline that would be affected. The cumulative visual prominence of windfarms in the view needs to be assessed, e.g. the increase in the proportion of a view that would be occupied by windfarms, and whether views to other features would be maintained or not.

8.4.2 The direction of views to the windfarms should also be described and their impacts assessed. For example, a proposal that would result in all directions from a location having views to a windfarm is likely to have a greater impact than a proposal that left arcs of the view clear of such views.

8.4.3 Distance will affect the apparent size and scale of the proposal. For this reason the distance to the nearest turbine from any assessed viewpoint should be stated. Factors such as whether the proposal would be seen "back-clothed" or skylined, the openness of the view; and its relationship to other features will also influence the perceived scale of the proposal.

8.4 Duration of effect

8.4.4 Generally, the longer a view lasts the greater the magnitude of impact. This is dependent on the speed of travel as well as the direction and openness of the view. Thus, residents, walkers and cyclists are rated as more sensitive than drivers. Conversely, however, a sudden, surprising, or intermittent first view of a windfarm can be startling and this would increase the impact. The gap between views of the windfarms is also important when considering sequential views.

8.5 Separation

8.5.1 The amount of separation between the proposed windfarm and other windfarms is important. Separation can be real or apparent. Factors involved include the distance(s) between windfarms; whether one is clearly more dominant or distant compared to the other(s); and the effect of landform and other features. The degree of perceived separation may be affected if the windfarms convey different images or designs.

8.5.2 Separation should be detailed in terms of straightforward distance(s), and times for sequential impacts, but also analysed for how a new windfarm will appear relative to others. For example, will the windfarms seem part of one (large) development or will they be clearly separate? Details should be given of how this relationship will vary from different locations. Greater separation may be judged to be beneficial if the designs of the windfarms are very different. Conversely, for example, where the impression of one large windfarm could be gained then lesser separation may be preferable. Much of this will depend on the relationship of the windfarm(s) to character type.

8.5.3 The impact of separation on sequential cumulative impacts needs to be assessed. The amount of space or time available between windfarms views whilst travelling should be stated and analysed. For example, it should be noted whether there is time to appreciate the landscape characteristics of an area without the potential distraction of approaching (yet) another windfarm having just passed one.

8.5.4 At one ‘extreme’ level of separation there could be visual overlap between windfarms. If the turbines of separate windfarms will overlap when viewed from some directions / locations this needs to be made clear. If overlap will occur then it needs to be assessed: the extent of overlap should be stated, perhaps as a percentage. It will also be important to assess how the windfarms would overlap, for example if they will be side-by-side or if one will be in the foreground of the other. The impact of any difference in layout design between the windfarms should also be assessed. For example, would overlap mean that the simplicity of one development becomes regarded as much more complex and confusing.

8.6 Design

8.6.1 Any similarities and differences between the proposed development and others need to be stated. Details should include turbine size (both tower height and blade tip height), turbine type, blade rotation speed (and direction). The design and layout of each windfarm should be described. All these attributes should then be assessed for their landscape and visual impacts. For example, a view of larger wind turbines in the foreground and smaller wind turbines in the background could exaggerate the apparent distance in a landscape.

8.7 Landscape character

8.7.1 If more than one windfarm is located within the same character type their design and relationship to the landscape should be similar. If this does not occur then a viewer is likely to question whether one or another of the windfarms is appropriately designed. Conversely, if the windfarms are of a similar and appropriate design and relationship to the landscape, they may seem to reinforce their appropriateness for that landscape.

8.7.2 It should be assessed whether the windfarms, cumulatively, would dominate, or seem to dominate, the landscape character area. If so, they would become the key landscape characteristic and the landscape character would change. Where the landscape in question is rare the result would be the loss of a landscape resource. However, if there are other unaffected units of this character type, this may result in only local change.

8.7.3 It should be established if windfarms in a particular area would be linked to other elements in the landscape by association. For example, they may always be associated with hill tops, the coast or even particular powerline routes. Where this is the case, the character of other areas of a region may seem unaffected. However, if the windfarms seem associated with a wide range of characteristics, they may seem unpredictable in their location, and thus seem to affect the landscape experience of an entire area.

8.8 Visual impacts / considerations

8.8.1 The impact that more than one wind farm could have on the pattern of visual foci in a landscape needs to be assessed. This is because while one windfarm may create a single feature, two or more may create a different pattern or a collective linear element.

8.8.2 The degree of visual confusion or integration between windfarms should also be described and assessed (see also section 8.5 above). This would take into account aspects such as level of separation or visual overlap, and the design of individual windfarms. It also related to whether any differences are evident in windfarm design, or in the relationship between the windfarm and landscape character.

9.0 References

- Horner and MacLennan and Envision, Consultation Draft 22.7.2005, Visual Analysis of Windfarms: Good Practice Guidance. SNH Commissioned Report No. xxxxx
- Benson, John et al (2000) Visual Assessment of Windfarms: Best Practice. SNH Commissioned Report No. F00xxx Perth: SNH.
- The Highland Council (2002) Interim Recommendations for Visual Impact Assessment of Windfarms. Inverness: the Council.
- The Landscape Institute & the Institute of Environmental Management and Assessment (2002) Guidelines for Landscape and Visual Impact Assessment. 2nd ed. London: Spon Press.
- Scottish Natural Heritage. (2001) Guidelines on the Environmental Impacts of Windfarms and Small-scale Hydro Electric Schemes. Perth.
- Scottish Natural Heritage (2003) Cumulative Effect of Windfarms. SNH Guidance note. Available on SNH website.

APPENDIX C

LEGAL REQUIREMENTS: EUROPEAN SITES AND EUROPEAN PROTECTED SPECIES

European Sites

The status of the River Tay as a Special Area of Conservation (SAC) under the EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (the "Habitats Directive"), means that the Conservation (Natural Habitats, &c.) Regulations 1994 as amended, (the "Habitats Regulations") apply. The requirements are summarised in Circular 6/1995 as amended June 2000 and include, at paragraph 12,

> The Regulations (*48*) require that, where an authority concludes that a development proposal unconnected with the nature conservation management of a Natura 2000 site is likely to have a significant effect on that site, it must undertake an appropriate assessment of the implications for the conservation interests for which the area has been designated.

The need for appropriate assessment extends to plans or projects <u>outwith</u> the boundary of the site in order to determine their implications for the interest protected <u>within</u> the site.

Under regulation 48 of the Habitats Regulations, this means that the competent authority has a duty to:

- determine whether the proposal is directly connected with or necessary to site management for conservation; and, if not,
- determine whether the proposal is likely to have a significant effect on the site either individually or in combination with other plans or projects; and, if so, then
- make an appropriate assessment of the implications (of the proposal) for the site in view of that site's conservation objectives.

SNH's advice in respect of this process is that while the Frawney windfarm proposal could have potential connectivity to the River Tay SAC – as watercourses on the proposed windfarm site eventually connect to the SAC watercourse – the distances involved are sufficiently great for there to be no risk of the windfarm proposal having any significant effects on the SAC, at any stage of the proposed development, including construction.

European Protected Species

Regulations 39 and 43 of The Conservation (Natural Habitats &c.) Regulations 1994 (as amended) (Habitats Regulations) provide full protection for certain animal and plant species. The species identified above are referred to as European protected species and are listed on Schedules 2 (animals) and 4 (plants) of the Habitats Regulations.

This means it is illegal to:

- Deliberately or recklessly capture, injure or kill a European protected species of wild animal or to deliberately or recklessly (i) harass an animal or group of animals; (ii) disturb an animal while it's occupying a structure or place used for shelter or protection; (iii) disturb an animal while it's rearing or otherwise caring for its young; (iv) obstruct access to a breeding site or resting place, or otherwise deny the animal use of the breeding site or resting place; (v) disturb an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs; (vi) disturb an animal in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young.

- Deliberately or recklessly take or destroy its egg.
- Deliberately or recklessly disturb any cetacean.
- Damage or destroy the breeding sites or resting places of such animals.
- Deliberately or recklessly pick, collect, cut, uproot or destroy European protected species of wild plant.

Where it is proposed to carry out works which will affect European protected species or their shelter/breeding places, whether or not they are present in these refuges, a licence is required from the licensing authority (in this case likely to be Scottish Government). It is strongly advised that you refer to the Scottish Government information on the current interim licensing arrangements, which can be found in the document *European Protected Species, Development Sites and the Planning System: Interim Guidance for Local Authorities on Licensing Arrangements*, (October 2001) before applying for a licence. Copies of this are available at http://www.scotland.gov.uk/library3/environment/epsg-00.asp or by writing to the Landscapes and Habitats Division, Scottish Government Rural Directorate, Room GH 93, Victoria Quay, Edinburgh EH6 6QQ or by telephoning 0131 244 7140.

As highlighted in the Interim Guidance, three tests must be satisfied before the licensing authority can issue a licence under Regulation 44(2) of the Conservation (Natural Habitats &c.) Regulations 1994 (as amended) to permit otherwise prohibited acts. An application for a licence will fail unless all of the three tests are satisfied. The three tests involve the following considerations:

- Test 1 - The licence application must demonstrably relate to one of the purposes specified in Regulation 44(2) (as amended). For development proposals, the relevant purpose is likely to be Regulation 44(2)(e) for which Scottish Government is currently the licensing authority. This regulation states that licences may be granted by Scottish Government only for the purpose of *"preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment."*

- Test 2 - Regulation 44(3)(a) states that a licence may not be granted unless Scottish Government is satisfied *"that there is no satisfactory alternative".*

- Test 3 - Regulation 44(3)(b) states that a licence cannot be issued unless Scottish Government is satisfied that the action proposed *"will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their natural range*" (Scottish Government will, however, seek the expert advice of Scottish Natural Heritage on this matter).

Consideration of European protected species must be included as part of the planning application process, not as an issue to be dealt with at a later stage. Any planning consent given without due consideration to these species is likely to breach European Directives with the possibility of consequential delays or the project being halted by the EC.

AC33

Scottish Natural Heritage
All of nature for all of Scotland

— Copy —

Dave Scott
Angus Council
Planning & Transport
County Buildings
Market Street
Forfar
Angus
DD8 3LG

Tayside & Clackmannanshire

direct dial 01738 - 458665
email Catriona.Gall@snh.gov.uk
our ref CNS REN WF FRAWNEY
your ref N.1.5/DS/KW
date 2 April 2009

Dear Dave,

TOWN & COUNTRY PLANNING (SCOTLAND) ACT 1997
ENVIRONMENTAL IMPACT ASSESSMENT (SCOTLAND) REGULATIONS 1999

SNH SCOPING ADVICE FOR A PROPOSED 7 TURBINE WINDFARM, AT FRAWNEY, NETHER FINLARG, ANGUS

Further to SNH's scoping advice of 27 January 2009 and the scoping meeting of 3 March 2009, I am writing to confirm that the following issue will also need to be considered in Environmental Impact Assessment (EIA) for this windfarm proposal. My apologies for this ommission, and for the delay in correcting it.

SNH's Comments on Issues to be Included in Environmental Impact Assessment

There is an **update** to the scoping advice that SNH provided for the Frawney windfarm proposal. Our letter of 27 January 2009 needs to be updated to include reference to the Firth of Tay and Eden Estuary Special Protection Area (SPA) in Section 2 of Appendix A as follows:

2. NATURE CONSERVATION DESIGNATIONS

2i. Sites of European Importance

The proposed Frawney windfarm site lies within 20km of the Firth of Tay and Eden Estuary Special Protection Area Protection Area (SPA), partly designated for its wintering populations of pink-footed geese and greylags. There are roosts of the geese at various locations in the Tay Estuary, including Invergowrie Bay and we enclose a map showing the main indicative dispersal routes of the pink-footed geese from this roost. We note that the greylags which use the Estuary do not tend to travel so far from their roosts to feed.

The proposed Frawney windfarm site is located at about 15km from the SPA and so it is within the distance that we consider geese could forage in a day. SNH therefore advises that there could potentially be connectivity between the development proposal and the SPA if foraging geese are recorded flying over the proposed windfarm site and/or potentially feeding in its proximity. We note the presence of the powerlines on this site which may make it unattractive for geese, however, we advise that the applicant will now need to consider this issue in their Environmental Statement.

In the Annex, we provide a copy of the legislative requirements relating to Special Protection Areas. A copy of the Firth of Tay and Eden Estuary SPA citation can be obtained from from the SNHi page of our website: http://www.snh.org.uk/snhi/ (click on the blue "SiteLink" box). We note that the other birds which are qualifying interests of this SPA feed within the site and/or forage at sea, therefore they do not require further consideration by the applicant.

SNH's Consideration of the Planning Application

Please get back to me if you need any further information regarding this update to our scoping advice. While SNH is supportive of the principle of renewable energy, our advice is given without prejudice to a full and detailed consideration of the impacts of the proposal when it is submitted for formal consultation.

For further information or advice from SNH in connection with this proposal, please contact me at this office, or alternatively contact Shona Hill (Area Officer) in our Airlie office (telephone. 01575 530333).

Yours sincerely

[redacted]

Catriona Gall
Renewable Energy Casework Adviser
SNH Policy and Advice

Enc.

ANNEX

LEGAL REQUIREMENTS FOR EUROPEAN SITES

European Sites
The status of the Firth of Tay and Eden Estuary as a Special Protection Area (SPA) under the EC Directive 79/409/EEC on the Conservation of Wild Birds (the "Birds Directive"), means that the Conservation (Natural Habitats, &c.) Regulations 1994 as amended, (the "Habitats Regulations") apply. The requirements are summarised in Circular 6/1995 as amended June 2000 and include, at paragraph 12,

> The Regulations (*48*) require that, where an authority concludes that a development proposal unconnected with the nature conservation management of a Natura 2000 site is likely to have a significant effect on that site, it must undertake an appropriate assessment of the implications for the conservation interests for which the area has been designated.

The need for appropriate assessment extends to plans or projects <u>outwith</u> the boundary of the site in order to determine their implications for the interest protected <u>within</u> the site.

Under regulation 48 of the Habitats Regulations, this means that Angus Council, as the competent authority, has a duty to:

- determine whether the proposal is directly connected with or necessary to site management for conservation; and, if not,
- determine whether the proposal is likely to have a significant effect on the site either individually or in combination with other plans or projects; and, if so, then
- make an appropriate assessment of the implications (of the proposal) for the site in view of that site's conservation objectives.

The competent authority can only agree to the proposal under regulation 48 after having ascertained that it will not adversely affect the integrity of the site. In order for Scottish Borders Council to carry out the appropriate assessment it is important that the applicant submits the necessary information as part of the Environmental Statement for their proposal.

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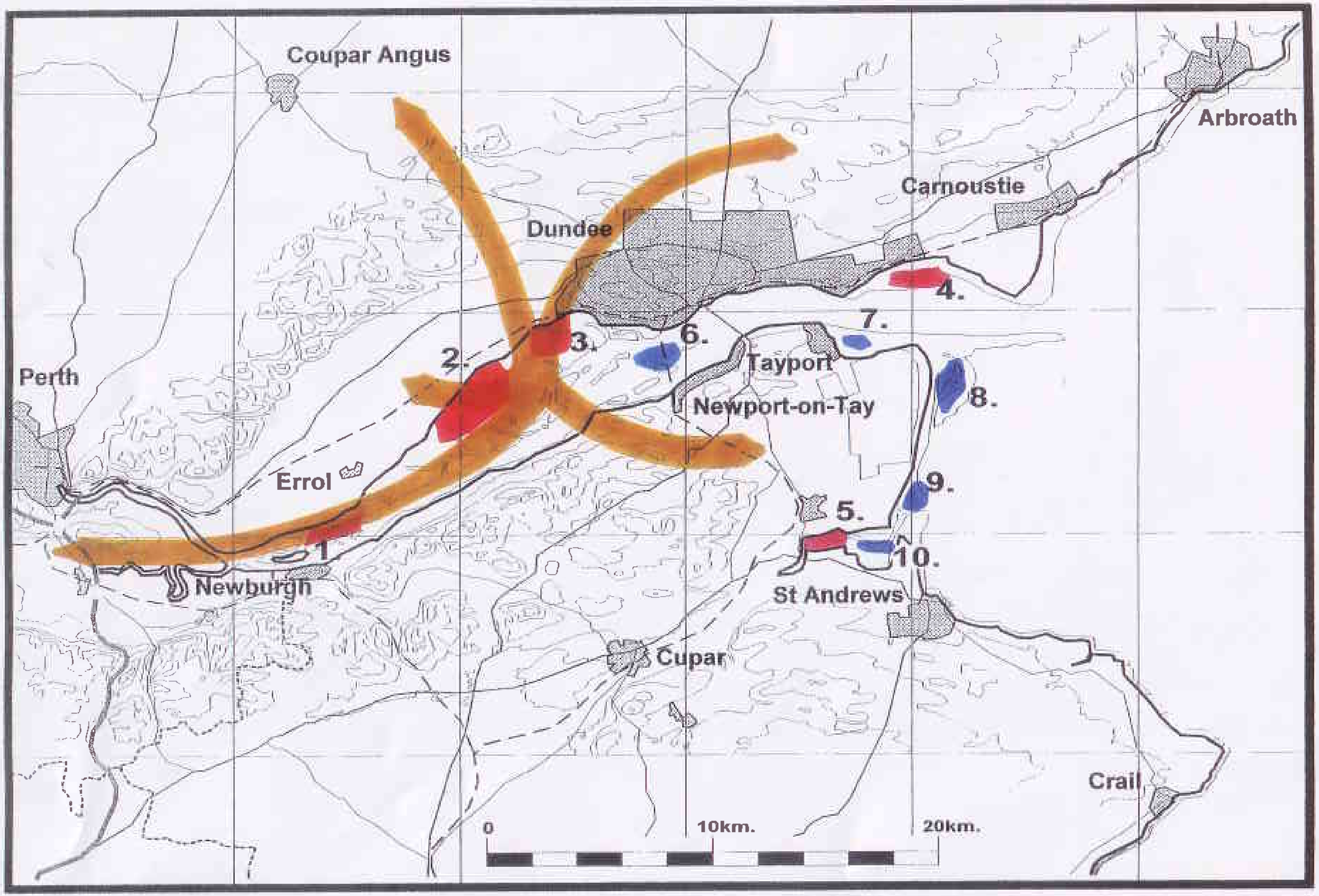

LEGEND

Main Roosts

1. Port Allen
2. Seaside
3. Invergowrie Bay
4. Monifieth Bay
5. Edenside

Subsidiary Roosts

6. Railway Bridge
7. Taport Bay
8. Tentsmuir Point
9. Goose Pool
10. Balgove Bay

Main roost dispersal to feeding grounds

NB. Greylags stay within the estuary & feed @ Newburgh Marsh.

SITES OF ROOSTS OF GEESE ON THE FIRTH OF TAY

MAP 07

AC33

Our Ref: EA/2009/1223
Your Ref: N.1.5/DS/KW

If telephoning ask for:
Julia Garritt
DD: 01738 448801

Angus Council
Planning and Transport
County Buildings,
Market Street,
Forfar
Angus
DD8 3LG.

For the attention of Dave Scott

16 January 2009

Dear Sir,

TOWN & COUNTRY PLANNING (SCOTLAND) ACT 1997
ENVIRONMENTAL IMPACT ASSESSMENT (SCOTLAND) REGULATIONS 1997
PROPOSED SCOPING OPINION, WIND FARM DEVELOPMENT, FRAWNEY, NETHER FINLARG, KINCALDRUM
APPLICATION NUMBER: N.1.5/DS/KW (FRAWNEY LAND HOLDINGS LTD)
NATIONAL GRID REFERENCE: NO 41717 41820

Thank you for your consultation in respect of the above, which SEPA received on 15 December 2008.

There are a number of key areas which must be addressed in the Environmental Statement regarding issues which fall within SEPA's remit. These are:

Pollution Prevention Measures
It is the responsibility of the developer to assess their site, identify all potential sources of pollution and detail mitigation measures in the environmental statement. However, the key areas of potential pollution typically related to wind farm construction are by siltation of surface water from road construction and subsequent erosion, fuel storage and management, and foul effluent disposal.

SEPA produces a series of Pollution Prevention Guidelines, available on the SEPA website at www.sepa.org.uk/water/groundwater/policy,_legislation__guidance/planning.aspx. SEPA would seek that the principles contained within these PPG notes are incorporated into the environmental statement.

Details of all proposed discharges should be provided in the environmental statement, including disposal of surface water from any proposed treatment facilities. SEPA's preferred method of treating and disposing of surface water is through the use of SUDS (Sustainable Urban Drainage Systems), details of which are available in the SUDSWP/CIRIA design manual for sustainable urban drainage systems (SUDs) – available to download at www.ciria.org/downloads.htm. SEPA would seek that these measures are incorporated into the proposed mitigation measures at this site.

Method statements and contingency plans should be produced for all aspects of the development liable to effect the environment. It is important that all staff working on the site are aware of these plans are appropriately trained. SEPA's Dundee & Angus Environmental Protection and

Improvement Team should be given the opportunity to comment on these at a draft stage to ensure best practise is proposed. They can be contacted as below.

All private water supplies within the catchment should be identified and measures taken to ensure protection of these supplies from pollution. Contact should be made with Angus Council's Environmental Health Department regarding this issue.

Proposed methods of disposing of foul effluent at the site should be laid out in the environmental statement, taking account of SEPA's Pollution Prevention Guidelines 4 *'Disposal of sewage where no mains drainage is available'*.

Roads and Crane Hardstanding Construction
Details of the proposed methods of road construction should be included, with consideration being given to ways of minimising impact. Relevant guidance is provided by the Forest and Water Guidelines (4th Edition), available at www.forestry.gov.uk/pdf/FCGL002.pdf/$FILE/FCGL002.pdf.

Hydrology
Potential impacts on hydrology must be addressed within the environmental statement. These may include impacts on watercourses and any change to potential flood risk in the catchment caused by modifications to the drainage from the proposed works.

SEPA is generally opposed to the culverting of watercourses. It is therefore important that there is no intention to culvert any of the burns within the development area. However, it is recognised that sometimes road crossings of burns will be necessary, and bridge crossings should be considered in preference to culverts.

SEPA may hold relevant hydrological information relating to rainfall levels. Contact should be made with SEPA's local hydrology team on 01738 627989 regarding this matter.

Waste
SEPA encourages the recovery and reuse of waste such as soil provided that it is in accordance with the Waste Management Licensing Regulations 1994 (as amended). There are specific criteria which, if met, will constitute an exemption under the above Regulations. These exemptions are required to be registered by SEPA and the details must be forwarded to our Dundee & Angus office. Further details can be found on SEPA's website at www.sepa.org.uk/waste/waste_publications/policy_guidance.aspx

The development should include construction practices to minimise the use of raw materials and maximise the use of secondary aggregates and recycled or renewable materials. Waste material generated by the development should also be reduced and, where appropriate, re-used or recycled on site. The Environmental Statement should address these aspects.

Air Quality
The use of borrow pits will not normally involve quarrying and grading processes as defined under the terms of the Environmental Protection Act 1990 and requiring authorisation from SEPA. However, the applicants or their contractors will have to clarify precisely what is intended, particularly in respect of any plant that may be used. Mobile plant would either be authorised by SEPA or by the appropriate authority at its place of origin.

Ecological Impact Assessment

The Institute of Ecology and Environmental Management has produced guidance in relation to the scope of ecological assessment necessary to support such developments and this is available on the IEEM website at http://www.ieem.org.uk/ECIA.htm . The applicant should provide a sufficient level of information in this respect and should take account of any seasonal variability which might impact on the field-survey programming.

SEPA contact information
If the applicant has any queries in respect of these matters, they are welcome to consult with SEPA's Dundee & Angus Environmental Protection and Improvement team (tel: 01241 874370).

Yours faithfully

Julia Garritt
Acting Senior Planning Officer

Cc: SEPA D&A EPI team, by e-mail

Appendix 5-1: Calculation parameters and noise data

Site Name	*Frawney Wind Farm Height Extension*	
Checklist for key points for inclusion in a wind turbine assessment report		**Reference within Report**
Consultations	Consultation with Local Planning Authority	Section 5.2.2
	EHO input into selection of Background Noise Monitoring Locations	Section 5.2.2
Background Measurements	Number of monitoring locations; map	Sections 5.2.2 & 5.3.1 Figure 5-1
	Description of monitoring locations	Section 5.2.5
	Monitoring period	Section 5.2.5
	Description of noise measurement equipment	Section 5.2.5
	Certification / Calibration of all equipment used and any calibration drift	Appendix 5-2
	Wind (speed and direction) and rainfall measurement data sources	Section 5.2.5
Noise Predictions	Prediction methodology	Section 5.4.1
	Candidate turbine model	Section 5.4.1
	Turbine source noise data, including noise-reduced modes if used & octave band levels	Section 5.4.1. & Appendix 5-1
	Description of noise propagation and attenuation factors	Section 5.4.1
	Atmospheric attenuation – assumed temperature and relative humidity	Section 5.4.1
	Ground effects – assumed ground factor	Section 5.4.1
	Assumed receiver height; barrier attenuation	Section 5.4.1
	Wind direction filtering (if considered)	Not considered
	Noise contours	Figures 5-2, 5-3 and 5-4
Assessment	Wind shear assessment method	Section 5.4.1
	Derivation of prevailing background noise	Section 5.2.5 & Appendix 5-3
	Type, order and coefficients of regression line; scatter data shown on plots	Appendix 5-3
	Derivation of noise limits and numerical values	Section 5.4.1
	Amenity noise limit; justification for amenity noise limit if chosen	Section 5.4.1
	Night-time noise limit; financial involvement	Section 5.4.1
	Capping of noise limits at highest wind speed measured	Not required
	Comparison of predicted noise level with derived noise limits	Section 5.4.1
	Correction from LAeq to LA90	Section 5.4.1
	Potential tonal content	None
	Properties covered by assessment	Section 5.2.6 & Figure 5-1
	Incorporated mitigation (turbines running in low noise mode, if relevant)	Not required
	Cumulative issues	Section 5.5

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Site name	FRAWNEY
Atmos site number	4603

Baseline Measurements Locations

Baseline monitoring locations	Location ID	X	Y	Name
	M01	341557	741360	Over Finlarg
	M03	342652	741777	Nether Finlarg
	M04	342334	743324	Govals Cottage

Derived background noise	Location ID	Formula
Amenity hours	M01	$y = -0.033x^3 + 0.8562x^2 - 4.3153x + 39.214$
	M03	$y = 0.2256x^2 - 1.7391x + 37.988$
	M04	$y = 0.0052x^3 + 0.1232x^2 - 1.0788x + 34.155$
Night-time	M01	$y = -0.0224x^3 + 0.5694x^2 - 1.2737x + 25.097$
	M03	$y = 0.0854x^2 + 0.9626x + 23.168$
	M04	$y = 0.0713x^2 + 1.2356x + 22.082$

Assessment Locations

Name	Location ID	X	Y	L90 ID
Govals	NSR001	342320	743311	Govals Cottage
Govals Cottage	NSR002	340441	741539	Govals Cottage
Lumleyden	NSR003	342702	742003	n/a
1 to 4 Farm Cottages - Nether Finlarg	NSR004	342630	741814	Nether Finlarg
Nether Finlarg Farmhouse	NSR005	341446	741348	Nether Finlarg
Over Finlarg (bungalow)	NSR006	341538	741390	Over Finlarg
Over Finlarg (old farmhouse)	NSR007	341445	741105	Over Finlarg
1 & 2 Farm Cottage - Over Finlarg	NSR008	341393	741367	Over Finlarg
Over Finlarg (new farmhouse)	NSR009	342320	743311	Over Finlarg

Calculations

Noise propagation	Model	ISO9613
	Software	CadnaA ver 4.2.141
	Temp	10°C
	Humidity	70%
	Ground factor	G=0.5
	Barriers	No structural barriers. Flat earth modelling.
	Receptor height	4m

Meteorology	Wind direction	All receptors assumed to be downwind					
	Wind shear	2 year historical data (30m & 50m). *M values for wind speed bins and time periods calculated and used to shift turbine SWL values.*					
		5	6	7	8	9	10
	Quiet Daytime *m*	0.23	0.22	0.20	0.18	0.17	0.14
	Night-time *m*	0.27	0.26	0.23	0.20	0.18	0.15
	Rain	All periods of rainfall excluded					

Noise source data

Turbine manufacturer	Enercon
Turbine type	E70
Power rating	2.3M
Operational mode	MODE 2

Warranty	Yes		
Broadband noise source	SIAS-04-SPL E-70 E4 OM II 2_3MW Rev1_0-eng-eng.doc and Test Report 049SE206/01, (Sch/03.2010).		
Broadband noise levels	**Wind speed (m/s)**	**SWL dBA**	**Uncertainty**
	5	93.6	1
	6	98.5	1
	7	101.3	1
	8	102.9	1
	9	104.5	1
	10	104.5	1
Octave band noise source	Wind-Consult Test Report 049SE206/01		
Tonality	KTN ≤ 2 dB.	No penalty required	
Noise limits - non financially involved	Daytime hours	35dB lower level limit	
	Night-time hours	43dB lower level limit	
Noise limits - financially involved	Amenity hours	45dB lower level limit	
	Night-time hours	45dB lower level limit	

Appendix 5-2: Calibration Certificates

AC33

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	Sound Level Meter
Model Number	CR:171B
Serial Number	G056911

Calibration Procedure

The instrument detailed above has been calibrated to the published test and calibration data as detailed in the instrument handbook, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. Which are traceable to the appropriate International Standards.

The Cirrus Research plc calibration laboratory standards are:

Microphone Type	B&K4180	Serial Number 1893453	Calibration Ref. S 6009
Pistonphone Type	B&K4220	Serial Number 613843	Calibration Ref. S 5964

Calibrated by [redacted]

Calibration Date

Calibration Certificate Number 190617

This Calibration Certificate is valid for 18 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	Acoustic Calibrator
Model Number	CR:515
Serial Number	57445

Calibration Procedure

The acoustic calibrator detailed above has been calibrated to the published data as described in the operating manual. The procedures and techniques used to follow the recommendations of the IEC standard Electroacoustics – Sound Calibrators IEC 60942:2003, IEC 60942:1997, BS EN 60942:1998 and BS EN 60942:2003 where applicable.. The calibrator's main output is 94.00 dB (1 Pa) and this was set within the 0.01 dB resolution of the test system, i.e. one hundredth of a decibel. Numbers in {parenthesis} refer to the paragraph in IEC 60942.

Calibration Traceability

The calibrator above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	B&K4180	Serial Number 1893453	Calibration Ref. S 6009
Pistonphone Type	B&K4220	Serial Number 613843	Calibration Ref. S 5964

Calibration Climate Conditions

The climatic test conditions were all maintained within the permitted limits of IEC 60942:1997.

Temperature	{B.3.2}	Permitted band 15°C to 25°C
Humidity	{B.3.2}	Permitted band 30% to 90% RH
Static Pressure	{B.3.2}	Permitted band 85 kPa to 105 kPa
Ambient Noise Level	{B.3.3.6}	Max permitted level 64 dB(Z)

Measurement Results

The figures below are the Calibration Laboratory test limits for this model calibrator and have a smaller tolerance than those permitted in IEC 60942.

94 dB Output	94.00	dB	Permitted band 93.95 to 94.05dB
Frequency	1000	Hz	Permitted band 990 to 1010Hz

Uncertainty

With an uncertainty coefficient of k=2, i.e. a 95% confidence level, the uncertainty of each measure is

94 dB Output	± 0.13 dB	104 dB Output	± 0.14 dB
Frequency	± 0.1 Hz	Level Stability	± 0.04 dB

Calibrated by [redacted]

Calibration Date 04 October 2011

Calibration Certificate Number 190618

This Calibration Certificate is valid for 18 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

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Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	Sound Level Meter
Model Number	CR:171B
Serial Number	G056908

Calibration Procedure

The instrument detailed above has been calibrated to the published test and calibration data as detailed in the instrument handbook, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. Which are traceable to the appropriate International Standards.

The Cirrus Research plc calibration laboratory standards are:

Microphone Type	B&K4180	Serial Number	1893453	Calibration Ref.	S 6009
Pistonphone Type	B&K4220	Serial Number	613843	Calibration Ref.	S 5964

Calibrated by [redacted]

Calibration Date [redacted]

Calibration Certificate Number 190615

This Calibration Certificate is valid for 18 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	Acoustic Calibrator
Model Number	CR:515
Serial Number	57446

Calibration Procedure

The acoustic calibrator detailed above has been calibrated to the published data as described in the operating manual. The procedures and techniques used to follow the recommendations of the IEC standard Electroacoustics – Sound Calibrators IEC 60942:2003, IEC 60942:1997, BS EN 60942:1998 and BS EN 60942:2003 where applicable.. The calibrator's main output is 94.00 dB (1 Pa) and this was set within the 0.01 dB resolution of the test system, i.e. one hundredth of a decibel. Numbers in {parenthesis} refer to the paragraph in IEC 60942.

Calibration Traceability

The calibrator above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	B&K4180	Serial Number	1893453	Calibration Ref.	S 6009
Pistonphone Type	B&K4220	Serial Number	613843	Calibration Ref.	S 5964

Calibration Climate Conditions

The climatic test conditions were all maintained within the permitted limits of IEC 60942:1997.

Temperature	{B.3.2}	Permitted band 15°C to 25°C
Humidity	{B.3.2}	Permitted band 30% to 90% RH
Static Pressure	{B.3.2}	Permitted band 85 kPa to 105 kPa
Ambient Noise Level	{B.3.3.6}	Max permitted level 64 dB(Z)

Measurement Results

The figures below are the Calibration Laboratory test limits for this model calibrator and have a smaller tolerance than those permitted in IEC 60942.

94 dB Output	94.00	dB	Permitted band 93.95 to 94.05dB
Frequency	1000	Hz	Permitted band 990 to 1010Hz

Uncertainty

With an uncertainty coefficient of k=2, i.e. a 95% confidence level, the uncertainty of each measure is

94 dB Output	± 0.13 dB	104 dB Output	± 0.14 dB
Frequency	± 0.1 Hz	Level Stability	± 0.04 dB

Calibrated by [redacted]

Calibration Date 04 October 2011

Calibration Certificate Number 190616

This Calibration Certificate is valid for 18 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

Appendix 5-3: Baseline Noise Regression Analysis

Chart 5-1:
M01 Over Finlarg. Background noise regression analysis - Amenity Hours.

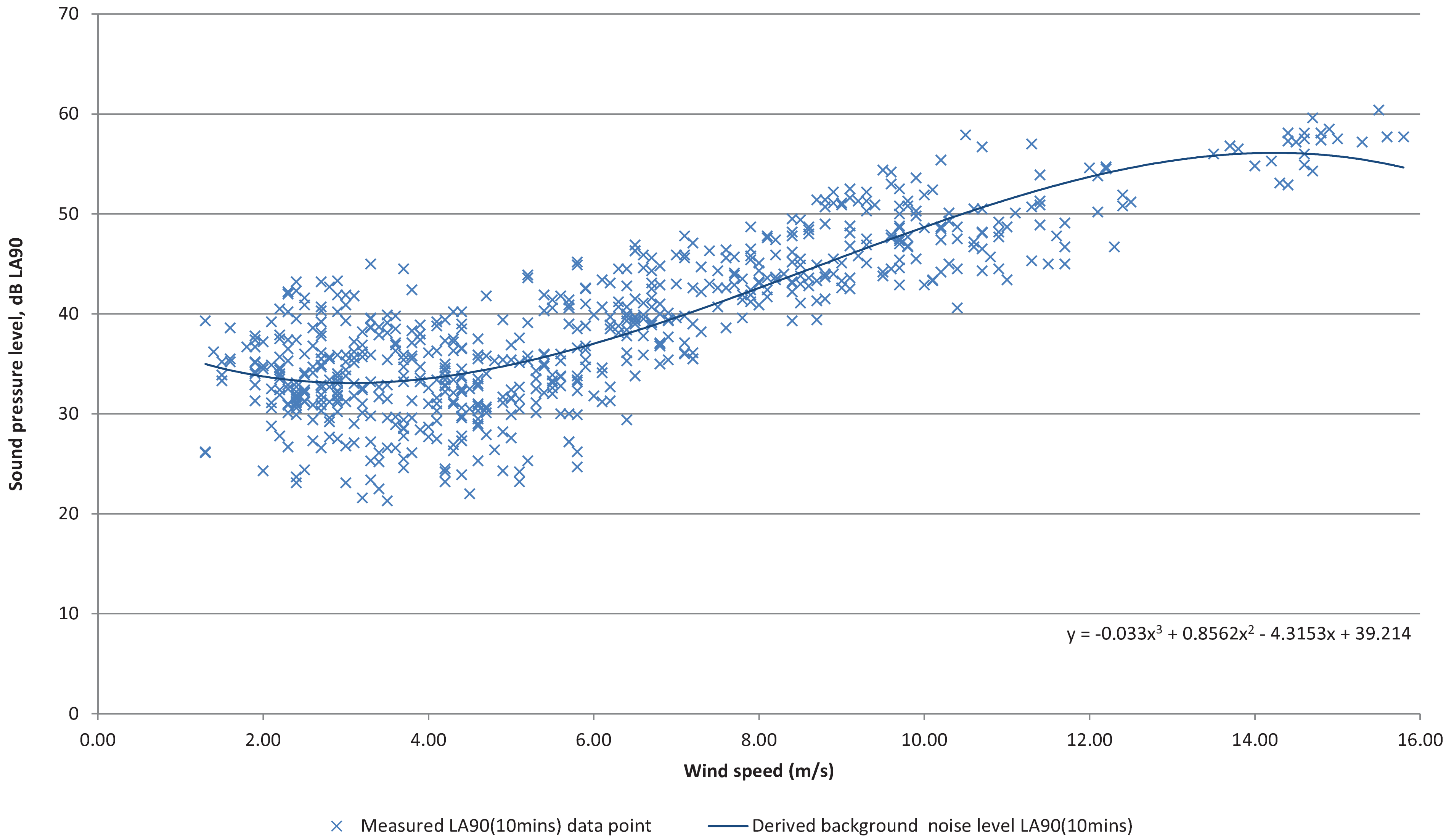

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Chart 5-2:
M01 Over Finlarg. Background noise regression analysis - Night-time Hours.

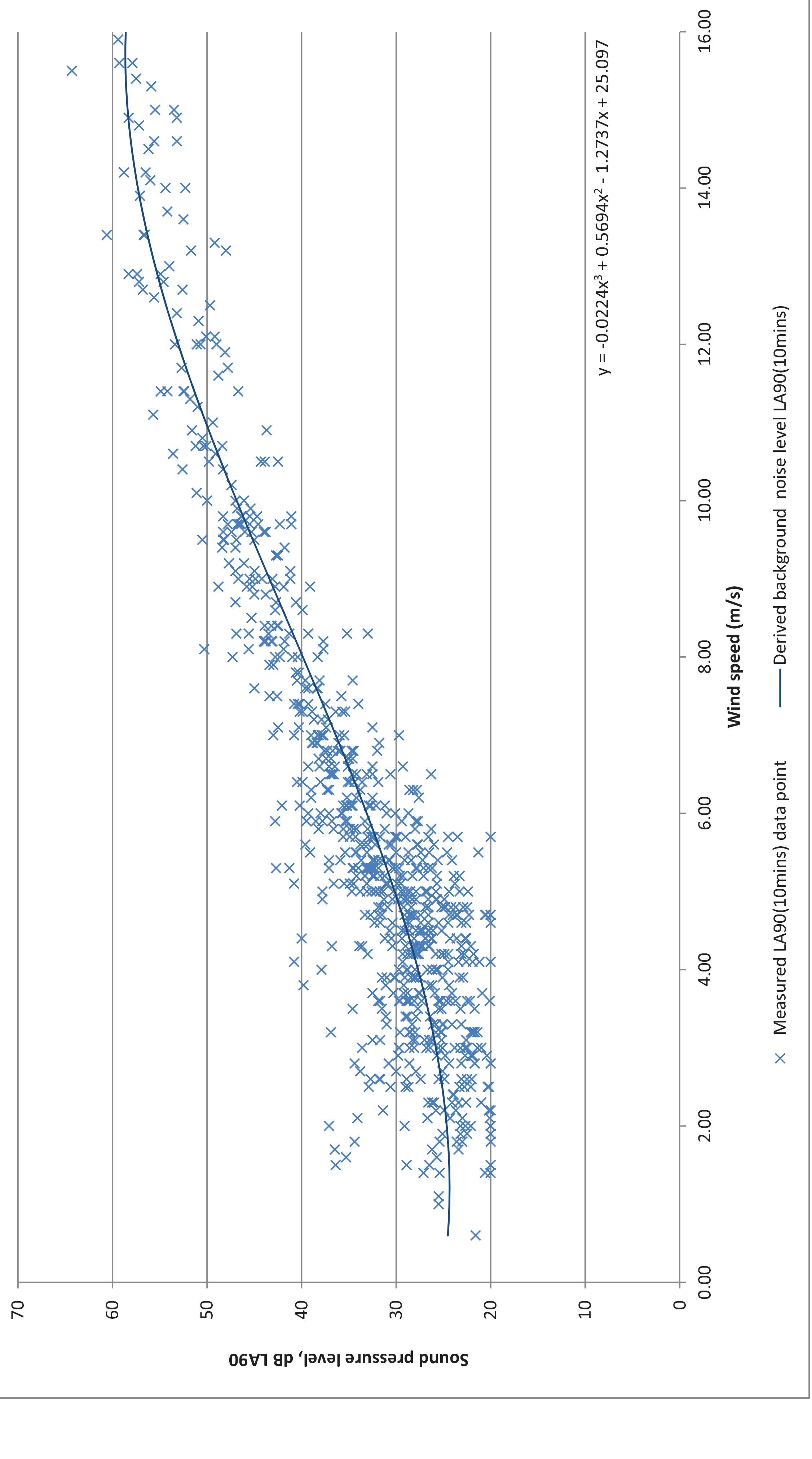

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Chart 5-3:
M03 Nether Finlarg. Background noise regression analysis - Amenity Hours.

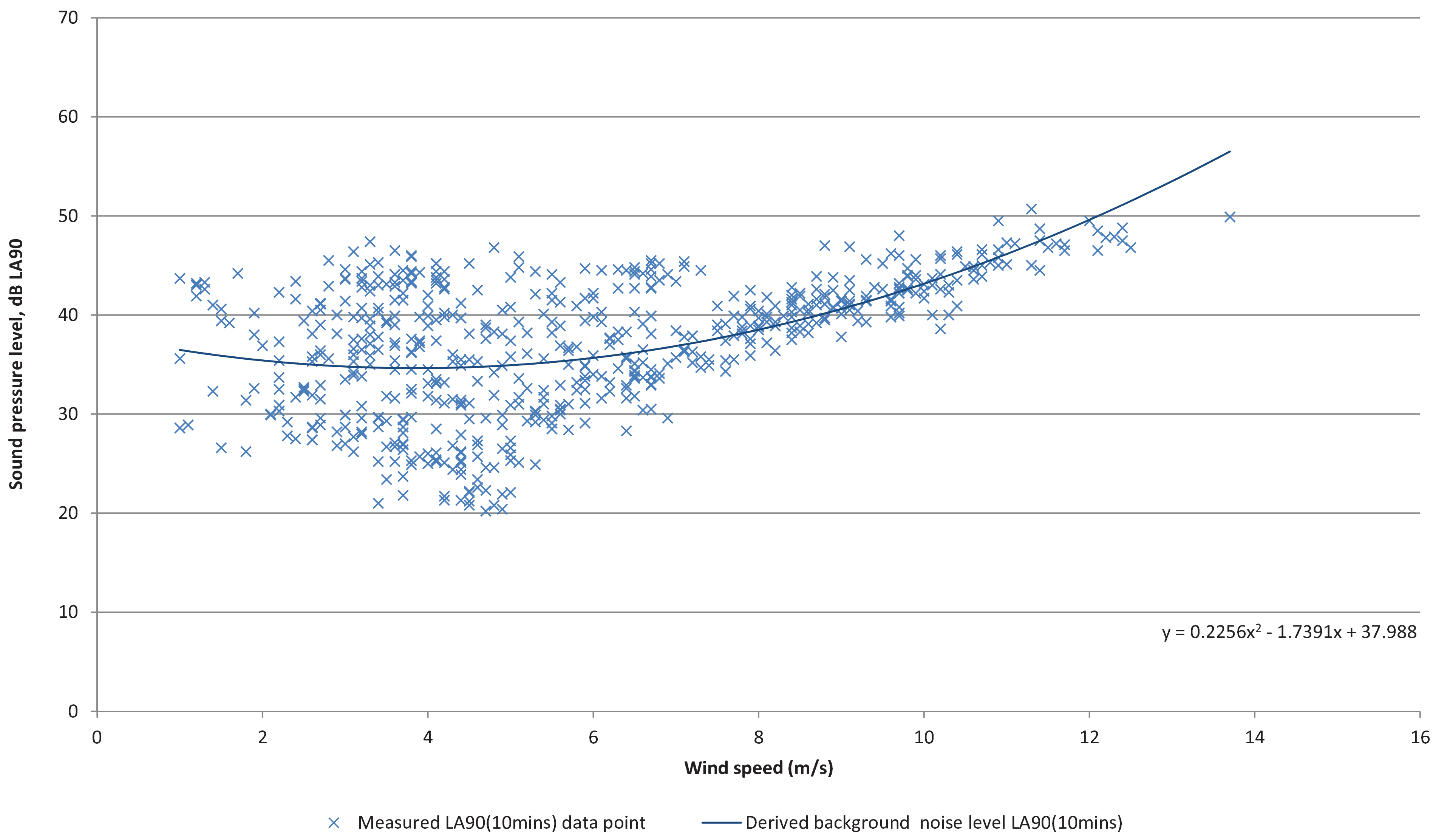

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Chart 5-4:
M03 Nether Finlarg. Background noise regression analysis - Night-time Hours.

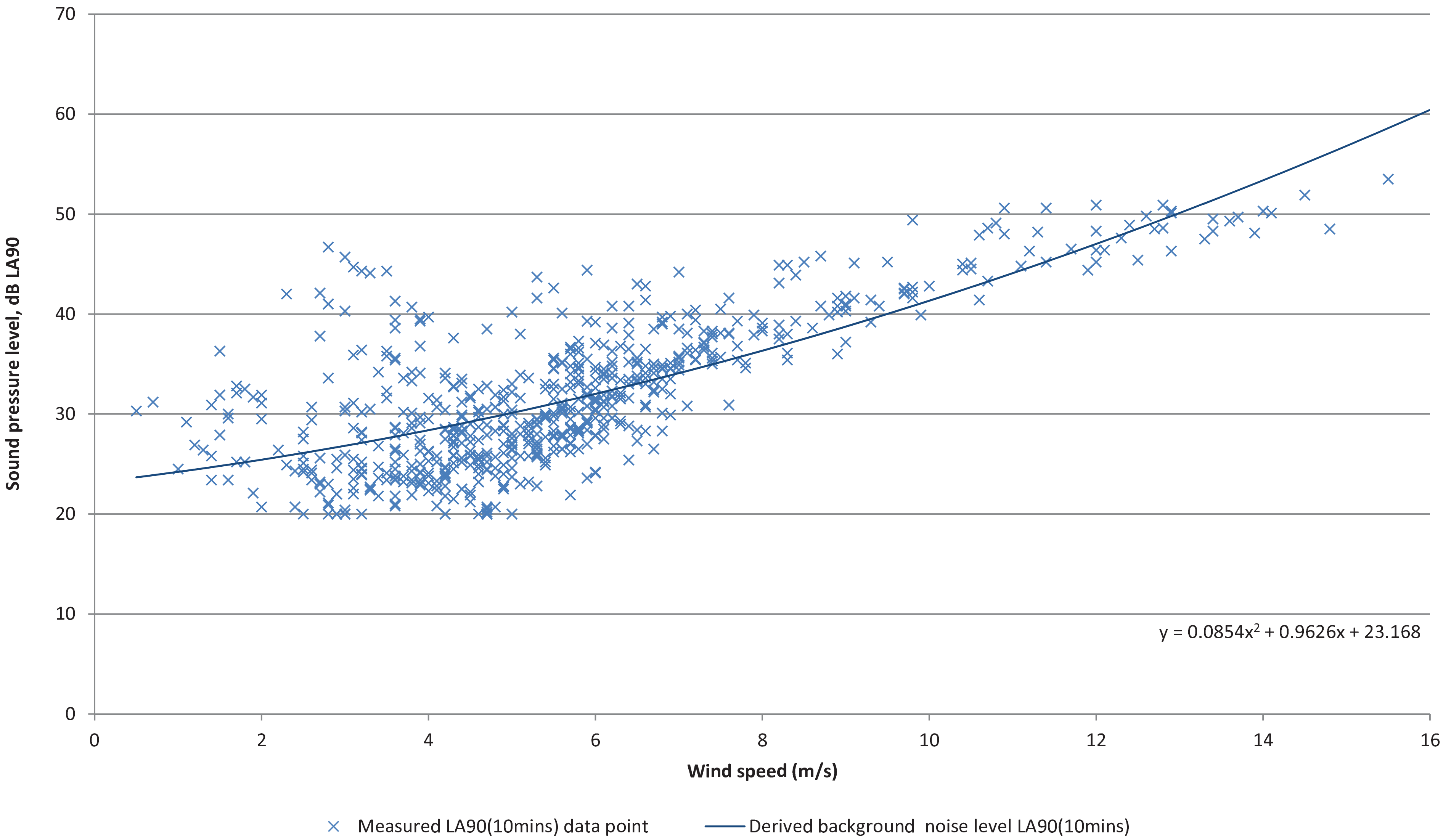


Chart 5-5:
M04 Govals Cottage. Background noise regression analysis - Amenity Hours.

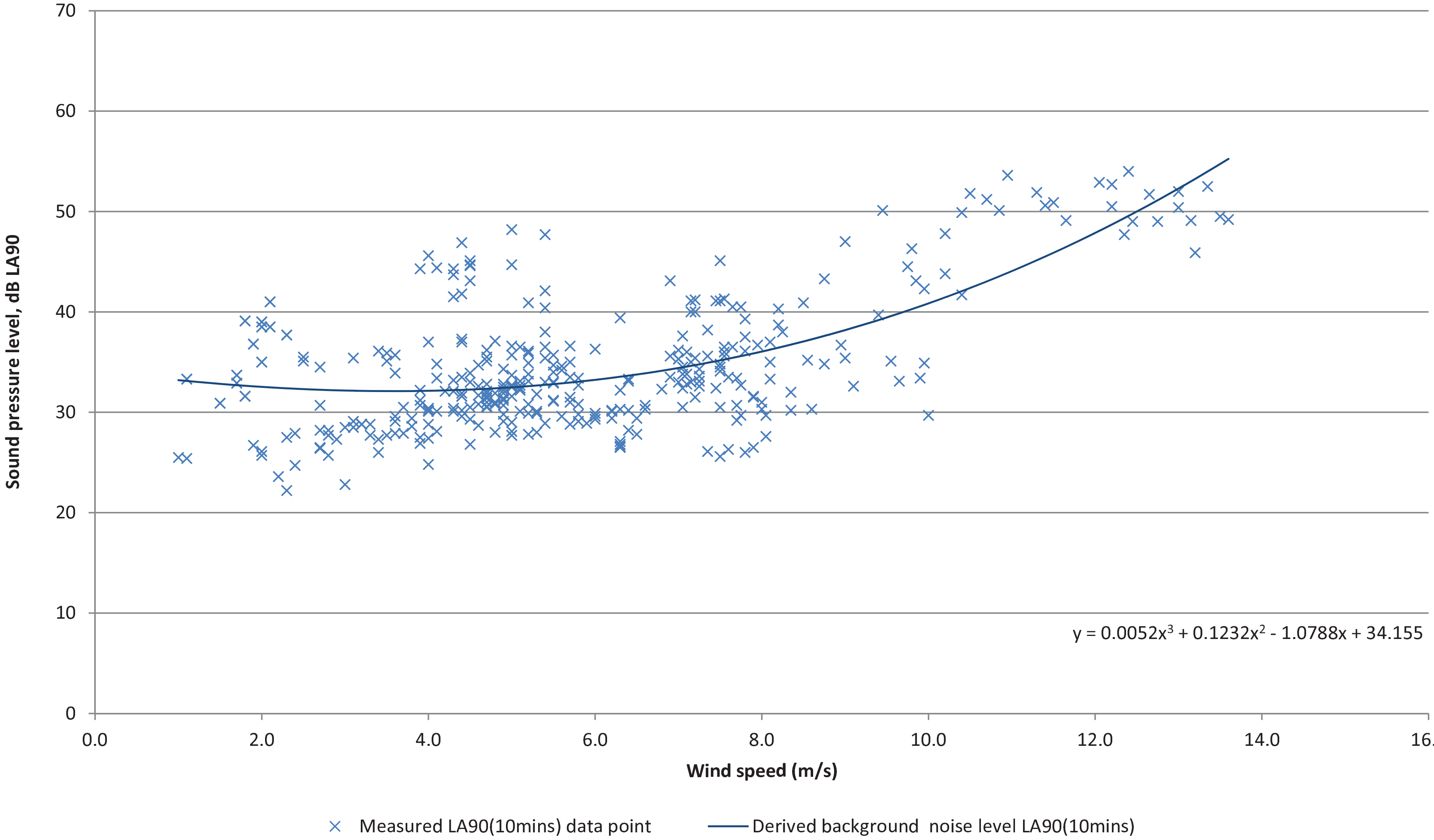
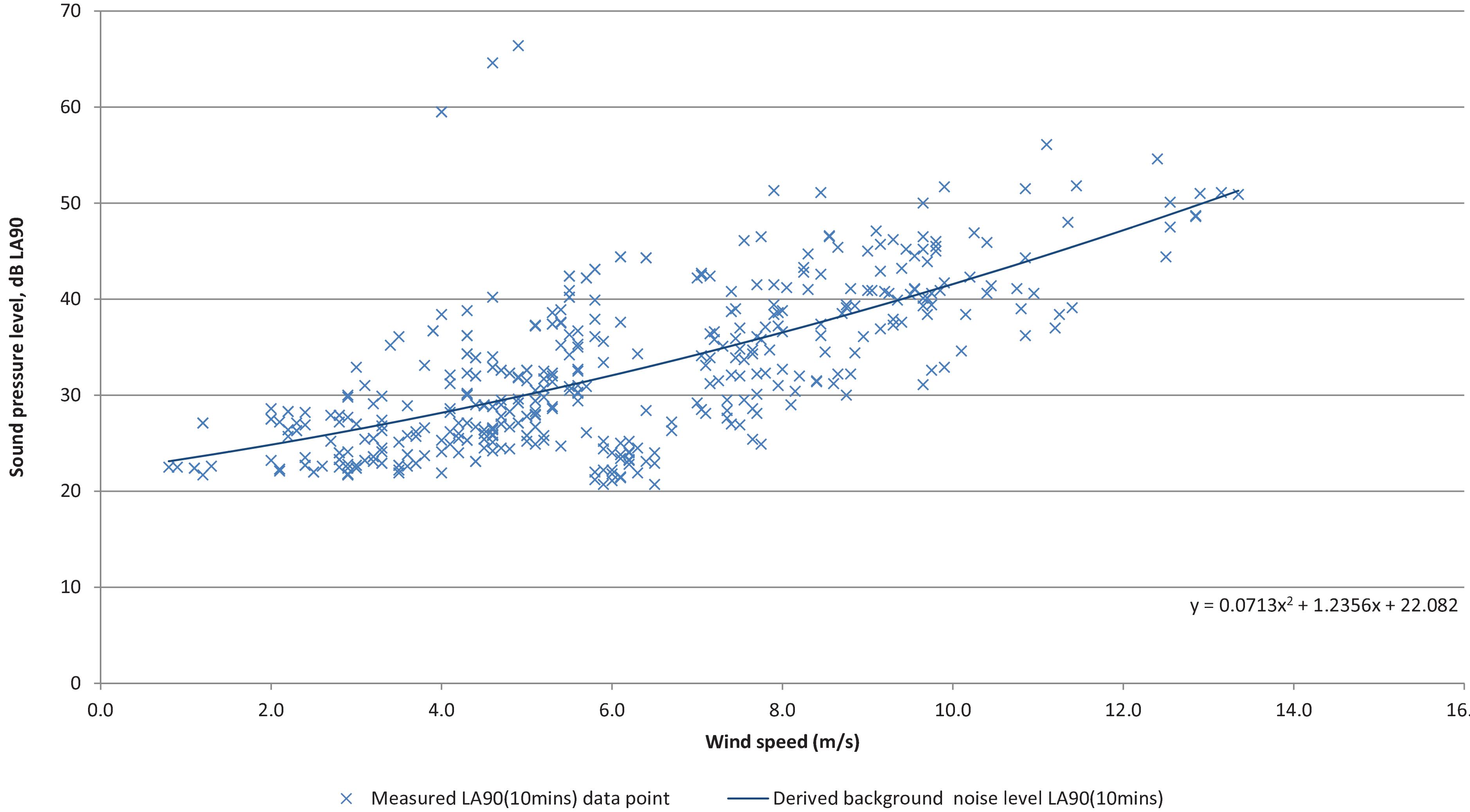


Chart 5-6:
M04 Govals Cottage. Background noise regression analysis - Night-time Hours.



Appendix 5-4 Source noise level data (turbines)

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Sound Power Level

of the

ENERCON E-70 E4

Operational Mode II

(Data Sheet)

Imprint

Publisher: ENERCON GmbH ▪ Dreekamp 5 ▪ 26605 Aurich ▪ Germany
Phone: +49 4941 927-0
Fax: +49 4941 927-109

Content subject to change: ENERCON GmbH reserves the right to change, improve and expand this document and the subject matter described herein at any time without prior notice.

Revision

Revision: 1.0

Department: ENERCON GmbH / Site Assessment

Glossary

WEC means an ENERCON wind energy converter.

WECs means more than one ENERCON wind energy converter.

Sound Power Level for the E-70 E4 Operational Mode II with 2300 kW rated power

in relation to standardized wind speed v_S at 10 m height					
hub height / V_s in 10 m height	58	64	85	99	113
5 m/s	93.6 dB(A)	93.6 dB(A)	94.1 dB(A)	94.6 dB(A)	95.1 dB(A)
6 m/s	98.5 dB(A)	98.8 dB(A)	99.7 dB(A)	100.0 dB(A)	100.3 dB(A)
7 m/s	101,3 dB(A)	101,4 dB(A)	101,6 dB(A)	101,7 dB(A)	101,9 dB(A)
8 m/s	102.9 dB(A)	103.1 dB(A)	103.5 dB(A)	103.7 dB(A)	103.8 dB(A)
9 m/s	104.5 dB(A)	104.5 dB(A)	104.5 dB(A)	104.5 dB(A)	104.5 dB(A)
10 m/s	104.5 dB(A)	104.5 dB(A)	104.5 dB(A)	104.5 dB(A)	104.5 dB(A)
95% rated power	104.5 dB(A)	104.5 dB(A)	104.5 dB(A)	104.5 dB(A)	104.5 dB(A)

Measured value at 95% rated power		*104,0 dB(A)* *WICO 141SE707/02* *104,1 dB(A)* *Busch135208gs01*		*104,4 dB(A)* *WICO 314SEA05/01*	

in relation to wind speed at hub height									
wind speed at hub height [m/s]	7	8	9	10	11	12	13	14	15
Sound Power Level [dB(A)]	94.3	98.8	100.7	101.8	103.4	104.0	104.3	104.5	104.5

1. The relation between the sound power level and the standardized wind speed v_S in 10 m height as shown above is valid on the premise of a logarithmic wind profile with a roughness length of 0.05 m. The relation between the sound power level and the wind speed at hub height applies for all hub heights. During the sound measurements the wind speeds are derived from the power output and the power curve of the WEC.
2. A tonal audibility of $\Delta L_{a,k} \leq 2$ dB can be expected over the whole operational range (valid in the near vicinity of the turbine according to IEC 61 400 -11 ed. 2).

3. The sound power level values given in the table are valid for the **Operational Mode II** (defined via the rotational speed range of 6 – 21 rpm). The respective power curve is the calculated power curve E-70 E4 2,3MW dated May 2005 (Rev. 1.x).
4. The values displayed in the tables above are based on official and internal measurements of the sound power level. If available the official measured values are given in this document as a reference (in italic print). The extracts of the official measurements can be made available upon request. The values given in the measurement extracts do not replace the values given in this document. All measurements have been carried out according to the recommended German and international standards and guidelines as defined in the measurement reports, respectively.
5. Due to the typical measurement uncertainties, if the sound power level is measured according to one of the accepted methods the measured values can differ from the values shown in this document in the range of +/- 1 dB.

   Accepted measurement methods are:

   a) IEC 61400-11 ed. 2 („Wind turbine generator systems – Part 11: Acoustic noise measurement techniques; Second edition"), and

   b) the FGW-Guidelines („Technische Richtlinie für Windenergieanlagen – Teil 1: Bestimmung der Schallemissionswerte", published by the association "Fördergesellschaft für Windenergie e.V.", 18th revision).

   If the difference between total noise and background noise during a measurement is less than 6 dB a higher uncertainty must be considered.
6. For noise-sensitive sites it is possible to operate the E-70 E4 with reduced rotational speed and reduced rated power during night time. The sound power levels resulting from such operational mode can be provided in a separate document upon request.
7. The sound power level of a wind turbine depends on several factors such as but not limited to regular maintenance and day-to-day operation in compliance with the manufacturer's operating instructions. Therefore, this data sheet can not, and is not intended to, constitute an express or implied warranty towards the customer that the E-70 E4 WEC will meet the exact sound power level values as shown in this document at any project specific site.

Extract II of test report

Master Information „Noise“, according to “Wind turbine generator systems - Part 11: Acoustic noise measurement techniques.”

IEC 61400-11 ED. 2 from 2002 (published by: Central Office of the IEC, Geneva, Switzerland)

Extract of test report 049SE206/01 regarding noise emission of wind turbine (WT)

type ENERCON E-70 E4 2.3 MW (Mode II), hub height 58 m

General			**Technical specifications (manufacturer)**	
Manufacturer:	**ENERCON GmbH** **Dreekamp 5** **D-26605 AURICH**		**Rated power (generator):** **Rotor diameter:** **Hub height above ground:**	**2300 kW** **71.0 m** **58.0 m**
Serial number:	**702320**		**Tower design:**	**Tubular steel tower**
WT-location:	**WF Holtriem**	**GK RW 25.94.632** **GK HW 59.43.726**	**Power control:**	**pitch/stall/active-stall**

Complementations of rotor (manufacturer)		**Complementations of gear and generator (manufacturer)**	
Manufacturer of rotor blades	**ENERCON GmbH**	**Manufacturer of gear:**	**No**
Type of blades:	**70-4**	**Type of gear:**	**No**
Pitch angle:	**variabel**	**Manufacturer of generator:**	**ENERCON GmbH**
Number of blades	**3**	**Type of generator:**	**E-70**
Rated speed(s)/speed range:	**6 – 21 min^{-1} (Mode II)**	**Rated speed(s):**	**6 – 21 min^{-1} (Mode II)**

Report power curve: power curve calculated by the manufacturer (Mode II, Rev. 1,0) date: 23.05.2005

	Reference		**Noise emission parameter**	**Remarks**
	Standardized wind speed at 10 m above ground	Electric power		
Sound power level L_{WA}	6 ms^{-1} 7 ms^{-1} 8 ms^{-1} 9 ms^{-1} 10 ms^{-1}	614 kW 982 kW 1441 KW 1876 kW 2117 KW	97.5 dB(A) 99.7 dB(A) 101.9 dB(A) 103.5 dB(A) 104.3 dB(A)	1)
Tonal components ΔL_a (near proximity)	6 ms^{-1} 7 ms^{-1} 8 ms^{-1} 9 ms^{-1} 10 ms^{-1}	614 kW 982 kW 1441 KW 1876 kW 2117 KW	No tone No tone No tone No tone No tone	1)

One third octave sound power level at reference point v_{10} = 6 m/s [dB(A)]

Frequency	50	63	80	100	125	160	200	250	315	400	500	630
L_{WA}	71.5	76.4	77.9	81.0	83.9	85.2	85.3	89.4	90.0	88.1	87.3	87.4
L_{WA}		80.8			88.5			93.4			92.4	
Frequency	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
L_{WA}	84.3	82.6	80.6	79.3	78.2	75.9	73.9	73.2	71.9	70.6	69.2	69.7
L_{WA}		87.5			82.8			77.8			74.6	

One third octave sound power level at reference point v_{10} = 7 m/s [dB(A)]

Frequency	50	63	80	100	125	160	200	250	315	400	500	630
L_{WA}	74.1	78.3	80.9	83.5	86.1	87.2	87.1	91.1	91.8	90.4	89.6	90.1
L_{WA}		83.4			90.6			95.2			94.8	
Frequency	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
L_{WA}	87.1	85.3	83.3	81.6	80.7	78.8	77.0	76.6	76.1	75.2	73.4	71.9
L_{WA}		90.3			85.3			81.4			78.5	

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One third octave sound power level at reference point v_{10} = 8 m/s [dB(A)]

Frequency	50	63	80	100	125	160	200	250	315	400	500	630
L_{WA}	75.8	80.2	83.8	87.4	89.8	90.3	89.5	93.0	93.5	91.5	90.8	91.4
L_{WA}	85.8			94.1			97.1			96.0		
Frequency	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
L_{WA}	89.3	89.2	87.8	86.2	85.2	82.9	79.9	77.8	75.5	73.1	71.1	70.1
L_{WA}	93.6			89.7			82.9			76.4		

One third octave sound power level at reference point v_{10} = 9 m/s [dB(A)]

Frequency	50	63	80	100	125	160	200	250	315	400	500	630
L_{WA}	77.4	80.5	83.2	86.6	89.5	92.0	90.9	94.5	95.6	94.3	93.7	93.8
L_{WA}	85.8			94.7			98.9			98.7		
Frequency	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
L_{WA}	90.9	89.2	87.3	85.9	84.7	82.8	80.9	80.5	79.7	78.5	76.7	74.8
L_{WA}	94.1			89.4			85.2			81.7		

One third octave sound power level at reference point v_{10} = 10 m/s [dB(A)]

Frequency	50	63	80	100	125	160	200	250	315	400	500	630
L_{WA}	78.3	82.6	86.2	89.6	91.9	93.6	92.1	95.3	95.5	93.3	92.5	93.4
L_{WA}	88.2			96.8			99.3			97.9		
Frequency	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
L_{WA}	91.6	92.0	91.1	89.8	88.2	86.1	83.1	81.3	78.7	75.5	73.3	72.1
L_{WA}	96.4			93.1			86.2			78.6		

1) Data basis is a measurement at a hub height of 99 m.

This extract of test report is valid only in connection with the enclosed „Manufacturer's certificate" from 2005-11-07.

This declaration does not replace above-mentioned report.

measured by: WIND-consult GmbH
Reuterstraße 9
D-18211 Bargeshagen

- PDF document was signed electronically -

[redacted]

date: 2006-03-14

Dipl.-Ing. A. Petersen Dipl.-Ing. J. Schwabe

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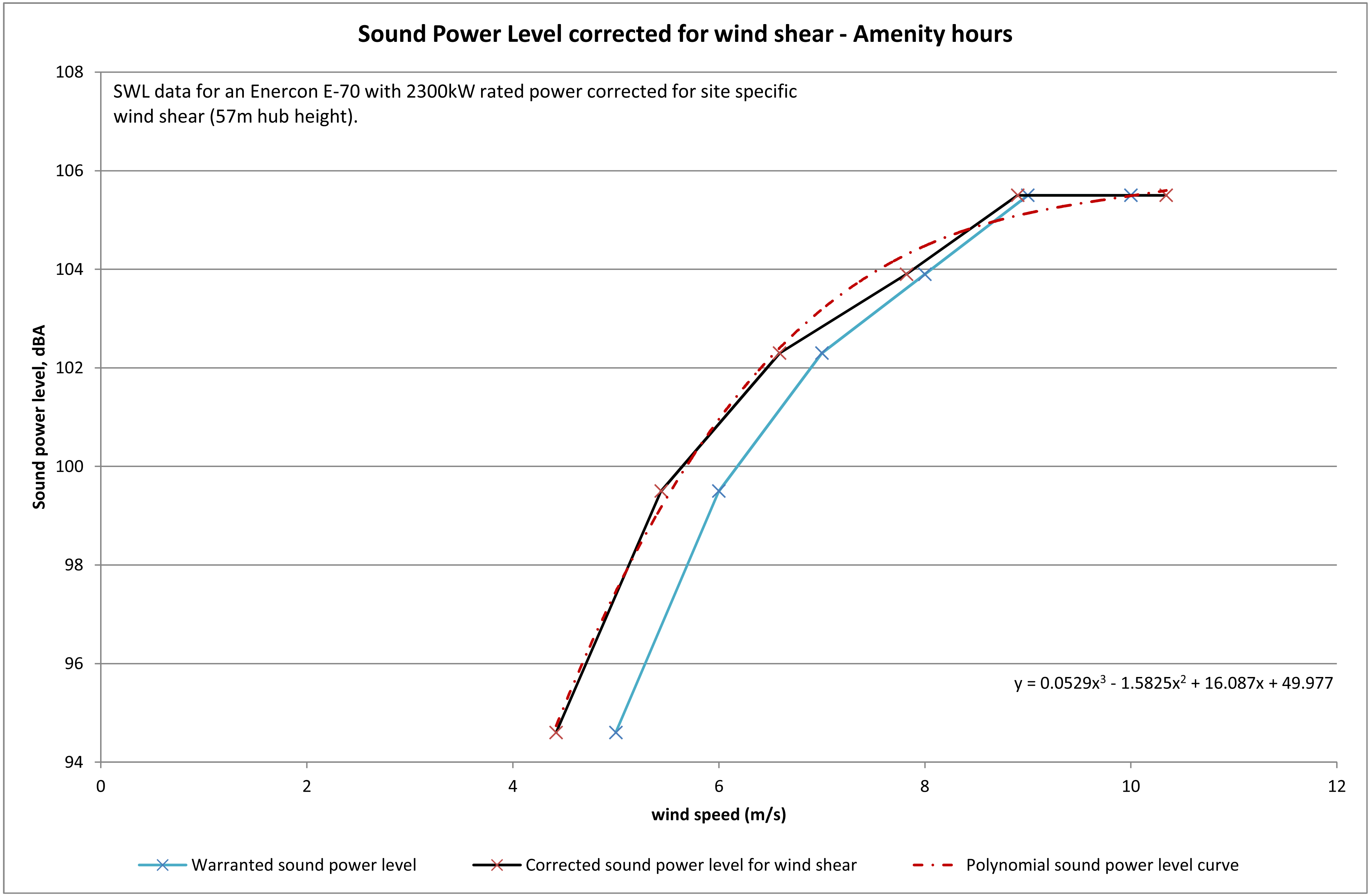
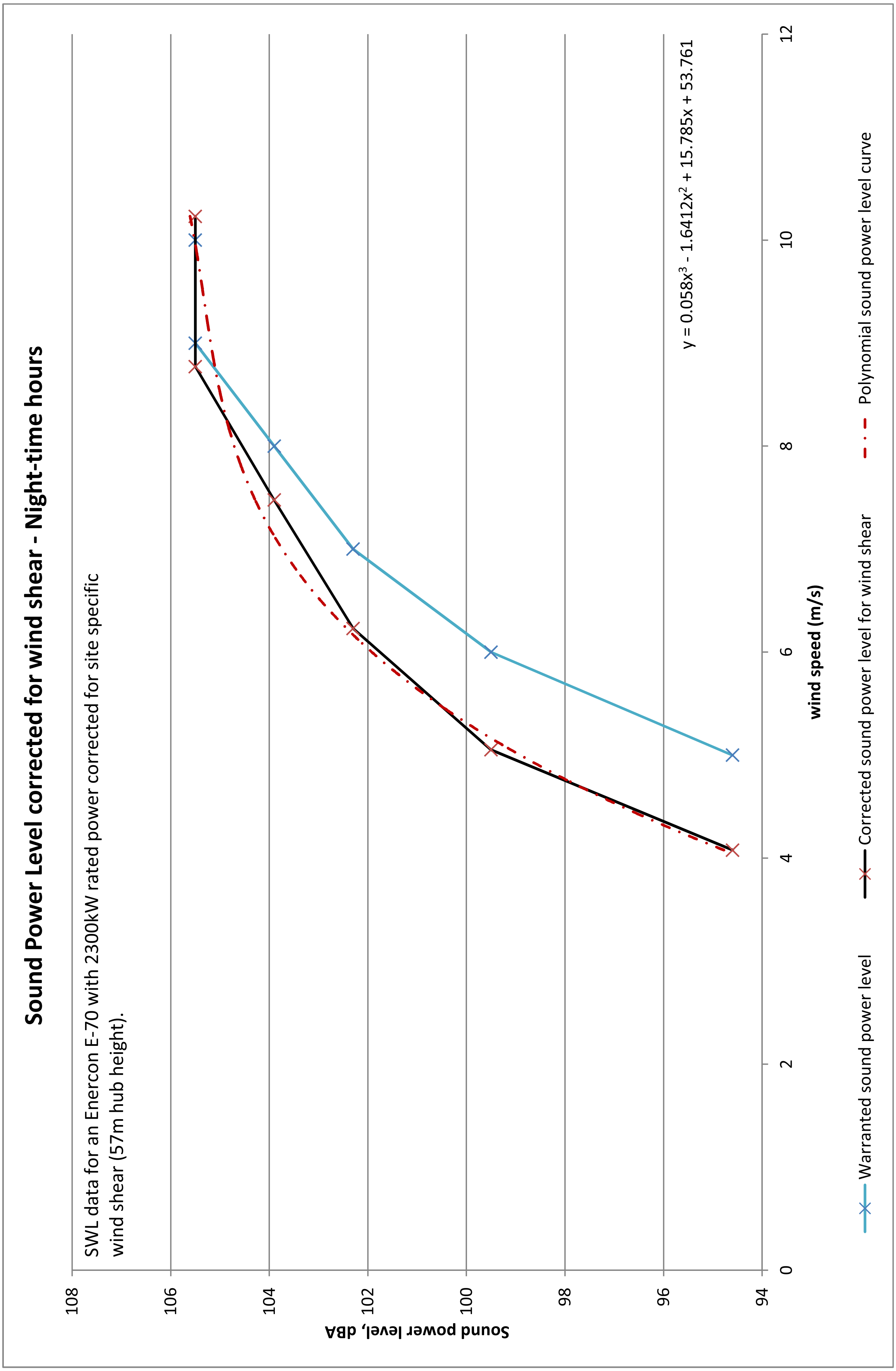


Sound Power Level corrected for wind shear - Amenity hours
SWL data for an Enercon E-70 with 2300kW rated power corrected for site specific wind shear (57m hub height).
Sound power level, dBA
108
106
104
102
100
98
96
94
0
2
4
6
8
10
12
wind speed (m/s)
y = 0.0529x³ - 1.5825x² + 16.087x + 49.977
Warranted sound power level
Corrected sound power level for wind shear
Polynomial sound power level curve

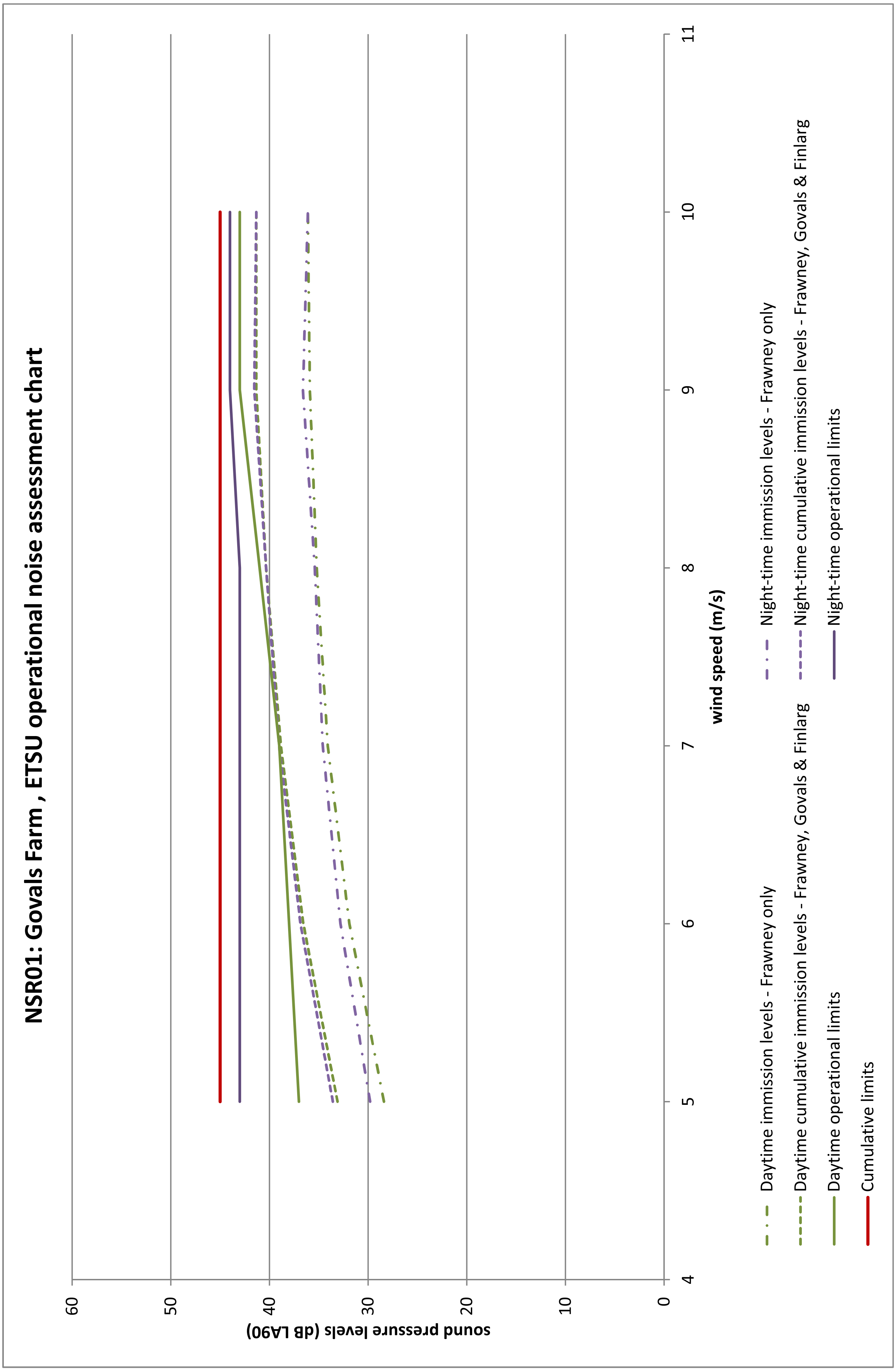
AC33



Sound Power Level corrected for wind shear - Night-time hours
SWL data for an Enercon E-70 with 2300kW rated power corrected for site specific wind shear (57m hub height).
y = 0.058x³ - 1.6412x² + 15.785x + 53.761
Sound power level, dBA
108
106
104
102
100
98
96
94
wind speed (m/s)
0
2
4
6
8
10
12
Warranted sound power level
Corrected sound power level for wind shear
Polynomial sound power level curve

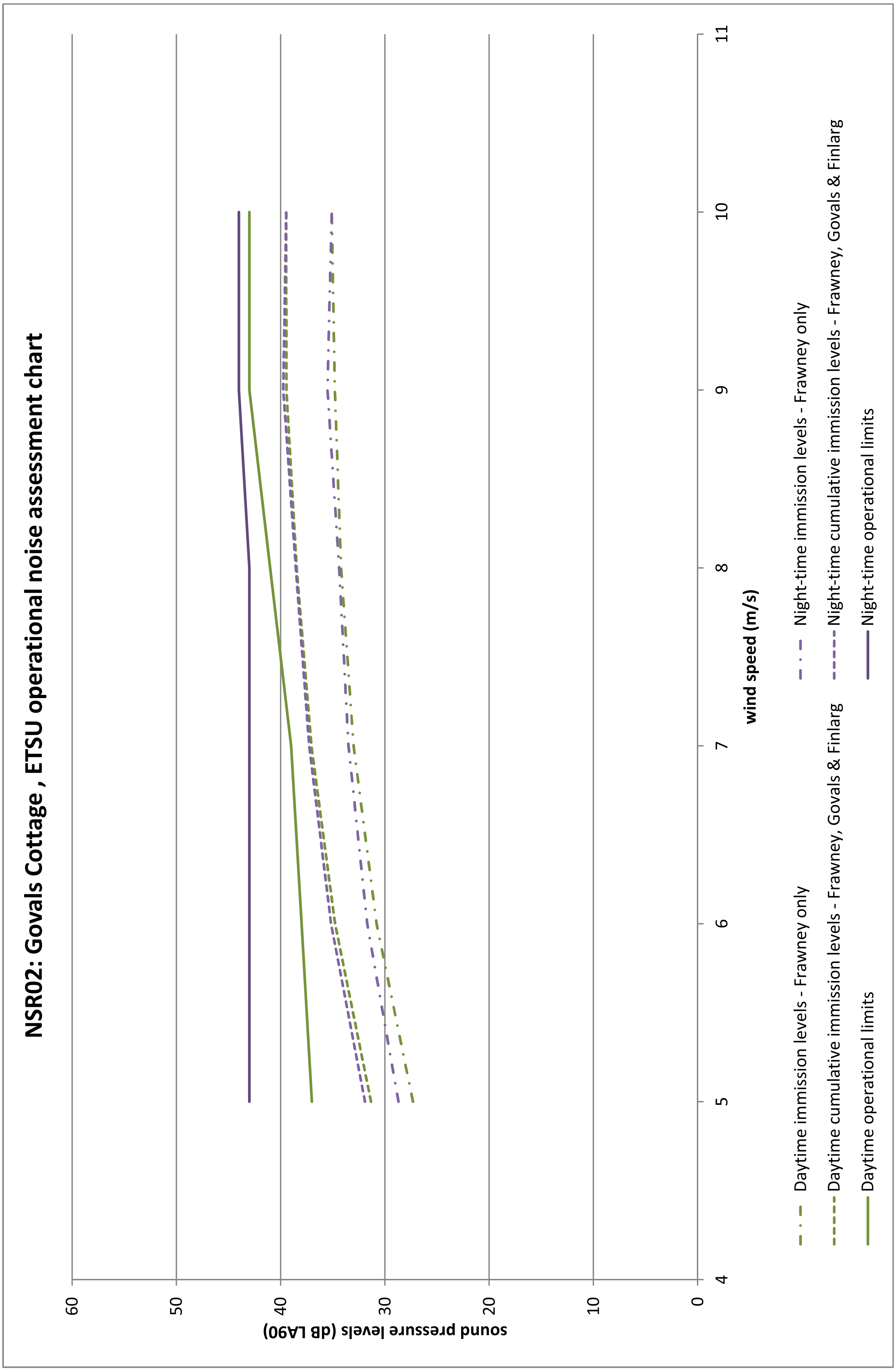
Appendix 5-5 Operational assessment charts

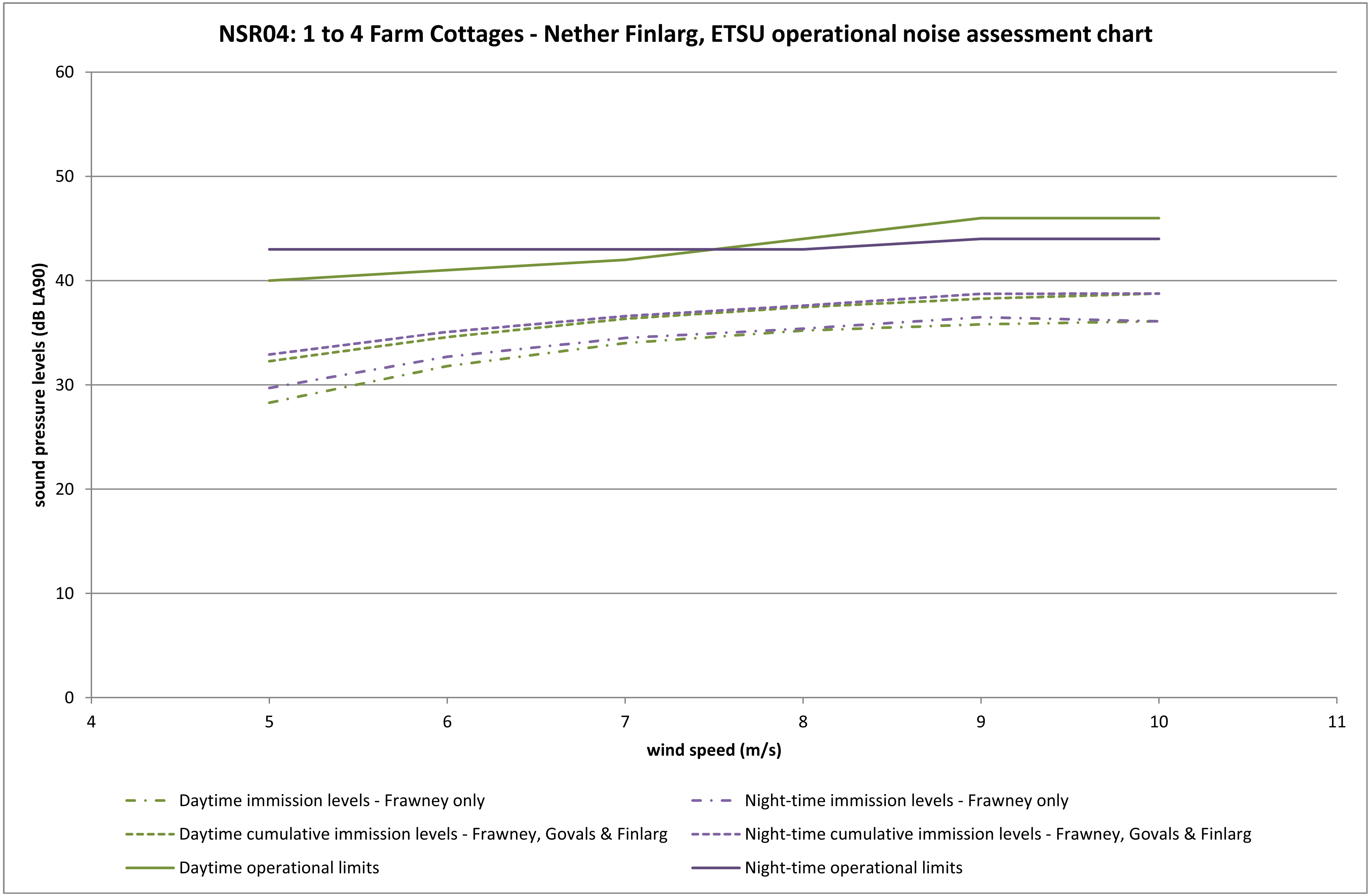
AC33



NSR01: Govals Farm , ETSU operational noise assessment chart
sound pressure levels (dB LA90)
0
10
20
30
40
50
60
wind speed (m/s)
4
5
6
7
8
9
10
11
Daytime immission levels - Frawney only
Daytime cumulative immission levels - Frawney, Govals & Finlarg
Daytime operational limits
Cumulative limits
Night-time immission levels - Frawney only
Night-time cumulative immission levels - Frawney, Govals & Finlarg
Night-time operational limits

AC33

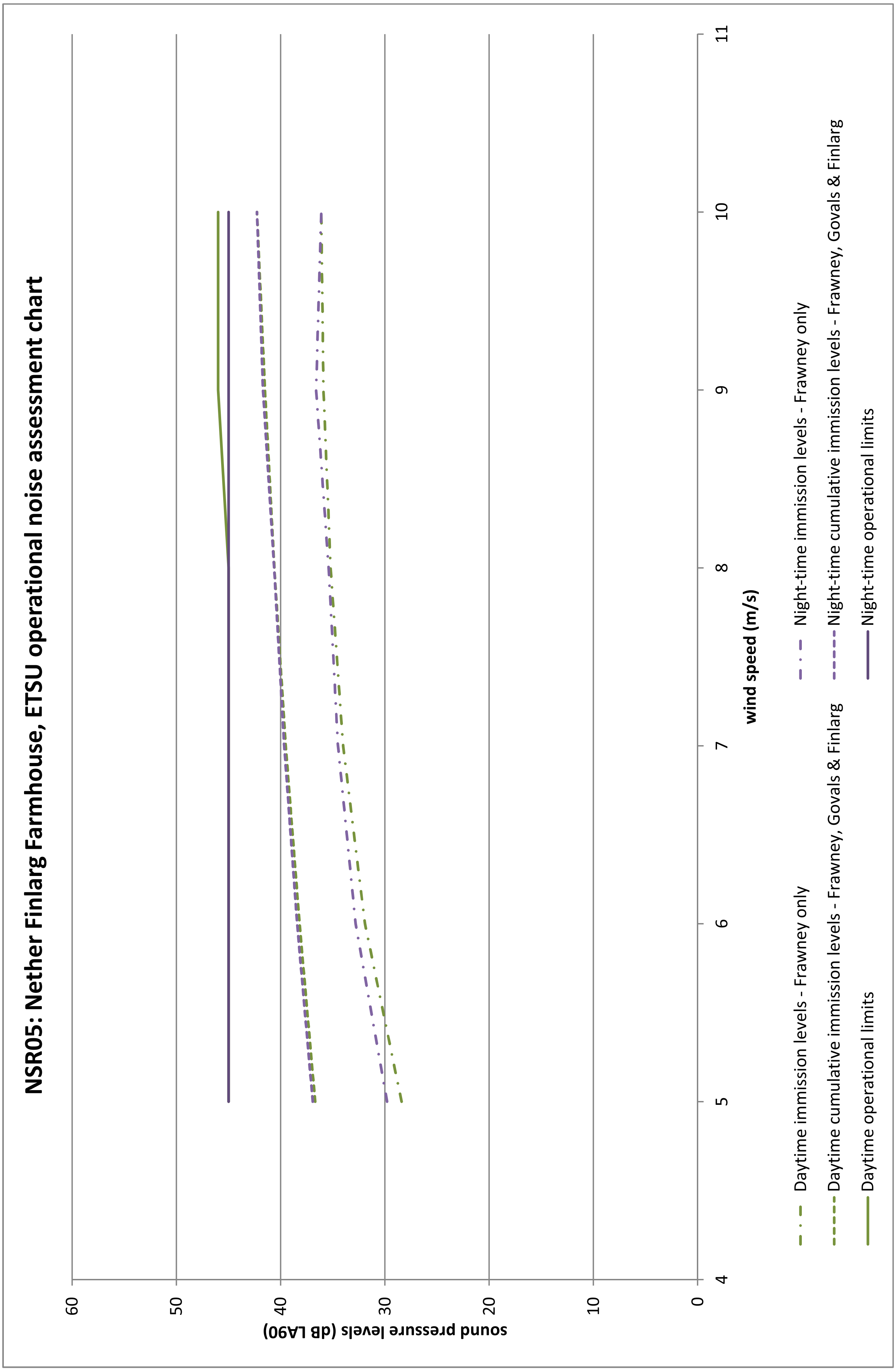

NSR02: Govals Cottage , ETSU operational noise assessment chart
sound pressure levels (dB LA90)
0
10
20
30
40
50
60
wind speed (m/s)
4
5
6
7
8
9
10
11
Daytime immission levels - Frawney only
Daytime cumulative immission levels - Frawney, Govals & Finlarg
Daytime operational limits
Night-time immission levels - Frawney only
Night-time cumulative immission levels - Frawney, Govals & Finlarg
Night-time operational limits



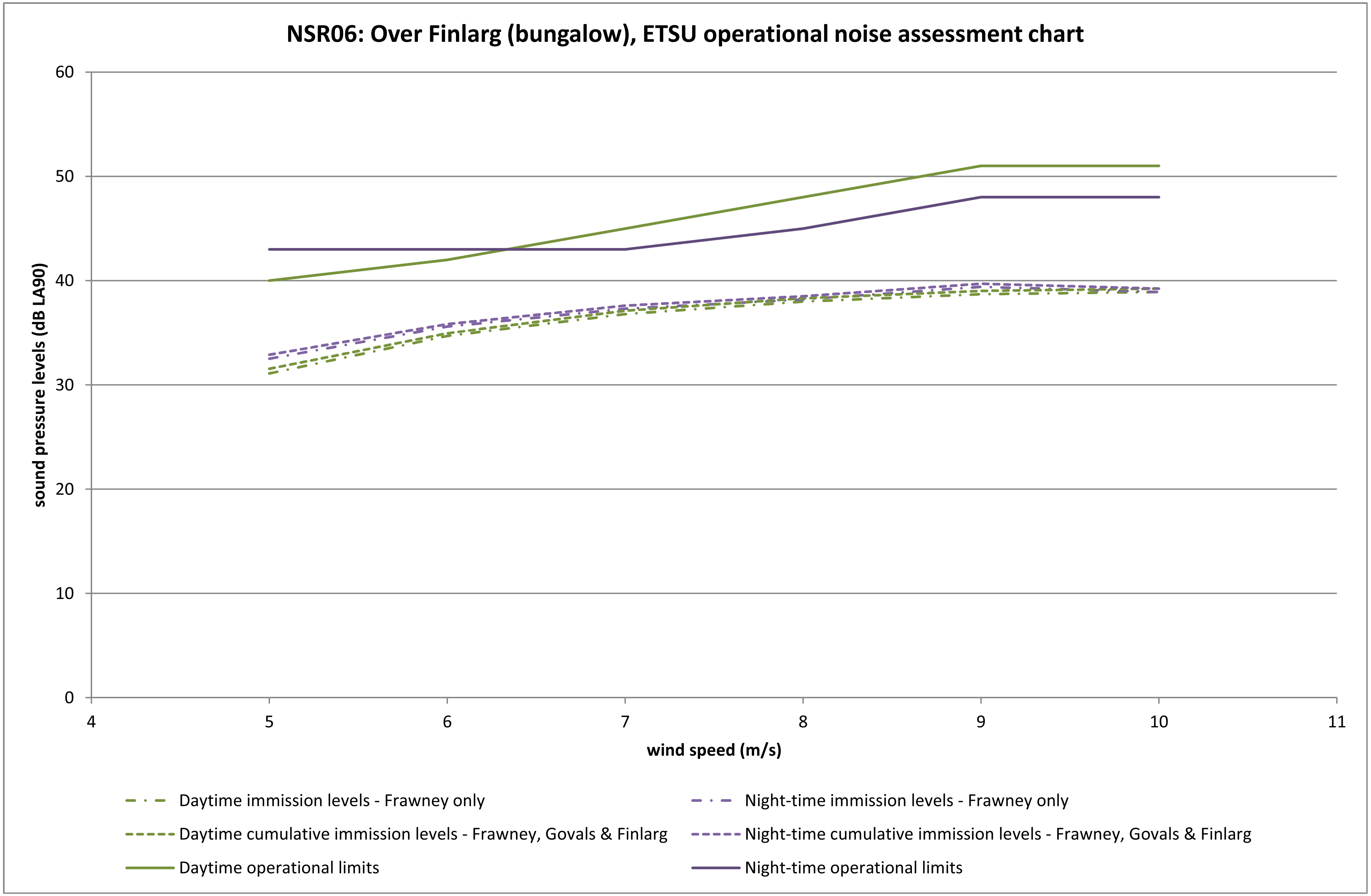
NSR04: 1 to 4 Farm Cottages - Nether Finlarg, ETSU operational noise assessment chart
sound pressure levels (dB LA90)
0
10
20
30
40
50
60
wind speed (m/s)
4
5
6
7
8
9
10
11
Daytime immission levels - Frawney only
Daytime cumulative immission levels - Frawney, Govals & Finlarg
Daytime operational limits
Night-time immission levels - Frawney only
Night-time cumulative immission levels - Frawney, Govals & Finlarg
Night-time operational limits

AC33

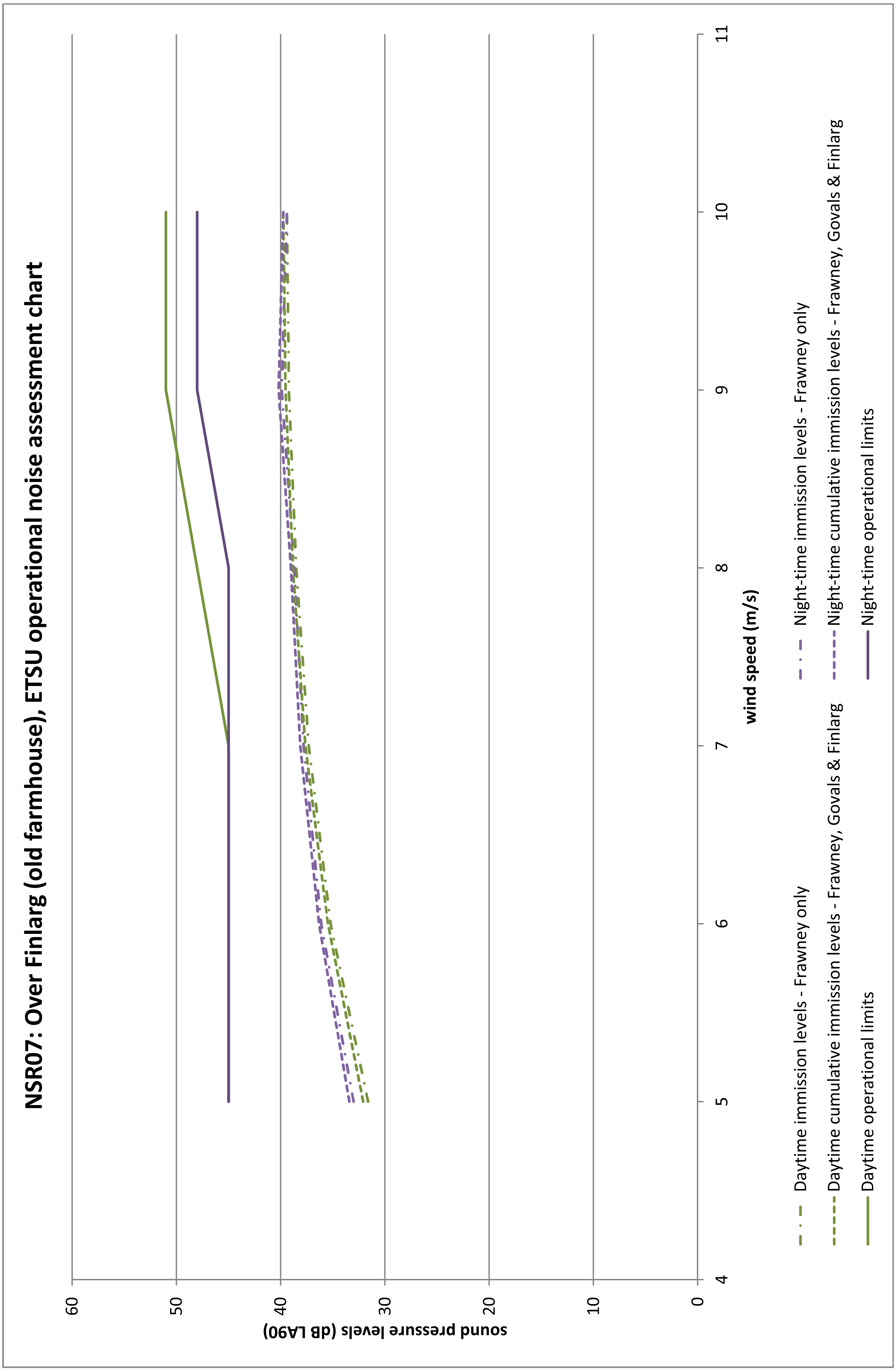
AC33


NSR05: Nether Finlarg Farmhouse, ETSU operational noise assessment chart
sound pressure levels (dB LA90)
0
10
20
30
40
50
60
wind speed (m/s)
4
5
6
7
8
9
10
11
Daytime immission levels - Frawney only
Daytime cumulative immission levels - Frawney, Govals & Finlarg
Daytime operational limits
Night-time immission levels - Frawney only
Night-time cumulative immission levels - Frawney, Govals & Finlarg
Night-time operational limits

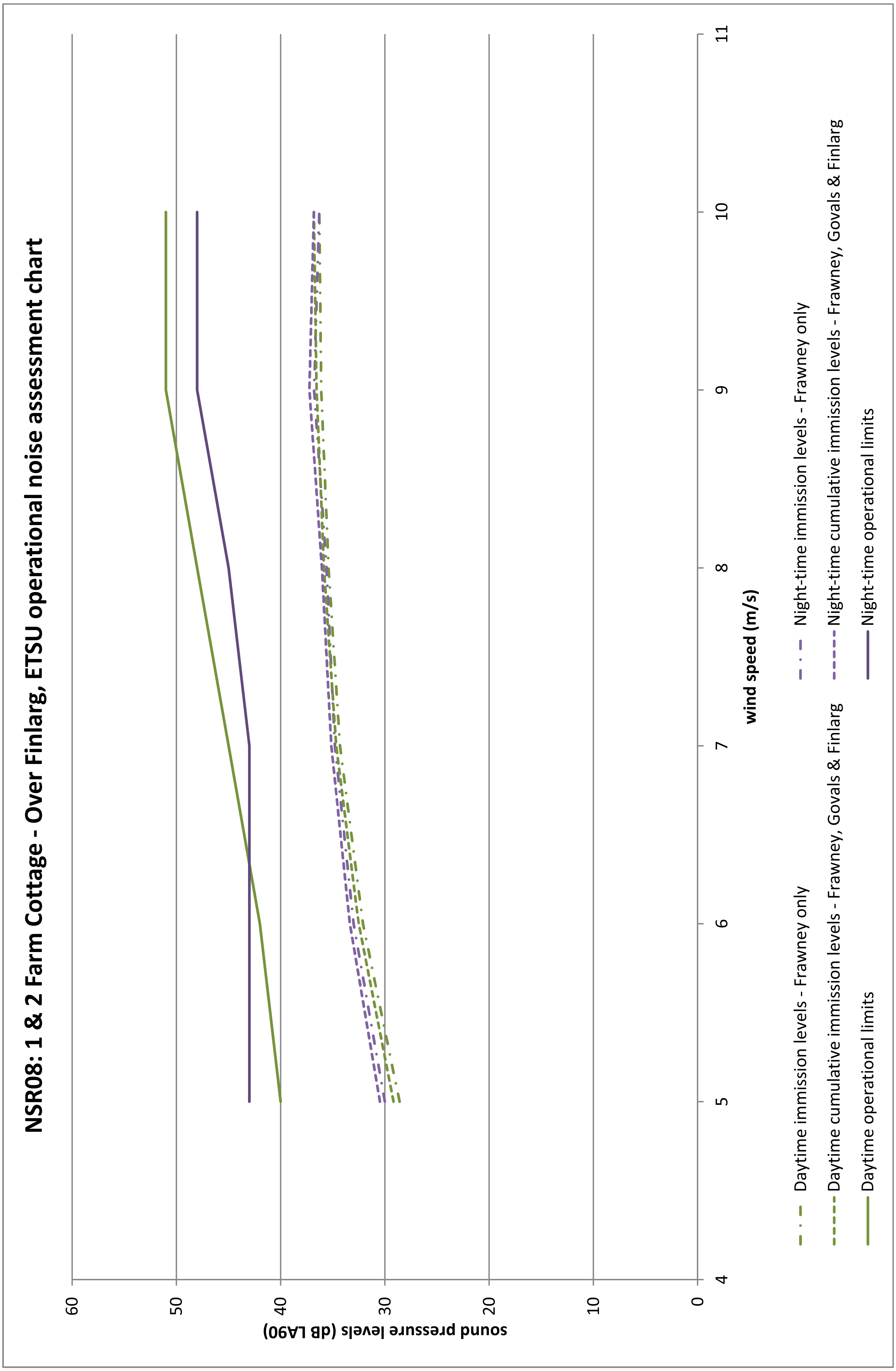
AC33


NSR06: Over Finlarg (bungalow), ETSU operational noise assessment chart
sound pressure levels (dB LA90)
0
10
20
30
40
50
60
wind speed (m/s)
4
5
6
7
8
9
10
11
Daytime immission levels - Frawney only
Daytime cumulative immission levels - Frawney, Govals & Finlarg
Daytime operational limits
Night-time immission levels - Frawney only
Night-time cumulative immission levels - Frawney, Govals & Finlarg
Night-time operational limits

AC33

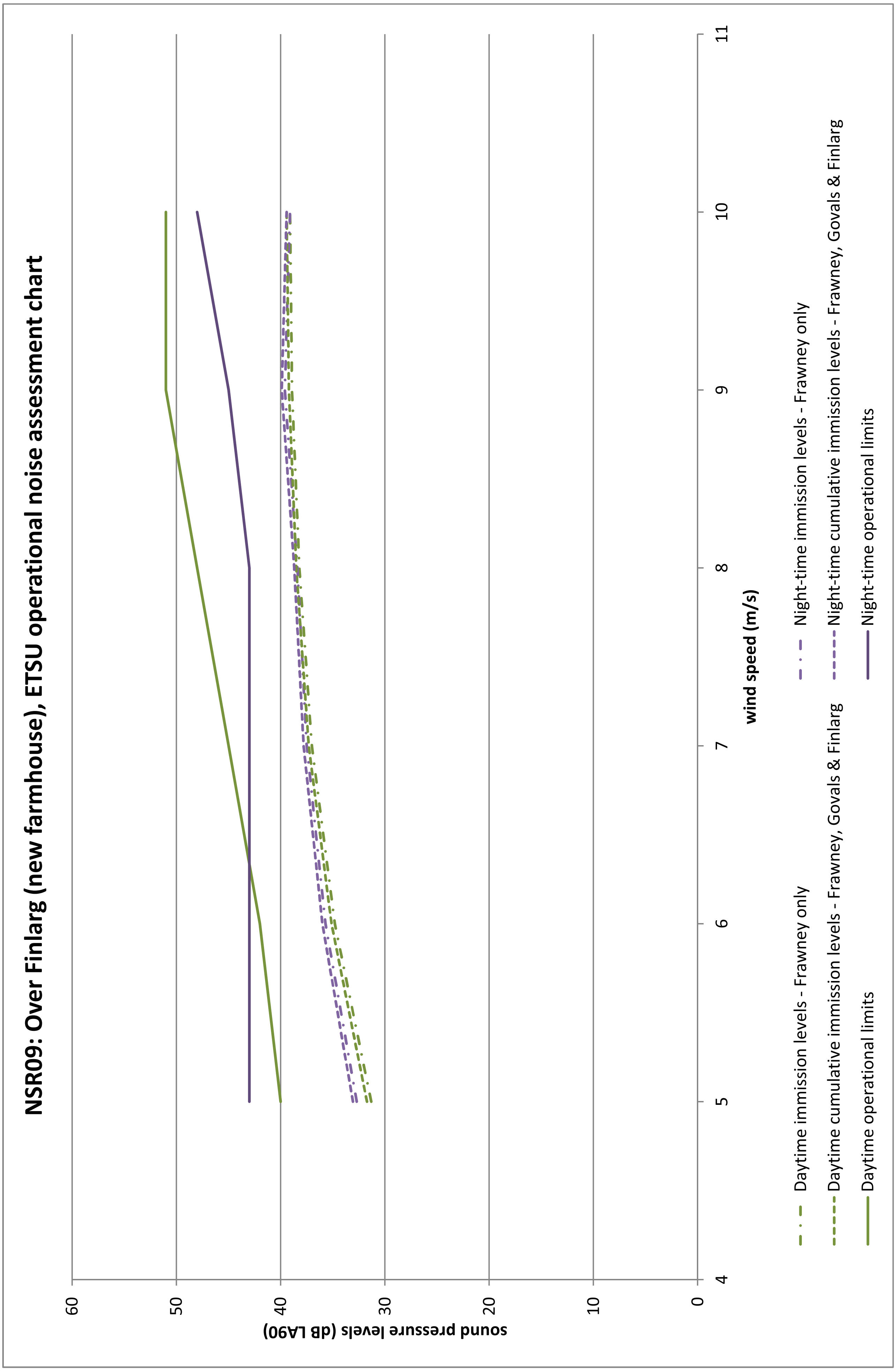

NSR07: Over Finlarg (old farmhouse), ETSU operational noise assessment chart
sound pressure levels (dB LA90)
0
10
20
30
40
50
60
wind speed (m/s)
4
5
6
7
8
9
10
11
Daytime immission levels - Frawney only
Daytime cumulative immission levels - Frawney, Govals & Finlarg
Daytime operational limits
Night-time immission levels - Frawney only
Night-time cumulative immission levels - Frawney, Govals & Finlarg
Night-time operational limits

AC33



NSR08: 1 & 2 Farm Cottage - Over Finlarg, ETSU operational noise assessment chart
sound pressure levels (dB LA90)
0
10
20
30
40
50
60
wind speed (m/s)
4
5
6
7
8
9
10
11
Daytime immission levels - Frawney only
Daytime cumulative immission levels - Frawney, Govals & Finlarg
Daytime operational limits
Night-time immission levels - Frawney only
Night-time cumulative immission levels - Frawney, Govals & Finlarg
Night-time operational limits

AC33



NSR09: Over Finlarg (new farmhouse), ETSU operational noise assessment chart
sound pressure levels (dB LA90)
0
10
20
30
40
50
60
4
5
6
7
8
9
10
11
wind speed (m/s)
Daytime immission levels - Frawney only
Daytime cumulative immission levels - Frawney, Govals & Finlarg
Daytime operational limits
Night-time immission levels - Frawney only
Night-time cumulative immission levels - Frawney, Govals & Finlarg
Night-time operational limits

Appendix 6-1: Landscape and Visual Impact Assessment Methodology

A.1. Overview

Landscape and visual matters are separate, although closely related and interlinked issues, and are dealt with as such in the assessment.

The assessment aims to establish the following:

- A clear understanding of the site and its setting in respect of landscape character and visual amenity;
- An understanding of the proposed development in terms of how this would relate to landscape character and visual amenity;
- An identification of all potential direct and indirect effects of the proposed development upon the landscape;
- An identification of effects on visual receptors;
- Those mitigation measures necessary to reduce/eliminate any potential adverse effect on the landscape or visual amenity as a result of the development; and
- A conclusion as to the residual effects of the proposed development.

The process follows a standard approach, namely:

- The establishment of the baseline conditions, i.e. the existing character and relative sensitivity of the landscape and visual resource to the change proposed;
- The prediction of the magnitude of change that the proposed development would bring, allowing for mitigation measures, upon the landscape and upon visual receptors; and
- An assessment of the significance of effect that would occur, by considering the predicted magnitude of change in line with the sensitivity of the landscape or sensitivity of visual receptor respectively.

As stated within Chapter 6, the methodology for Landscape and Visual Impact Assessment is based upon the following documents:

- Landscape Institute and Institute of Environmental Management & Assessment's (IEMA) Guidelines for Landscape and Visual Impact Assessment, second edition, published in 2002 Spoon Press (GLVIA); Incorporating references in the third edition (published April 2013)
- SNH Commissioned Report F01AA303A, Visual Assessment of Windfarms Best Practice, University of Newcastle (2002);
- The Visual Representation of Windfarms: Good Practice Guide, SNH (2007);
- The Strategic Locational Guidance for Onshore Wind Turbines in respect of the Natural Heritage, SNH Policy Statement No 02/02, updated 2009;
- Guidelines on the Environmental Impacts of Windfarms and Small Scale Hydroelectric Schemes;
- Siting and Designing Wind Farms in the Landscape, SNH (2009, version1);
- Assessing the Cumulative Impact of Onshore Wind Energy Developments, SNH (March 2012);

- Swanwick C (2002) Landscape Character Assessment - Guidelines for England and Scotland Countryside Agency/Scottish Natural Heritage;
- The Countryside Agency / Scottish Natural Heritage (2004) Topic Paper 6: Techniques and Criteria for Judging Capacity and Sensitivity;
- Angus Wind Farms Landscape Capacity and Cumulative Impacts Study, Ironside Farrar, (2008); updated by the Strategic Landscape Capacity Assessment for Wind Energy, November 2013; and
- Renewable Energy Implementation Guide, Angus Council (June 2012).

A.2. Methodology

The methodologies and guidance identified above, aim to systematically appraise the existing landscape condition, to identify all the significant physical and visual characteristics and assess their visual amenity value and sensitivity. These then provide a baseline against which the key landscape and visual effects can be predicted and evaluated and their magnitude and significance assessed in a logical and well-reasoned fashion. The methodology is outlined below.

Defining Baseline Sensitivity

To determine the extent of landscape and visual effects of the proposed wind turbines, the sensitivity (or susceptibility) of the landscape and visual resource is first considered.

Landscape sensitivity is defined within GLVIA 2 (paragraph 7.16) as "*the extent to which a landscape type or area can accept change of a particular type and scale without unacceptable adverse effects on its character*". The identification of sensitivity, therefore, needs to be considered in relation to the nature of the change, i.e. the type and scale of development proposed within a particular area or type of landscape and the association and tolerance of the identified landscape to that change. GLVIA also indicates that the degree to which a particular landscape can accommodate change arising from a particular development will vary with:

- Existing land use;
- The pattern and scale of the landscape;
- Visual enclosure/openness of view and distribution of visual receptors; and
- The value placed on the landscape.

The determination of the sensitivity of the landscape resource is based upon an evaluation of the key characteristics that are 'likely to be affected'. The evaluation will also consider the relative distance to the change proposed, the association of the particular area to that landscape and the presence/absence of other comparable features, including existing wind farm elements. It will acknowledge the established sensitivities defined in the Angus Wind Farm Study.

Visual sensitivity will be dependent upon "*the susceptibility (of different receptors) to change in views and visual amenity they experience at particular locations*". It includes a combination of parameters, including the activity / occupation / pastime of the receptors at particular locations, which are "publically accessible". It will also include the extent to which the receptors attention or interest may be focused on the "particular view" and the visual amenity they experience at particular locations. It will comprise the location, relative focus and orientation of views, the quality or importance of the existing view; the principal or secondary interest in that view and the ability of the view to accommodate the type of development and the frequency and duration of the view.

As an additional measure of visual effect, the visual sensitivity of "private views" from residential properties will also be assessed. This is defined in more detail in the section on residential amenity effects (6.7). As for the main LVIA it will define the susceptibility to change "*in particular views*". Although residents are recognised as being more susceptible and sensitive, the relative sensitivity will also depend on the nature of the receptor and the value, importance and interest placed on particular views, which contribute to the enjoyment of the property.

Landscape and visual sensitivity is categorised on a graduated scale from High, Medium or Low, or by a combination of two categories to provide a more detailed, group i.e. High to Medium or Medium to High (Table A6-1). It is also important to recognise that some landscapes may exhibit characteristics that fall within more than one sensitivity level and as such professional judgement is required when determining sensitivity and the rationale for assigning a specific sensitivity assessment should be explained in the assessment.

Table A6-1: Landscape and Visual Sensitivity

Sensitivity	Receptor type	Definition
High	Landscape	Typically small scale, enclosed landscapes with complex landform and a mosaic of habitat and landcover where turbines would be out of scale. Irregular patterns of enclosure and traditional settlement pattern with a general absence of contemporary structures giving a sense of remoteness and wilderness. Well used recreational areas with extensive views within/into/out of area to distant horizons; Landscape of distinctive character with strong cultural associations
	Visual	Residents with principal/direct views; Visitors to scenic viewpoints/ beauty spots with views constantly available; Long distance footpath routes with prolonged viewing opportunities; Important landscape features with physical, cultural or historic attributes; locations likely to attract high numbers of people with a primary interest in the view and the landscape.
Medium	Landscape	Medium scale landscape with a combination of open and more enclosed landform. Contemporary structures/development are an element of views either within/into/out of area. Rural working landscapes containing evidence of human activity with strong characteristics, relatively intact.
	Visual	Residents and visitors with secondary, distant views away from key focus from houses/curtilage; Footpaths with fleeting/transient/ peripheral views. Other tracks; roads used for tourism or journeys of a recreational nature, locations likely to attract moderate numbers of people. Viewers with a moderate interest in their surroundings e.g. users of outdoor recreation areas
Low	Landscape	Large scale open/exposed landscapes with smooth regular flowing landform and limited variation in landcover in which turbines would not be out of scale. Contemporary structures such as pylons, masts and other infrastructure evident. Visually contained by landform or vegetation with limited views within/into/ out of area with near horizons. Limited cultural associations and little if any recreational or amenity function.
	Visual	Viewers with a passing interest in the view e.g. Views from industrial or commercial buildings or areas; roads used primarily for commercial

Sensitivity	Receptor type	Definition
		travel and/or commuting; views from trains, locations likely to attract low numbers of people. visitors engaged in an occupation/pastime, rather than focused on the wider landscape

Defining Magnitude of Change

Once the sensitivity to change is established, the magnitude of change is then identified. This is defined within GLVIA as "*a combination of the scale, extent and duration of an effect*". Magnitude is categorised as High, Medium, Low or Negligible, or as a combination of two categories to provide a more detailed, intermediate group i.e. High to Medium or Medium to High. Criteria for defining the level of magnitude are identified in Table A6-2. Levels of visual magnitude are derived from the definitions listed in the 'Visual Assessment of Wind Farms: Best Practice' (University of Newcastle 2002). The magnitude will also be influenced by the spatial extent of the effect, the duration of the effect the degree to which the effect is reversible.

Table A6-2: Landscape and Visual Magnitude

Magnitude	Receptor	Definition
High	Landscape	Very obvious or notable change in the balance of landscape characteristics; ranging to particularly intensive change (i.e. a dominating effect) over a more limited area. The proposal would be a prominent feature in the make-up of the character area
	Visual	DOMINANT: Major changes to the make-up and balance of the view Commanding, controlling the view, striking, sharp, unmistakable easily seen.
Medium	Landscape	Whilst notable or obvious, the change would not fundamentally alter the balance of the landscape characteristics
	Visual	PROMINENT/CONSPICUOUS: Moderate changes in the nature of the view. Noticeably distinct, catching the eye or attention, clearly visible and well defined.
Low	Landscape	Very small change in the balance of overall characteristics, such that post development the change would be discernible but the underlying pattern of characteristics would remain similar to the baseline condition.
	Visual	APPARENT: Minor change in the nature of the view. Evident but lacking sharpness of definition, not obvious, indistinct, not clear, obscure, blurred indefinite. Discernible but the underlying nature of the view would remain similar to the baseline (limit of potential visual significance).
Negligible	Landscape	Change, which whilst occurring, would not influence the wider landscape character and would be barely discernible, perceptible or legible , approximating to a "no change" situation
	Visual	FAINT/SLIGHT: Very minor change to the view, weak, not legible, near limit of acuity of human eye. Change would be barely discernible, approximating to the "no change" situation.

The assessment will provide interpretation and rationale for the criteria selected. In doing so it will highlight, any relevant modifying factors, such as the potential for weather conditions to restrict views; the principle aspect of the landscape and visual receptor; the mobility or static nature of receptors, the proportion of any particular character/view affected, the potential for the development to attract the eye or to become a focal point in the view/landscape, to the detraction/benefit of competing visual elements and the presence/absence of other comparable features, including existing wind farm elements.

Establishing Extent (Significance) of Effect

Once the sensitivity and magnitude are classified, the two are considered together to assess the extent of effect and its potential significance. This is done using well argued narrative text to assess whether an effect is significant or not, with tables and matrices to support this and to guide the determination of significance and decide whether an effect is significant or not (Table A6-3). This is in line with GLVIA. Where the extent of an effect becomes 'significant', this is considered to be Moderate or more for the proposal, as outlined in EIA Regulations. Where these occur the greatest weight in decision making will be given to Moderate - Major effects or more, with Moderate effects generally less important.

The prediction and extent of effect cannot always be absolute. Paragraph 7.38 of GLVIA, states that "*Significance of effect is not absolute and can only be defined in relation each development and its location. It is for each assessment to determine the assessment criteria and the significance thresholds, using informed and well-reasoned judgement supported by thorough justification for their selection, and explanation as to how the conclusions about significance for each effect assessed have been derived*". Consequently, it is important to recognise, that some judgements may fall between one or more level and that the matrices is just a guide. As a result, professional judgement is required to provide detailed rationale for the determination of specific effects, as supported by GLVIA.

Table A6-3: Significance of Landscape and Visual Effect

		SENSITIVITY (of the landscape or visual receptor)		
		Low	Medium	High
MAGNITUDE (of effect upon the landscape and visual resource)	High	Moderate	Moderate/Major	Major
	Medium	Minor/Moderate	Moderate	Moderate/Major
	Low	Minor	Minor/Moderate	Moderate
	Negligible	Negligible	Negligible	Negligible

It should be noted that landscape and visual effects may be either adverse (negative) or beneficial (positive) in nature. This is a largely subjective judgement related to individual perceptions and is not related to significance of effect, but to the fit with the existing landscape character/elements. If no material effect is experienced, this can be said to be neutral in nature.

A.3. Photography and Visualisation Methodology

The photographs used to produce the photomontages have been using a Canon EOS 5D Mark II Digital SLR camera with a fixed 50mm lens. This camera has a full frame CMOS sensor, which provides a focal length once combined with a fixed 50mm lens that is commonly considered best practice. The camera is mounted and levelled on a Nodal Ninja panoramic tripod head at 1.5m above the ground, which itself is mounted on a sturdy tripod. The photographs are taken in portrait format at 15° intervals giving at least 50% overlap between frames.

The photos are then cylindrically projected and digitally joined to create a fully cylindrically projected panorama using Hugin stitching software. This process avoids the wide-angle effect that would result should these frames be arranged in a perspective projection, whereby the image is not faceted to allow for the cylindrical nature of the full 360-degree view but appears essentially as a flat plane. For this reason the most representative image of the appearance of the wind farm is obtained by curving the images in order to maintain the correct viewing distance for all parts of the view.

Wireframe representations that illustrate the development, set within a computer generated model of the terrain are used in the assessment to predict the theoretical appearance of the turbines. These are produced using Resoft Windfarm software using Ordnance Survey 50m Panorama DTM data. The wireframes illustrate the bare earth scenario which does not take into account the screening effects of vegetation, buildings or other local features that may prevent or reduce visibility. The wireframe is also based on 50m resolution DTM data, therefore small scale terrain features may not be represented in this model, such terrain features may alter the visibility of the development. The wireframes are checked on site to ascertain the extent of any localised screening effects. All wind turbines are shown as worst case with blades set to maximum height and set to face the viewer.

Photomontages have been produced again using Resoft Windfarm software to provide a realistic impression of how the development would appear. Wind turbines are rendered according to the lighting conditions within the photographs. Unlike the wireframes, turbine blades are randomly rotated while they are set to face the viewer or to correspond with the direction in which any existing turbines within the photograph may face. Photomontages have been produced for views up to 15km from the proposed development, which includes viewpoints 1-16 (Figures 6-6 to 6-21). Views from the remaining six viewpoints (17 to 22; Figure 6-22 to 6-27) are distant and, therefore, photographs and wireframes are presented only. This approach was agreed with Angus Council on 12th March 2012.

Photographs, wireframes and photomontages are shown with a 73° horizontal field of view which accords with SNH and Landscape Institute guidance. When printed onto A3 the 73° panoramic photographs, wireframes and photomontages should be viewed with one eye from a distance of approximately 315mm in order to gain an accurate representation of the real effect on the views.

In addition Angus Council confirmed through consultation that they would also require single frame images with a 70mm field of view. Since the single frame images are typically take with a 50mm fixed lens; Angus Council agreed by email on 14th March 2012 that so long as the photographs are of high resolution and the light is good then it would be acceptable for the single frame images be extracted from 50mm equivalent photos. Single frame photomontages with a 70mm field of view are presented for viewpoints 1-16 on Figures 6-6 to 6-21.

Whilst every effort has been made to ensure the accuracy of the photomontages, it must be appreciated that no photomontage could ever claim to be 100% accurate as there are a number of technical limitations in the model relating to the accuracy of information available from Ordnance Survey and from the GPS. For a detailed discussion regarding the limitations of photomontages, please refer to Visual Representation of Wind farms – Good Practice Guidance (SNH commissioned report FO3 AA 308/2).

The photographs and other graphic material such as wireframes and photomontages used in this assessment are for illustrative purposes only and, whilst useful tools in the assessment, are not considered to be completely representative of what will be apparent to the human eye. The assessments are carried out from observations in the field and, therefore, may include elements which are not visible in the photographs.

Appendix 7-1: Habitat Survey Report

A.1. Introduction

Terms of Reference

Atmos Consulting Ltd was commissioned to undertake an extended Phase 1 and National Vegetation Classification (NVC) habitat survey, at the proposed development site. This survey was required to provide baseline ecological information on the site.

This report presents the findings of the extended Phase 1 habitat survey as detailed on Figure 7-2 and a further habitat survey carried out on any potential groundwater dependent terrestrial ecosystems (GWDTEs) which were identified during the Phase 1 habitat survey.

For the purpose of placing the habitats into context an area wider than the proposed development boundary was surveyed. For the purpose of clarity the development boundary, hereafter referred to as the Site, and wider Survey Area, which encompasses the Site, are indicated on Figure 7-2.

Objectives of the Study

The purpose of this study was to establish the baseline ecological conditions of the Site by undertaking an extended Phase 1 habitat survey covering both the Site and its immediate environs. This is referred to as the Survey Area and is illustrated on Figure 7-2.

In April 2011 (updated in Mach 2012) SEPA published 'Planning Guidance on Windfarm Developments' (LUPS GU4) which included assessing the impacts of wind farms on groundwater and GWDTEs i.e. wetland habitats which are indicators of groundwater presence and which are dependent on the continued supply of groundwater. GWDTEs are protected under 'Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy' or for short the EU Water Framework Directive (WFD). Within the SEPA guidance LUPS-GU4 document it is recommended that a Phase 1 habitat survey is used to identify wetland habitats and then a NVC survey is carried out on these wetland habitats to determine their dependency on groundwater. This applies to wetland areas which are within 100m from roads, tracks or trenches or within 250m from borrow pits and foundations.

The results from this, along with further surveys will be used to inform the design of the proposed development and constitute part of a full Ecological Impact Assessment (EcIA).

This report will detail the following:

- Field survey methodology;
- Identification of any wetland areas and their NVC community and determination on their groundwater dependency; and
- Field survey results.

Site Description

The Site is situated approximately 8km north of Dundee in Angus at the eastern end of the Sidlaw Hills. The Survey Area which includes the Site covers 464ha, approximately

180m – 330m above sea level and is located within an area of intensive agricultural farming. It is comprised mainly of agricultural fields, which are a mixture of semi-improved and improved grassland and arable crops. In addition there are two small coniferous plantations, small areas of mixed and deciduous woodland, two small ponds and a number of ditches.

To the south of the Site is the intensely farmed Carse of Gowrie, renowned for its production of soft fruit and the urban area of Dundee and Invergowrie. Immediately to the northwest of the Site on the northern side of the Sidlaws the ground is more upland in nature and there is an extensive area of heath. Beyond this, Strath More, a wide flat valley, which again is an intensely farmed area is scattered with small towns and villages.

The only water bodies within the Survey Area are two small man made ponds, one of which is used for collecting water for a private water supply and the other is in the garden of Nether Finlarg farmhouse and although the site of a natural collection, has been augmented for ornamental purposes. Watercourses within the Survey Area are represented by a few wet ditches and a small burn running from the man-made pond in the north of the Survey Area.

There are a number of wooded areas on and around the Site with two coniferous plantations in the northwest corner of the Survey Area and a number of small areas of mixed woodland around the farms and strips of planting along field boundaries.

A.2. Methodology

Extended Phase 1 Habitat Survey

An extended Phase 1 habitat survey, as described in the 'Guidelines for Baseline Ecological Assessment' (IEA, 1995), was undertaken on 14th March 2012. Extended Phase 1 habitat survey is a standardised method of recording habitat types and characteristic vegetation, as set out in the 'Handbook for Phase 1 Habitat Survey – a technique for Environmental Audit' (JNCC, 2010). This survey method is extended through the additional recording of specific features indicating the presence, or likely presence, of protected species or other species of nature conservation significance and any habitats which would be suitable for them. Habitats are mapped and 'target notes' are made to describe characteristic habitats, features of ecological interest, or any other features which require ecologically sensitive design or mitigation. Higher plant species nomenclature follows that provided in Stace (2010) for vascular plants and Bosanquet and Lawley (2010) for bryophytes. Information on threat categories have been consulted using the Red Data Book (Cheffings and Farrell, 2005).

The main purpose of this extended Phase 1 habitat survey was to:

- Describe and map the habitats of the Site;
- Target note (TN) flora, evidence of protected species and other ecologically significant features;
- Assess the ecological value of the flora and habitats;
- Assess the potential of the habitats as suitable for protected species;
- Collate species lists and TNs; and
- Identify any potential GWDTEs.

GWDTE Survey

The Phase I habitat survey identified four areas within 100m of tracks or 250m of turbines, which were considered to be wetlands and potential GWDTEs. Generally these were areas of marshy grassland or wet areas where there was a dominance of rushes. These were present around the lined pond to the north of the Survey Area (TN20); an area to the east of the lined pond in the corner of an improved field (Q3); an area close to the sheep wash pens (Q5) and within the planted area next to the ruined house (TN17) (Figure 7-2).

The survey was carried out on 30th April 2012 and the approach adopted consisted of a revised NVC methodology as outlined in Rodwell 2006, with a single quadrat being taken in each of the areas. Results of the quadrat samples are outlined in Annex 3.

As the area of each habitat was relatively small and uniform it was considered that a single quadrat sample for each habitat was sufficient to classify the vegetation and assign it to an NVC community using the habitat definitions in Rodwell, J.S. British Plant Communities, Vols 2 (1998), 3 (1998) and 4 (2000).

Potential Limitations

The surveys which were carried out in March and April 2012 were considered to be early in the season, especially as the weather had been cold and wet during April, so many of the plant species would not be evident. As the majority of the Site was under arable or improved grassland the timing of the surveys was not considered to be a limitation in terms of the habitats. The extended Phase 1 habitat survey and the protected species surveys and habitat assessments for protected species were carried out within the appropriate season for most protected species so the timing of these surveys was not considered to be a limitation. The habitats and farming practices have not altered sine the surveys were undertaken and, therefore, they are considered to be representative of the current baseline conditions.

A.3. Survey Results

Extended Phase 1 Habitats

The findings of the extended Phase 1 habitat survey were mapped (Figure 7-2) with habitat types and the area of their extent detailed in Table A7-1. Target notes of features of ecological interest taken during the surveys are presented in Annex 1, with a species list from Phase 1 and NVC surveys presented in Annex 2.

Table A7-1: Habitats Present within the Survey Area

Description	Area (ha)	% of total area
Cultivated/disturbed land - arable	251.50	54.25%
Neutral grassland - semi-improved	99.07	21.37%
Improved grassland	73.85	15.93%
Coniferous woodland - plantation	8.59	1.85%
Acid grassland - semi-improved	8.44	1.82%
Mixed woodland - plantation	6.71	1.45%
Scrub - scattered	4.50	0.97%
Track	2.14	0.46%
Bare ground	2.09	0.45%

Description	Area (ha)	% of total area
Marsh/marshy grassland	1.83	0.40%
Bracken - scattered	1.52	0.33%
Buildings	1.01	0.22%
Broadleaved woodland - plantation	0.77	0.17%
Scrub - dense/continuous	0.36	0.08%
Other tall herb and fern - ruderal	0.35	0.08%
Cultivated/disturbed land - amenity grassland	0.31	0.07%
Standing water	0.16	0.03%
Coniferous Parkland/scattered trees	0.14	0.03%
Mixed Parkland/scattered trees	0.09	0.02%
Quarry	0.08	0.02%
Other habitat	0.07	0.01%
Marginal and inundation - marginal vegetation	0.05	0.01%
Total (to nearest ha)	**464**	**100%**

Dominant Phase 1 Habitats

Cultivated/Disturbed Land - Arable

At the time of survey, over 50% of the area surveyed was under arable crops, the field immediately to the north of Over Finlarg had turnips in it but the majority of these fields had recently been ploughed so it was not possible to determine which crops were being grown. The arable fields which had not been ploughed were arable leys which were being managed for silage. This habitat is of low ecological value, although it can provide refuge and food for species such as badgers and small mammals. The field boundaries were a mixture of old stone walls and wire and post fences. The field margins were dominated by grasses such as tufted hair-grass *Deschampsia cespitosa*, perennial rye grass *Lolium perrene*, cock's foot *Dactylis glomerata* and Yorkshire fog *Holcus lanatus*, along with common nettle *Urtica dioica*, broad-leaved dock *Rumex obtusifolius* and spear thistle *Cirsium vulgare*. Some small areas of rosebay willowherb *Chamerion angustifolium* and common gorse *Ulex europaeus* were also present.

Semi-Improved Neutral Grassland

The next dominant habitat type was the semi-improved neutral grassland which covered over 20% of the Survey Area and could be found mostly on the southern slopes of Finlarg Hill. These southern slopes were too steep for arable crops and as a consequence were actively managed for grazing livestock. This habitat was dominated by grasses such as perennial rye grass and sweet vernal grass *Anthoxanthum odoratum,* with a few flowering herbs such as white clover *Trifolium repens* and creeping buttercup *Ranunculus repens*, along with occasional heath bedstraw *Galium saxatile* and tormentil *Potentilla erecta*.

Improved Grassland

The improved grassland covered almost 16% of the Survey Area and included fields which were used for grazing livestock. This habitat was dominated by perennial rye grass, white clover, daisy *Bellis perennis* and creeping buttercup *Ranunculus repens*.

Minor Phase 1 Habitats

The following three habitats each covered between 1-2% of the total area of the Survey Area.

Coniferous Woodland

There were two areas of coniferous plantation which were located in the northwest of the Survey Area (TNs 22 and 25) and were planted with Sitka spruce *Picea sitchensis*, lodgepole pine *Pinus contorta* and Scots pine *Pinus sylvestris*; the larger of the two plantations (TN22) was dominated by Sitka spruce. Both plantations were made up of mature trees between 10-15m tall and were densely planted so that there was no ground flora other than at the edges or along the track (TN22), as in the larger of the two plantations. In the larger plantation along the track which runs from the gate to an open disturbed area (TN22) there was semi-improved neutral grassland with scattered blaeberry *Vaccinium myrtillus* and heather *Calluna vulgaris* (these were remnants of the heath which previously covered the area and was present to the north outwith the Survey Area) and areas of ruderal plants such as rosebay willowherb and common nettle where the ground had been disturbed.

The other area of coniferous plantation was situated along the west side of the track to Over Finlarg; again these were mature trees (there were many cones on the trees) of approximately 10-12m high. The dominant species was Sitka spruce, although there was some Japanese larch *Larix kaempferi* along the edges of the plantation with a few scattered sycamore *Acer pseudoplatanus* and ash *Fraxinus excelsior*. The trees were closely planted so there was no ground flora other than along the edges of the plantation.

These plantations had potential to support protected species such as badgers *Meles meles* and red squirrel *Sciurus vulgaris* which could use the plantation for sheltering opportunities, i.e. sett and drey construction respectively as well as a food resource. There were no trees which were suitable for roosting bats in these plantations. There were no signs of any protected species found during the survey.

There was one area of scattered conifers which consisted of a group of four mature 7-9m high, Scots pine in the corner of a field (TN29). These were in reasonable condition and were isolated from other features so would have a low potential for roosting bats and had limited food resource in terms of cone bearing so would have no potential for other protected species such as red squirrel.

Semi-Improved Acid Grassland

There were two areas of semi-improved acid grassland located in the northwest of the Survey Area (around TNs 24 and 26). This habitat was dominated by mosses and grasses such as *Rhytidiadelphus squarrosus*, *Hylocomium splendens* and mat grass *Nardus stricta*, along with heath rush *Juncus squarrosus*, heath bedstraw and tormentil.

Mixed Woodland

There were several small areas of mixed plantation woodland around the farms and houses and narrow strips along field boundaries. The trees were a mix of sycamore, beech *Fagus sylvatica*, ash, willow *Salix species*, Sitka spruce and Scots pine. The ground flora could be a mix of grass and ruderal plants or shrub layer with bramble *Rubus fruticosus* and young hawthorn *Crataegus monogyna*. Around the houses and farms in particular more ornamental/non-native species were found such as eucalyptus

Eucalyptus sp., Lawsons cypress *Chamaecyparis lawsoniana* and bird cherry *Prunus padus*.

Because of the variety of food sources and refugia available within this habitat, it has potential to provide good quality habitat for species such as badgers, bats and other small mammals; however no field signs of protected species were observed at this location during the survey.

Other Phase 1 Habitats

Additional habitats which formed only a very small part of the Survey Area included the following habitats.

Scrub

The areas of scattered scrub were mostly found on the steeper slopes of Finlarg Hill and were composed of small clumps of common gorse. These were small bushes and very scattered so would not provide good cover for larger mammals such as badgers and no evidence of use by badgers was observed. There was one area of continuous scrub in a corner of a field (TN30) next to Tarbrax Wood to the south of and outwith the Site. The dominant species here was blackthorn *Prunus spinosa*.

Broadleaved Woodland

There were small areas of broadleaved woodland around the residential properties. One area west of Over Finlarg farmhouse (TN3) was composed mostly of mature penduncluate oak *Quercus robur* and some small elder *Sambucus nigra*. This was a small open copse with a ground flora of snow drops *Galanthus nivalis*, bracken *Pteridium aquilinum*, bramble and rosebay willowherb. A number of the trees were old and there were a number of rot holes and broken branches which could provide some potential for roosting bats (Appendix 7-2). To the northeast along the track into the Site was a line of mature (10-15m tall) beech trees (TN33). There were some rot holes and cracks which would provide potential bat roosts.

Marshy Grassland

There were a number of small areas of marshy grassland (TNs 17, 19 and 31) which were generally dominated by soft rush *Juncus effusus*, although the area to the east of the northern pond (TN19) was dominated by sharp flowered rush *Juncus acutiflorus*. These areas did not have a great variety of plants.

Bracken - Scattered

There were two areas of scattered bracken which were found on Finlarg Hill.

Tall Ruderal

There was one area of tall ruderal habitat which was dominated by rosebay willowherb and could be found on the banks of the small burn to the north of the Survey Area (TN19). Other species present were small nettle *Urtica urens* and soft rush. This type of habitat could also be found around the field margins where there would be species such as spear thistle *Cirsium vulgare*, broadleaved dock and cock's foot.

These areas provide cover and have potential to be used by a range of species for shelter or to conceal entrances to setts, holts or burrows. Badger, otter *Lutra lutra* or water vole *Arvicola terrestris* may make use of this habitat; however, no signs of protected species were identified during the surveys.

Amenity Grassland

There was one area of amenity grassland at Nether Finlarg which was planted with a mix of grass species with meadow grass *Poa* spp. species being dominant.

Standing and Running Water

There were four areas of standing water (TNs 20, 14, 31 and 32). All of them were artificial. The pond to the north (TN20) was dammed and lined with polythene which went up over the banks and was enclosed by a wire fence. It was 0.3-1.5m deep with some algae and common water starwort *Callitriche stagnalis* growing in the middle. It was being fed by a short ditch coming from a field drain where there was brooklime *Veronica beccabunga*, water-cress *Rorippa nasturtium-aquaticum* and floating sweet grass *Glyceria fluitans*.

The pond near to the sheep wash pens (TN14) had been recently drained and apart from a small area in the middle was now completely overgrown with mosses, soft rush, marsh marigold *Caltha palustris*, water-cress with some flag iris *Iris pseudacorus* in the middle and no longer formed an area of standing water.

In the garden at Nether Finlarg there was a large ornamental pond (TN32) which was surrounded by garden and mixed woodland.

The remaining area of standing water (TN31) was in a field near Nether Finlarg where a field drain appeared to have collapsed and a small area (approximately $4m^2$) of water had accumulated.

These ponds are within an intensely farmed area with large areas of ploughed arable land with surrounding habitat relatively open although a number of field boundaries, woodland areas and stone walls offer some suitable habitat for commuting and potentially hibernating great crested newts *Triturus cristatus*. In general the rest of the survey area is sub-optimal for supporting this species. No fish were observed in these ponds and as they are limited in size it would be unlikely that they would be suitable for otters or water voles.

Most of the ditches were overgrown with tall ruderal vegetation such as rosebay willowherb, common nettle, cocks foot and broad-leaved dock. Many of these ditches had been diverted through culverted pipes forming field drainage networks. The only ditch with running water in it was the ditch (TN21) on the northern boundary of the Survey Area. It was also mostly overgrown with soft rush, gorse and rosebay willowherb and at the time of the survey had a trickle of water in it.

A small burn (TN16) was observed from the lined pond to the east running for 200-300m and before becoming culverted through a field drain. This was approximately 0.5m wide by 0.5m deep. The surrounding vegetation was mostly soft rush, sharp flowered rush, rosebay willowherb and gorse. This small stretch of water was suitable for water vole but as it was restricted in size and connectivity it was unlikely to support water voles and no evidence to suggest presence of the species was observed.

Buildings

Within the Survey Area there were two clusters of buildings at Over Finlarg and Nether Finlarg with two further cottages to the south of Over Finlarg Farm. These comprise of a variety of domestic and agricultural buildings both old and new. Over Finlarg Farm area had three houses (old farmhouse, new farmhouse and bungalow), two of which were built of stone with slate roofs and a third built of harled brick and slate roof. The farm buildings were a variety of old stone built and newer open walled metal structures. Some of these buildings could offer potential bat roosts, particularly the central stone buildings and the farmhouse (ref buildings 11, 12, 14 and 15, Appendix 7-2). Nether Finlarg was very similar with a mix of domestic and agricultural buildings, old and new but due to the surrounding habitat and the open nature of the buildings they would offer low potential for bat roosts (Appendix 7-2). An additional ruined croft building (TN17) is located within the north of the Site. This would not offer any suitable roosting habitat as there was no roof and the walls were exposed to the elements.

Boundaries

The field boundaries were mostly a mix of old stone walls and wire and post fences. There were one or two boundaries with hedges and these were generally of hawthorn *Crataegus monogyna*. These would not offer great potential for protected species other than commuting bats or small birds or mammals.

Quarry

An area below one of the coniferous plantations to the north of the Survey Area had been dug up by the landowner and used for extracting stone (TN27). This area was all bare ground and would not offer any habitat for protected species.

NVC Survey and GWDTE

A number of small areas were identified as supporting wetland habitats (Figure 7-2). From the NVC survey the area to the west of the northern lined pond (Q1) was found to be similar to the MG10 *Holcus lanatus – Juncus effusus* rush-pasture which is an impoverished vegetation type and rarely contains any uncommon species. The area to the east of this pond (Q2) had a greater variety of species and was found to be similar to the M23 *Juncus effusus/Juncus acutiflorus – Galium palustre* rush-pasture community. Here sharp flowered rush was dominant, along with Yorkshire fog and other less frequent species such as creeping buttercup and meadow vetchling *Lathryus pratensis*. Both of these areas were in a collection zone with culverted field drains draining to the pond. OS maps identify this area as a spring, however hydrological investigations confirm that this spring is actually a piped or culverted supply. It runs along the base of a former stream valley that originates further up gradient on the hillside. The valley is currently a dry valley, as runoff is likely to be collecting into the underground culvert/drain discharging into the open man-made reservoir (Chapter 9 – Hydrology). Due to the close association of these areas with the pond and drainage systems it is not assessed that the habitats are dependent on natural groundwater and therefore do not qualify as GWDTE.

The area close to the ruined house in the north of the Site (Q4) was within a fenced off plantation of young coniferous and deciduous trees, at the edge of an arable field. Here soft rush and reed canary grass *Phalaris arundinacea* were the dominant species with a few individuals of creeping buttercup, creeping thistle and broad leaved dock. It was considered to resemble the S28 *Phalaris arundinacea* tall-herb fen community because of the dominance of the reed canary grass. A well is marked at this approximate location on OS maps and although no evidence of this structure remains, the damper ground may signify its former location.

The other two wet areas, one at the sheep wash (Q5) and one in the corner of the improved field (Q3) had so few species present which were of common occurrence that it was not possible to define these into NVC communities so these are not considered further within this section. A well is also shown on OS maps adjacent to the sheep wash. Again no evidence of this well was observed during the site visit but the landowner confirmed that adjacent to this area was the site of a former pond which has been recently drained. The location within the north of the improved field was immediately adjacent to an apparent collapsed culverted drain which has resulted in a surface drainage channel in a shallow depression being created. As a result the shallow depression supports damper vegetation with a diffuse drainage channel although the vegetation is of common improved grassland species within a damp grassland setting. The channel itself supported some creeping buttercup and brooklime with occasional water cress.

With reference to SEPA LUPS GU4 (2012) the MG10 NVC community is moderately groundwater dependent and the M23 community is highly groundwater dependent, although this does depend on the hydrogeological setting. The S28 community is not considered to be dependent on groundwater. Within the Survey Area the MG10 and M23 areas are not considered to be groundwater dependent as locally raised water levels are as a direct result of manipulation of natural surface water drainage to increase productive agricultural land.

A.4. Discussion

There were no protected plant species, or any habitats of conservation interest within the Survey Area. The habitats within the application area where the turbines and infrastructure will be located are predominately arable fields, some improved grassland for livestock grazing, small blocks of woodland and species poor hedges.

The Survey Area is relatively uniform in the type of habitats present, being dominated by arable fields so does not provide a diverse range of habitats for protected species. The most ecologically valuable habitats are around the deciduous woodlands around Over Finlarg and Nether Finlarg, the wet ditches and the area around the pond and small burn in the north of the Survey Area.

There were four areas which were identified as potential GWDTEs which were within 250m of proposed turbines or 100m of proposed tracks. Four of these were of sufficient size to allow NVC surveys to be undertaken with the remaining two assessed to be small areas of wetter grassland where local surface drainage has resulted in a wetter habitat developing. The four potential GWDTE were all identified as dependent not on groundwater but on surface drainage connected to the artificial drainage (both open ditches and culverted drains) system that is present across the Survey Area.

There was some suitable habitat for protected species such as bats, badgers and red squirrel and very little suitable habitat for otters and water vole. The most suitable habitat for bats was around the farms at Over Finlarg and Nether Finlarg and a number of mature trees located to the north of Nether Finlarg and close to Over Finlarg Farmhouse. Possible suitable sett building habitat for badgers was identified around the coniferous plantations near to the semi-improved grassland in the north of the Survey Area. The coniferous plantations could also be suitable habitat for red squirrel as there were many cones on the trees and scattered on the ground. There were very limited watercourses or water bodies in the Survey Area which would be suitable for otters or water voles. No signs of any protected species were found during the Phase 1 survey.

A.5. References

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Annex 1: Phase 1 Habitat Survey Target Notes

Target Note	Eastings	Northings	Description
1	341456	741435	Over Finlarg Farm. A mixture of agricultural and domestic buildings which are surrounded by bare ground, disturbed ground and various planted and naturally regenerating trees. The agricultural buildings are a mixture of old and new and are constructed with various materials such as stone, brick, wood walls, corrugated metal walls. The roofs are mostly of corrugated composite with some slate roofs. These buildings are used for livestock and storage of agricultural equipment. There are a couple of open barns which are used for storing straw bales. There is a large silage pit at the western end of the farm. There are three dwellings on the farm, one a two storey brick house with harled walls and a slate roof, the other two houses are stone built with slate roofs. These buildings have low potential for roosting bats. On the disturbed ground are plants such as broad leaved dock, creeping buttercup, common nettle, rosebay willowherb, bramble, white clover, soft rush, common chickweed, groundsel, ash seedlings.
2	341264	741537	Old stone wall covered in moss running along the east edge of the track. Some scattered gorse bushes.
3	341324	741358	Mixed woodland around the newer house consisting of Scots pine, eucalyptus, Lawson cypress, sycamore, European larch, a line of young bird cherry trees next to the garden fence, a line of mature conifers runs along the fence to the west. Further over to the west is a small copse consisting of more deciduous trees including sessile oak and elder. The trees were mature 10-12m high, there were some small holes and cracks but they had low bat roost potential. The ground flora consisted of bramble, rosebay willowherb, snow drops and bracken.
4	341546	741416	Line of mature 10-12m ash trees along south side of track, some cracks and holes with a bat roost potential. Stone wall either side of the track, mostly covered in moss.
5	341518	741459	Line of semi-mature, 7-9m, ash trees along fence line.
6	341570	741432	Group of mixed mature deciduous trees including beech, sycamore and pedunculate oak.
7	341802	741516	Manure heap.
8	341821	741464	Dry ditch 2m wide at top and 0.5m wide at the bottom, 0.5m deep, completely overgrown, bracken, spear thistle, cocksfoot, gorse, hogweed, broad leaved dock. Stone wall running along south side of ditch, fence on north side.
9	341867	741475	Small triangle of immature/young mostly deciduous trees, beech, silver birch, Scots pine, Sitka spruce.
10	342010	741642	Meeting of two ditches, ditch to west 2m wide at top and <1m wide at bottom, 0.5m deep, muddy, gravelly bottom, a trickle of water <10cm deep. Banks 45-75°, mostly rock, mud and short ruderal plants including broadleaved dock, creeping buttercup, common nettle. Ditch to the northeast the same as above; both have recently been cleaned out.
11	341777	741866	Line of mature, 10m, beech trees along fence line, some little rot holes and cracks but generally trees in good health so low bat roost potential. No sign of drain in field to north.
12	341534	741793	No drain, completely overgrown and filled in.
13	341608	742120	Sheep wash area, stone wall construction. To the south of the

Target Note	Eastings	Northings	Description
			sheep wash area is a large area of bare ground, an area of marshy grassland and disturbed ground with soft rush, common nettle, broadleaved dock.
14	341540	742135	Pond which is completely overgrown with soft rush, water-cress, marsh marigold, flag iris in the middle.
15	341848	742482	Short ditch 2m wide at top and 0.5m wide at bottom, <1m deep with <10cm of water, sandy and gravelly bottom. Up and downstream piped underground. Wet area with brooklime, creeping bent, floating sweet grass, common starwort, water-cress. Around gorse bushes was common nettle, pineappleweed and spear thistle. Stone dump in the corner of the field.
16	341748	742610	Planted hawthorn hedge with some young beech trees at the north end.
17	341900	742604	Fenced off area with very young, 1-2m, planted mixed trees including beech, larch and silver birch. In centre was a ruined house with stone walls and no roof.
18	342021	742515	A couple of young, 3-5m, sycamores at the gate.
19	341661	742624	Small burn <0.5m and <0.5m deep, gravelly bottom. Tall ruderal mostly rosebay willowherb, some soft rush, some gorse.
20	341597	742646	Pond approximately 25m by 10m, 0.3-1.5m deep, polythene lined, some water starwort and algae. Brooklime, water-cress, floating sweet grass, starwort, common duckweed.
21	341716	743086	Ditch along north boundary, 2m wide at top and 0.5m wide at bottom, 1-2m deep with <10cm of water. Mostly overgrown with soft rush, gorse, rosebay willowherb, cocksfoot.
22	341434	743063	Open clearing along track in plantation. Craggy area with ruderal species such as common nettle and rosebay willowherb, with 2 young birch and rowan. Surrounded by mature, 10-15m, Sitka spruce.
23	341335	743088	Large pile of field stones.
24	341232	743248	Pile of stones, possibly a small old quarry, in semi-improved area of grassland.
25	341096	742765	Coniferous mature, 10-15m, plantation mixed with Sitka spruce and lodgepole pine.
26	341264	742581	Unimproved grassland with scattered gorse bracken up valley. Dominated by matt grass and mosses such as *Hylocomium splendens* and *Rhytidiadelphus squarrosus*.
27	341365	742631	Area where landowner has extracted stone.
28	340813	741563	Area in corner of field with a group of mature, 10m, mixed trees, Scots pine, sycamore, ash with some holes but low bat roost potential.
29	341007	741287	Group of 4 mature, 7-9m, Scots pine in a corner of field.
30	342067	740616	Area of scrub in corner of arable field, mostly blackthorn.
31	342126	741618	Small pond in middle of field where field drain had collapsed and water had accumulated. Surrounded by young mixed woodland.
32	342616	741724	Large ornamental pond in garden at Nether Finlarg. Surrounded by woodland and ornamental plants.
33	342859	742425	Line of mature (10-15m) beech trees along north side of track. Some rot holes and cracks which would be suitable bat roosts.

Annex 2: Phase 1 Habitat Survey Botanical Species List

Common Name	Scientific Name
Annual Meadow grass	*Poa annua*
Ash	*Fraxinus excelsior*
Beech	*Fagus sylvatica*
Bird cherry	*Prunus padus*
Blackthorn	Prunus spinosa
Bracken	*Pteridium aquilinum*
Bramble	*Rubus fruticosus*
Broad-leaved dock	*Rumex obtusifolius*
Brooklime	*Veronica beccabunga*
Cleavers	*Galium aparine*
Cock's-foot	*Dactylis glomerata*
Colt's-foot	*Tussilago farfara*
Common bent	*Agrostis capillaris*
Common chickweed	*Stellaria media*
Common duckweed	*Lemna minor*
Common gorse	*Ulex europaeus*
Common hogweed	*Heracleum sphondylium*
Common mouse-ear	*Cerastium fontanum*
Common nettle	*Urtica dioica*
Common ragwort	*Senecio jacobaea*
Common sorrel	*Rumex acetosa*
Common water-starwort	*Callitriche stagnalis*
Creeping bent	*Agrostis stolonifera*
Creeping buttercup	*Rannunculus repens*
Creeping soft grass	*Holcus mollis*
Creeping thistle	*Cirsium arvense*
Daisy	*Bellis perennis*
Dandelion	*Taraxacum officinale*
Elder	*Sambucus nigra*
Eucalyptus	*Eucalyptus sp.*
European larch	*Larix deciduas*
Field horsetail	*Equisetum arvense*
Field wood-rush	*Luzula campestris*
Floating sweet-grass	*Glyceria fluitans*
Foxglove	*Digitalis purpurea*
Ground elder	*Aegopodium podagraria*
Groundsel	*Senecio vulgaris*
Hard fern	*Blechnum spicant*
Hawthorn	*Crataegus monogyna*
Heath bedstraw	*Galium saxatile*
Heath rush	*Juncus squarrosus*
Hogweed	*Heracleum sphondylium*

Common Name	Scientific Name
Ivy leaved crowfoot	*Ranunculus hederaceus*
Japanese larch	*Larix kaempferi*
Jointed rush	*Juncus articulatus*
Lawson cypress	*Chamaecyparis lawsoniana*
Lodgepole pine	*Pinus contorta*
Marsh marigold	*Caltha palustris*
Mat grass	*Nardus stricta*
Meadow buttercup	*Rannunculus acris*
Meadow fescue	*Festuca pratensis*
Meadow vetchling	*Lathryus pratensis*
Opposite leaved golden saxifrage	*Chrysosplenium oppositifolium*
Pedunculate oak	*Quercus robur*
Perennial rye-grass	*Lolium perenne*
Pineappleweed	*Matricaria discoidea*
Red clover	*Trifolium pratense*
Reed canary grass	*Phalaris arundinacea*
Ribwort plantain	*Plantago lanceolata*
Rosebay willowherb	*Chamerion angustifolium*
Scot's pine	*Pinus sylvestris*
Sharp flowered rush	*Juncus acutiflorus*
Sheeps Sorrel	*Rumex acetosella*
Silver birch	*Betula pendula*
Silverweed	*Potentilla anserine*
Sitka spruce	*Picea sitchensis*
Soft rush	*Juncus effusus*
Small nettle	*Urtica urens*
Snowdrop	*Galanthus nivalis*
Spear thistle	*Cirsium vulgare*
Sweet vernal grass	*Anthoxanthum odoratum*
Sycamore	*Acer pseudoplatanus*
Tormentil	*Potentilla erecta*
Tufted hair-grass	*Deschampsia cespitosa*
Water-cress	*Rorippa nasturtium-aquaticum*
White clover	*Trifolium repens*
Willow	*Salix sp.*
Yellow flag iris	*Iris pseudacorus*
Yorkshire fog	*Holcus lanatus*
Mosses	
Glittering wood-moss	*Hylocomium splendens*
Springy turf moss	*Rhytidiadelphus squarrosus*
Common haircap	*Polytrichum commune*

Annex 3: NVC Survey Results

Quadrat No.	1	2	3	4	5
Grid Ref	**NO 41591 42646**	**NO 41624 42630**	**NO 41815 42528**	**NO 41931 42586**	**NO 41593 42049**
Location	**Upstream of pond**	**Downstream of pond**	**Corner of improved field**	**Area at ruined house**	**Sheep wash area**
Habitat Code	**B5**	**B5**	**B5**	**B5**	**B5**
NVC	**MG10**	**M23**	**N/A**	**S28**	**N/A**
Herbs, grasses & ferns					
Juncus effusus	7		Y	9	9
Juncus articulatus		9			
Deschampsia cespitosa	5				
Urtica urens	4	4			
Chamerion angustifolium	4				
Rumex obtusifolius	4	1	Y		
Holcus mollis	5				
Ranunculus repens	3	4		2	
Rumex acetosa	2	4		2	
Potentilla anserine		3			
Cirsium arvense		4		2	
Galium aparine					4
Lathryus pratensis		2			
Holcus lanatus		6			
Epilobium montanum					4
Stellaria media					
Phalaris arundinacea				8	
Veronica beccabunga			Y		
Agrostis stolonifera			Y		
Glycerica fluitans			Y		
Callitriche sp.			Y		
Rorippa nasturtium-aquaticum			Y		
Field height (cm)	100	20	50	150	100
Field cover (%)	90	100	60	90	75
Moss height (cm)					
Moss cover (%)					
Grazing Pressure	L	L	H	N	L
No of species/quadrat	**8**	**9**	**6**	**5**	**3**
Size of quadrat	1m x 1m	2m x 1m	1m x 1m	2m x 1m	2m x 1m

Appendix 7-2: Bat Survey

A.6. Executive Summary

The Site of the proposed Frawney Wind Farm was subject to a number of surveys in relation to bats, in order to ascertain the risk that the proposed development may have to local bat populations.

A daytime roost assessment survey together with nocturnal transect and static detector surveys were undertaken across the Survey Area which encompasses the Site.

Results of these surveys identified that a number of buildings and trees are present within the Survey Area that offer suitable features for roosting bats although no definitive evidence of bats roosting within these buildings or trees was identified. All potential roosts are in excess of 400m from the proposed turbine locations and will not be disturbed as part of the proposed wind energy development.

Activity surveys undertaken during late April 2012 identified extremely low activity levels with only a single common pipistrelle pass recorded during the dusk transect surveys and only two soprano pipistrelle passes recorded during five nights of static detector deployment. Both of these surveys were undertaken across the Survey Area at previously proposed turbine locations (Table 3-2: layout d) and suitable bat habitat features.

This interim report represents initial results. Further surveys undertaken in July and late August 2012 complete a full activity season in accordance with new guidance (HUNDT, 2012) and are reportd in Appendix 7-3. From the March - April 2012 results, it is assessed that activity levels are extremely low across the Survey Area.

A.7. Introduction

Terms of Reference

Atmos Consulting Ltd was commissioned to undertake bat surveys at the proposed application site. This survey was identified as necessary following both preliminary consultations and the results of an extended Phase 1 habitat survey. This report presents the findings of the bat surveys completed in relation to the 'Survey Area' which encompasses the application site, hereafter referred to as 'the Site'.

Objectives of the Study

This report examines the possible constraints imposed upon the proposed development by bats, details the habitat suitability for these species and their likely presence within the Survey Area; based on a single survey undertaken late April 2012.

This report details the following:

- Legislative context;
- Field survey methodology;
- Field survey results; and
- Conclusions.

Site Description

The Site for the proposed Frawney Wind Farm is located within an area which is dominated by agriculture, primarily sheep grazing and arable. The wider Survey Area also supports a number of small woodland blocks of broadleaved and coniferous species, along with several linear features including: ditches, fences and hedges. Two small ponds are also present within the Survey Area, which offers suitability habitat for foraging bats. The wider landscape supports extensive agriculture, coniferous woodland and heathland. Key habitats within the landscape that are likely to offer suitability for roosting, foraging and commuting bats include woodland edges, ditches, small ponds and farm buildings.

A.8. Legislative Context

All bat species in the UK are afforded full statutory protection as European protected species listed on Schedule 2 of the Conservation (Natural Habitats, &c.) Regulations 1994 as amended in Scotland, which transpose into Scottish Law in the European Community's Habitats Directive (92/43/EEC).

Under the terms of Regulation 39(1), with certain exceptions, it is an offence:

- Deliberately or recklessly to capture, injure or kill a wild bat;
- Deliberately or recklessly–
  - to harass a wild bat or group of wild bats;
  - to disturb a bat while it is occupying a structure or place which it uses for shelter or protection;
  - to disturb a bat while it is rearing or otherwise caring for its young;
  - to obstruct access to a breeding site or resting place of a bat, or otherwise to deny the bat use of the breeding site or resting place;
  - to disturb a bat in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs; or
  - to disturb a bat in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young; or
- To damage or destroy a breeding site or resting place of such an animal.

It is also an offence under Regulation 39 to keep, transport, sell or exchange, or offer for sale or exchange, any live or dead bat, or any part of, or anything derived from one. All of the above protections apply regardless of the stage of the life of the animal in question.

Of the 18 UK bat species, ten occur in Scotland: common pipistrelle *Pipistrellus pipistrellus*, Soprano pipistrelle *P. pygmaeus*, Nathusius' pipistrelle *P. nathusii*, Natterer's *Myotis nattereri*, Daubenton's *M. daubentonii*, noctule *Nyctalus noctula*, brown long-eared bats *Plecotus auritus*, Leisler's *N. leisleri* and whiskered/Brandt's M. *mystacinus/M. brandtii* bats.

A.9. Consultation and Review of Existing Information

Consultations

A desk-based study was undertaken to determine the presence of nature conservation sites designated for bat interest in proximity to the proposed development, as well as to obtain any existing records for bats. The following organisations were contacted:

- Tayside Bat Group;
- McManus Galleries Local Biological Records Centre; and
- Perth Museum.

The Tayside Bat Group supplied five records of bats within 5km of the Site. These included a maternity roost of 500 soprano pipistrelle in Glamis NO384467; a dead pipistrelle within Glamis church; a maternity roost of 100 pipistrelle bats in Glamis at NO385425; a further maternity roost of 100 pipistrelle bats in a hotel near Glamis NO324467; and a roost (no additional details) at Mains of Kinettles NO432462. None of these records are within the Survey Area and all are at least 2.4km away from the Survey Area.

The McManus Galleries provided information on biological records although no records of bats for the area were present.

Perth Museum confirmed that they do not hold any data for the Angus area.

In addition the NBN Gateway (http://data.nbn.org.uk) was used to identify any additional bat records. Two records were identified from the SNH dataset although details on location, species or number of bats were not accessible.

Statutory Designated Sites

Review of the SNH Sitelink mapping site (www.snh.gov.uk/snhi) confirmed there to be no statutory designated nature conservation sites listing bat interest within or adjacent to the Site boundary.

A.10. Survey Methodology

Bat surveys were undertaken by a team of suitably experienced ecologists across the Site during 2012 (from March to April). Three types of survey methodologies were undertaken at the Site: roost assessments, activity transects and static recording.

Additional surveys were undertaken later in the year (July and late August 2012) to complete the required surveys to meet new guidance published by Bat Conservation Trust (Hundt, 2012) and agreed by SNH (email to Atmos Consulting from Mark Moore, SNH 19th March 2012) and Angus Council (meeting 12th March 2012). Surveys undertaken in July and August 2012 were previously presented as Supplementary Information in September 2012 and are reported in Appendix 7-3 of this ES.

Roost Assessments

External roost assessments were undertaken on all buildings and mature trees identified as being suitable to support bats within or immediately adjacent to the Site (Figure 7-4). The external roost assessments were undertaken by a suitably experienced and licenced ecologist (SNH Licence 12770) on the 13th March 2012.

Two main building complexes were present on Site at the farms of Over Finlarg (NO 41433 41395) and Nether Finlarg (NO 42660 41844). A small croft ruin (building 7) was also present within the Site.

All buildings were visually examined to look for features that could provide potential for roosting bats: such features include loose tiles, missing or loose slates, gaps under areas of lead flashing, particularly around the chimneys, gaps under fascia boards and soffits and any gaps/holes in the general stonework of the buildings. Non-residential buildings were also examined internally where accessible for any evidence of bats such as droppings and staining due to urine and/or oil from the bats fur.

All mature broadleaved trees or other structures within or adjacent to the Site offering suitability for bats were identified during the extended Phase 1 habitat survey. Any trees or other features present were visually assessed to identify any features which may provide potential for roosting bats such as cracks, rot holes, crevices and sections of loose bark. Evidence of bats, such as droppings and urine staining was also looked for. Video endoscopes were used where necessary to investigate accessible cavities.

Activity Transects

An activity survey, using handheld Anabat SD2 detectors, was undertaken during favourable weather conditions on 30th April 2012. The activity survey comprised of two separate transects, commenced simultaneously at sunset, to assess the activity levels of the bats present on the Site.

Each transect started half an hour before sunset and continued for approximately 2.5 hours.

The transect routes (Figure 7-3) covered a representative area of the Site and included all of the previously proposed turbine locations (Table 3-2; layout d), along with sections of suitable habitat, such as ditches and woodland edges.

Transects were undertaken on foot and followed standard transect methodology (HUNDT, 2012). Five minute 'listening points' were located along each transect, which consisted of the surveyor stopping at pre-defined points for five minutes, recording any bats foraging and/or commuting in the vicinity. The type of activity (commuting and/or foraging) and the direction in which the bats were travelling in were also recorded where the bat was observed.

Any bats recorded were identified to species, where possible, and recorded on a field map. The calls were recorded and, if field identification was not possible, the calls were later analysed by an experienced bat ecologist, using Titley Electronics Analook software, to allow identification to species.

Static Recorders

Eight Anabat SD2 recorders were used at the Site in order to survey the number, species and distribution of bats across the Site as a whole. Habitats considered to be representative of those in which turbines are likely to be located i.e. in open habitat were included in the survey as well as edge habitat that represent good quality foraging resources in relative close proximity to turbines. Figure 7-3 shows the location of the static recorder stations and Annex 1 provides their grid references.

Anabat SD2 units were placed on the 25th April 2012 and collected on 30th April 2012.

Static detectors were deployed before sunset on deployment date and collected after sunrise on collection date.

Weather Conditions

During the surveys the weather conditions were variable. Transect surveys were conducted under the most suitable weather conditions for the time of year with overcast conditions and a low temperature of 6°C at the start of the transect falling to 4.7°C when transects were complete. In addition light intermittent rain was present. Although these conditions are not ideal for bat activity they were typical for the season during 2012. In discussion with Rob Raynor (email 17th May 2012) of SNH it is known that pipistrelle bats, for instance, will regularly be active at temperatures as low as 7°C and such low temperatures although likely to affect general activity levels of bats do not invalidate surveys when such weather conditions are typical of the time of year.

During the static deployment night time temperatures were consistently low with temperatures not exceeding 9°C with occasional heavy rain and often brisk northeast winds. It should be noted that March conditions were generally better with higher temperatures and less rain and despite poor conditions in April bats were observed to be active at various locations within Scotland.

Analysis

All the data from the Anabat SD2s were downloaded and analysed, by an experienced bat ecologist, using Analook software to enable identification of species and to calculate and assess the activity levels present across the Site and between each turbine and habitat locations. The levels of activity recorded on the Site, however, are not absolute, but are relative to the Site. For ease of examination three arbitrary levels have been created to provide a context in which to discuss the results. Table A7-2 indicates the levels of activity required to be considered to be low, medium or high activity. Activity levels are assessed in terms of the risk levels outlined in Natural England's guidance note – TIN051 (Natural England, 2009) which identifies the risk of species based on both an individual basis (habitat and behaviour) and population basis (distribution and rarity).

Table A7-2: Criteria for Determining Relative Bat Activity Levels

Activity Level	Number of bat passes/hour*
Low	<10
Medium	10 - 20
High	>20

** A bat pass is classified as the presence of a species within a single Anabat file.*

Limitations

During the activity surveys (transects and duration of static detector survey) the weather conditions were not optimal with night time temperatures at the Site ranging between 4 and 9°C with periods of rain (light rain during transects but occasional heavy rain potentially occurring during static deployment during hours of darkness). Despite bat activity being identified at sites within the region and further afield it is likely that the level of activity recorded during these initial surveys is lower than would be expected under optimal weather conditions. The lack of comprehensive data covering an entire season is a limitation at this stage, however, two additional survey visits were undertaken in July and August 2012 with information submitted in September 2012 (Appendix 7-3),

No other significant limitations were experienced during the surveys that have been conducted to date (May 2012).

A.11. Results

Habitat Assessment

The Site is dominated by relatively open and intensive agriculture with a land use dominance of improved pasture and arable fields. A number of small woodland copses and shelter belts are located within the Survey Area but the majority of these are not well connected in terms of suitable commuting routes or foraging habitats. Field boundaries across the Survey Area are generally formed by post and wire fences or stone walls with no significant field margins offering suitable foraging habitat or navigational features.

Throughout the Survey Area a number of buildings, primarily residential and agricultural are present which offer an array of suitable roosting locations. In addition, a number of mature trees with features capable of supporting roosting bats are also present. Again due to the lack of connectivity to the majority of these locations and general lack of suitable foraging areas, the 'attractiveness' of these sites to bats may be somewhat reduced; although roost opportunities may be present. It should be recognised that bats are transient species in many situations and roosts may only be used by a small number of bats on a sporadic basis. This is particularly likely where large maternity roosts are present within the wider landscape and smaller roosts of males are often located away from the main maternity roosts.

Additional bat habitat features include two small ponds that may offer suitable foraging habitat. The northern pond (NO414426) is small and exposed, formed by an artificial butyl liner. As a result this pond is not likely to offer an extensive foraging resource for foraging bats although some degree of invertebrate foraging resource is likely to be present during the summer months. The second pond is located within the grounds of Nether Finlarg Farmhouse and is a natural collection point for drainage which feeds the Gallowfauld Burn. This pond is larger (approximately 35m by 30m) and offers a more sheltered environment with woodland edges and an increased invertebrate biomass would be expected offering some suitability for foraging bats (NO426417).

Roost Assessments

The roost assessments identified a number of suitable structures and trees that are capable of supporting roosting bats.

Nether Finlarg is dominated by large modern agricultural and light industrial buildings and as such offers few opportunities for roosting bats. The farmhouse at Nether Finlarg and the Farm Cottages to the north offer some opportunities for roosting bats but due to the very open nature of the Site and only moderate suitability for foraging within the surrounding landscape; the potential for supporting significant roosts is low. To the north of Nether Finlarg is an avenue of mature beech trees, the majority of which have suitable roosting opportunities for bats and it is possible that a number of these trees are used for roosting although no definitive evidence to confirm this was identified by roost inspections.

A number of older farm buildings at Over Finlarg offer suitable roosting opportunities, in particular the central stone farm buildings (buildings 11, 12 and 14) and farmhouse (building 15) (Figure 7-4). These buildings offer crevices within damaged stone walls and supported slate roofs with damage in various locations and a number of missing or raised slates. Many of these buildings had extensive detritus on the floor or were used for housing livestock or animal feed/bedding and a search for evidence of bats such as droppings was very difficult. The farm also houses livestock within large open barns which may offer some sheltered foraging, especially during sub-optimal weather conditions. The majority of the other buildings located within the farm offered less suitable opportunities, although the presence of small roosts within these buildings cannot be completed ruled out.

Within the Over Finlarg Farm a number of trees offering good opportunities for roosting bats were also identified. These were primarily trees located north and east of the main farmhouse, although a single tree located west of the farmhouse also offered significant potential for roosting bats (Annex C and Figure 7-4).

As with the avenue of beech trees, not all of the suitable features could be accessed to undertake internal inspections using an endoscope due to the height of the feature. Inspections, where possible, did not identify any definitive evidence to suggest the features were used as roosts at the time of the survey.

The ruined croft (building 7) offers no suitable roosting opportunities as the building has no roof and the walls are all exposed to the elements.

Activity Transects

During the April 2012 activity transect only a single bat pass was recorded during the two transect surveys. This pass of a common pipistrelle was identified along the access road to Nether Finlarg approximately 50m south of Nether Finlarg Farmhouse. This identifies extremely low activity levels (0.2 bat passes per hour) across the Survey Area with no activity of bats recorded within 500m of any proposed infrastructure.

Static Recorders

The static detectors also recorded very low activity during the period of deployment with a total of two soprano pipistrelle passes at Static Location H2 (along avenue of beech trees). This results in an extremely low activity rate of 0.05 bat passes per hour at this location. The results of the initial static detector survey provided similar usage patterns to those identified during the transect surveys and suggest that what little activity was present within the Survey Area during the survey time period was concentrated close to Over Finlarg and the avenue of beech trees to the north where more sheltered foraging and potential tree roosting opportunities are present.

A.12. Discussion

The results of the single transect survey and static surveys identify that the Site supports very low levels of activity from bats. Only a single common pipistrelle pass during transect surveys and two soprano pipistrelle passes during five nights of static detectors were recorded across the Survey Area. In addition no activity was recorded within 500m of the proposed infrastructure.

All buildings excluding the ruined croft (building 7) were in excess of 500m from the proposed turbine locations and connectivity from buildings to turbine locations is generally poor. It is possible that the older farm buildings at Over Finlarg along with the residential buildings at Nether Finlarg provide shelter for roosting bats, although the potential for significant roosts to be present is thought to be low, based on suitability and connectivity of the surrounding landscape for foraging and commuting.

The ruined croft (building 7) is the only building in close proximity to the proposed turbines and this does not offer any suitability for roosting bats.

In addition a number of trees were assessed to offer significant opportunities for roosting. The avenue of beech trees where two soprano pipistrelle passes were identified are all in excess of 400m from the nearest turbines. The track running west may offer some commuting/foraging opportunities resulting in bats flying within 50m of the turbines, although the frequency of this is likely to be extremely low with bats remaining on the track and not flying at height within proximity of the turbine rotor sweep.

Pipistrelles were the only species recorded within the Survey Area and these species generally prefer to forage and commute along edge habitat, particularly along the edges of woodland and around human habitations as their type of flight, body shape and behaviour is adapted for foraging in these cluttered habitats. All species of bats also tend to use linear features, such as hedgerows, or tracks as commuting routes, as these provide features by which the bats can orientate themselves in the landscape. In the case of open habitats such as on this Site, edge habitats may also include more subtle changes in vegetation such as scrub or marginal vegetation along rivers.

Although the surveys undertaken in March – April 2012 provide only a narrow snapshot of activity at the start of the bat activity season, the results suggest that activity levels across the Survey Area are likely to be low with only pipistrelle bats present. Additional surveys during the Summer and Autumn activity periods under more suitable weather conditions provide further information on the bat activity levels at the Site (Appendix 7-3).

Both common and soprano pipistrelles are considered to be species at medium risk of turbine impact (Natural England, 2010), with the risk of collision fatalities significantly affecting bat populations considered to be low. It is suggested that, in accordance with Natural England's published guidance, a minimum of a 50m buffer should be retained between blade tips and all woodland, riverine, scrub and hedgerow habitats.

Overall the level of bat activity is very low and although a complete season of activity has not to date been surveyed at present the data so far suggests that bats are unlikely to pose any significant constraint to the development of the Site for a wind energy project.

Annex 1: Static Detector Location Details

Static Location Code	Habitat Feature/ Turbine	Grid Reference
H1	Habitat	NO 4161442637
H2	Habitat	NO 4266442423
H3	Habitat	NO 4148941387
H4	Habitat	NO 4257141347
T1	Proposed Turbine (layout d)	NO 4212442490
T2	Proposed Turbine (layout d)	NO 4176242467
T3	Proposed Turbine (layout d)	NO 4143642197
T4	Proposed Turbine (layout d)	NO 4123341842

Annex 2: Building Assessment Survey Forms

Building Complex	Potential Roost	Potential Roost ID	External Assessment	Internal Assessment	Likelihood of active roost
Nether Finlarg	Main Industrial Building Complex	Building 1	Yes	Limited	Low
Nether Finlarg	Detached Industrial building	Building 2	Yes	No	Negligible
Nether Finlarg	Small Utilities Building	Building 3	Yes	No	Negligible
Nether Finlarg	Farmhouse	Building 4	Yes	No	Moderate
Nether Finlarg	Semi Detached Houses 1	Building 5	Limited	No	Negligible
Nether Finlarg	Semi Detached Houses 2	Building 6	Limited	No	Negligible
Ruined Croft	Ruin	Building 7	Yes	Yes	Negligible
Over Finlarg	NW Dutch Barn	Building 8	Yes	Yes	Negligible
Over Finlarg	N Barn	Building 9	Yes	Yes	Negligible
Over Finlarg	NE Barn	Building 10	Yes	Yes	Negligible
Over Finlarg	Central Building	Building 11	Yes	Yes	Low
Over Finlarg	Central Building Eastern Annex	Building 12	Yes	Yes	Moderate
Over Finlarg	Detached Garage	Building 13	Yes	Yes	Low
Over Finlarg	Central Building Western Annex	Building 14	Yes	Yes	Moderate
Over Finlarg	Farmhouse	Building 15	Yes	No	Moderate
Over Finlarg	Detached Bungalow	Building 16	Yes	No	Low
Over Finlarg	Detached House	Building 17	Yes	No	Low
Over Finlarg	Detached House Garage	Building 18	Yes	No	Low

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name **Grid reference**		Building 1 - Main Industrial Building Complex NO 42671 41854			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		No internal searches, as a result no H&S issues other than general awareness within a farmyard setting.			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Complex of buildings is located within arable land with small area of mixed plantation woodland with hedge and tree connections to wider landscape. In addition a medium sized pond is located within the garden of the farmhouse which is likely to offer good foraging opportunities.			

Building structure	**Type**	**Wall materials**	**Date last occupied?**
	Mixture of agricultural/light industrial	brick, block and stone	Occupied
	Age	**Cladding**	**State of repair?**
	mostly ~50 years, up to ~100 years	None	moderate

Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***	Buildings are mix of industrial and agricultural style buildings with corrugated sheet roofing with skylights, silos, large shuttered doors. Areas of older construction including stone walls and lean to structure also present. Access points to majority of buildings are extensive through slatted window, ventilation holes and gaps around doors and under guttering.

Roof construction	**Type pitched, flat etc.**	**Eaves/soffits note if wooden**	**Internal truss type?**
	Pitched	None	Mixed
	Materials	**Sarking, underfelt?**	**Insulation**
	Corrugated composite sheets	Sarking present in areas	None

Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***	No evidence of bats identified, although limited access to interior results in only partial searches. No evidence from external assessments.

Initial assessment
Only area offering suitable roost habitat is small (lean to building of stone walls (far older than rest of complex). At time of survey this areas was being reroofed and no signs of bats had been identified
Overall Likelihood of Active Roost
Low - In general opportunities are very few with only areas of older stone work and small sections of slate roofing offering any value.
Recommendations
If static/transect monitoring identifies extensive use of building with flight paths connecting to proposed turbine locations then emergence surveys may be required to identify roost size and type.

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name ***Grid reference, mark on plan***		Building 2 - Detached Industrial building NO 42602 41842			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		No internal searches, as a result no H&S issues other than general awareness within a farmyard setting.			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Complex of buildings is located within arable land with small area of mixed plantation woodland with hedge and tree connections to wider landscape. In addition a medium sized pond is located within the garden of the farmhouse which is likely to offer good foraging opportunities.			
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Single storey light industrial style units		brick		Occupied
	Age		**Cladding**		**State of repair?**
	~10 years		None		good
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***		No access points identified from external assessment, small gaps around shuttered doors but unlikely to be used by bats.			
Roof construction	**Type** *pitched, flat etc*		**Eaves/soffits** *note if wooden*		**Internal truss type?**
	Pitched		None		unknown
	Materials		**Sarking, underfelt?**		**Insulation**
	Corrugated metal sheets		Unknown		unknown
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***			No evidence from external assessments.		
Initial assessment					
Unsuitable for use by bats.					
Overall Likelihood of Active Roost					
Very low					
Recommendations					
None					

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name ***Grid reference, mark on plan***		Building 3 - Small Utilities Building NO 42595 41802			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		No internal searches, as a result no H&S issues other than general awareness within a farmyard setting.			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Complex of buildings is located within arable land with small area of mixed plantation woodland with hedge and tree connections to wider landscape. In addition a medium sized pond is located within the garden of the farmhouse which is likely to offer good foraging opportunities.			
Building structure	**Type**		**Wall materials**	**Date last occupied?**	
	Small single storey building		block	N/A	
	Age		**Cladding**	**State of repair?**	
	~10 years		None	Poor	
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***		Small utilities building with door ajar. No other access opportunities.			
Roof construction	**Type *pitched, flat etc.***		**Eaves/soffits *note if wooden***	**Internal truss type?**	
	Pitched		None	N/A	
	Materials		**Sarking, underfelt?**	**Insulation**	
	Felt		None	None	
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***			No evidence from external assessments.		
Initial assessment					
Unsuitable for use by bats.					
Overall Likelihood of Active Roost					
Very low					
Recommendations					
None					

<table>
<tr><td>Job No.</td><td>4603</td><td>Date</td><td>13/03/2012</td><td>Surveyors</td><td>JB</td></tr>
<tr><td colspan="2">Building no, description or name
Grid reference, mark on plan</td><td colspan="4">Building 4 - Farmhouse
NO 42663 41813</td></tr>
<tr><td colspan="2">Health and safety issues and precautions taken
Work at height, in dark, asbestos, fibreglass, dust, droppings, other</td><td colspan="4">No internal searches, as a result no H&S issues other than general awareness within a farmyard setting.</td></tr>
<tr><td colspan="2">Surrounding habitat assessment
Foraging, flightlines, roosts</td><td colspan="4">Complex of buildings is located within arable land with small area of mixed plantation woodland with hedge and tree connections to wider landscape. In addition a medium sized pond is located within the garden of the farmhouse which is likely to offer good foraging opportunities.</td></tr>
<tr><td rowspan="4">Building structure</td><td colspan="2">Type</td><td colspan="2">Wall materials</td><td>Date last occupied?</td></tr>
<tr><td colspan="2">Detached farmhouse with extensions</td><td colspan="2">Stone</td><td>Occupied</td></tr>
<tr><td colspan="2">Age</td><td colspan="2">Cladding</td><td>State of repair?</td></tr>
<tr><td colspan="2">mostly ~100 years, modern additions</td><td colspan="2">None</td><td>Fair</td></tr>
<tr><td colspan="2">Access points
Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.</td><td colspan="4">A number of potential access points are present under missing or raised slates, ridge flashing and damaged soffits along modern extension.</td></tr>
<tr><td rowspan="4">Roof construction</td><td colspan="2">Type pitched, flat etc</td><td colspan="2">Eaves/soffits note if wooden</td><td>Internal truss type?</td></tr>
<tr><td colspan="2">Pitched</td><td colspan="2">None</td><td>Mixed</td></tr>
<tr><td colspan="2">Materials</td><td colspan="2">Sarking, underfelt?</td><td>Insulation</td></tr>
<tr><td colspan="2">Corrugated composite sheets</td><td colspan="2">sarking present in areas</td><td>None</td></tr>
<tr><td colspan="3">Evidence of bats
Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?</td><td colspan="3">No evidence from external assessments.</td></tr>
<tr><td colspan="6">Initial assessment</td></tr>
<tr><td colspan="6">Some potential roosting opportunities within the building exist with best opportunities under raised slates within the single storey older sections.</td></tr>
<tr><td colspan="6">Overall Likelihood of Active Roost</td></tr>
<tr><td colspan="6">Moderate</td></tr>
<tr><td colspan="6">Recommendations</td></tr>
<tr><td colspan="6">If static/transect monitoring identifies extensive use of building with flight paths connecting to proposed turbine locations then emergence surveys may be required to identify roost size and type.</td></tr>
</table>

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name ***Grid reference, mark on plan***		Building 5 - Semi Detached Houses 1 NO 42711 41980			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		No internal searches, as a result no H&S issues.			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Houses are located within arable land north of Nether Finlarg with hedge and tree connections to wider landscape. In addition a medium sized pond is located within the garden of the farmhouse which is likely to offer good foraging opportunities.			
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Semi-detached bungalow		Probably block		Occupied
	Age		**Cladding**		**State of repair?**
	~20 years		None		good
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***		Both houses are in a good state of repair and only opportunities are associated with slipping tiles around Velux windows. Sections of timber soffit boxes are present but appeared in good order although close inspections were not possible due to access restrictions.			
Roof construction	**Type *pitched, flat etc***		**Eaves/soffits *note if wooden***		**Internal truss type?**
	Pitched		Wooden soffits		unknown
	Materials		**Sarking, underfelt?**		**Insulation**
	tiled		unknown		unknown
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***			None, although detailed searches not possible.		
Initial assessment					
Unsuitable for use by bats.					
Overall Likelihood of Active Roost					
Very low					
Recommendations					
None although if static/transect monitoring identifies extensive use of building with flight paths connecting to proposed turbine locations then emergence surveys may be required to identify roost size and type.					

<table>
<tr><td>Job No.</td><td>4603</td><td>Date</td><td>13/03/2012</td><td>Surveyors</td><td>JB</td></tr>
<tr><td colspan="2">Building no, description or name
Grid reference, mark on plan</td><td colspan="4">Building 6 - Semi Detached Houses 2
NO 42721 42011</td></tr>
<tr><td colspan="2">Health and safety issues and precautions taken
Work at height, in dark, asbestos, fibreglass, dust, droppings, other</td><td colspan="4">No internal searches, as a result no H&S issues.</td></tr>
<tr><td colspan="2">Surrounding habitat assessment
Foraging, flightlines, roosts</td><td colspan="4">Houses are located within arable land north of Nether Finlarg with hedge and tree connections to wider landscape. In addition a medium sized pond is located within the garden of the Nether Finlarg farmhouse which is likely to offer good foraging opportunities.</td></tr>
<tr><td rowspan="4">Building structure</td><td colspan="2">Type</td><td colspan="2">Wall materials</td><td>Date last occupied?</td></tr>
<tr><td colspan="2">Semi-detached houses</td><td colspan="2">Probably block</td><td>Occupied</td></tr>
<tr><td colspan="2">Age</td><td colspan="2">Cladding</td><td>State of repair?</td></tr>
<tr><td colspan="2">~20 years</td><td colspan="2">None</td><td>good</td></tr>
<tr><td colspan="2">Access points
Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.</td><td colspan="4">Houses are older with slight damage to tiles above guttering on eastern face. Chimneys appear in good order although slight raising of tiles around chimney is visible.</td></tr>
<tr><td rowspan="4">Roof construction</td><td colspan="2">Type pitched, flat etc</td><td colspan="2">Eaves/soffits note if wooden</td><td>Internal truss type?</td></tr>
<tr><td colspan="2">Pitched</td><td colspan="2">None</td><td>Unknown</td></tr>
<tr><td colspan="2">Materials</td><td colspan="2">Sarking, underfelt?</td><td>Insulation</td></tr>
<tr><td colspan="2">Tiled</td><td colspan="2">Unknown</td><td>Unknown</td></tr>
<tr><td colspan="3">Evidence of bats
Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?</td><td colspan="3">None, although detailed searches not possible.</td></tr>
<tr><td colspan="6">Initial assessment</td></tr>
<tr><td colspan="6">Unsuitable for use by bats.</td></tr>
<tr><td colspan="6">Overall Likelihood of Active Roost</td></tr>
<tr><td colspan="6">Very low</td></tr>
<tr><td colspan="6">Recommendations</td></tr>
<tr><td colspan="6">None although if static/transect monitoring identifies extensive use of building with flight paths connecting to proposed turbine locations then emergence surveys may be required to identify roost size and type.</td></tr>
</table>

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name ***Grid reference, mark on plan***		Building 7 - Ruin NO 41919 42618			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		No roof and all walls appeared stable, caution used while in or around building.			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Small areas of woodland close by but surrounding area dominated by open farmland.			
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Ruined farm building		Stone		Unknown
	Age		**Cladding**		**State of repair?**
	>100 years		None		Ruined
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***		No roof and only stone walls with no internal spaces. Only very minor gaps within stone walls.			
Roof construction	**Type** ***pitched, flat etc***		**Eaves/soffits** ***note if wooden***		**Internal truss type?**
	Pitched		None		Unknown
	Materials		**Sarking, underfelt?**		**Insulation**
	Tiled		Unknown		Unknown
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***			None		
Initial assessment					
Generally unsuitable for use by bats and building very exposed to weather.					
Overall Likelihood of Active Roost					
Very low					
Recommendations					
None although if static/transect monitoring identifies extensive use of building with flight paths connecting to proposed turbine locations then emergence surveys may be required to identify roost size and type.					

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name ***Grid reference, mark on plan***		Building 8 - NW Dutch Barn NO 41359 41420			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		Storage of straw bales, risk of unstable bales.			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Building located within Over Finlarg farmyard. Site has limited connections to wider site although fences exist to the north and shelter belts (semi-mature mixed woodland) to south. Remaining buildings associated with farmyard also provide other roost and foraging opportunities.			
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Metal framed modern Dutch Barn		No walls present		N/A
	Age		**Cladding**		**State of repair?**
	~30 years		N/A		Good
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***		As open sided Dutch barn, no walls are present. Internal roof area fully accessible. No enclosed areas for bats to specifically access.			
Roof construction	**Type** ***pitched, flat etc***		**Eaves/soffits** ***note if wooden***		**Internal truss type?**
	Pitched		None		N/A
	Materials		**Sarking, underfelt?**		**Insulation**
	Corrugated composite		None		None
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***			No evidence of bats identified, although stored materials and straw bales makes searching for signs (e.g. droppings) difficult.		
Initial assessment					
No opportunities for roosting bats but may provide sheltered environments for foraging or light sampling.					
Overall Likelihood of Active Roost					
Very low - Not capable of supporting an active roost					
Recommendations					
None. May be suitable to support barn owl.					

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name ***Grid reference, mark on plan***		Building 9 - N Barn NO 41427 41438			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		Used for storage of grain and shelter of livestock including calving and lambing livestock so some areas inaccessible.			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Building located within Over Finlarg farmyard. Site has limited connections to wider site although fences exist to the north and shelter belts (semi-mature mixed woodland) to south. Remaining buildings associated with farmyard also provide other roost and foraging opportunities.			
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Modern barn		Slatted timber and block		N/A
	Age		**Cladding**		**State of repair?**
	~40 years		None		Fair
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***		Slatted upper walls and large open doorways allow free access to all internal areas.			
Roof construction	**Type** *pitched, flat etc*		**Eaves/soffits** *note if wooden*		**Internal truss type?**
	Pitched		None		N/A
	Materials		**Sarking, underfelt?**		**Insulation**
	Corrugated composite		None		None
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***			No evidence of bats identified, although stored materials and presence of livestock makes searching for signs (e.g. droppings) difficult.		
Initial assessment					
No opportunities for roosting bats but may provide sheltered environments for foraging or light sampling.					
Overall Likelihood of Active Roost					
Very low - Not capable of supporting an active roost					
Recommendations					
None					

Job No.	4603	Date	13/03/2012	Surveyors	JB
Building no, description or name ***Grid reference, mark on plan***	Building 10 - NE Barn NO 41491 41428				
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***	Used for storage of straw bales and shelter of livestock including calving and lambing livestock so some areas inaccessible.				
Surrounding habitat assessment ***Foraging, flightlines, roosts***	Building located within Over Finlarg farmyard. Site has limited connections to wider site although a line of immature trees are present to the east and shelter belts (semi-mature mixed woodland) to south. Remaining buildings associated with farmyard also provide other roost and foraging opportunities.				
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Modern barn		Slatted timber and block		N/A
	Age		**Cladding**		**State of repair?**
	~40 years		None		Fair
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***	Slatted upper walls and large open doorways allow free access to all internal areas.				
Roof construction	**Type *pitched, flat etc***		**Eaves/soffits *note if wooden***		**Internal truss type?**
	Pitched		None		N/A
	Materials		**Sarking, underfelt?**		**Insulation**
	Corrugated composite		None		None
Evidence of bats *Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?*			No evidence of bats identified, although stored materials and presence of livestock makes searching for signs (e.g. droppings) difficult.		
Initial assessment					
No opportunities for roosting bats but may provide sheltered environments for foraging or light sampling.					
Overall Likelihood of Active Roost					
Very low - Not capable of supporting an active roost					
Recommendations					
None. May be suitable to support barn owl.					

<table>
<tr><td>Job No.</td><td>4603</td><td>Date</td><td>13/03/2012</td><td>Surveyors</td><td>JB</td></tr>
<tr><td colspan="2">Building no, description or name
Grid reference, mark on plan</td><td colspan="4">Building 11 - Central Building
NO 41441 41398</td></tr>
<tr><td colspan="2">Health and safety issues and precautions taken
Work at height, in dark, asbestos, fibreglass, dust, droppings, other</td><td colspan="4">Calving livestock present in some areas restricting level of investigation.</td></tr>
<tr><td colspan="2">Surrounding habitat assessment
Foraging, flightlines, roosts</td><td colspan="4">Building located within Over Finlarg farmyard. Site has limited connections to wider site although fences exist to the north and shelter belts (semi-mature mixed woodland) to south. Remaining buildings associated with farmyard also provide other roost and foraging opportunities.</td></tr>
<tr><td rowspan="4">Building structure</td><td colspan="2">Type</td><td colspan="2">Wall materials</td><td>Date last occupied?</td></tr>
<tr><td colspan="2">Mixed age barns</td><td colspan="2">stone and block</td><td>N/A</td></tr>
<tr><td colspan="2">Age</td><td colspan="2">Cladding</td><td>State of repair?</td></tr>
<tr><td colspan="2">~100 years</td><td colspan="2">None</td><td>Moderate</td></tr>
<tr><td colspan="2">Access points
Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.</td><td colspan="4">Large number of open doors and slated walls enabling access throughout the interior of the large building.</td></tr>
<tr><td rowspan="4">Roof construction</td><td colspan="2">Type pitched, flat etc</td><td colspan="2">Eaves/soffits note if wooden</td><td>Internal truss type?</td></tr>
<tr><td colspan="2">Pitched</td><td colspan="2">None</td><td>N/A</td></tr>
<tr><td colspan="2">Materials</td><td colspan="2">Sarking, underfelt?</td><td>Insulation</td></tr>
<tr><td colspan="2">Corrugated composite</td><td colspan="2">None</td><td>None</td></tr>
<tr><td colspan="3">Evidence of bats
Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?</td><td colspan="3">No evidence of bats identified, although stored materials and presence of livestock makes searching for signs (e.g. droppings) difficult.</td></tr>
<tr><td colspan="6">Initial assessment</td></tr>
<tr><td colspan="6">The building comprises areas of varying age and structure with the main central sections constructed from stone and block walls with areas supporting a number of gaps, crevices and cavities. The northern side of the building also supports a taller section which supports old farm machinery and is presently used by a large number of nesting pigeons. On the eastern section an area of collapsed building is present with just stonework remaining. The southern side is of more modern barn construction and is similar in construction to buildings 2 and 3. The majority of the floors are concrete and used for the housing of livestock with detritus making detailed searches over large areas for bat droppings difficult. Many of the more significant gaps and cracks were investigated for signs of bats but none were evident.</td></tr>
<tr><td colspan="6">Overall Likelihood of Active Roost</td></tr>
<tr><td colspan="6">Although a number of gaps, cracks and cavities are present within the stone walls of the central section no signs of use by bats was identified. It is assessed that the overall likelihood of bats using this building is low as although the walls offer some suboptimal roosting habitat the large open modern roof is not suitable for roosting bats.</td></tr>
<tr><td colspan="6">Recommendations</td></tr>
<tr><td colspan="6">If building is to remain unaffected then no further recommendations are made.</td></tr>
</table>

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name ***Grid reference, mark on plan***		Building 12 - Central Building Eastern Annex NO 41487 41400			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		Stored materials and damage to internal structures. PPE used within building. No assessment to damaged roof space undertaken.			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Building located within Over Finlarg farmyard. Site has limited connections to wider site although fences exist to the north and shelter belts (semi-mature mixed woodland) to south. Remaining buildings associated with farmyard also provide other roost and foraging opportunities.			
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Stone farm building		Stone		N/A
	Age		**Cladding**		**State of repair?**
	~100 years		none		poor
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***		Access points to the interior of the building are numerous including permanently open windows and doors. In addition at roof height a number of potential bat ingress points exist including at damaged/missing slates; gaps under metal ridge covering; gaps within roof and chimney join; missing skylights; large holes in roof etc.			
Roof construction	**Type** ***pitched, flat etc***		**Eaves/soffits** ***note if wooden***		**Internal truss type?**
	Pitched		None		
	Materials		**Sarking, underfelt?**		**Insulation**
	Timber frame with slates		Sarking		None
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***			None identified despite comprehensive search within ground floor. Extensive detritus and stored materials made searches more difficult.		
Initial assessment					
Although no signs within the building the presence of a damaged slate roof with sarking present and numerous ingress opportunities suggest that the presence of small roosts is distinctly possible.					
Overall Likelihood of Active Roost					
Moderate - Roost possible but likely to be a small summer roost at best.					
Recommendations					
If static/transect monitoring identifies extensive use of building with flight paths connecting to proposed turbine locations then emergence surveys may be required to identify roost size and type.					

Job No.	4603	Date	13/03/2012	Surveyors	JB
Building no, description or name ***Grid reference, mark on plan***		Building 13 - Detached Garage NO 41503 41384			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		None			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Building located within Over Finlarg farmyard. Site has limited connections to wider site although fences exist to the north and shelter belts (semi-mature mixed woodland) to south. Remaining buildings associated with farmyard also provide other roost and foraging opportunities.			
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Brick flat roofed garage		Brick		N/A
	Age		**Cladding**		**State of repair?**
	~30 years		None		Good
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***		At time of survey garage door was open but it is assumed that this door is usually closed. When closed no access to interior is anticipated.			
Roof construction	**Type *pitched, flat etc***		**Eaves/soffits *note if wooden***		**Internal truss type?**
	Flat		None		N/A
	Materials		**Sarking, underfelt?**		**Insulation**
	Corrugated composite		None		None
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***			None		
Initial assessment					
No opportunities for roosting bats					
Overall Likelihood of Active Roost					
Low - Not capable of supporting an active roost					
Recommendations					
None					

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name ***Grid reference, mark on plan***		Building 14 - Central Building Western Annex NO 41415 41394			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		Access to majority of internal area not possible due to storage of straw bales.			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Building located within Over Finlarg farmyard. Site has limited connections to wider site although fences exist to the north and shelter belts (semi-mature mixed woodland) to south. Remaining buildings associated with farmyard also provide other roost and foraging opportunities.			
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Stone farm building		Stone		N/A
	Age		**Cladding**		**State of repair?**
	~100 years		none		poor
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***		Access points to the interior of the building are numerous including permanently open windows and doors. In addition at roof height a number of potential bat ingress points exist including at damaged sections of roof; missing slates; gaps under metal ridge covering; gaps within roof and chimney join; missing skylights etc.			
Roof construction	**Type *pitched, flat etc***		**Eaves/soffits *note if wooden***		**Internal truss type?**
	Pitched		None		
	Materials		**Sarking, underfelt?**		**Insulation**
	Timber frame with slates		Sarking (partial)		None
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***			None identified despite comprehensive search within accessible areas of ground straw bales made searches throughout the majority of the building impossible.		
Initial assessment					
Although no signs within the building the presence of a damaged slate roof with partial sarking present and numerous ingress opportunities suggest that the presence of small roosts is possible.					
Overall Likelihood of Active Roost					
Moderate - Roost possible but likely to be a small summer roost at best.					
Recommendations					
If static/transect monitoring identifies extensive use of building with flight paths connecting to proposed turbine locations then emergence surveys may be required to identify roost size and type.					

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name ***Grid reference, mark on plan***		Building 15 - Farmhouse NO 41544 41371			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		None - Internal assessment not undertaken			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Building located within Over Finlarg farmyard. Site has limited connections to wider site lines of mature trees with roosting opportunities exist around the building and shelter belts (semi-mature mixed woodland) to south. Remaining buildings associated with farmyard also provide other roost and foraging opportunities.			
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Two storey farmhouse building		Stone		Occupied
	Age		**Cladding**		**State of repair?**
	~100 years		None		Good
Access points *Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.*		No internal assessment was undertaken although a number of potential ingress opportunities were identified from the exterior assessment. These included small gaps within the stone walls close to the chimney on the eastern gable and some gaps within roof and chimney within the single storey northern section of the building			
Roof construction	**Type *pitched, flat etc***		**Eaves/soffits *note if wooden***		**Internal truss type?**
	pitched		None		Unknown
	Materials		**Sarking, underfelt?**		**Insulation**
	Slate		Unknown		Unknown
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***			No evidence of bats was identified during the external assessment.		
Initial assessment					
Although no bat signs were identified during the external assessment, opportunities for bat ingress are likely to be present, especially within the northern single storey section of the building.					
Overall Likelihood of Active Roost					
Low to moderate dependent on internal structure of roof and ingress opportunities.					
Recommendations					
If static/transect monitoring identifies extensive use of building with flight paths connecting to proposed turbine locations then emergence surveys and full internal assessment may be required to identify roost size and type.					

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name ***Grid reference, mark on plan***		Building 16 - Detached Bungalow NO 41456 41342			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		None - Internal assessment not undertaken			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Building located within Over Finlarg farmyard. Site has limited connections to wider site although mixed woodland is present to the north and west of the building with shelter belts (semi-mature mixed woodland) to the south. Remaining buildings associated with farmyard also provide other roost and foraging opportunities.			
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Detached bungalow		Rendered (block?)		Occupied
	Age		**Cladding**		**State of repair?**
	~70 years		None		Good
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***		Detailed assessment of building was not undertaken due to access permissions. No obvious ingress opportunities were visible using binoculars and in general the fabrics of the building were in good condition.			
Roof construction	**Type** ***pitched, flat etc***		**Eaves/soffits** ***note if wooden***		**Internal truss type?**
	Pitched		Small overhang by eaves		Unknown
	Materials		**Sarking, underfelt?**		**Insulation**
	Tiled		Unknown (probably sarking)		Unknown
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***			No evidence of bats was identified during the external assessment.		
Initial assessment					
Without a more detailed internal assessment it is difficult to confirm but the condition of the building suggests that use by bats is unlikely, although this building is possibly in the most suitable location for bats with woodland habitat in close proximity to the west.					
Overall Likelihood of Active Roost					
Low					
Recommendations					
If static/transect monitoring identifies extensive use of building with flight paths connecting to proposed turbine locations then emergence surveys and full internal assessment may be required to identify roost size and type.					

<table>
<tr><td>Job No.</td><td>4603</td><td>Date</td><td>13/03/2012</td><td>Surveyors</td><td>JB</td></tr>
<tr><td colspan="2">Building no, description or name
Grid reference, mark on plan</td><td colspan="4">Building 17 - Detached House
NO 41402 41353</td></tr>
<tr><td colspan="2">Health and safety issues and precautions taken
Work at height, in dark, asbestos, fibreglass, dust, droppings, other</td><td colspan="4">None - Internal assessment not undertaken</td></tr>
<tr><td colspan="2">Surrounding habitat assessment
Foraging, flightlines, roosts</td><td colspan="4">Building located within Over Finlarg farmyard. Site has limited connections to wider site although mixed woodland is present to the north and west of the building with shelter belts (semi-mature mixed woodland) to the south. Remaining buildings associated with farmyard also provide other roost and foraging opportunities.</td></tr>
<tr><td rowspan="4">Building structure</td><td colspan="3">Type</td><td>Wall materials</td><td>Date last occupied?</td></tr>
<tr><td colspan="3">Detached 2 storey house</td><td>Rendered (block?)</td><td>Occupied</td></tr>
<tr><td colspan="3">Age</td><td>Cladding</td><td>State of repair?</td></tr>
<tr><td colspan="3">~40 years</td><td>None</td><td>Good</td></tr>
<tr><td colspan="2">Access points
Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.</td><td colspan="4">Detailed assessment of building was not undertaken due to access permissions. No obvious ingress opportunities were visible using binoculars and in general the fabrics of the building were in good condition.</td></tr>
<tr><td rowspan="4">Roof construction</td><td colspan="3">Type pitched, flat etc</td><td>Eaves/soffits note if wooden</td><td>Internal truss type?</td></tr>
<tr><td colspan="3">Pitched</td><td>None, but sarking overhang</td><td>Unknown</td></tr>
<tr><td colspan="3">Materials</td><td>Sarking, underfelt?</td><td>Insulation</td></tr>
<tr><td colspan="3">Tiled</td><td>Unknown (probably sarking)</td><td>Unknown</td></tr>
<tr><td colspan="4">Evidence of bats
Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?</td><td colspan="2">No evidence of bats was identified during the external assessment.</td></tr>
<tr><td colspan="6">Initial assessment</td></tr>
<tr><td colspan="6">Without a more detailed internal assessment it is difficult to confirm but the condition of the building suggests that use by bats is unlikely.</td></tr>
<tr><td colspan="6">Overall Likelihood of Active Roost</td></tr>
<tr><td colspan="6">Low</td></tr>
<tr><td colspan="6">Recommendations</td></tr>
<tr><td colspan="6">If static/transect monitoring identifies extensive use of building with flight paths connecting to proposed turbine locations then emergence surveys and full internal assessment may be required to identify roost size and type.</td></tr>
</table>

Job No.	4603	**Date**	13/03/2012	**Surveyors**	JB
Building no, description or name ***Grid reference, mark on plan***		Building 18 - Detached House Garage NO 41412 41365			
Health and safety issues and precautions taken ***Work at height, in dark, asbestos, fibreglass, dust, droppings, other***		None - Internal assessment not undertaken			
Surrounding habitat assessment ***Foraging, flightlines, roosts***		Building located within Over Finlarg farmyard. Site has limited connections to wider site although fences exist to the north and shelter belts (semi-mature mixed woodland) to south. Remaining buildings associated with farmyard also provide other roost and foraging opportunities.			
Building structure	**Type**		**Wall materials**		**Date last occupied?**
	Detached garage		Rendered block		N/A
	Age		**Cladding**		**State of repair?**
	~ 40 years		None		Moderate
Access points ***Roof, windows, exterior features, chimney, cellar, walls. Record height above ground and aspect, show on sketch plan.***		Garage doors open at time of survey but assumed to be closed in general. Damage to fascia board on northern side of building may allow ingress although no clear route was evident. Felt tiled roof offers no suitable ingress opportunities.			
Roof construction	**Type** ***pitched, flat etc***		**Eaves/soffits** ***note if wooden***		**Internal truss type?**
	Pitched		damage to fascia board on N		Unknown
	Materials		**Sarking, underfelt?**		**Insulation**
	Felt tiles		Unknown		Unknown
Evidence of bats ***Number, species? Droppings: number, fresh or old, where found (collect sample)? Scratch marks/staining: where? Insect remains: Where, how much and what sorts of insect?***					
Initial assessment					
Without a more detailed internal assessment it is difficult to confirm but the condition of the building suggests that use by bats is unlikely.					
Overall Likelihood of Active Roost					
Low					
Recommendations					
If static/transect monitoring identifies extensive use of building with flight paths connecting to proposed turbine locations then emergence surveys and full internal assessment may be required to identify roost size and type.					

AC33

Annex 3: Tree Assessment Survey Forms

Tree ID	Grid Reference	Species	Photo ID	No. of trees	Evidence of use by bats	Feature Suitability and Abundance*											Overall Suitability
						High - Medium								Low			
						Wood pecker holes	Cracks/crevices	Loose/flaking bark	Medium-dense ivy	Large deadwood	Snagged branches	Hollow stem/limb	Large holes/splits/hollows	Small cracks crevices	low ivy cover	Small deadwood	
1	NO 42837 42387	Beech	399	1	None								1				Moderate
2	NO 42812 42401	Beech	400	1	None								1				Moderate
3	NO 42798 42413	Beech	401	4	None		2			1				2			Moderate
4	NO 42762 42419	Beech	402,403	1	None								1				Moderate
5	NO 42744 42417	Beech	404	1	None								1				Moderate
6	NO 42710 42422	Beech	405	1	None		2			1				2			Moderate
7	NO 42692 42423	Beech	406	1	None								2				Low
8	NO 42677 42424	Beech	407	1	None								1				Low
9	NO 42662 42424	Beech	408	1	None								1				Low
10	NO 42652 42425	Beech	409	1	None								1				Moderate
11	NO 42648 42428	Beech	410	1	None								1				Low
12	NO 42610 42435	Beech	411	1	None								1				Low
13	NO 42579 42433	Beech	412	1	None								1				Low
14	NO 42539 42439	Beech	413	1	None								2				Moderate
15	NO 42542 42439	Beech	414	1	None								2				Moderate
16	NO 42528 42444	Beech	416	1	None					1			2				Moderate
17	NO 42510 42445	Beech	417	1	None								2				Moderate

AC33

Tree ID	Grid Reference	Species	Photo ID	No. of trees	Evidence of use by bats	Feature Suitability and Abundance*											Overall Suitability
						High - Medium								Low			
						Wood pecker holes	Cracks/crevices	Loose/flaking bark	Medium-dense ivy	Large deadwood	Snagged branches	Hollow stem/limb	Large holes/splits/hollows	Small cracks crevices	low ivy cover	Small deadwood	
18	NO 42451 42446	Beech	418	2	None					2			2				Moderate
19	NO 42441 42446	Beech	419	1	None								1				Moderate
20	NO 42554 41312	Beech	494,495	1	None								1				Low
21	NO 41507 41372	Sycamore		1	None								1				High
22	NO 41518 41407	Ash	326	1	None			2					1				Moderate
23	NO 41542 41418	Oak	325	1	None								1				Moderate
24	NO 41560 41425	Dead – sp. unknown	324	1	None			3									Moderate
25	NO 41566 41432	Oak	323	1	None								2				Moderate

* Specify abundance level: 3 - Abundant, 2 - Several present, 1 - Single or one present

Appendix 7-3: Supplementary Bat Survey

A.13. Introduction

Terms of Reference

Atmos Consulting Ltd was commissioned to undertake bat surveys to support a planning application for the proposed Frawney Wind Farm. Bat surveys were identified as necessary following both preliminary consultations and the results of an extended Phase 1 habitat survey. In June 2012 an application for a five turbine wind farm was submitted (12/00577/EIAL) along with an Environmental Impact Assessment (EIA) including information in relation to bats. However, the EIA was submitted prior to completion of a full season's bat surveys in accordance with best practice guidance (Hundt, 2012). This appendix presents the information supplied as Supplementary Environmental Information (SEI) to Angus Council in September 2012. The SEI included additional survey information as requested by SNH in relation to the 'Survey Area' which encompasses the application site, hereafter referred to as 'the Site'. In combination with survey results presented within the June 2012 EIA (and Appendix 7-2) the impact assessment in relation to bats was reviewed and updated.

Objectives of the Study

This report re-examines the possible constraints imposed upon the proposed development by bats and is based on the additional survey information collected during the summer (July) and autumn (August) periods of the bat activity season 2012.

Technical Appendix 7-2 provides detailed information in relation to consultations, site description and survey components completed in spring 2012. In addition the legislative context and field survey methodology are also presented in section 7.2.4 and 7.2.8 of ES Chapter 7 respectively with further detail in Technical Appendix 7-2.

This report details the following:

- Field survey methodology;
- Field survey results (including a summary of those presented in the EIA);
- Conclusions; and
- Review of Impact Assessment.

Site Description

The proposed Site for the Frawney Wind Farm is located within an area which is dominated by agriculture, primarily sheep grazing and arable. The wider Survey Area also supports a number of small woodland blocks of broadleaved and coniferous woodland with several linear features including: ditches, fences and hedges. Two small ponds are also present within the Survey Area, which offers suitable habitat for foraging bats. The wider landscape supports extensive agriculture, coniferous woodland and heathland. Key habitats within the landscape that are likely to offer suitability for roosting, foraging and commuting bats include woodland edges, ditches, small ponds and farm buildings. A more extensive description of habitats present within the Survey Area is presented in Technical Appendix 7-1.

A.14. Survey Methodology

Bat surveys were undertaken by a team of suitably experienced ecologists across the Site during 2012. Three types of survey methodologies were undertaken at the Site: habitat evaluation (including roost assessments), activity transects and static detector recording.

This report presents a summary of the results presented within Technical Appendix 7-2 along with detailed results of subsequent surveys during July and August 2012. These surveys were required to meet new guidance published by Bat Conservation Trust (Hundt, 2012) and agreed by SNH (email to Atmos Consulting from Mark Moore, SNH 19th March 2012) and Angus Council (meeting 12th March 2012).

Roost Assessments

External roost assessments were undertaken on all buildings and mature trees identified as being suitable to support bats within 200m of the developable area (Figure 7-4). The external roost assessments were undertaken by a suitably experienced and licenced ecologist (SNH Licence 12770) during March 2012. Full details of the assessment methodology are presented in Technical Appendix 7-2.

Activity Transects

Activity surveys, using handheld Anabat SD2 recording units, were undertaken during favourable weather conditions on 30th April 2012. Additional surveys were then undertaken on 11th/12th July and 28th August 2012.

The two transect routes (Figure 7-3) covered a representative area of the Site and included a number of the previously proposed turbine locations (Table 3-2: layout d). For the purposes of this report, areas of sub-optimal bat habitat located in open areas with little or no navigational of foraging features are classified as 'open'. Sections of the Site that support features that may be used preferentially by bats such as woodland edges, buildings, ditches and hedgerows are classified as 'habitat' features. Survey times are detailed in Table 1; all routes and listening points were consistent with no deviation from previous surveys.

Table 10: Summary of transect survey times and temperature levels

Date of Survey	Transect	Dusk/ Dawn	Start	Finish	Direction	Temperature (˚C)		Precipitation
						Start	End	
30/04/2012	North	Dusk	20:22	22:29	Clockwise	6	5	Light intermittent
30/04/2012	South	Dusk	20:20	23:07	Anticlockwise	6	5	Light intermittent
11/07/2012	North	Dusk	21:41	23:58	Clockwise	14	11	None
11/07/2012	South	Dusk	21:41	23:47	Anticlockwise	14	11	None
12/07/2012	North	Dawn	02:20	04:28	Anticlockwise	10	10	None
12/07/2012	South	Dawn	02:17	04:23	Clockwise	10	10	None
28/08/2012	North	Dusk	20:00	22:21	Anticlockwise	14	12	None
28/08/2012	South	Dusk	20:00	22:36	Clockwise	14	12	None

Each visit comprised of two separate walked transects, which commenced at approximately ¼ hour before sunset (dusk surveys) continuing for 2.5 hours or 2.5 hours before sunrise (dawn survey) continuing to approximately sunrise. Direction of transect was altered to obtain better temporal coverage of the Site to account for changes in the level of bat activity.

Transects were undertaken on foot and followed standard transect methodology (Hundt, 2012). Five minute 'listening points' were located along each transect, which consisted of the surveyor stopping at pre-defined points for five minutes, recording any bats foraging and/or commuting at that location. The type of activity (commuting and/or foraging) and the direction in which the bats were travelling in were also recorded where the bat was observed.

Any bats recorded were identified to species, where possible, and recorded on a field map. The calls were recorded and, if field identification was not possible, the calls were later analysed by an experienced bat ecologist, using Titley Electronics Analook software, to allow identification to species.

Static Recorders

Eight Anabat SD2 recorders were used at the Site in order to survey the number, species and distribution of bats across the Site as a whole. Habitats considered to be representative of those in which the proposed turbines are likely to be located i.e. in open habitat were included in the survey as well as bat optimal *habitat* locations that represent good quality foraging resources in relative close proximity to turbines. Figure 7-3 shows the location of the static recorder stations and Table 2 provides location details. Static detectors were deployed before sunset on deployment date and collected after sunrise on collection date. Deployment duration was for five days on each occasion.

Table 11: Summary of static survey deployment dates and locations

Static Loc.	Infrastructure*	Bat Feature	Grid Reference	April		July		August	
				Start	End	Start	End	Start	End
1	Proposed Turbine	No	NO4212442490	25th	30th	11th	17th	23rd	28th
2	None	Yes	NO4161442637	25th	30th	11th	17th	23rd	28th
3	Proposed Turbine	No	NO4176242467	25th	30th	11th	17th	23rd	28th
4	None	Yes	NO4266442423	25th	30th	11th	17th	23rd	28th
5	Proposed Turbine	No	NO4143642197	25th	30th	11th	17th	23rd	28th
6	None	Yes	NO4148941387	25th	30th	11th	17th	23rd	28th
7	Proposed Turbine	No	NO4123341842	25th	30th	11th	17th	23rd	28th
8	None	Yes	NO4257141347	25th	30th	11th	17th	23rd	28th

* It should be noted that the four static recording locations were the originally proposed turbine locations of layout d (Figure 3-1), as applied for in application 12/00577/EIAL. As described in Chapter 3, the locations of the turbines have now been slightly amended to a more contained layout although within a similar area; and the tip height has been reduced. None of the proposed turbines are located any closer to features identified as being used extensively by bats. It is considered, therefore, that survey results are representative of turbines being placed within the site boundary and impacts identified will be no greater than previously assessed.

Weather Conditions

During the surveys the weather conditions were variable. Transect surveys were conducted under the most suitable weather conditions for the time of year. Detailed weather monitoring was not undertaken during the period of static detector deployment. However, from regional forecasts taken from the Meteorological Office website, April surveys were undertaken during low temperatures with values during the period of static detector deployment varying between 2°C to 8°C between dusk and dawn. During July surveys temperatures were higher, between 6°C and 16°C with August surveys slightly higher again during static deployment ranging between 8°C and 18 °C.

The limitations associated with the cool April surveys are discussed within Technical Appendix 7-2. All other static detector deployment periods were under favourable conditions for bat activity and were typical for the time of year at this location.

Analysis

All the data from the Anabat SD2s were downloaded and analysed, by an experienced bat ecologist, using Analook software to enable identification of species and to calculate and assess the activity levels present across the Site and between each turbine and *habitat* locations.

Sonogram identification included the recording of social and foraging calls. Where these occurred in the absence of standard diagnostic navigation calls they were also included within the general bat pass calculations. Where social or foraging calls were identified along with standard navigation calls within a single Analook file these were counted as a single pass. No attempt has been made to separate social or foraging calls of common and soprano pipistrelle for the purposes of this report.

The levels of activity recorded on the Site, however, are not absolute, but are relative to the Site. For ease of examination three arbitrary levels have been created to provide a context in which to discuss the results. Table 1 indicates the levels of activity which can be used to characterise the level of activity to be low, medium or high in terms of bat activity. Activity levels are assessed in terms of the risk levels outlined in Natural England's guidance note – TIN051 (Natural England, 2012) which identifies the risk of species based on both an individual basis (habitat and behaviour) and population basis (distribution and rarity).

Table 12: Criteria for Determining Relative Bat Activity Levels

Activity Level	Number of bat passes/hour*
Low	<10
Medium	10 - 20
High	>20

** A bat pass is classified as the presence of a species within a single Anabat file.*

Limitations

Despite bat activity being affected to some degree by the low temperatures during April surveys, bat activity was still evident although it may have been lower than would be expected under optimal weather conditions. This is not seen as a significant limitation as two additional surveys were undertaken across the survey season under more optimal weather conditions. In addition the cool temperatures during April are not abnormal for this location and activity would be relatively representative of this time of year.

No other significant limitations were experienced during the surveys.

A.15. Results

Habitat and Roost Assessments

Full results in relation to the habitat and roost assessment are presented in Technical Appendix 7-2. The roost assessments identified a number of suitable structures and trees that are capable of supporting roosting bats.

Nether Finlarg supports large modern agricultural and light industrial buildings and as such offers few opportunities for roosting bats although the farmhouse at Nether Finlarg and the Farm Cottages to the north offer some opportunities for roosting bats. To the north of Nether Finlarg is an avenue of mature beech trees, the majority of which have suitable roosting opportunities for bats and it is possible that a number of these trees are used for roosting although no definitive evidence to confirm this was identified by roost inspections.

A number of older farm buildings at Over Finlarg offer suitable roosting opportunities, in particular the central stone farm buildings and farmhouse (Figure 7-4). These buildings offer crevices within damaged stone walls and supported slate roofs with damage in various locations and a number of missing or raised slates. The majority of the other buildings located within the farm offered less suitable opportunities, although the presence of small roosts within these buildings cannot be completed ruled out.

Within the Over Finlarg Farm a number of trees are also present and offer good opportunities for roosting bats. These were primarily trees located north and east of the main farmhouse, although a single tree located west of the farmhouse also offered significant potential for roosting bats (Figure 7-4).

A ruined croft in the north of the Site offers no suitable roosting opportunities as the building has no roof and the walls are all exposed to the elements.

Activity Transects

During the April 2012 activity transects, only a single bat pass was recorded during surveys. This pass of a common pipistrelle *Pipistrellus pipistrellus* was identified along the access road to Nether Finlarg approximately 50m south of Nether Finlarg Farmhouse (listening Point 10 - northern transect).

During the dusk and dawn transects undertaken in July a total of 15 common pipistrelle and 34 soprano pipistrelle *Pipistrellus pygmaeus* bat passes were recorded across the northern transect with only a single pipistrelle pass from the southern transect during the dawn survey. A total of 49 bat passes recorded during the southern transect in August, although no records within the northern transect were recorded.

The surveys during July and August increased the species richness of the Site to at least three species. In addition a single call could not confidently be assigned to any species, but was confirmed as a bat.

Figure 2 Mean bat activity from transect surveys (North Transect - April to August 2012)

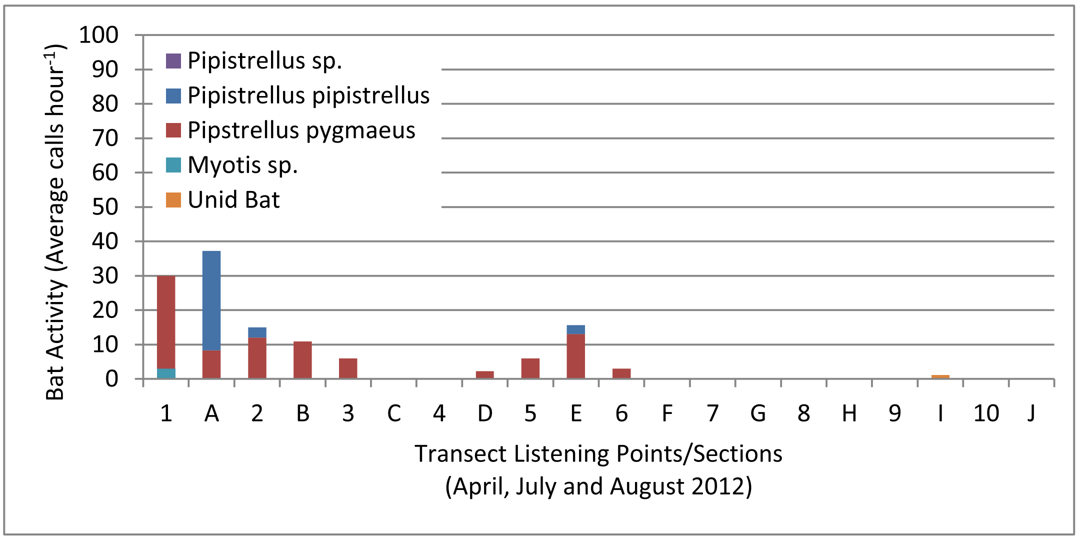
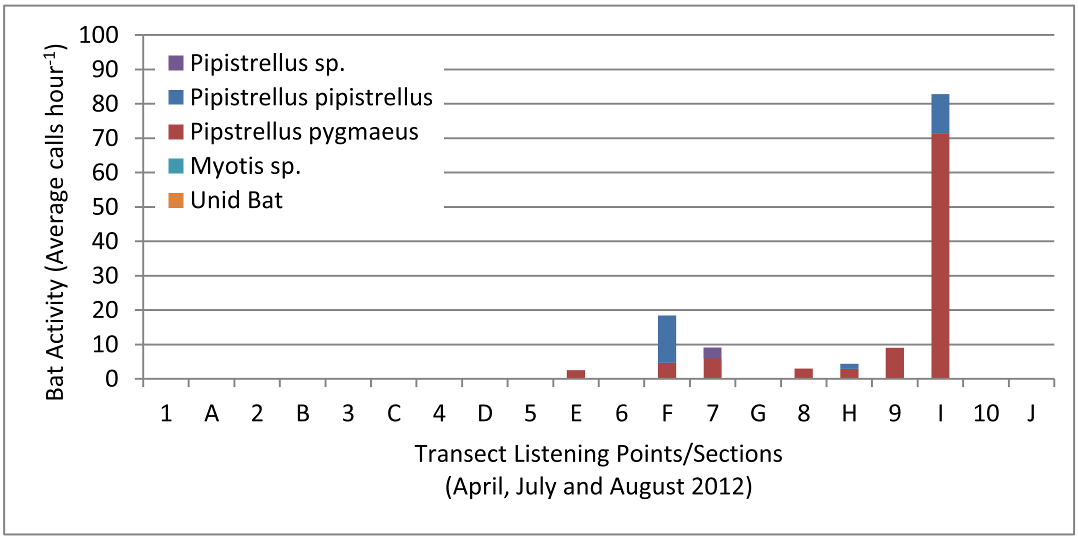


Figure 3 Mean bat activity from transect surveys (South Transect - April to August 2012)



Overall activity at *open* locations in comparison to that at *habitat* locations features was very low (Table 4) across all species recorded. As a result of the turbines being located within open locations these results were again reflected in the variation in activity in relation to proposed infrastructure (Table 5).

Table 4: Average activity levels at *open* and bat *habitat* features (passes hour^{-1})

Location	*Pipistrellus sp.*	*Pipistrellus pipistrellus*	*Pipstrellus pygmaeus*	Myotis sp.	Unidentified Bat
Open	0.00	0.29	2.21	0.00	0.00
Habitat	0.12	2.20	6.04	0.12	0.04

Table 5: Average activity levels at locations of proposed infrastructure (passes hour-1)

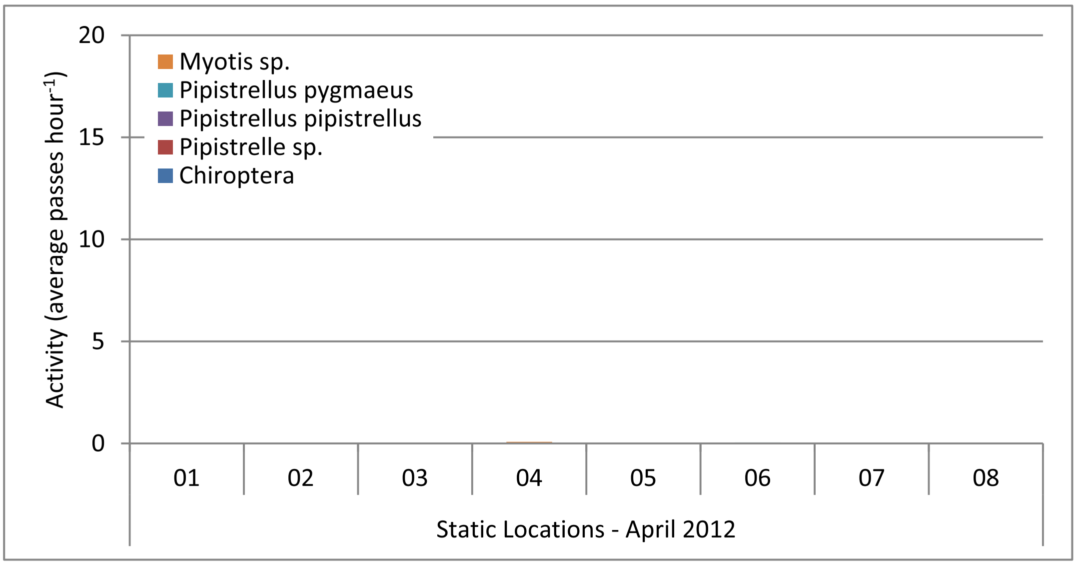
Infra-structure	*Pipistrellus* sp.	*Pipistrellus pipistrellus*	*Pipstrellus pygmaeus*	Myotis sp.	Unidentified Bat
None	0.09	1.92	5.61	0.09	0.03
Tracks	0.00	0.00	0.74	0.00	0.00
Turbine	0.00	0.00	1.20	0.00	0.00

Static Recorders

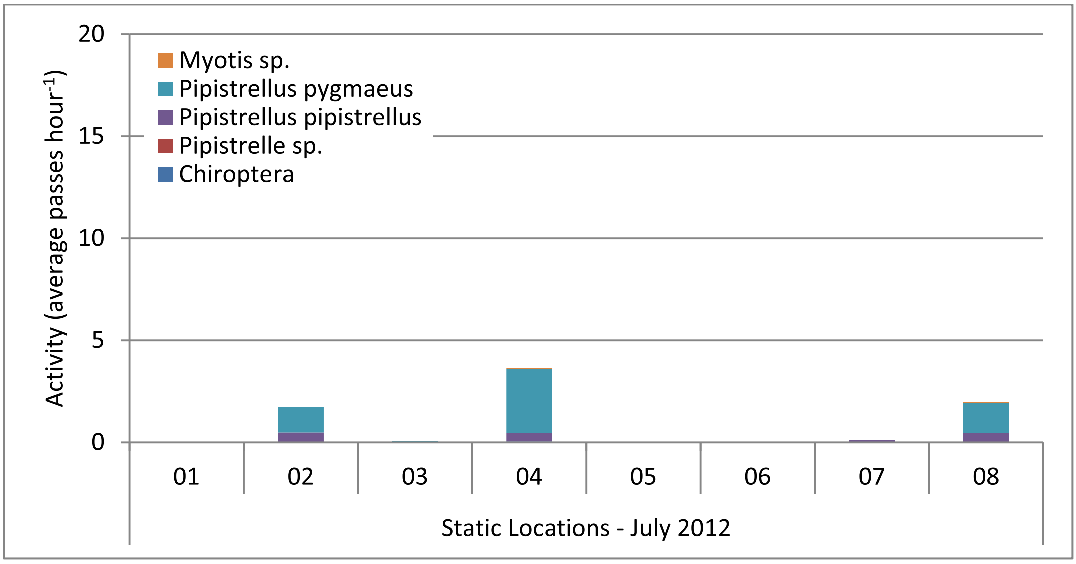
The static detectors recorded very low activity during their deployment in April. A total of two soprano pipistrelle passes at Static Location 4 (Figure 3a). During July and August increased levels of activity were noted with moderate levels recorded during August (Figure 3b and c).

However, taking all months into account, levels across the site remained low (Figure 3d). Activity across static locations was not uniform with static locations at *habitat* locations suitable for bats (e.g. woodland edges, farm buildings, hedges etc.) supporting far greater activity than at more open locations (Figure 4). Species richness on Site based on static detector data was dominated by common pipistrelle and soprano pipistrelle with nine passes of *Myotis* species and a single pass of an unidentified bat making up the remainder of the records.

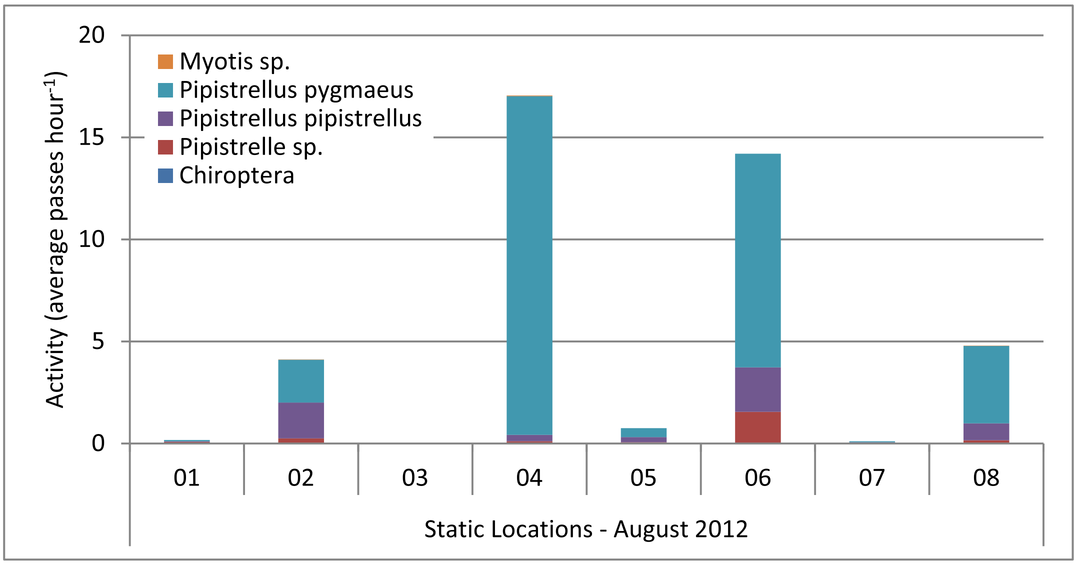
Figure 4 Average activity levels (passes hour-1) at static detector locations during a) April, b) July, c) August and d) April to August 2012.
April recorded extremely limited results which do not register on scale, which has been maintained across graphs for comparisons.



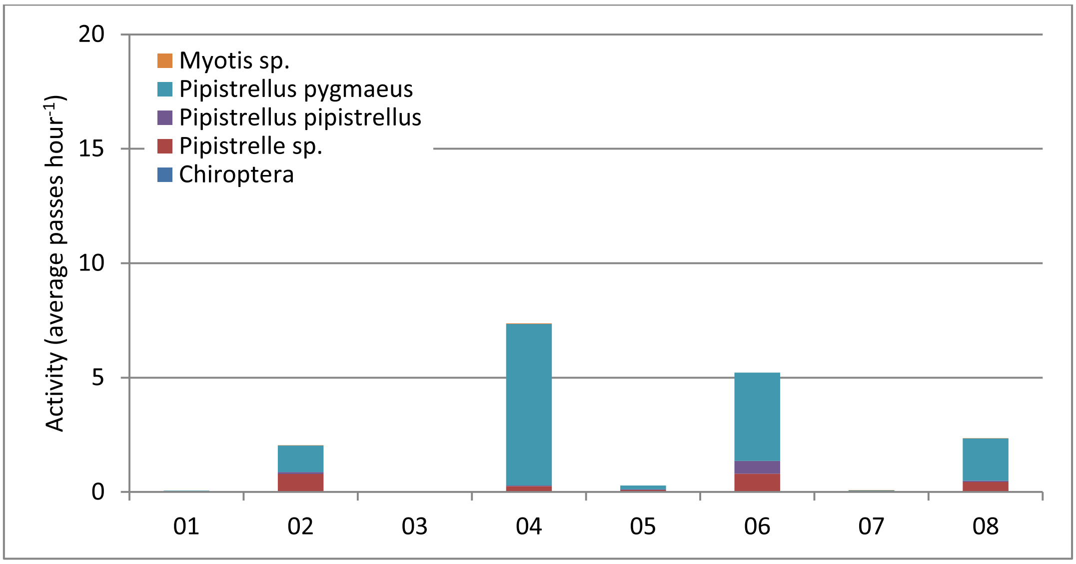
a)


20
15
10
5
0
Activity (average passes hour-1)
Myotis sp.
Pipistrellus pygmaeus
Pipistrellus pipistrellus
Pipistrelle sp.
Chiroptera
01
02
03
04
05
06
07
08
Static Locations - July 2012

b)

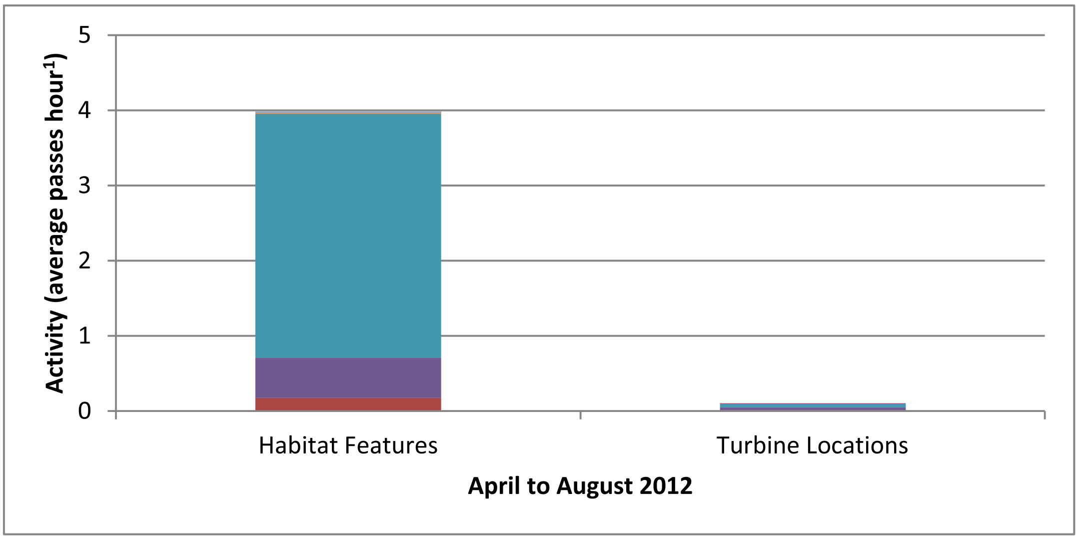

20
15
10
5
0
Activity (average passes hour-1)
Myotis sp.
Pipistrellus pygmaeus
Pipistrellus pipistrellus
Pipistrelle sp.
Chiroptera
01
02
03
04
05
06
07
08
Static Locations - August 2012

c)



d)

Figure 5 Average activity levels (passes hour^{-1}) from static detectors located at bat *habitat* and *open* locations.



When considering activity levels of bats based on their respective individual risk from wind turbines (Natural England, 2012) the survey results show that the vast majority of species present are of moderate risk (Figure 5) and also at low activity. In addition to this grouping, the results across turbine locations (static locations 1, 3, 5 and 7) and non-turbine locations (static locations 2, 4, 6 and 8) show a defined difference in activity levels along with species that are active at proposed turbine locations are also of predominantly moderate individual risk (Figure 6).

Figure 6 Average activity levels (passes hour^{-1}) based on species individual risk levels across static detector locations

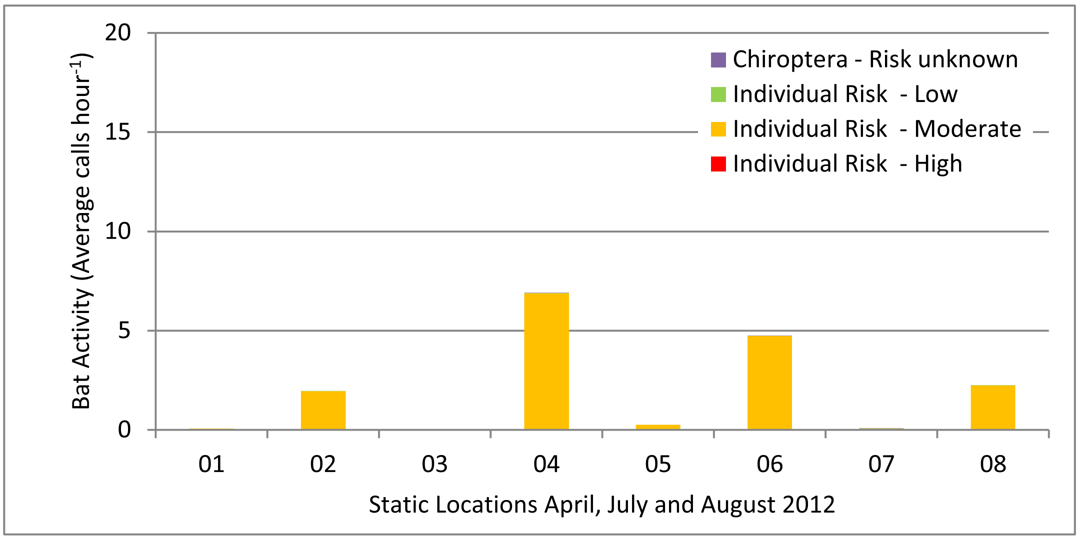
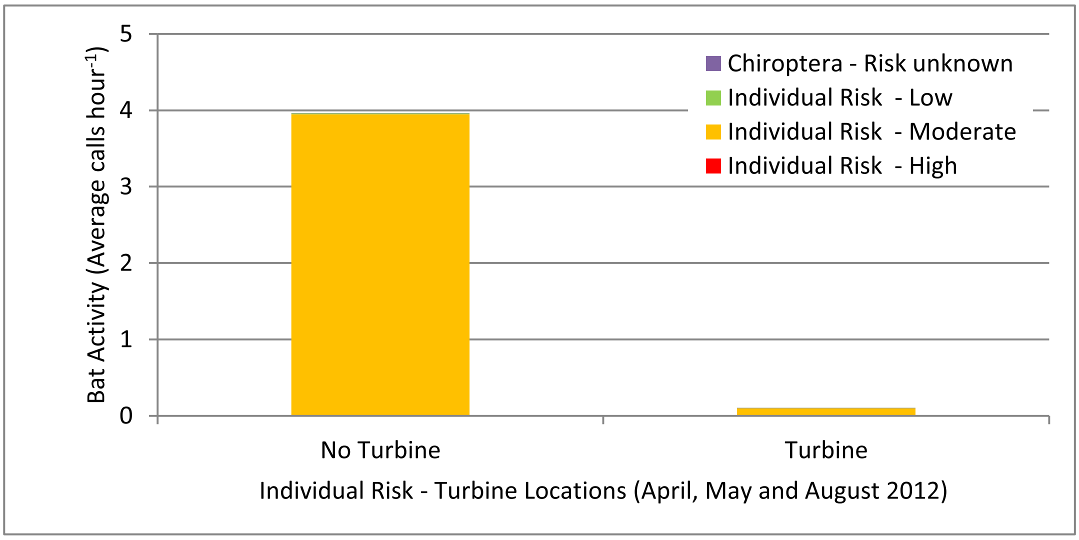


Figure 7 Average activity levels (passes hour^{-1}) based on species individual risk levels across proposed infrastructure locations.



When taking into account the risk levels of bat species on a population level (Natural England, 2012) the vast majority of records (99%) are from low risk species with only one record form an unknown bat, and therefore of unknown risk.

Figure 8 Average activity levels (passes hour-1) based on species population risk levels across static detector locations.

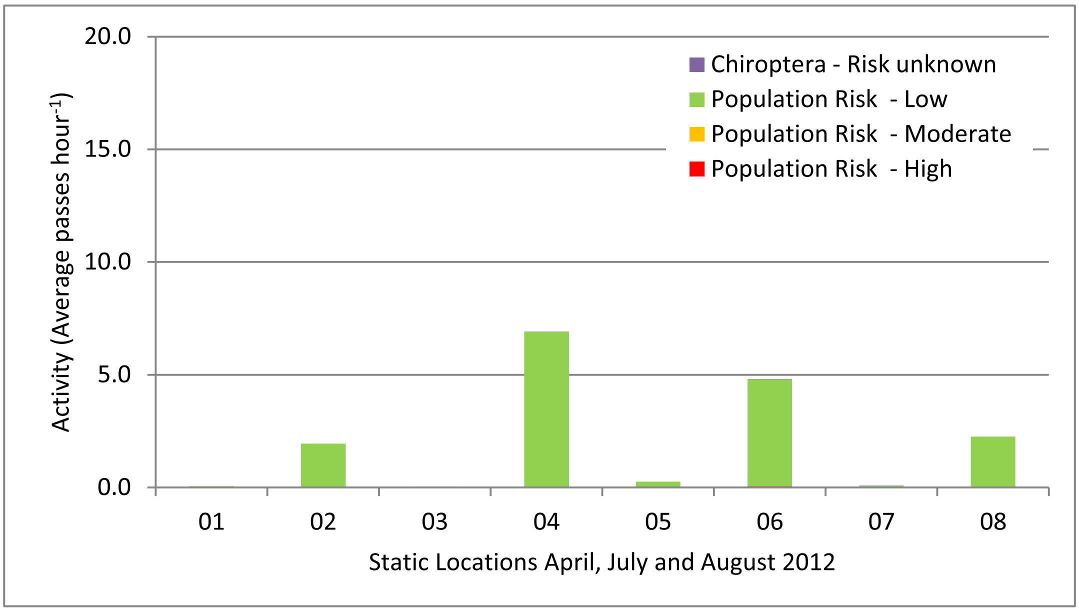
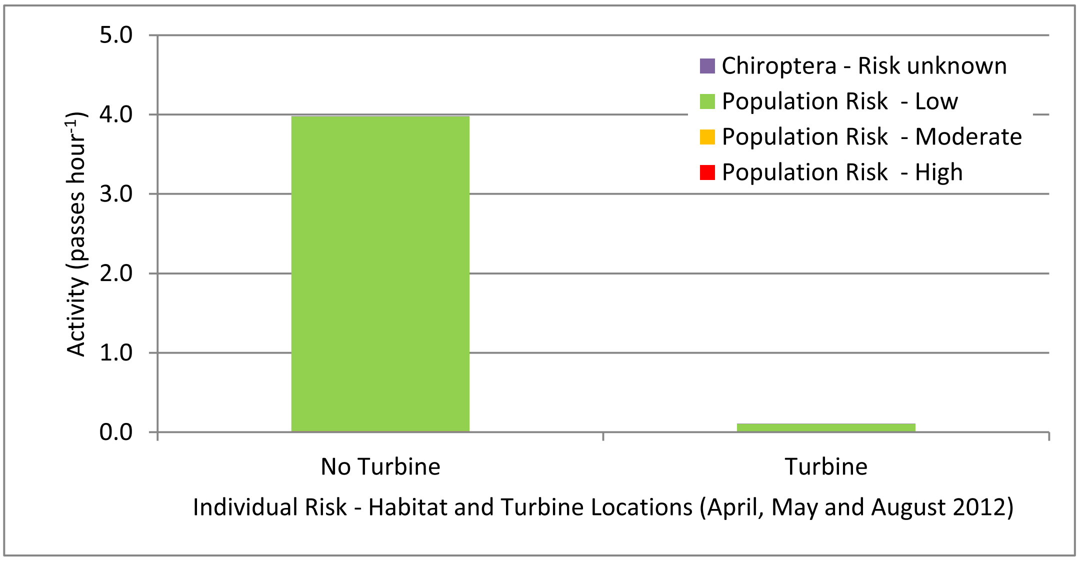
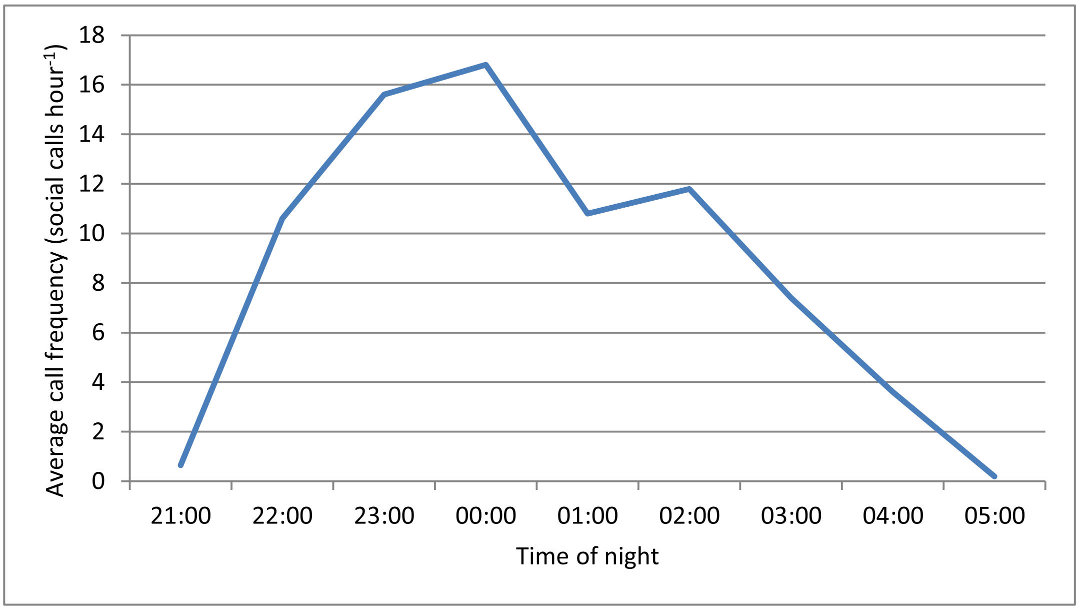


Figure 9 Average activity levels (passes hour-1) based on species population risk levels across proposed infrastructure locations.



Social and foraging calls were restricted to static detector locations within bat suitable habitat features with no social or foraging calls detected at proposed turbine locations (layout d). A significant peak of pipistrelle social calls was identified at static location 6 during August 2012 with social calls present throughout the night-time period. This may be indicative of a maternity roost being present with bats frequently returning to the roost location throughout the night to feed young. Activity was also present in close temporal proximity to sunset and sunrise also suggesting that roosting nearby is likely (Figure 9). In addition, although a number of foraging calls were recorded, foraging activity was not high enough to suggest that the level of activity at the farm was due to foraging resources. Although during roost assessment surveys no definitive evidence to suggest roosting was occurring was identified, the buildings and a number of trees did provide suitable opportunities.

Figure 10 Frequency of *Pipistrelle* species social calls over five day period grouped by hour of night. During survey period: Average sunset 21:23, Average sunrise 05:04).



A.16. Impact Assessment Review

Ecological Evaluation

Following consultations, desk study and field surveys, criteria are applied to assess the nature conservation value of the 'receptor' along with an assessment of impact magnitude and significance. Full details of the process are detailed within Chapter 7.

Bats are European protected species and as such are assessed as being of international importance within the framework of the EIA. Bat activity levels at the Frawney Wind Farm Site are assessed as being relatively low, across the entire Survey Area, when assessed across the entire survey period. However activity was greatest at *habitat* locations with peaks identified at two locations (Static location 6 - Over Finlarg Farm and Static location 4 - an avenue of beech trees in the north east of the Survey Area). At these locations bat activity was observed as being moderate during August 2012. In addition, despite roost assessment surveys not identifying definitive evidence of roosts within buildings and trees within the Survey Area, a significant number of opportunities exist for roosting bats and the high numbers of social calls identified at the static location within the farm buildings at Over Finlarg suggest that a roost may be present. Within the original Frawney Wind Farm ES (June 2012) the ecological value of bats was assessed as being 'less than local', however as a result of increased level of activity noted during subsequent surveys, along with the high level of social calls noted bats were re-assessed as an ecological receptor value to **Local Value.**

Construction Impacts

Although the impacts of wind turbines on bats in the UK are not completely understood, guidance has been provided by Natural England (2012) and Bat Conservation Trust (Hundt, 2012). Potential construction impacts of wind farms on bats considered here include:

- Direct loss of foraging habitat and/or roosts; and
- Loss of flightlines.

Habitat Loss – Roost Habitat

A number of trees and buildings which offer suitable roosting habitat (moderate to high potential) are present within the Survey Area. Although no roosts were identified from the roost assessment surveys, a number of the trees and areas of the buildings were inaccessible for thorough searches of evidence of roosting bats. The results of the static detector surveys, although limited in their spatial coverage, suggest that there may be a roost located within the Over Finlarg Farm. It is also possible that this roost is a maternity roost as high levels of social calls are recorded throughout the night time activity period. As a result, following the precautionary principle it is assumed that a roost is located somewhere within the farm complex.

Direct Impacts

The location of potential roost sites (Over Finlarg Farm and numerous trees throughout the Survey Area) are all situated in excess of 400m from proposed turbine locations and no direct impact on the potential roost locations are expected as part of the proposed scheme. Bats are assessed to be of local nature conservation value within the context of the Site and no significant impact on bat roosts at this Site location is anticipated.

Nonetheless mitigation measures will be required to ensure that no impacts on these potential roost areas occur. If at any stage the removal or significant pruning of any mature trees, especially those highlighted as potential bat roosts (Figure 7-4) is required, pre-construction work checks will be required to assess whether the tree currently supports a bat roost. These inspections would require full access to all relevant sections of the tree using ladders or access platform. If a bat roost was confirmed at this stage, then a license under regulation 44 of the Conservation (Natural Habitats, &c.) Regulations 1994 as amended would be required to ensure compliance with the legislation protecting bats.

Indirect Impacts

No infrastructure (access tracks) is proposed in proximity (closer than 80m) to potential bat roosts within trees or buildings and as such indirect impacts are not anticipated as a result of the development. It is possible that indirect impacts from increased disturbance throughout the Site, including disturbance to field boundaries for example, could result in disruption of flight lines to and from a particular roost. However, as the areas being impacted upon do not form significant flightline features this is very unlikely. In addition, bright flood lighting should be avoided within close proximity of Over Finlarg Farm but if required the impact on bats can be minimised by the use of low pressure sodium lamps or high pressure sodium instead of mercury or metal halide lamps where glass glazing is preferred due to its ultra-violet filtration characteristics.

Lighting should be directed to where it is needed and light spillage avoided. This can be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvres and shields to direct the light to the intended area only. Planting can also be used as a barrier or manmade features that are required within the build can be positioned so as to form a barrier.

As a result a barely perceptible impact would be expected on bat roosts from indirect impacts at this location. However, if the design of the proposed wind farm was to change involving any impacts on trees or buildings highlighted as offering potential to roosting bats then this would need to be reassessed.

Habitat Loss – Foraging Habitat

As detailed within Chapter 7 the Survey Area does not support extensive areas of suitable habitat with the majority of land under intensive agriculture which offers no significant foraging resource for local bat populations. The farm buildings are likely to provide the most suitable foraging areas with sheltered locations and presence of livestock likely to support a foraging resource. A small number of ditches and woodland blocks are likely to support some degree of connectivity although these are unlikely to provide significant foraging resources. The low levels of bat activity recorded to date suggest that the Site does not support extensive foraging especially in areas of the proposed turbines.

With bats identified as of local nature conservation status within the Survey Area it is assessed that the construction phase of the proposed wind farm will result in a barely perceptible magnitude impact, which constitutes no significant impact as part of this EIA review.

Loss of Flightlines

The only impact expected from the proposed development will be removal of small sections of post and wire fencing and drystone walls. The post and wire fencing and drystone walls are unlikely to provide any significant flightline/navigational resources for local bats and this loss can be considered to be a non-significant impact. The current layout avoids the loss of species poor hedgerow to the north of turbine 3 and removes the potential to sever a flightline link close to the line of beech trees in the north of the Site.

Impacts on bat flightlines during construction are, therefore, assessed to be of low magnitude across the Site as a result of the proposed wind farm development, resulting in no significant impact.

Table 13: Construction Impacts Summary

Receptor	Evaluation	Nature of Impact	Impact Magnitude	Impact Significance
Bats	Local	Roost habitat loss Foraging habitat loss Loss of flightlines	Barely perceptible Barely perceptible Low	No Significant Impact No Significant Impact Minor

Mitigation Measures

Despite the non-significant impacts, mitigation is proposed to ensure effects on bats are minimised as far as possible. Although the majority of impacts are identified as being of no significant impact, a number of recommendations are made.

Trees with roosting potential should be avoided in the first instance or checked by a licensed bat worker prior to felling or substantial pruning. If a bat roost was confirmed at this stage, then a license would be required to ensure compliance with the legislation protecting bats. If the wind farm design changes and potential impacts are identified, further surveys may be required.

Measures should be implemented to reduce the potential for disturbance from artificial lighting. This is particularly the case near potential foraging, commuting or roosting areas. At all times lighting should be limited as discussed in Habitat Loss – Roost Habitat section.

The extent to which field boundaries are affected should be minimised with micrositing of tracks designed to reduce length of boundary removed. Post construction it is recommended that any hedgerow removal is reinstated as far as possible while still retaining access to the infrastructure for maintenance.

Residual Impacts

The nature and significance of residual impacts i.e. impacts following mitigation, are summarised in Table 5. Given the small scale of the proposal and with the mitigation measures proposed, the residual impacts of the construction are considered to have no significant impacts on the bat populations present on Site.

Table 14: Residual Impacts Summary

Receptor	Impact Without Mitigation	Mitigation Measures	Residual Impact
Bats	No significant impact	Lighting directed only on working areas. Avoidance of impacts to farm buildings. Pre-construction survey of trees to be felled/pruned. Reduction of impacts to field boundaries with reinstatement of hedgerows where possible. Re-assessment if significant design changes required.	No significant impact

Permanent and Operational Impacts

According to Natural England's TIN 051 guidance (adopted by SNH), although individual common and soprano pipistrelle bats are at medium risk of collision with wind turbines, populations of these species are considered to be at a low risk of threat from wind turbines. This is due to the relative population sizes and common status of these species across the UK. Myotis bats are all identified as having a low risk from wind turbines both in terms of individuals and populations.

Within wind energy developments the potential to impact upon local bat populations exists. The design process of the wind development has taken bat habitat into account and followed best practice guidance (Natural England, 2012) in siting of turbines away from optimal bat habitat features in order to minimise potential impacts on local bat populations. As a result proposed turbine locations are all in excess of 50m plus rotor diameter from any potential foraging habitat significantly reducing the potential for bat collisions (Natural England, 2012). Proposed turbines have a hub height of 56m and blade length of 24m, with hedge height approximately 2m, to maintain minimum distances as per guidance this results in a minimum distance of 39.5m will be required.

Results from static detectors identified that sampled turbine locations (layout d) supported very little activity. Areas of focused bat activity were all limited to detectors in excess of 500m from turbine locations. This survey information is restricted to static detector locations only and as such significant areas of the Survey Area do not have long term monitoring information. However, all previously proposed turbine locations (layout d) supported extremely low levels of bat activity with a total of 69 passes across the four static detectors throughout the 19 survey nights. This results in an average activity of 0.1 calls hour^{-1} at each of the four monitored turbines. This is in comparison to static detectors at *habitat* locations (away from proposed turbines) identifying an average of 4.2 calls hour^{-1} at each of the four monitored turbines.

Given the above, it is considered that the impact of the operational phase of the development on bat populations, assessed as being of local nature conservation value, would most likely result in, a barely perceptible impact, which constitutes no significant impact as part of this Ecological Impact Assessment (EcIA).

Mitigation Measures

Table 15: Summary of Mitigation Measures

Generic Impacts	Mitigation of Effects on Habitat Features/Species on Site
Displacement of species	The presence of a wind farm at the proposed site is unlikely to cause any displacement of species. The area supports low bat populations which will remain unaffected.
Collision risk	If micrositing allowances allow, turbines should not be moved closer to bat habitat features and ideally distances from such features should be maximised.

Predicted Residual Impact

Given the relatively small scale of the proposal and it's siting within an area of intensive agriculture (sub-optimal in terms of bat habitat) and the mitigation measures proposed above, the residual impacts of the operational phase are considered to have no significant impacts on local bat populations.

Cumulative Impacts

Bats are of international conservation importance and can be affected by cumulative impacts from wind farms with the greatest theoretical risk to bats from increases in collision risks and disturbances to roosting locations.

There are two wind farm planning proposals located within a 5km radius of the Frawney Wind Farm. The Dodd Hill Wind Farm is located approximately 3.5km southeast and is comprised of five turbines to a capacity of 12.5 MW. The Dodd Hill Environmental Statement identifies bats as an ecological receptor of less than local value and overall the impacts on bat populations at the site would not be significant. The Govals Wind Farm is located 1.5km north of the Site and consists of a planning proposal for six turbines. The Govals Wind Farm Environmental Assessment also concludes that no significant impact with respect to local bat populations is expected. In addition a single micro turbine to 25m tip height is presently located within an arable field south of Nether Finlarg.

As the Frawney Wind Farm is also expected to have no significant impact on bat populations at the Site and the wider area is not optimal bat habitat it is assessed that the cumulative impacts to bats will not be significant.

Summary

The additional surveys undertaken in July and August 2012 in order to meet current guidance identified a greater level of bat activity across the Survey Area than had been identified during the April 2012 surveys. This resulted in the nature conservation value of the site for bats being raised to Local.

However, all activity is at significant distance from the proposed turbines and as such no significant impacts are expected. The potential for impacts is further reduced through recommended mitigation measures.

References

Hundt L. 2012. Bat Surveys: Good Practice Guidelines, 2nd Edition. Bat Conservation Trust.

Natural England 2012. Technical Information Note TIN051 Bats and onshore wind turbines *Interim Guidance*. 2nd Edition. Natural England 2012.

Appendix 8-1: Ornithology

A.17. Introduction

Terms of Reference

Ornithological surveys were completed between October 2008 and September 2009 including Vantage Point (VP) watches, winter walkover surveys, Common Birds Census (CBC) and barn owl surveys.

This technical appendix presents the methodology and results of the ornithological surveys and includes the following information:

- Consultation and data gathering;
- Baseline survey methodology;
- Baseline results;
- Collision risk modelling; and
- Annexes.

The proposed development boundary and survey area are shown on Figure 8-1 and will be referred to as the 'Site'.

Objectives of the Study

The objectives of this technical appendix are as follows:

- To document survey methodologies;
- To document the avian species recorded throughout the year on and around the Site;
- To assess the use of the Site by over-wintering and migrating birds;
- To assess and identify any migration flight activity over and around the Site; and
- To assess the use of the Site for breeding birds.

A.18. Selection of Target Species

Target species were identified as those which are either afforded specific legislative protection or represent qualifying interests in designated sites in the wider area. Reference was then made to guidance for the identification of potentially vulnerable species (SNH 2005 revised 2010, SNH 2006). The final list of target species was determined using these guidance documents along with the likelihood of each species being present at the Site and environs (based upon available habitat). All other bird species are referred to as secondary species.

Target species are considered to be:

- Those identified as potentially at risk from impacts of onshore wind farms (SNH, 2006);
- Species listed as part of the qualifying interest of local (20km radius for geese) Special Protection Area (SPA);
- Included in Annex 1 of the EC Wild Birds Directive (79/409/EEC);

- Listed in Schedule 1 of the Wildlife and Countryside Act 1981 (as amended);
- UK Biodiversity Action Plan (UKBAP) species;
- Tayside Local Biodiversity Action Plan (LBAP); and
- Species of Principal Importance in Scotland.

A.19. Consultation and Data Gathering

SNH, RSPB and the Tayside Raptor Study Group (TRSG) were first contacted in September 2008 to gather any existing data and additional information on the avian assemblage of the Site.

In 2008 SNH commented on the presence of the Whitehouse Den SSSI, designated for its geological interest within 2km of the Site. Furthermore, SNH stated that they held data on red squirrels within the woodland at the southeast and historical bat records from within a 2km buffer around the Site. No information on birds was provided.

In 2008 the RSPB responded that they held no bird information for the Site or its immediate vicinity and that they did not know of any other parties who might do, although they were able to provide wider information as below. They commented that the Site was near one of the few areas of heather moorland remaining on the Sidlaws. Therefore, the presence of waders, red grouse and other moorland species was considered likely and the RSPB recommended completing relevant moorland surveys.

No response was received from the TRSG.

Further consultations with a larger number of consultees were carried out early in 2012 to obtain any relevant data that might have been gathered since 2008.

SNH recommended that the ornithological survey work followed the guidance documents published by SNH. They also recommended using the SNH online information service (SNHi) as well as the National Biodiversity Network (NBN) to check for existing ecological and ornithological data for the Site as they held no reports specific to the Site.

In 2012 the RSPB provided a spreadsheet of ornithological records for the wider area. This included five red kite records near Glamis obtained from radio tagged individuals and four barn owl records from 2005 and 2006 near Glamis and Lumley Den. Barn owl was considered to be probably breeding in the area. Two other raptor records included one of a merlin from 1992 near Lumley Den and an osprey nest location near the Glamis Estate. The RSPB commented that they held no further information on this osprey territory and that details on this pair would have to be obtained from the TRSG. Confirmed breeding records for oystercatcher, curlew, lapwing, redshank and snipe data back to 1992 but the RSPB commented that revised wader surveys in the area were not due to be completed until 2012. Other species confirmed to be breeding in the area included swift and a common gull near Petterden.

In 2012 the Local Bird Recorder (LBR) provided a spreadsheet with records from the British Trust for Ornithology (BTO) as well as a summary of records of the BTO 2007-2011 British Bird Atlas project. He commented that merlin, peregrine and goshawk which were recorded for the BTO atlas work might have been passing through the area only although suitable breeding habitat was considered to be present. Based on the data, breeding species in the area included red grouse, oystercatcher, skylark, song and mistle thrush, house sparrow, linnet, siskin, lesser redpoll, bullfinch, yellowhammer and redwing.

The TRSG was not consulted in 2012 but Atmos is aware of a record for a goshawk nest location in the woodland at the southeastern corner of the Site.

A.20. Baseline Survey Methodology

The methods for vantage point, winter walkover, CBC and barn owl surveys and rationale behind the identification of target and secondary species of interest are detailed below.

Diurnal Vantage Point (VP) Watches

The locations of three VPs were identified during a scoping visit to the site in September 2008. The VPs and their viewsheds are presented on Figure 8-1 and detailed in Table A8-1. VP watches were undertaken using the methods recommended by SNH (SNH, 2005, updated 2010) from October 2008 to September 2009. Each VP watch was undertaken by a suitably experienced single observer in conditions of good visibility. The surveyor positioned themselves as inconspicuously as possible to minimise their effects on the birds' natural behaviour.

Table A8-1: Details of Diurnal Vantage Point Locations

VP Number	Grid Reference		View Bearing
VP 1	342483	742193	260°
VP2	341241	740598	35°
VP3	340508	742060	28°

Diurnal VP surveys were completed over a 12 month period. Surveys were undertaken in watches of no longer than three hours. Where practical the watches were completed fortnightly. Surveys were completed by one surveyor per day. Potential collision risk height was defined between 20m and 125m height.

Migration Vantage Point Watches

In addition to the diurnal vantage points detailed above, dawn and dusk vantage point watches were completed from one VP location to ensure that any migrating and overwintering passage birds, mainly geese, would be detected.

Migration VP watches were undertaken by a single observer in a range of conditions and visibility and were undertaken from VP1.

Dawn and dusk watches focused on the periods around dawn and dusk, starting one hour before dawn and completing one hour after dusk; diurnal surveys were also completed. Dawn and dusk times are considered as sunrise and sunset respectively.

VPs were completed in watches of no longer than three hours.

Vantage Point Survey Effort

Table A8-2 summarises the observation effort of the VP watches. A total of 72 hours were completed from the three VPs in the autumn season (September - November 2008) although no surveys were completed in September. During the winter season (October 2008 - March 2009) a total of 168 survey hours were completed, 42 of which were dawn and dusk watches. The spring migration period (March-May 2009) was covered with a total of 72 hours and the during the summer period (April-September 2009), 120 VP survey hours were completed. Details of the date, timing and surveyor for each VP watch are provided in Annex 1.

Table A8-2: Vantage Point Observation Effort October 2008 – September 2009 (hours)

Month	VP1 (diurnal)	VP1 (dawn & dusk)	VP2 (diurnal)	VP3 (diurnal)	Total
Oct-08	12:00	12:00	12:00	12:00	48:00
Nov-08	6:00	6:00	6:00	6:00	24:00
Dec-08	6:00	6:00	6:00	6:00	24:00
Jan-09	6:00	6:00	6:00	6:00	24:00
Feb-09	6:00	6:00	6:00	6:00	24:00
Mar-09	6:00	6:00	6:00	6:00	24:00
Apr-09	6:00	6:00	6:00	6:00	24:00
May-09	6:00	6:00	6:00	6:00	24:00
Jun-09	6:00	-	6:00	6:00	18:00
Jul-09	6:00	-	6:00	6:00	18:00
Aug-09	6:00	-	6:00	6:00	18:00
Sep-09	6:00	-	6:00	6:00	18:00
Total	**78:00**	**54:00**	**78:00**	**78:00**	**288:00**

Target species flight lines recorded during the surveys were digitised for later analysis. Other information associated with the flight line (number of birds, duration, height and other) was entered into a Microsoft Access database which was for further analysis.

Winter Walk-over Survey

The winter survey method involved following a route within the survey area between vantage points (not specifically those for diurnal VP watches) and ensuring that each part of the survey area was viewed. The route was walked slowly using periodic scanning with binoculars, stopping at suitable vantage points (stopping for periods up to an hour if appropriate) where observations could be made by scanning and listening for bird activity. These shortened vantage points aimed to target areas in the landscape where potential ornithological important features, such as streams and woodland edges etc, could attract bird activity that may not be observed from the formal diurnal VP surveys.

Six surveys were undertaken over the winter period, spread at representative intervals between October 2008 and March 2009. Due to the potential for geese to use this Site for foraging it was considered appropriate to complete surveys on a monthly basis, to determine usage by feeding geese in the area. These surveys were carried out, in suitable weather conditions, avoiding conditions such as high winds, poor visibility and rain.

Table A8-3: Winter Walkover Survey Details

Month	Date	Start time	Stop time	Duration
October	30/10/2008	8:00	13:30	5:30
	31/10/2008	8:00	13:30	5:30
November	27/11/2008	8:30	13:30	5:00
	28/11/2008	8:30	13:30	5:00
December	18/12/2008	9:30	14:30	5:00
	20/12/2008	9:30	14:30	5:00
January	29/01/2009	9:00	14:30	5:30
	30/01/2009	9:00	14:30	5:30
February	24/02/2009	9:30	14:30	5:00
	25/09/2009	9:30	14:30	5:00
March	17/03/2009	9:30	14:30	5:00
	18/03/2009	8:00	13:00	5:00

Breeding Bird Survey (Common Bird Census)

An adapted CBC method (Bibby et al., 2000) was carried out at the proposed development site to investigate the breeding bird population on the Site. The CBC is an intensive (normally ten visits per breeding season) study most appropriately used on lowland areas for detecting birds for the purposes of establishing a species list and territory map of breeding birds. For wind farm developments a scaled down three visit survey is recommended (SNH, 2005) and this method was carried out throughout the development Site. This survey was undertaken by walking the survey area which includes the development Site boundary and a 500m buffer around possible turbine locations. This was carried out on three occasions during the breeding season, ensuring that all parts of the survey area were approached within 50m or 100m in open habitats. The development area largely comprised of farmed agricultural land with two small conifer plantations in the north, a mature conifer plantation at its southern boundary and Finlarg Hill in the west. In the west, heathland habitats are dominating the 500m buffer area. There was also a scattering of scrubs and trees near buildings and along tracks and fences. Surveys were carried out in April, May and June 2009 as detailed in Table A8-4.

Table A8-4: Common Bird Census Details

Month	Date	Start time	Stop time	Duration
April	24/04/2009	6:00	11:15	5:15
	25/04/2009	6:00	10:00	4:00
	29/04/2009	6:30	10:30	4:00
May	18/05/2009	5:30	9:30	4:00
	18/05/2009	5:30	11:30	6:00
	21/05/2009	5:30	10:00	4:30
June	19/06/2009	4:40	8:40	4:00
	20/06/2009	4:30	9:15	4:45
	21/06/2009	4:30	8:15	3:45

Barn Owl Survey

Barn owl was seen twice during winter walkover and later, a flight was recorded during the vantage point surveys in March. However, as recommended by Hardey et al. 2006, no specific survey for suitable nest sites and signs occupancy has been undertaken. To ensure that any potentially breeding barn owls on site would not be disturbed, a single visit was carried out on 31/07/2009, surveying possible nest locations such as derelict buildings and tree cavities.

Selection of Target Species

Target species were identified as those which are either afforded specific legislative protection or represent qualifying interests in designated sites in the wider area. Reference was then made to guidance for the identification of potentially vulnerable species (SNH 2005, 2006). The final list of target species was determined using these guidance documents along with the likelihood of each species being present at the Site and environs (based upon available habitat). All other bird species are referred to as secondary species.

A.21. Baseline Survey Results

Vantage Point Watches

Nine target species were recorded during VP watches in the period October 2008 to September 2009: peregrine *Falco peregrinus*, barn owl *Tyto alba*, golden plover *Pluvialis apricaria*, curlew *Numenius arquata*, lapwing *Vanellus vanellus*, oystercatcher *Haematopus ostralegus*, whooper swan *Cygnus cygnus*, greylag goose *Anser anser* and pink-footed goose *Anser brachyrhynchus*.

A summary of numbers of target species flights and flight times are presented in Table A8-5. Data is summarised from 'standard' observation records during timed surveys and do not include incidental or ground observations. The column 'At Risk Bird second' represents the total flight time of all individuals at collision risk height during the survey year. Annex 2 details individual flight data. Figure 8-2 illustrates the flightlines of raptors and owls and Figure 8-3 those of waders and waterfowl.

Table A8-5: Summary Flight Data for Target Species from Vantage Point Surveys

Species	No. of Flights	Minimum No. of Birds	Maximum No. of Birds	Median No. of Birds	Total Bird Seconds	At Risk Bird Seconds
Barn owl	1	1	1	1	105	0
Curlew	3	2	31	3	3257	3257
Golden plover	5	15	104	28	5884	5355
Greylag goose	1	48	48	115	5520	0
Lapwing	6	2	47	32	11649	11499
Oystercatcher	1	2	2	2	250	0
Peregrine	2	1	1	1	40	0
Pink-footed goose	6	37	221	95	48580	0
Whooper swan	3	4	24	17	1972	268

One barn owl flight was noted in March 2009 northwest of Nether Finlarg cottages. Curlew flights were noted on three occasions with two flocks of three and 31 birds in

March 2009 and two birds in June 2009. All flights were recorded at collision risk height. There was also one ground record of a flock of 14 birds noted in August 2009.

Golden plover flocks were present on Site only in October and November 2008 with a total of five flocks recorded. Four flocks were small with 15 to 33 individuals, only one flock was larger with 104 birds. Two ground records of three and 23 birds were reported in August and September 2009.

One flock with 48 greylag geese was recorded in March 2009, flying above collision risk height across the Site. Ground registrations for greylag geese were noted on three occasions; all of these were recorded from VP3: a flock of 188 birds was recorded on 10/12/2008 and a flock of 288 on 14/01/2009. The smallest flock of 94 was noted on 21/01/2009. All three flocks were recorded foraging on pasture, over 1km to the northwest of the Site and the nearest turbine locations (Figure 8-3).

Lapwing flocks of 15 to 47 birds were noted in October 2009, March and August 2009 and flock of 64 birds was noted on the ground.

One oystercatcher flight with two individuals was recorded in June 2009.

Peregrine flights were recorded on two occasions in October 2008 and January 2009. One bird was identified as an adult male; both flights were recorded above collision risk height.

Six pink-footed goose flights were recorded: four of these were noted on a single morning in November 2008 with flocks between 37 and 113 individuals. Two further flocks were recorded on one day in March 2009 with 86 and 221 birds respectively. All flights were recorded above collision risk height.

Three whooper swan flights were recorded in November and December 2008 and March 2009 with four to 24 birds. The flight with four individuals was recorded at collision risk height; the other two flights were above collision risk height.

Winter Walkover Surveys

A total of 48 bird species were recorded on the Site over the winter months with the least number of species recorded in January 2009 (28 species) and 47 species recorded in March 2009 at locations where many breeding species had already been recorded. The following target species were recorded:

- Golden plover with two flocks of eight and 27 in October and one flock of nine birds in November. Both flocks were recorded in the northwest quarter of the Site;
- Barn owl was noted on two occasions in October and January south of Muirside House;
- Common crossbills with five individuals near the small square plantation woodland at the northwest corner of the Site during the October visit;
- Goshawk was noted on two occasions: a female bird was recorded during the October visit in the woodland at the southeastern corner and a female bird was observed displaying over the triangular plantation in the northwest of the Site;
- An adult male peregrine was recorded during the October visit flying over the northern part of the Site;
- A flock of four redwing was recorded during the December visit; and

- Migrating geese were recorded only during the October visit with one flock of 12 greylag geese and one flock of 74 pink-footed geese flying over the Site in southerly directions.

Table A8-6 details the number of registrations recorded per winter walkover visit and describes the status of each species on the Site. Where no number is given in the Table, x indicates that the species was recorded during the visit.

Table A8-6: Winter Walkover Bird Species and Status List

Species	Oct 2008	Nov 2008	Dec 2008	Jan 2009	Feb 2009	Mar 2009	Status
Barn owl	1			1			Probably resident
Blackbird	x	x	x	x	x	x	Resident
Blue Tit	x	x	x	x	x	x	Resident
Bullfinch	11	x			x		Resident
Buzzard	x	x	x	x	x	x	Resident
Carrion Crow	x	x	x	x	x	x	Resident
Chaffinch	60	34	100	200	100	x	Resident, wintering flocks
Coal Tit			x	x	x	x	Resident
Collared Dove				x			Occasional visitor
Common Crossbill	5						Occasional visitor
Common Gull	350	150	200	x	x	x	Wintering flocks
Curlew						x	Absent, returning to breed
Dunnock	x	X	x	x	x		Resident
Goldcrest		X		x			Resident
Golden Plover	35	9					Autumn migrant
Goldfinch	x	X	50	x	50	x	Resident
Goshawk	x					x	Display noted in March
Great Tit	x	x	x	x	x	x	Resident
Greenfinch			50	x	50		Resident, wintering flocks
Grey Heron	1			1	1		Occasional visitor
Grey Partridge	7	x	5	13	x	x	Resident
Greylag Goose	12						Autumn migrant
Herring Gull	x	x	x	100	x	x	Foraging flocks
House Sparrow	20	x	x	x	x	x	Resident
Jackdaw		x	100	200	x		Resident
Kestrel	1	x	x				Occasional visitor
Lapwing						x	Absent, returning to breed
Linnet	100	34			x	x	Resident
Long-tailed Tit	x	x				x	Occasional visitor
Meadow Pipit	x	x	x	x	x	x	Resident
Oystercatcher					x	x	Absent, returning to breed
Peregrine		1					Occasional visitor
Pink-footed Goose	74						Autumn migrant
Red Grouse	x	x		x			Resident nearby
Red-legged Partridge		x	x				Resident

Species	Oct 2008	Nov 2008	Dec 2008	Jan 2009	Feb 2009	Mar 2009	Status
Redwing			4				Winter visitor
Robin	x	x	x	x	x	x	Resident
Rook	250	x	100	200	x	x	Resident, wintering flocks
Skylark		x			x	x	Resident
Snipe					x	x	Absent, returning in spring
Song Thrush			x	x	x	x	Resident
Sparrowhawk			2				Occasional visitor
Starling	600	500	700	500	200	200	Resident, wintering flocks
Tree Sparrow	8	20	5			x	Resident
Woodcock	x	x	x	x			Winter visitor
Woodpigeon	x	x	200	100	x	x	Resident
Wren	x	x	x	x	x	x	Resident
Yellowhammer	x	150	x		x	x	Resident, wintering flocks

During the winter walkover surveys, one Annex I species, five Schedule 1 species, 17 Scottish Priority species, 14 UK BAP species, 11 red and 14 amber listed species were recorded. This included six species considered to be at risk form wind farms. A complete species list including species designations is included in Annex 3.

Breeding Bird Survey (Common Bird Census)

During the breeding season of 2009, a total of 50 species were recorded during the CBC survey, 33 of which were confirmed or probably breeding within the survey area. A further four were considered to possibly breed on Site. Of the species found to be breeding, only curlew is listed to be potentially at risk from onshore wind farms (SNH, 2006).

The breeding bird assemblage was diverse and included typical farmland passerines such as skylark, linnet, reed bunting, starling, house sparrow, grey partridge, yellowhammer, lapwing and oystercatcher. These species were noted on the open farmland and grassland areas or near farm buildings and hedgerows. The 500m survey area buffer included some heathland habitats to the west and south where red grouse and meadow pipits were recorded. Also noted was a common gull colony to the south of the site at gas installation station and a rookery near Govals Cottage to the north of the Site. The number of breeding pairs was not determined for either colony.

Other species of note recorded during the CBC survey during the April 2009 visit included two flocks of 85 and 33 golden plovers, flying over the Site; six common crossbills in the plantation woodland in the southeastern 500m survey area buffer; and one pair and a single corn bunting. Corn bunting was not recorded during any of the following visits and, therefore, is not considered to be breeding on the Site.

A total of 18 Scottish Priority Species, 18 UK BAP species, 13 red and 15 amber listed species were recorded during the surveys. A complete list of all species including the breeding status is presented in Table A8-7.

Table A8-7: Common Bird Census Results

Species	Apr 2009	May 2009	Jun 2009	Status
Black-headed gull	40		40	Not breeding, foraging on site
Blue Tit	5	3	9	Breeding in woodland in southeast
Bullfinch	2		2	Probably breeding in woodland in southeast
Buzzard	6	7	11	Breeding
Carrion Crow	12	24	33	Single pairs breeding on site, foraging flocks
Chaffinch	26	39	27	Abundant breeder
Coal Tit	5	5	2	Breeding in woodland in southeast
Collared Dove	1		6	Possibly breeding near farm buildings
Common Crossbill	6			Possibly breeding in woodland in southeast
Common Gull	124	5+	64	Colony at gas installation station south of the Site
Corn Bunting	3			Not breeding
Cuckoo		1	1	Probably breeding
Curlew	8	6	6	One or two pairs on heathland in the northwest buffer
Dunnock	13	15	10	Common breeder
Goldcrest	2	4	2	Breeding in woodland in southeast
Golden Plover	118			Migrant only
Goldfinch	3	4	4	One to two pairs breeding on Site
Great Tit	5	5	5	Few pairs breeding near farms and woodlands
Grey Heron	1		1	Not breeding
Greenfinch	5	4	4	One to two pairs breeding on Site
Grey Partridge	5	3	2	One to two pairs breeding on Site
Herring Gull	11	78	11	Not breeding, foraging flocks on site
House Sparrow	2	7	4	Breeding in low numbers near farms
Jackdaw	100	32		Possibly breeding on Site, foraging flocks on Site
Kestrel	1		1	Not breeding on Site
Lapwing	7	10	3	One to two pairs probably breeding on Site
Lesser Black-backed Gull	8	4	5	Not breeding, flying over in low numbers
Lesser Redpoll			6	Not breeding, in woodland in southeast
Linnet	24	11	20	Common breeder on Site, near hedges
Meadow Pipit	15	10	22	Breeding, mostly on heathland habitats
Oystercatcher	16	12	46	Three to four pairs breeding on Site
Pheasant	20	1	2	Present in northeast
Pied Wagtail	7	5	7	Few pairs breeding on Site
Reed Bunting	2	1	9	One to two pairs breeding on Site
Robin	21	10	11	Common breeder
Rook	147	100	130	Rookery to the north in trees at Govals cottage
Sedge warbler		2	5	Few pairs breeding on Site
Siskin	9		1	Possibly breeding in woodland in southeast
Skylark	72	42	40	Abundant breeder on grassland and pasture
Song Thrush	15	12	8	Common breeder at farms and woodlands
Starling	3	3	115	Probably breeding with few pairs

Species	Apr 2009	May 2009	Jun 2009	Status
Swallow	3	20	25	Breeding in farms
Swift		1		Not breeding
Tree Sparrow	2			Not breeding
Whitethroat	1	6	3	Few pairs breeding
Willow Warbler	31	17	8	Common breeder
Woodpigeon	67	400	60	Common breeder in woodlands
Wren	37	17	19	Abundant breeder
Yellowhammer	11	21	23	Abundant breeder

A complete species list including species designations is provided in Annex 3.

Barn Owl Survey

During the dedicated barn owl survey in July 2009, evidence for a barn owl roost (feathers and pellets) were found in a derelict building northeast of the Site. Another location within the Site boundary south of Govals was checked but no signs were noted.

A.22. Collision Risk Modelling

A collision risk model (CRM) was carried out for the following species: golden plover, curlew and lapwing.

No other species were considered to require CRM as the number of bird flights flying at risk height and/or through the collision risk window was negligible.

The general methodology used to predict collision risk for birds using the wind farm airspace is provided by SNH (SNH, 2000b).

In summary, the following steps were followed for random bird movements (as assumed for all three species) in this assessment:

- Digitise all flight lines and record relevant characteristics (including species, number of birds, start time of flight and time within each height band) in database.
- Review the flight line data, which in this instance indicated that a random collision analysis should be conducted for each species.
- Identify all flights for each species which are at any point within the 'at risk' height band and sum the total 'at risk' flight duration for each vantage point, multiplying any flight at risk time by the number of birds observed, where more than one bird is recorded per flight line.
- Calculate an 'occupancy rate' for each vantage point, defined as the observed 'at risk' activity levels divided by total observation time and area observed, giving the occupancy per unit time and unit area for each vantage point.
- Average the occupancy rate across the vantage points using an un-weighted mean approach.
- Apply the average occupancy rate to the wind development Site, based on a Site area, risk volume and total turbine rotor volume, applying a factor to estimate the total time that the birds could theoretically be active during the year, based on an

algorithm for calculating day length Forsythe et al (1995); therefore, determining the total predicted time spent by the individual species within air space which could be swept by turbine blades.

- Run the collision model with relevant turbine and ornithological parameters to calculate the theoretical probability of transits resulting in a collision assuming no avoiding action.
- Multiply the number of transits by the collision rate, avoidance factor and operating parameters of the project to estimate the theoretical number of collisions per year.

Avoidance rates used were in accordance with SNH guidance on default values (SNH, 2010).

The predicted mortality through collision is dependent on a number of variables, including flight activity within the turbine envelope, the species' physiology, nocturnal flight behaviour and flight velocity, weather conditions, the predicted avoidance rate, the number, rotational speed and dimensions of the turbines and the proportion of the time that the turbines are operational throughout the year.

The following assumptions were made for the various species:

- A daylight calculator was used to produce figures for the total daylight period at the proposed development Site;
- Biometric data (bird length and wingspan) for the various species were obtained from the BTO webpage;
- Golden plover were assumed to be present over the winter months and as an autumn passage migrants between August and March and a 20% nocturnal allowance was also added to allow for night movements;
- Curlew were assumed to be potentially present all year as breeding birds as well as passage migrants to represent a worst case scenario; and
- Lapwing were also assumed to be present all year as breeding birds as well as passage migrants.

Table A8-8 summarises the assumptions used within the collision risk random model.

Table A8-8: Biometric parameters used for the CRM

Species	Bird length(m)	Bird wingspan (m)	Flight speed (m/s)	Avoidance rate	Months active	Daylight hours	Night time hours	Total activity hours	Activity period
Golden plover	0.28	0.72	10.0	0.98	Aug - Mar	2507.23	831.19	3338.42	daylight hours plus 25% night time hours
Curlew	0.55	0.90	8.0	0.98	the year	4500.56	0.00	4500.56	daylight hours only
Lapwing	0.30	0.84	10.0	0.98	the year	4500.56	0.00	4500.56	daylight hours only

The proposed dimensions of the four turbines at Frawney are: a maximum tip height of 92.5m, the tower height to centre of hub is 57m with a 35.5m rotor radius; and the estimated standard operation rate is taken as 85%.

All flights at risk height were included into the random collision risk model.

The results for the random collision risk model for golden plover, curlew and lapwing are summarised in Table A8-9. Annex 4 presents a worked example for the CRM for golden plover.

Table A8-9: CRM results for golden plover, curlew and lapwing

Species	Avoidance Rate	Predicted Annual Collision Risk	Number of Years per Collision
Golden Plover	98%	0.026	37.13
Curlew	98%	0.030	33.15
Lapwing	98%	0.121	8.21

Annex 1: Vantage Point Details

Table A8-10 presents the timings of the vantage point surveys. The comment NTSR indicates that no target species were recorded.

Table A8-10: Vantage Point Data

Visit Date	VP	VP Type	Observer	Start	End	Duration	Comments
15-Oct-08	VP2	Day	VF	09:00	12:00	03:00	NTSR
15-Oct-08	VP3	Day	VF	13:00	16:00	03:00	NTSR
16-Oct-08	VP1	Dawn	VF	06:45	09:45	03:00	
16-Oct-08	VP2	Day	VF	11:00	14:00	03:00	NTSR
20-Oct-08	VP2	Day	VF	12:00	15:00	03:00	
20-Oct-08	VP1	Dusk	VF	16:00	19:00	03:00	NTSR
22-Oct-08	VP3	Day	VF	09:00	12:00	03:00	NTSR
22-Oct-08	VP1	Day	VF	13:00	16:00	03:00	NTSR
23-Oct-08	VP1	Dawn	VF	07:00	10:00	03:00	NTSR
23-Oct-08	VP2	Day	VF	11:00	14:00	03:00	NTSR
24-Oct-08	VP1	Day	VF	09:00	12:00	03:00	
26-Oct-08	VP3	Day	VF	09:00	12:00	03:00	NTSR
26-Oct-08	VP1	Dusk	VF	14:45	17:45	03:00	
28-Oct-08	VP1	Day	VF	13:00	16:00	03:00	NTSR
29-Oct-08	VP1	Day	VF	09:00	12:00	03:00	NTSR
29-Oct-08	VP3	Day	VF	13:00	16:00	03:00	NTSR
07-Nov-08	VP3	Day	VF	09:00	12:00	03:00	
07-Nov-08	VP2	Day	VF	13:00	16:00	03:00	NTSR
19-Nov-08	VP2	Day	VF	10:00	13:00	03:00	NTSR
19-Nov-08	VP1	Dusk	VF	14:00	17:00	03:00	NTSR
21-Nov-08	VP1	Day	VF	10:00	13:00	03:00	NTSR
24-Nov-08	VP1	Day	VF	09:00	12:00	03:00	
24-Nov-08	VP3	Day	VF	13:00	16:00	03:00	NTSR
25-Nov-08	VP1	Dawn	VF	07:15	10:15	03:00	
08-Dec-08	VP1	Day	VF	10:30	13:30	03:00	NTSR
10-Dec-08	VP1	Day	VF	08:30	11:30	03:00	NTSR
10-Dec-08	VP3	Day	VF	12:30	15:30	03:00	
12-Dec-08	VP3	Day	VF	08:30	11:30	03:00	NTSR
12-Dec-08	VP2	Day	VF	12:30	15:30	03:00	NTSR
14-Dec-08	VP1	Dusk	VF	13:40	16:40	03:00	NTSR
16-Dec-08	VP2	Day	VF	09:00	12:00	03:00	NTSR
17-Dec-08	VP1	Dawn	VF	07:40	10:40	03:00	NTSR
09-Jan-09	VP1	Day	VF	10:30	13:30	03:00	NTSR
14-Jan-09	VP3	Day	VF	11:00	14:00	03:00	
15-Jan-09	VP2	Day	VF	09:00	12:00	03:00	NTSR
19-Jan-09	VP1	Dusk	VF	14:20	17:20	03:00	NTSR
21-Jan-09	VP3	Day	VF	09:00	12:00	03:00	
23-Jan-09	VP1	Day	VF	09:00	12:00	03:00	NTSR
27-Jan-09	VP1	Dawn	VF	07:20	10:20	03:00	

Visit Date	VP	VP Type	Observer	Start	End	Duration	Comments
27-Jan-09	VP2	Day	VF	12:00	15:00	03:00	NTSR
05-Feb-09	VP1	Day	VF	12:00	15:00	03:00	NTSR
06-Feb-09	VP3	Day	VF	09:00	12:00	03:00	NTSR
10-Feb-09	VP1	Dawn	VF	07:00	10:00	03:00	NTSR
10-Feb-09	VP2	Day	VF	11:00	14:00	03:00	NTSR
16-Feb-09	VP3	Day	VF	12:00	15:00	03:00	NTSR
18-Feb-09	VP1	Day	VF	10:00	13:00	03:00	NTSR
19-Feb-09	VP2	Day	VF	09:00	12:00	03:00	NTSR
19-Feb-09	VP1	Dusk	VF	15:30	18:30	03:00	NTSR
05-Mar-09	VP3	Day	VF	13:00	16:00	03:00	NTSR
10-Mar-09	VP1	Day	VF	12:00	15:00	03:00	NTSR
12-Mar-09	VP3	Day	VF	09:00	12:00	03:00	
12-Mar-09	VP2	Day	VF	13:00	16:00	03:00	
15-Mar-09	VP2	Day	VF	09:00	12:00	03:00	
20-Mar-09	VP1	Dawn	VF	05:00	08:00	03:00	NTSR
23-Mar-09	VP1	Day	VF	13:00	16:00	03:00	NTSR
26-Mar-09	VP1	Dusk	VF	16:45	19:45	03:00	
08-Apr-09	VP3	Day	VF	09:00	12:00	03:00	NTSR
08-Apr-09	VP2	Day	VF	13:00	16:00	03:00	NTSR
10-Apr-09	VP1	Day	VF	09:00	12:00	03:00	NTSR
10-Apr-09	VP3	Day	VF	13:00	16:00	03:00	NTSR
13-Apr-09	VP1	Dusk	VF	18:20	21:20	03:00	NTSR
15-Apr-09	VP1	Dawn	VF	04:45	07:45	03:00	NTSR
16-Apr-09	VP1	Day	VF	08:00	11:00	03:00	NTSR
16-Apr-09	VP2	Day	VF	12:00	15:00	03:00	NTSR
05-May-09	VP2	Day	VF	09:00	12:00	03:00	NTSR
06-May-09	VP1	Dusk	VF	19:00	22:00	03:00	NTSR
07-May-09	VP3	Day	VF	13:00	16:00	03:00	NTSR
11-May-09	VP1	Dawn	VF	04:00	07:00	03:00	NTSR
12-May-09	VP1	Day	VF	13:00	16:00	03:00	NTSR
13-May-09	VP3	Day	VF	14:00	17:00	03:00	NTSR
14-May-09	VP1	Day	VF	10:00	13:00	03:00	NTSR
22-May-09	VP2	Day	VF	13:00	16:00	03:00	NTSR
02-Jun-09	VP2	day	VF	10:00	13:00	03:00	NTSR
03-Jun-09	VP1	Day	VF	08:00	11:00	03:00	
02-Jun-09	VP3	Day	VF	14:00	17:00	03:00	
07-Jun-09	VP2	Day	VF	14:00	17:00	03:00	NTSR
13-Jun-09	VP1	Day	VF	13:00	16:00	03:00	NTSR
25-Jun-09	VP3	Day	VF	08:00	11:00	03:00	NTSR
23-Jul-09	VP2	Day	VF	13:00	16:00	03:00	NTSR
24-Jul-09	VP1	Day	VF	09:00	12:00	03:00	NTSR
27-Jul-09	VP3	Day	VF	14:00	17:00	03:00	NTSR
28-Jul-09	VP2	Day	VF	08:00	11:00	03:00	NTSR
30-Jul-09	VP3	Day	VF	09:00	12:00	03:00	NTSR

Visit Date	VP	VP Type	Observer	Start	End	Duration	Comments
31-Jul-09	VP1	Day	VF	13:00	16:00	03:00	NTSR
11-Aug-09	VP2	Day	VF	09:00	12:00	03:00	
13-Aug-09	VP1	Day	VF	13:00	16:00	03:00	
17-Aug-09	VP3	Day	VF	08:00	11:00	03:00	
18-Aug-09	VP1	Day	VF	09:00	12:00	03:00	
25-Aug-09	VP2	Day	VF	13:00	16:00	03:00	
28-Aug-09	VP3	Day	VF	13:00	16:00	03:00	
16-Sep-09	VP2	Day	VF	13:00	16:00	03:00	
17-Sep-09	VP3	Day	VF	08:00	11:00	03:00	
21-Sep-09	VP1	Day	VF	08:00	11:00	03:00	
22-Sep-09	VP2	Day	VF	08:00	11:00	03:00	
23-Sep-09	VP3	Day	VF	13:00	16:00	03:00	
27-Sep-09	VP1	Day	VF	13:00	16:00	03:00	

Annex 2: Vantage Point Flightline Details

Table A8-11 presents a complete list of all target species registrations including flightlines and ground registrations. For each registration, the date, VP, species, time the birds were first observed as well as age and sex are presented. In addition, the height band (G: ground, A: 0-20m, B: 20-125m and C: over 130m) and time spent flying in the height band are included. Note: ground registrations have no time in height band. The final column presents the total time at collision risk height B.

Table A8-11: Vantage Point Flightline Details

Date	Species	VP Number	Time First Observed	Number of Birds	Sex	Age	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk Height
16/10/2008	Peregrine	1	09:15	1	x	x	C	17	0
20/10/2008	Golden plover	2	13:30	15	x	x	B	25	375
20/10/2008	Lapwing	2	14:45	33	x	x	B	68	2244
24/10/2008	Golden plover	1	09:35	104	x	x	B	33	3432
26/10/2008	Golden plover	1	16:50	28	x	x	B	27	756
07/11/2008	Whooper swan	3	09:25	4	x	x	B	67	268
24/11/2008	Golden plover	1	09:25	33	x	x	B	24	792
24/11/2008	Golden plover	1	09:30	23	x	x	C	23	0
25/11/2008	Pink-footed goose	1	07:40	104	x	x	C	47	0
25/11/2008	Pink-footed goose	1	07:45	37	x	x	C	52	0
25/11/2008	Pink-footed goose	1	07:55	113	x	x	C	55	0
25/11/2008	Pink-footed goose	1	08:10	82	x	x	C	52	0
10/12/2008	Greylag goose	3	12:30	188	x	x	G		0
10/12/2008	Whooper swan	3	14:25	17	x	x	C	24	0
10/12/2008	Greylag goose	3	12:30	188	x	x	G		0
14/01/2009	Greylag goose	3	11:00	288	x	x	G		0

Date	Species	VP Number	Time First Observed	Number of Birds	Sex	Age	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk Height
14/01/2009	Greylag goose	3	11:00	288	x	x	G		0
21/01/2009	Greylag goose	3	09:00	94	x	x	G		0
21/01/2009	Greylag goose	3	09:00	94	x	x	G		0
27/01/2009	Peregrine	1	09:50	1	M	A	C	23	0
12/03/2009	Curlew	2	14:07	3	x	x	B	184	552
12/03/2009	Lapwing	2	13:20	23	x	x	B	220	5060
12/03/2009	Whooper swan	3	10:45	24	x	x	C	54	0
15/03/2009	Curlew	2	10:20	31	x	x	B	85	2635
15/03/2009	Greylag goose	2	09:35	48	x	x	C	115	0
15/03/2009	Pink-footed goose	2	10:45	221	x	x	C	105	0
15/03/2009	Pink-footed goose	2	10:50	86	x	x	C	94	0
26/03/2009	Barn owl	1	18:50	1	F	A	A	105	0
02/06/2009	Curlew	3	15:50	2	x	x	B	35	70
03/06/2009	Lapwing	1	08:45	2	pair	A	A	75	0
03/06/2009	Oystercatcher	1	10:15	2	pair	A	A	125	0
17/08/2009	Lapwing	3	08:25	15	x	x	B	38	570
17/08/2009	Lapwing	3	08:40	47	x	x	B	67	3149
25/08/2009	Golden plover	2	13:00	3	x	x	G		0
25/08/2009	Curlew	2	13:00	14	x	x	G		0
28/08/2009	Lapwing	3	13:50	17	X	X	B	28	476
21/09/2009	Golden plover	1	07:45	23	x	x	G		0
21/09/2009	Lapwing	1	07:45	64	x	x	G		0

Annex 3: Complete Species List

Table A8-12 presents a complete list of all species recorded during the 12 months of ornithological surveys at the proposed development site. The table provides common and Latin names for every species followed by three columns indicating during which survey the species were recorded. This is followed by the nature conservation value of each species with the final column indicating whether the species is considered to be at risk from wind farms by SNH. The BOCC columns describes whether a species is red (R) or amber (A) listed in the British list of Birds of Conservation Concern.

Table A8-12: Species List

Vernacular Name (2010)	Scientific Name (2010)	VP Survey Species List	CBC Survey Species List	Winter walkover Species List	Nearby SPA qualifier	Annex I 2009/147/EC council directive	Schedule 1 WCA 1981	Scottish Priority List	UK BAP	Local BAP	BOCC	At risk from wind farms (SNH 2012)
Greylag Goose	*Anser anser*	X		X	X						A	Y
Pink-footed Goose	*Anser brachyrhynchus*	X		X	X						A	Y
Whooper Swan	*Cygnus cygnus*	X				X	X	X			A	Y
Golden Plover	*Pluvialis apricaria*	X	X	X		X		X			A	Y
Redwing	*Turdus iliacus*			X			X	X			R	
Barn Owl	*Tyto alba*	X		X			X	X			A	
Peregrine	*Falco peregrinus*	X		X			X	X				Y
Common Crossbill	*Loxia curvirostra*		X	X			X					
Goshawk	*Accipiter gentilis*			X			X					Y
Corn Bunting	*Emberiza calandra*		X					X	X		R	
Grey Partridge	*Perdix perdix*		X	X				X	X		R	
Herring Gull	*Larus argentatus*		X	X				X	X		R	
Lapwing	*Vanellus vanellus*	X	X	X				X	X		R	
Linnet	*Carduelis cannabina*		X	X				X	X		R	
Skylark	*Alauda arvensis arvensis/scotica*		X	X				X	X		R	
Song Thrush	*Turdus philomelos*		X	X				X	X		R	
Tree Sparrow	*Passer montanus*		X	X				X	X		R	
Yellowhammer	*Emberiza citrinella*		X	X				X	X		R	
Bullfinch	*Pyrrhula pyrrhula*		X	X				X	X		A	
Curlew	*Numenius arquata*	X	X	X				X	X		A	Y
Reed Bunting	*Emberiza schoeniclus*		X					X	X		A	
Kestrel	*Falco tinnunculus*		X	X				X			A	
Swift	*Apus apus*		X					X			A	
Woodcock	*Scolopax rusticola*			X				X			A	
Robin	*Erithacus rubecula*		X	X				X				
Siskin	*Carduelis spinus*		X					X				
Cuckoo	*Cuculus canorus*		X						X		R	
House Sparrow	*Passer domesticus*		X	X					X		R	
Lesser Redpoll	*Carduelis cabaret*		X						X		R	
Starling	*Sturnus vulgaris*		X	X					X		R	
Dunnock	*Prunella modularis*		X	X					X		A	
Red Grouse	*Lagopus lagopus scoticus*			X					X		A	
Common Gull	*Larus canus*		X	X							A	

Vernacular Name (2010)	Scientific Name (2010)	VP Survey Species List	CBC Survey Species List	Winter walkover Species List	Nearby SPA qualifier	Annex I 2009/147/EC council directive	Schedule 1 WCA 1981	Scottish Priority List	UK BAP	Local BAP	BOCC	At risk from wind farms (SNH 2012)
Lesser Black-backed Gull	*Larus fuscus*		X								A	
Meadow Pipit	*Anthus pratensis*		X	X							A	
Oystercatcher	*Haematopus ostralegus*	X	X	X							A	
Snipe	*Gallinago gallinago*			X							A	
Swallow	*Hirundo rustica*		X								A	
Whitethroat	*Sylvia communis*		X								A	
Willow Warbler	*Phylloscopus trochilus*		X								A	
Blackbird	*Turdus merula*		X	X								
Blue Tit	*Cyanistes caeruleus*		X	X								
Buzzard	*Buteo buteo*		X	X								
Carrion Crow	*Corvus corone*		X	X								
Chaffinch	*Fringilla coelebs*		X	X								
Coal Tit	*Periparus ater*		X	X								
Collared Dove	*Streptopelia decaocto*		X	X								
Goldcrest	*Regulus regulus*		X	X								
Goldfinch	*Carduelis carduelis*		X	X								
Great Tit	*Parus major*		X	X								
Greenfinch	*Carduelis chloris*		X	X								
Grey Heron	*Ardea cinerea*		X	X								
Jackdaw	*Corvus monedula*		X	X								
Long-tailed Tit	*Aegithalos caudatus*			X								
Pheasant	*Phasianus colchicus*		X									
Pied Wagtail	*Motacilla alba*		X									
Red-legged Partridge	*Alectoris rufa*			X								
Rook	*Corvus frugilegus*		X	X								
Sedge Warbler	*Acrocephalus schoenobaenus*		X									
Sparrowhawk	*Accipiter nisus*			X								
Woodpigeon	*Columba palumbus*		X	X								
Wren	*Troglodytes troglodytes*		X	X								

Annex 4: Collision Risk Modelling - Worked Example for Golden Plover

Stage 1: Number of Birds Flying Through the Rotors per Year

Calculate the time the site was observed for and how long birds (as a % area-time activity) were seen in the observation area during this time and bird activity for each vantage point

The survey period for this species is taken as August - March.

Table A8-13: Collision Risk Modelling Results

VP	Area (Ha)	Time (hours)	Ha hours	Ha seconds (hours x 3600)	Flight time observed in risk window (s)	Bird Activity (flight time/ha-s)
1	580	84	48720.00	175392000	4980	2.8394E-05
2	579.6	42	24343.20	87635520	375	4.2791E-06
3	331.7	42	13931.40	50153040	0	0.0000E+00
Total	1491.3	168	250538.40	901938240	5355	3.2673E-05

<u>Calculate the average bird observation activity in all areas and the percentage of time birds active within the overall observed area</u>

Mean bird activity =Total bird activity/number of VPs
Mean bird activity = 3.26726281605985E-05/3 = **1.089E-05**

Overall area covered by VPs (excluding overlap) = 1030.33 ha

<u>Proportion of time birds active in the area = Overall area (excluding overlaps) in ha x mean bird activity</u>
Proportion of time birds active in area = 1030.3 x 1.08908760535328E-05 = **1.1221E-02**

<u>Correct for differences between the recording height band and the actual height swept by the rotors</u>

Corrected bird activity=Proportion of actual height band x Proportion of time birds active in the area

Hub height = 57 m Observed height band max = 125 m

Rotor radius = 35.5 m Observed height band min = 20 m

Rotor max height= hub height + rotor radius

Rotor min height= hub height - rotor radius

Rotor max height = 92.5 m

Rotor min height = 21.5 m

Proportion of actual height band = (Rotor max height – rotor min height)/(observed height band max – observed height band min)

Proportion of actual height band = (92.5 – 21.5)/(125 - 20)

Proportion of actual height band = 0.6761905

Corrected bird activity = **7.587E-03**

<u>Calculate the number of hours per day the birds are potentially active over a year and the number of hours of bird occupancy in the airspace per year</u>

Hours potentially active are taken as daylight hours plus 25% night time hours for August - March and then calculated where the day length is a function of latitude and day of the year[1]

Hours potentially active = 3338.43463489883

No. of hours of bird occupancy in the airspace per year =hours potentially active x bird activity

No. of hours of bird occupancy in the airspace per year = 3338.43463489883 x 0.00758744515671234

No. of hours of bird occupancy = 25.33019

Calculate the flight risk volume

Flight risk volume (Vw) = Overall area (ha) x 10000 x rotor radius (m) x 2

Vw = 1030.33 x 10000 x 35.5 x 2
Vw = 731513000 m3

Calculate the combined rotor swept volume

Number of turbines = 4

Maximum chord = 3.25 m

Bird length = 0.28 m

Combined rotor swept volume (Vr) = number of turbines (N) x Pi x r2 x (maximum chord + bird length)
Vr = 4 x Pi x 35.5 x 35.5 x (3.25 + 0.28)
Vr = 55903.793 m3

Calculate the bird occupancy in the rotor swept volume

No. of hours of bird occupancy (converted to seconds) x Combined rotor swept volume/Flight risk volume = n x (Vr/Vw)

Bird occupancy in rotor swept volume = 25.3301897015639 x 3600 x 55903.79/731513000

Bird occupancy in rotor swept volume = 6.96883443

Calculate the bird transit time through the rotors and the potential number of transits per year

Bird speed = 10 m/s

Bird transit time through the rotors = (maximum chord + bird length) /bird speed

Bird transit time through the rotors = (3.25 + 0.28)/10

Bird transit time through the rotors = 0.353 s

No. of transits = bird occupancy in the rotor swept volume/bird transit time
No. of transits = 6.968834/0.353
No. of transits = 19.741741

Stage 2: Collision risk for bird passing through rotor area (assuming no avoidance)

Convert pitch of chord into radians

K: 1D or 3D (0 or 1) = 1

No. of blades = 3

Maximum chord = 3.25 m

Pitch (degrees) = 15

Rotor radius = 35.5 m

Rotation Period = 4 s

Pitch in radians = pitch (degrees) x Pi/180

Pitch in radians = 15 x Pi/180

Pitch in radians = 0.2618

Calculate the bird aspect ratio

Bird length = 0.28 m

Wingspan = 0.72 m

Bird speed = 10 m/s

F:Flapping = 1

Bird aspect ratio (b) = bird length/wingspan

Bird aspect ratio (b) = 0.28/0.72

Bird aspect ratio (b) = 0.3889

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Table A8-14: Calculation of alpha and p(collision) as a function of radius

			Upwind:			Downwind:			
r/R radius	c/C chord	a alpha	collide length	p(collision)	contribution from radius r	collide length	p(collision)	contribution from radius r	check area total
0.025	0.575	7.173181	18.5965	1	0.00125	17.6291	1	0.00125	0.00125
0.075	0.575	2.39106	6.52127	0.4890954	0.003668215	5.55394	0.4165452	0.00312409	0.0075
0.125	0.7015	1.434636	4.78235	0.3586766	0.004483457	3.6022	0.2701653	0.00337707	0.0125
0.175	0.8601	1.02474	4.22817	0.317113	0.005549477	2.78121	0.2085905	0.00365033	0.0175
0.225	0.99435	0.79702	3.89818	0.2923635	0.006578178	2.22536	0.1669021	0.0037553	0.0225
0.275	0.94665	0.652107	3.20372	0.2402792	0.006607677	1.61115	0.1208363	0.003323	0.0275
0.325	0.89895	0.551783	2.7106	0.2032949	0.006607084	1.19827	0.0898705	0.00292079	0.0325
0.375	0.85125	0.478212	2.33827	0.1753706	0.006576398	0.9062	0.0679648	0.00254868	0.0375
0.425	0.80355	0.421952	2.04412	0.1533087	0.00651562	0.69228	0.0519214	0.00220666	0.0425
0.475	0.75585	0.377536	1.81161	0.1358709	0.00645387	0.54003	0.0405021	0.00192385	0.0475
0.525	0.70815	0.34158	1.63502	0.1226268	0.006437906	0.44369	0.0332765	0.00174701	0.0525
0.575	0.66045	0.311877	1.48217	0.1111626	0.00639185	0.37108	0.0278308	0.00160027	0.0575
0.625	0.61275	0.286927	1.34735	0.1010512	0.006315702	0.31651	0.0237379	0.00148362	0.0625
0.675	0.56505	0.265673	1.22656	0.091992	0.00620946	0.28404	0.0213028	0.00143794	0.0675
0.725	0.51735	0.247351	1.1169	0.0837673	0.006073127	0.31345	0.023509	0.0017044	0.0725
0.775	0.46965	0.231393	1.01621	0.0762155	0.0059067	0.3339	0.0250423	0.00194078	0.0775
0.825	0.42195	0.217369	0.92286	0.0692143	0.005710182	0.347	0.0260249	0.00214706	0.0825
0.875	0.37425	0.204948	0.83559	0.0626694	0.00548357	0.35402	0.0265514	0.00232324	0.0875
0.925	0.32655	0.19387	0.75342	0.0565067	0.005226866	0.35594	0.0266956	0.00246934	0.0925
0.975	0.27885	0.183928	0.67557	0.0506674	0.00494007	0.35355	0.0265163	0.00258534	0.0975
Overall p(collision)			**Upwind**		**0.11298541**	**Downwind**		**0.04751876**	**0.99875**

Average probability of collision = (upwind collision total + downwind collision total)/2
Average probability of collision = (0.112985410024865 + 0.0475187621344924)/2
Average probability of collision = 0.080252

Annual collision risk for Golden plover assuming no avoidance

Annual collision risk = no. of transits per year through the rotors x the average probability of collision
Annual collision risk = 19.7417405959016 x 0.080252
Annual collision risk = 1.584316 birds

Corrected annual collision risk assuming avoidance

Golden plover avoidance rate = 0.98

Annual collision risk, with avoidance = annual collision risk x (1 - avoidance rate)
Annual collision risk, with avoidance = 1.58431586566498 x (1 - 0.98)
Annual collision risk, with avoidance = 0.0316863173132996 birds

Corrected for assumed operational downtime of the rotors

Proportion of time wind turbines operational = 0.85

Corrected annual risk = annual risk, with avoidance x proportion of time wind turbines operational
Corrected annual risk = 0.026933 birds

Calculate number of years per collision

Number of years per collision for Golden plover = 1/corrected annual risk

Number of years per collision for Golden plover = 37.1287

[1] Forsythe, W. C., Rykiel, E. J., Stahl, R. S., Wu, H. and Schoolfield, R. M.,1995. A model comparison for daylength as a function of latitude and day of year. *Ecological Modelling Vol 80, Issue 1, 87-95*

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Appendix 9-1: Inventory of Main Water Features

Water Feature	Watercourse Crossing
NGR	341825 742530
Description	Small watercourse / drain crossing required for internal wind farm access track. Small watercourse originating from open air reservoir overflow runoff. Channel approximately 0.4 to 0.7m wide. Water depth 0.05 to 0.012m. Channel appears to be artificially excavated rather than natural. Evidence of livestock disturbing the ground around the channel.
Crossing Type	Culvert or open arch. Likely to be under the General Binding Rule (GBRs) or require registration with SEPA under The Water Environment (Controlled Activities) (Scotland) Regulations (2011) (CAR).

		
Watercourse crossing channel approximately 0.5m wide with soil and sand substrate, with some vegetation.	Up gradient of watercourse crossing, section of diffuse drainage through marshy grass rather than a distinct channel/	Down gradient of watercourse crossing location the drainage ditch has recently been cleared and flows into an underground drain.

Water Feature	
NGR	341590 742650

<table>
<tr><th>Water Feature</th><th colspan="2"></th></tr>
<tr><td>Description</td><td colspan="2">Private water supply source supplying Nether Finlarg Farm and 1 to 4 Farm Cottages, Nether Finlarg . Source from underground piped surface/water spring into open air reservoir. Pump immediately down gradient.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Open air reservoir construction</td><td>Open air reservoir feed by dry valley / spring piped under fields to reservoir</td><td>Concrete pump house down gradient of reservoir, ground shows evidence of hydrocarbon staining.</td></tr>
</table>

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Water Feature	
NGR	341385 742335
Description	Two underground reservoirs: Disused concrete tank used to hold water from open reservoir to supply Over Finlarg properties. Recently installed fibre glass tank holding water from Over Finlarg borehole

Facing northeast, both tanks.

Over flow on fibre glass tank.

Looking into disused concrete water tank.

Water Feature	
NGR	341360 742630
Description	Borrow pit adjacent to northwestern watercourse that flows underground into the open air reservoir. Evidence that borehole has been backfill with old fencing and agricultural waste.

		
Scale of borrow pit	Shallow bed rock exposure red to purple medium grained sandstone	Evidence of made ground, backfilled with old fencing

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Water Feature	
NGR	342605 741790
Description	Nether Finlarg Borehole


Borehole and pump house


Borehole pressure tank within pump house


Borehole casing, 100ft depth into sandstone

Water Feature		
NGR	341550 741440	
Description	Over Finlarg borehole private water supply location, private water supply piping and septic tank to the south of the property.	
		
Pump house for borehole	Private water supply piping	Over Finlarg septic tank, located south of property

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Water Feature	
NGR	341595 742070
Description	Cleared area recently undergone drain improvements adjacent to drained pond, bonfire and sheep wash area.

		
Recent drainage up grades.	Former pond area, drained at the time of the site visit. NGR 341535 742135	Recently cleared area, bare earth. Bonfire area.

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Appendix 9-2: Private Water Supplies

Properties Supplied	Source NGR	Location Description	Source Type	Use	Treatment	Hydraulically Connected to infrastructure? (Y/N)	Justification
Over Finlarg Farm Over Finlarg	341560 741445	Recent borehole to the north of Over Finlarg Farm	Groundwater	Potable Livestock Agricultural	Pumped to 100 gallon fibre glass holding tank up gradient. Tank up graded in 1990s with EU grant. Good quality and quantity.	N	Significant distance from track (0.137km) and infrastructure (>0.50km). Glacial till unlikely to be penetrated, therefore, local old red sandstone aquifer remains confined Drain and underground culvert between turbine and borehole could intercept surface water and shallow groundwater.
1 Nether Finlarg Cottage (reliant) 2 Nether Finlarg Cottage Nether Finlarg Farm, Mayfield (reliant) 3 Nether Finlarg Cottage(optional) 4 Nether Finlarg Cottage (optional)	341570 742660	Open aired manmade reservoir sourced by spring /surface water up gradient. Concrete storage tanks by reservoir.	Spring / surface water Open aired reservoir sourced by spring /surface water up gradient	Potable Domestic	UV and filter treatment. Low quantities occasionally in summer. Regular quality checks (6 months). EColi issue once. 1 Nether Finlarg Cottage noted a disruption to supply historically by farm machinery cutting through supply. Mayfield owners	N	Significant distance from track and infrastructure (0.26km). Up gradient of wind farm infrastructure.

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Properties Supplied	Source NGR	Location Description	Source Type	Use	Treatment	Hydraulically Connected to infrastructure? (Y/N)	Justification
					noted they have never had an issue with the supply.		
Nether Finlarg Farm 3 Nether Finlarg Cottage 4 Nether Finlarg Cottage	342605 741815	Borehole to the west of Nether Finlarg Farm, 100ft deep into sandstone. Installed as spring to reservoir unreliable. Reservoir is used if there is a power cut.	Groundwater	Potable Livestock Agricultural	No treatment. Tested recently, passed. Good quantity.	N	Significant distance from track (0.137km) and infrastructure (>0.50km). Glacial till unlikely to be penetrated, therefore local old red sandstone aquifer remains confined. Drain and underground culvert between turbine and borehole could intercept surface water and shallow groundwater.
Govals	341415 743270	Spring up gradient of watercourse	Spring	Potable Livestock Agricultural	-	N	Significant distance from infrastructure (>0.50km). Up gradient of wind farm infrastructure. Located on opposite site of watercourse to wind farm. Within separate sub-catchment to wind farm.
Lumley Dens	340540 741510	Hut adjacent to watercourse	Spring / surface water	Potable	-	N	Significant distance from infrastructure (>0.50km). Up gradient of wind farm infrastructure. Located on opposite site of watercourse to wind farm.
West Tarbrax	-	Mains pipeline from	Mains	Potable	-	N	Mains supply

Properties Supplied	Source NGR	Location Description	Source Type	Use	Treatment	Hydraulically Connected to infrastructure? (Y/N)	Justification
		A90					
South Tarbrax	-	Mains pipeline from A90	Mains	Potable	-	N	Mains supply
Tarbrax House	-	Mains pipeline from A90	Mains	Potable	-	N	Mains supply

Appendix 13-1: Aviation Report

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SPAVEN CONSULTING

FRAWNEY WIND FARM, ANGUS

ASSESSMENT OF IMPACT ON MILITARY AVIATION

September 2009

Report No.09/200/ME/2

Reservoir House, Gladhouse, Midlothian EH23 4TA
Tel: 01875 830750
E-mail: info@spavenconsulting.co.uk

1. Introduction

1.1 This document reports on an assessment of the Ministry of Defence objection to the proposed Frawney wind farm, Angus, as set out in a letter of 26 March 2009 from Defence Estates to Atmos Consulting Ltd (Defence Estates reference DE/C/SUT/43/10/1/6986). This work was commissioned by Macauley Enterprises on 16 April 2009.

1.2 The author of this report, Malcolm Spaven, is a former flying instructor with Tayside Aviation, flying regular instructional flights out of Dundee, Perth and Fife Airports in the airspace in the vicinity of Frawney in the period 2001-2007. He continues to instruct from Edinburgh and Fife Airports and to fly in that airspace, receiving air traffic services from RAF Leuchars.

2. Grounds for objection

2.1 The Defence Estates letter states that the Ministry of Defence objection is on the basis that the Frawney turbines will be within line of sight of and will cause unacceptable interference to the air traffic control (ATC) radar at RAF Leuchars.

2.2 Following discussions with the Ministry of Defence it is understood that their principal concern relates to the provision of air traffic radar services to aircraft departing from runway 09 at RAF Leuchars under the Instrument Flight Rules along a standard instrument departure route known as SID 4.

3. History of consultation

3.1 A standard industry consultation proforma was submitted to the Ministry of Defence (Defence Estates) by the agents for the developers in October 2008. Defence Estates issued a response letter on 26 March 2009.

3.2 Following receipt of the MoD letter of objection, Spaven Consulting was commissioned to engage with the MoD to assess the basis for the objection and to explore the potential for mitigation of any effects. On 29 April Spaven Consulting confirmed to the MoD that Frawney was one of the projects which they wished to discuss in a meeting to be held with Defence Estates to discuss wind farm projects.

3.3 A meeting with officials from Defence Estates was held at the DE offices in Sutton Coldfield on 11 June. At this meeting, Malcolm Spaven pointed out that RAF Leuchars was already dealing with radar returns from the two existing wind turbines at the Michelin plant in Dundee and suggested that any operational mitigation measures applied to deal with those might be applied equally to Frawney. Mr Spaven wrote a note of the meeting which was circulated to the MoD participants on 1st July with a request to notify any corrections or amendments. The text of that note relating to Frawney reads as follows:

Discussion revolved around the potential for the Frawney development to be treated in a similar way to the existing Michelin turbines, i.e. when these paint on radar, controllers call them as traffic but qualify this as "may be wind turbines"; pilots then decide whether to continue or to request vectors around. Controllers and pilots at Leuchars are briefed on and familiar with these procedures.
W/O Hyam agreed to investigate whether this procedure could be applied to Frawney.
MS agreed to supply revised layout details to CD.

3.4 On 10 July Spaven Consulting requested an update on progress with the agreed actions from the meeting. On 17 July an e-mail was received which set out the method used by RAF Leuchars to deal with the existing Michelin turbines. The relevant parts of the text of this e-mail are set out in Appendix 1. However, since this response from MoD did not address the key question of whether the measures adopted in relation to the Michelin turbines could be applied to Frawney, a further request was made to DE for a response on this point. This was received on 18 August. The relevant parts of that e-mail are attached at Appendix 2.

3.5 In view of discrepancies between the MoD account of the way the Michelin turbines are dealt with by RAF Leuchars controllers and Mr Spaven's understanding and experience of their treatment, it has been agreed that this issue will be further discussed at a meeting with DE officials scheduled for 22nd September. However in view of the importance to the developers of progressing the issue without further delay, the MoD were invited to a further meeting at the Angus Council Planning Department on 7th September. The MoD responded that they did not believe their attendance was required at that meeting.

3.6 On 19 August, Spaven Consulting received a further letter of objection from DE in response to the revised Frawney layout of June 2009. A copy of that letter is attached at Appendix 3. It indicates no change in the grounds for objection compared to the letter of 26 March 2009.

4. Radar line of sight

4.1 The ATDI online path profile tool was used to assess the line of sight from the Watchman primary ATC radar at RAF Leuchars to each of the eight Frawney turbines in the revised layout of June 2009. The results are shown at Figures 1 to 8. They confirm that, apart from the lowest parts of the turbine towers, all eight turbines will be within radar line of sight of the primary radar at RAF Leuchars.

4.2 Comparison has been made of the radar visibility of the current proposed layout versus that of the original seven-turbine layout. Some aspects of this are summarised in Table 1. Overall, the new layout is more compact than the previous proposal, covering approximately 0.75km² compared to approximately 2.5km² for the original layout; it extends only 808 metres in range as viewed from the RAF Leuchars radar compared to 2438 metres; it is generally lower in elevation; and it is slightly further away from the nominal track of the SID 4 standard instrument departure route which is understood to be the MoD's principal concern (see below). However it is slightly wider in azimuth extent (width) as viewed from the RAF Leuchars radar – 3.43° compared to 3.01° - and has one additional turbine, which in simple terms, and ignoring the slightly reduced radar visibility of the revised layout, can be expected to increase the frequency with which turbines generate returns on the Leuchars radar by some 14%.

4.3 While the revised layout has reduced radar visibility in several respects and will occupy a smaller area on the RAF Leuchars radar screen, the differences from the original layout are not significant in operational terms. In view of the clear radar visibility of all eight turbines and their range from the Leuchars radar (21 to 22 km) it can be expected that the wind farm will generate primary radar returns on the RAF Leuchars radar display on a regular and relatively consistent basis, when the turbine blades are moving.

Table 1:
Comparison of RAF Leuchars radar line of sight to original and revised Frawney layout

Tbn No.	*Indicative radar line of sight (height above ground level at each turbine in metres)*		*Indicative radar elevation angle*	
	Original layout	*Revised layout*	*Original layout*	*Revised layout*
1	0	25	0.95°	0.76°
2	0	35	0.80°	0.71°
3	25	25	0.76°	0.80°
4	25	20	0.73°	0.78°
5	5	40	0.82°	0.72°
6	35	25	0.69°	0.75°
7	25	25	0.76°	0.74°
8	n/a	35	n/a	0.70°

5. Air traffic in the Frawney area

5.1 The RAF Leuchars air traffic control unit provides ATC radar services to aircraft departing from and arriving at Leuchars and also provides a Lower Airspace Radar Service (LARS) to civil and military aircraft in uncontrolled airspace up to 9500 feet within a 40 nautical mile radius of the airfield. This service is provided 24 hours a day, seven days a week. There is no controlled airspace below approximately 10,500 feet in the vicinity of Frawney.

5.2 There are three types of air traffic service which can be provided to aircraft outside controlled airspace by air traffic radar units:

- Deconfliction Service, in which the controller advises the pilot of any potentially conflicting traffic showing on radar and issues headings and/or levels aimed at achieving five nautical miles (5nm) separation from unknown traffic
- Traffic Service, in which the controller advises the pilot of any potentially conflicting traffic showing on radar which may come within 3nm, but does not provide avoidance advice; the avoidance of other traffic remains the pilot’s responsibility

- Basic Service, a non-radar service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights. Controllers are not required to monitor flights receiving Basic Service on radar and pilots should not expect any form of traffic information from a controller.

5.3 It is the responsibility of the pilot to determine what type of service is most appropriate to their requirements and to request that service; the controller will then endeavour to provide that service, subject to workload, traffic density, equipment capability etc. In general terms, Deconfliction Service (DS) is most frequently requested by commercial air transport aircraft and other aircraft operating in cloud; Traffic Service is most frequently requested by aircraft which are manoeuvring or are flying in conditions which will allow them to see and avoid other aircraft visually; and Basic Service is most commonly requested by light aircraft.

5.4 Objects on the ground which generate radar returns, such as wind turbines and road traffic, have the greatest potential impact on air traffic radar services when they are in close proximity to routes regularly flown by aircraft which are flying under the Instrument Flight Rules (IFR) and which are receiving a Deconfliction Service (DS). Controllers may have to issue turn instructions to such aircraft to ensure that they avoid any unknown radar returns by a minimum of five nautical miles.

5.5 Aircraft which are being provided with a Traffic Service (TS) or Basic Service (BS) are not provided with separation from unknown radar returns, so any impact which these unknown returns might have on the provision of air traffic services is limited to the controller advising the pilot of the returns, and/or advising the pilot of "Reduced Traffic Information" due to the radar returns.

5.6 To assess the potential for the Frawney development resulting in aircraft being instructed to avoid the area around the wind farm, information on RAF Leuchars in the UK Military Aeronautical Information Publication was consulted. This showed that:

- of the eight published Standard Instrument Departure (SID) routes out of Leuchars, only one – SID 4 from runway 09, involving a take-off to the east followed by a left turn on to a north-westerly heading after passing 2000 feet – passes within 5nm of the Frawney site (it passes approximately 1.5 km south west of the closest turbine position);
- none of the published instrument approach procedures for Leuchars pass within 10nm of the Frawney site.

The Standard Instrument Departure (SID) routes from runway 09 at RAF Leuchars are shown at Figure 9. The proximity of the Frawney development and other wind turbines to SID 4 is shown in Figure 10.

5.7 In the event that a controller considers the radar returns from the Frawney wind farm to represent a possible unknown aircraft while he is providing a DS to an aircraft on SID 4 out of Leuchars, that aircraft may have to be routed away from the wind farm. To achieve 5nm separation from the wind farm, two alternative routings would be possible – (1) turning initially on to a northerly heading until passing east abeam the wind farm, followed by a turn on to the required north-westerly heading, or (2) turning left immediately after take-off on to a westerly heading to pass between Leuchars and Dundee, followed by a right turn on to the required north-westerly heading.

5.8 RAF Leuchars already has two radar-visible wind turbines located close to the SID 4 route, at the Michelin plant in Dundee (see section 6 below). Operational measures were adopted by RAF Leuchars air traffic control to mitigate the impact of these turbines. The potential for the Frawney turbines to be treated in a similar manner is discussed in the paragraphs below.

5.9 In addition to services to its own air traffic, RAF Leuchars provides radar services to transiting aircraft outside controlled airspace, as a Lower Airspace Radar Service (LARS) provider. In principle an aircraft in uncontrolled airspace could be flying on any route chosen by the pilot or under radar vectors from the controller. Thus there will be occasions when transiting aircraft fly over the Frawney site while receiving a radar service from Leuchars. However this area is not a busy piece of airspace. Low level military traffic is likely to avoid the Frawney wind farm area because of the constraints on routing through this area caused by the airspace around RAF Leuchars and Dundee Airport, the Barry Buddon weapons range danger area, and the city of Dundee, and because it is already an obstacle-rich environment, with TV masts up to 803 feet above ground level, power lines greater than 200 feet above ground level crossing the site, and multiple radio masts on Craigowl Hill.

5.10 The other principal source of air traffic in this area is light training aircraft operating out of Dundee Airport. It is standard practice for these aircraft to be in contact with Leuchars Radar during their operations over Angus and to be in receipt of a non-radar Basic Service (BS). This means that they are 'known traffic' to Leuchars ATC and that they do not require, and cannot be given, vectoring away from any unknown radar returns. Nor, in most circumstances, are they given information on any unidentified radar returns showing on radar. Most of this training activity takes place in the area to the east of the A90 road so the frequency of overflight of the wind farm will be low. In general, traffic levels outside controlled airspace in this area, other than low level military and Dundee training traffic, are very light and the addition of a small area of radar clutter should not pose any significant difficulties for controllers.

6. The Michelin example

6.1 The only existing wind turbines within 20km of Frawney are the two machines at the Michelin factory in Dundee,. These turbines are fully within radar line of sight of RAF Leuchars (see Figures 11 and 12).

6.2 The Ministry of Defence submitted a "very late" objection to the original application for three turbines at the Michelin plant in 2003, on grounds of effects on the RAF Leuchars radar, and told Dundee City Council that they "may invoke other legislation to have the application called in by the Secretary of State for Defence, should Members be minded to approve the application."[1] Planning permission was nevertheless granted for this development and there was no call-in by the MoD. However the consent was never implemented.

6.3 A revised proposal for two turbines at the Michelin plant was submitted in 2005. No MoD objection was lodged against this revised proposal. The MoD was consulted by the developers and agreed that the radar returns from the two turbines would be deemed 'permanent echoes'. This allows controllers not to treat them as unknown aircraft and therefore not to have to vector aircraft around them. A planning condition was agreed under which development would not take place until the MoD had been informed of the date of commencement of construction, to ensure that the MoD had time to amend the radar map overlay and brief the controllers at Leuchars.[2]

6.4 The Michelin turbines are located within 5nm of the RAF Leuchars circuit pattern and within one nautical mile of Standard Instrument Departure 4 – the same route which passes close to the Frawney wind farm site. The route of SID 4 has not been altered since the Michelin turbines became operational in May 2006. It remains in use as the published route for IFR traffic departing from runway 09 and routing to the north west. Runway 09 is used when the wind is easterly – approximately 30% of the time.

6.5 The official MoD response to the Frawney development, as set out in Appendices 1 and 2, indicates that the policy of deeming wind turbines, in certain circumstances, to be 'permanent echoes' which therefore do not need to be avoided, is no longer accepted by the MoD, and that it is this which lies behind their unwillingness to treat the Frawney turbines in a similar way. However the account of the current policy as set out in those appendices does not explain how SID4 continues to be used in the presence of unidentified radar returns generated by the Michelin turbines, in the face of that change of policy.

6.6 Given the clear radar line of sight to the Michelin turbines, and the wind regime in the area (average annual wind speed at both Dundee Airport and RAF Leuchars is 10 knots), it can be expected that these turbines are normally in a configuration which is likely to cause them to appear on the Leuchars radar. If, as Appendix 1 states, aircraft on a Deconfliction Service are always vectored at least 5nm away from the Michelin turbines, and the provision of a DS to aircraft on this route is a key requirement, this would render SID4 operationally unusable since aircraft would be routed off the SID track, 5nm around the Michelin site, on a regular basis. In these circumstances the MoD would normally re-design the SID to ensure that it

1 Dundee City Council, Application No 03/00424/FUL: Report by Director of Planning and Transportation.

2 Dundee City Council, Application No 05/00607/FUL: Report by Director of Planning and Transportation.

remains operationally usable. However no such re-design has been carried out and the SID as depicted in Figure 9 continues in use.[3]

6.7 If the rejection of the 'deeming as permanent echoes' policy means that aircraft are now regularly vectored around the Michelin turbines, as Appendix 1 suggests, any aircraft departing from runway 09 and routing to the north west would already have to route clear of the Frawney site; the addition of a 5nm avoidance requirement around Frawney would make little or no difference to the tracks flown by these aircraft.

6.8 The account set out in Appendix 1 is not an accurate depiction of the provision of air traffic services outside controlled airspace. The statement that "all aircraft under a…Deconfliction Service will be offered avoiding action in order to achieve 5nm lateral separation on all unknown primary radar returns" does not accord with ATC practice. Controllers – including those at Leuchars – routinely make judgements about particular unknown primary radar returns and whether they represent possible unknown aircraft, and either choose not to notify pilots of them, or offer qualified advice such as "traffic in your 11 o'clock range 7 miles, no height information, believed to be in the Dundee visual circuit, are you happy to continue against that traffic?". In particular, Leuchars provides radar services to commercial air transport aircraft inbound to Dundee (notably scheduled passenger services from Belfast, Birmingham, London City and Jersey) on a daily basis. When runway 27 is in use at Dundee (landing from the east – at least 60% of the time) Leuchars controllers will vector these aircraft towards a position approaching the final approach track for runway 27 – over the Tay Estuary east of Newport – from which they may be able to emerge into visual conditions below cloud from where they can complete a visual approach to Dundee. Leuchars controllers can instruct these aircraft to descend no lower than 2000ft in this area. However, the whole of this area, from approximately 3km north of Leuchars, is within 5nm of any radar returns from the Michelin turbines. If the statement in Appendix 1 of MoD policy was applied in practice at RAF Leuchars, it would make it impossible for Leuchars controllers to vector these Dundee inbound aircraft towards a visual approach for runway 27, since, if the pilot did not report "visual with Dundee" before reaching the Leuchars overhead, Leuchars controllers would then be unable to meet the terms of a Deconfliction Service because they would be vectoring aircraft directly towards, and to within 5nm of, the radar returns from the Michelin turbines. It is understood that, in fact, aircraft inbound to Dundee under the circumstances outlined above are not routinely advised of the radar returns from the Michelin turbines – in other words, in effect, the pre-existing 'permanent echoes' policy continues to be applied.

6.9 The statement in the e-mail referenced in Appendix 1 that aircraft on a Traffic Service or a Basic Service "will be informed of the Michelin wind Turbines in the form of a traffic information call" is known from direct experience not to be the case. The author of this report has flown directly over or within close proximity of the Michelin turbines on many occasions

[3] SID4 was re-designed in the period 2001-2005, it is believed to reduce conflicts with Dundee IFR traffic.

since they became operational, while in receipt of a Basic Service or a Traffic Service from Leuchars, with no traffic information offered. This is not a criticism of the conduct of RAF Leuchars controllers; the MoD accepted in 2005 that radar returns from the two Michelin turbines would be acceptable, and there are no known cases of this policy having been found to be unacceptable in safety terms at this particular site. Moreover, rejection of the previously accepted policy would place a significant additional constraint not only on RAF Leuchars controllers but also on the operators of IFR traffic into Dundee. As an illustration, the difference in track miles between vectoring to a visual approach to runway 27 from overhead RAF Leuchars, and having to fly a full instrument procedure into Dundee from that point, is at least 10 minutes flying time for a typical twin-turboprop airliner. That would be a significant additional commercial constraint on airlines operating into Dundee.

6.10 In addition to the expedient of asking pilots if they are happy to continue against unidentified radar returns in specified circumstances, as exemplified above, air traffic controllers have other tools in their toolbox which can be applied to this situation. First, they can inform the pilot that they are subject to 'Reduced Traffic Information' (formerly called 'limited service') while within 5nm of the displayed radar returns. This procedure is routinely applied by controllers at all UK civil and military ATC units providing services outside controlled airspace, to deal with radar clutter from any source. It is applied in a variety of circumstances, including when the aircraft is:

- at or close to the base of radar coverage
- below the unit's terrain safe level
- in an area where there is high traffic density
- in an area of poor radar performance
- close to permanent echoes on the radar
- close to areas of weather clutter on the radar.

6.11 Second, controllers may opt to provide only a Traffic Service in the affected area. This measure is also routinely applied by controllers at UK civil and military ATC units to deal with radar clutter from any source. However, in areas where it is unit policy to provide a Deconfliction Service if requested, it will usually be preferable to provide a Deconfliction Service with Reduced Traffic Information, under which deconfliction headings and/or levels will continue to be provided, rather than offer a Traffic Service, under which no deconfliction advice is offered.

6.12 It should be emphasised that the proximity of RAF Leuchars and Dundee Airport means that close co-ordination is undertaken between the two air traffic control units on a routine basis. If Leuchars has an IFR departure via SID4, which passes close to the north of Dundee Airport and its traffic patterns, the RAF Leuchars controller will phone Dundee to co-ordinate that departure against any potentially conflicting Dundee traffic. Equally, when Dundee has an IFR departure, they will phone Leuchars to co-ordinate the departure against any potentially conflicting Leuchars traffic and to make arrangements for the handover of that traffic to Leuchars after departure in order to provide it with a radar service, as is normally the case for IFR departures from Dundee. In the latter case, any aircraft departing IFR from runway 09 at Dundee and requesting a radar service will be within 5nm of the Michelin turbines immediately on departure from Dundee. Leuchars can provide a Deconfliction Service once the aircraft has passed 2000ft; but since the aircraft would then be well within 5nm of the turbines, the policy set out in Appendix 1 could not be applied if those turbines are showing on radar. Clearly, then, RAF Leuchars cannot be applying a policy of always avoiding every unidentified primary radar return by 5nm.

6.13 It is concluded that existing procedures at Leuchars, as at other ATC units in the UK, routinely and safely accommodate unidentified radar returns from sources such as the Michelin turbines, and, given that this is the case, the addition of the Frawney development in proximity to the same IFR route out of Leuchars is amenable to treatment in the same way.

7. Other wind turbines in the area

7.1 While the existing Michelin turbines provide the clearest example of the applicability of existing ATC procedures to the proposed Frawney development, there are other pertinent examples in the area.

7.2 The Leuchars primary radar may have marginal visibility of some blade tips in the 16–turbine Drumderg wind farm (see Figure 13), although this would require confirmation from more detailed analysis.

7.3 The Drumderg wind farm is also close to the SID 4 outbound route from Leuchars. If it is confirmed that this wind farm is also visible to the Leuchars radar, this would provide further indication that unknown radar returns adjacent to SID 4 are already regarded as acceptable.

7.4 During 2009 a planning application was submitted for a single wind turbine, 93.5 metres in height to the blade tips, on the former Tealing airfield, 4.5km south of the Frawney site and 17km north north west of the RAF Leuchars radar. An appeal against non-determination was lodged on 5 August 2009 and the application has not yet been determined. However the MoD was consulted on the application and informed the developers that the turbine is "not in an area of concern to the MoD".

7.5 The radar line of sight from the RAF Leuchars radar to the proposed Tealing turbine shows that approximately the top 20 metres of the turbine will be visible to the radar (see Figure 14). This is sufficient to cause intermittent returns on a primary radar at that range. The Tealing turbine site is approximately 2km from SID4. The MoD non-objection to the Tealing turbine is at odds with their continued objection to the Frawney development.

7.6 On 26 May 2009 the Scottish Government rejected a non-determination appeal against Angus Council in relation to a three-turbine development at Mountboy, near Montrose. Aviation issues formed no part of the appeal and the MoD was fully consulted on the proposal. The Mountboy turbines would have been within radar line of sight of the RAF Leuchars radar (see Figure 15). While not in close proximity to SID4, the absence of an MoD objection to Mountboy indicates that the appearance of wind turbines on radar does not inevitably create insurmountable difficulties for air traffic controllers.

8. Precedents at other RAF airfields

8.1 There are many examples of radar-equipped RAF and other UK military airfields co-existing with wind farms visible on their radar screens, many of them significantly closer than Frawney would be to RAF Leuchars and closer to instrument approach and departure paths. These examples are set out in Table 2 below. The air traffic control units at these airfields have dealt with these wind farms by employing a variety of techniques ranging from unit knowledge of the locations of local wind farms through to variation of the types of radar service available in the area. There have been no known air traffic incidents resulting from the provision of air traffic radar services to aircraft flying over or in close proximity to these or other radar-visible wind farms.

8.2 In addition to the case of the Leuchars runway 09 SID4 and the Michelin turbines, there are numerous specific cases of SIDs from other UK military airfields which pass within 5nm of existing operational wind turbines which are within radar line of sight from that airfield. These include:

- the East SID from runways 31 and 01 at RAF Valley passes 1.8nm from the Llyn Alaw wind farm (34 turbines);
- the South SID from runway 23 at RAF Lossiemouth passes 2.1nm from the Rothes wind farm (22 turbines) and crosses directly over the Paul's Hill wind farm (24 turbines);
- the Bravo South SID from runway 08 at RAF Kinloss passes 1.5nm from the Rothes wind farm (22 turbines) and 2.7nm from the Paul's Hill wind farm (24 turbines). The Bravo South SID from runway 26 at Kinloss passes just within 5nm of the Paul's Hill wind farm;
- SID 2 from runway 09 at RAF Cranwell passes 1.1nm from the Bicker Fen wind farm (13 turbines). SID 4 from runway 19 is 4.2nm from Bicker Fen;
- RAF Marham has no published SIDs but every departure from runway 06 passes 2.3nm from the Swaffham wind farm (2 turbines) and 4.4nm from North Pickenham (8 turbines);
- every departure from either runway at RAF St Mawgan – before its transfer to civilian control in late 2008 - was within 2.3nm of the Bear's Down wind farm (16 turbines) and all departures from runway 13 were within 4.7nm of the St Breock wind farm (11 turbines).

8.3 Many of these SIDs have been operating in the presence of radar-visible wind farms for more than a decade. None of these SIDs has been altered as a result of the presence of wind turbines.

9. Obstacle clearance considerations

9.1 Currently, the highest obstacle within 5nm of the Frawney site is the Angus television transmitter mast, located 2km to the west of the wind farm site. This mast extends to 1814 feet above sea level. Aircraft flying under the Instrument Flight Rules must fly no lower than 1000 feet above the highest obstacle within 5nm of the aircraft. This means that any aircraft flying under the IFR within 5nm of the TV mast cannot fly lower than 2900 feet above sea level. The highest turbine blade tips in the Frawney wind farm will be those of Turbine 1, which will be 1102ft amsl. Thus the Frawney wind farm will have no impact on minimum altitudes for aircraft flying IFR in the vicinity.

10. Lighting considerations

10.1 The Ministry of Defence has intimated that it may wish to request lighting on the turbines. Emerging MoD policy on lighting of wind turbines is driven primarily by the requirement for aircrew flying at low level at night, using night vision goggles, to see and avoid obstacles.

10.2 The benefit to low flying aircrew of lighting the Frawney turbines will depend on the extent to which this area is used for low flying, and the lighting status of other obstacles in the area. As noted above, it can be expected that airspace constraints already limit the frequency of low level flying in the area. In addition, the two most prominent local obstacles – the Angus TV mast, 2km to the west of Frawney, and the BBC Monikie radio mast, 6km to the east – are both lit. The Angus mast is 500 feet higher than the highest turbine tips in the Frawney wind farm. In addition the two Michelin turbines in Dundee, 8km south of Frawney, are also lit. These lit obstacles will give clear orientation to any pilots flying at low level at night in the area. The fact that the terrain rises to heights greater than the highest Frawney blade tips within 4km west of the site and that a 200ft+ power line runs through the site also reduce the likelihood that any aircraft could be flying in the vicinity of the wind farm at a height low enough to pose a collision risk. Taking all these facts together, it is unlikely that lighting on the turbines could provide any measurable benefit to pilots flying at low level. The wind farm will be clearly marked on all aeronautical charts and wind turbines are significantly more visible at night and in poor visibility than radio masts.

11. Summary and conclusions

11.1 The Frawney turbines will be within radar line of sight of the primary radar at RAF Leuchars.

11.2 The development is clear of all published instrument approach procedures to RAF Leuchars.

11.3 One of RAF Leuchars' standard instrument departure routes – SID 4 - passes approximately 1nm south west of the wind farm site.

11.4 In the event of a Leuchars controller seeking to provide 5nm separation from radar returns generated by the Frawney turbines to an aircraft on a Deconfliction Service, flying on SID 4, alternative routes to the east and south west of the wind farm could be used.

11.5 The MoD approved a two turbine development closer to RAF Leuchars and to its instrument departure routes in 2005. Aircraft are not routed away from these turbines.

11.6 The airspace in the vicinity of Frawney is relatively lightly used and a high proportion of air traffic in the area is known to Leuchars controllers and/or not in receipt of a radar service.

11.7 The stated MoD policy on provision of air traffic services in the vicinity does not accord with known ATC practice in relation to the Michelin turbines.

11.8 There are additional operational mitigation measures available to controllers which are in everyday use at all ATC radar units in the UK providing services outside controlled airspace.

11.9 The Frawney development is amenable to being treated in the same way as the Michelin turbines, using proven and approved operational mitigation measures.

11.10 The Drumderg, Tealing and Mountboy turbines are further examples of wind energy projects visible to the RAF Leuchars radar which have been found to be acceptable.

11.11 There are numerous examples of radar-equipped military airfields elsewhere in the UK co-existing with wind farms.

11.12 The Frawney wind farm will have no impact on the minimum altitudes for aircraft flying on instruments in the vicinity.

11.13 Installation of obstacle lighting on the turbines is unlikely to provide any measurable benefit to pilots flying in the area at low level at night.

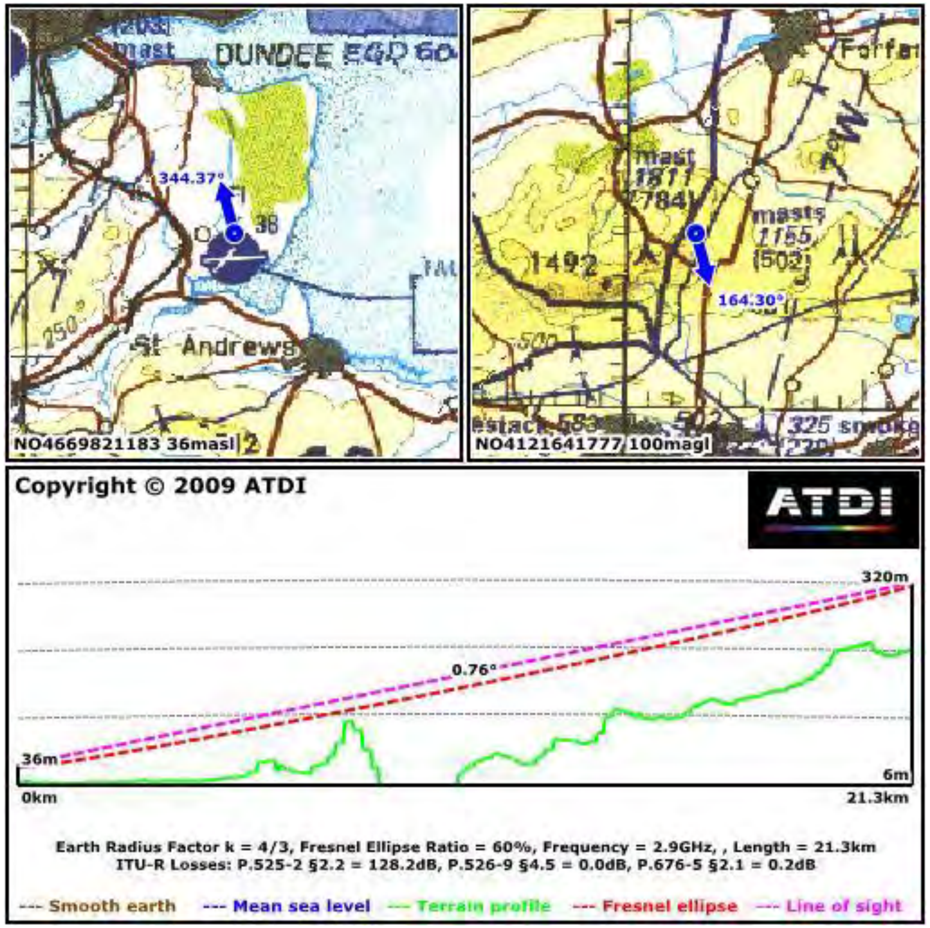

Figure 1: ATDI radar path profile from RAF Leuchars Watchman radar to Frawney Turbine 1

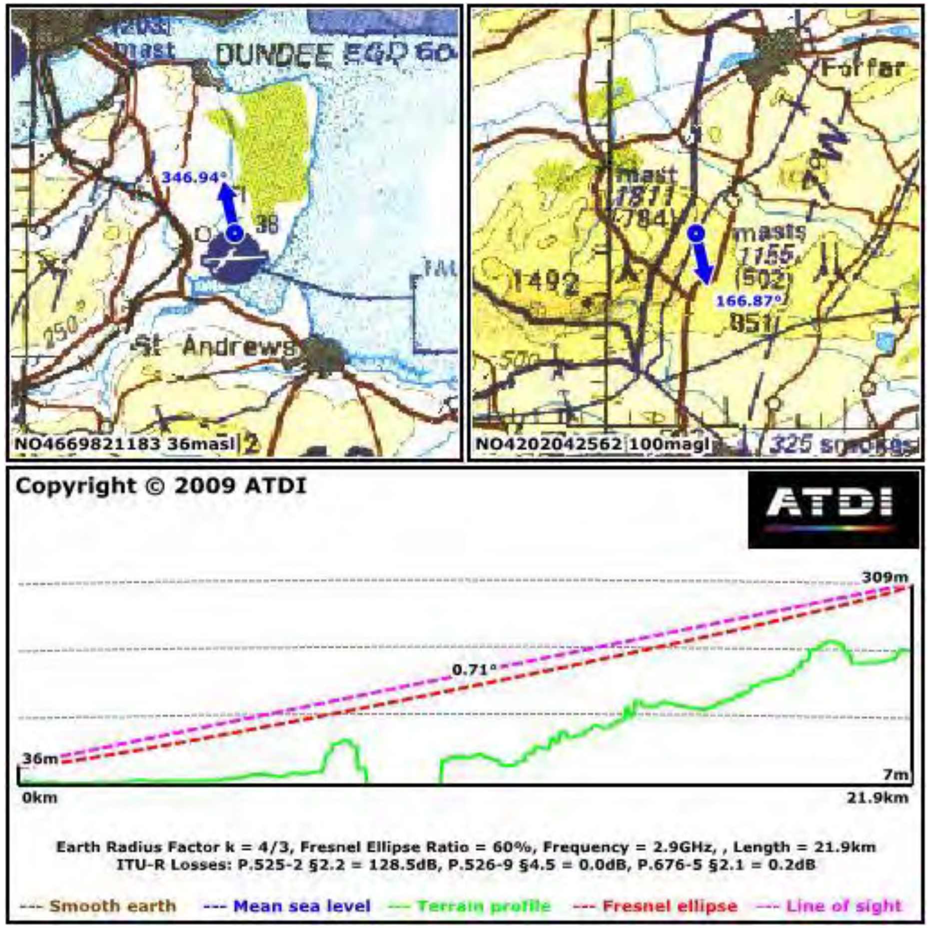

Figure 2: ATDI radar path profile from RAF Leuchars Watchman radar to Frawney Turbine 2

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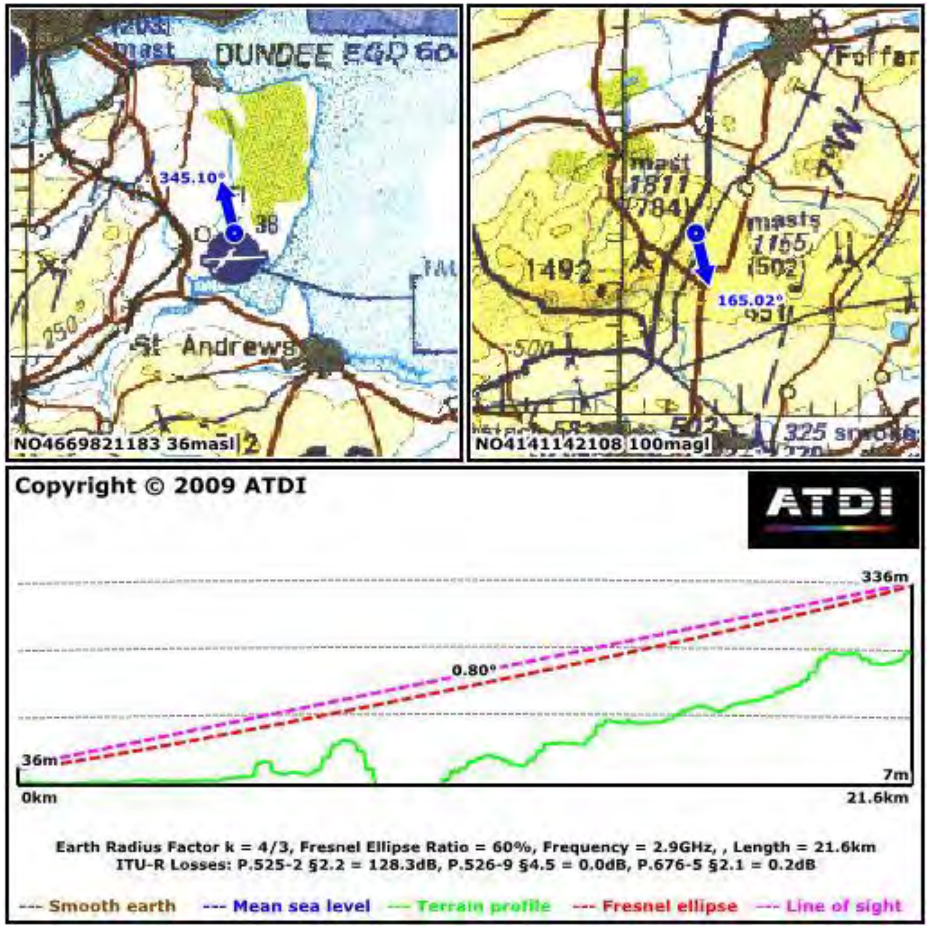

Figure 3: ATDI radar path profile from RAF Leuchars Watchman radar to Frawney Turbine 3

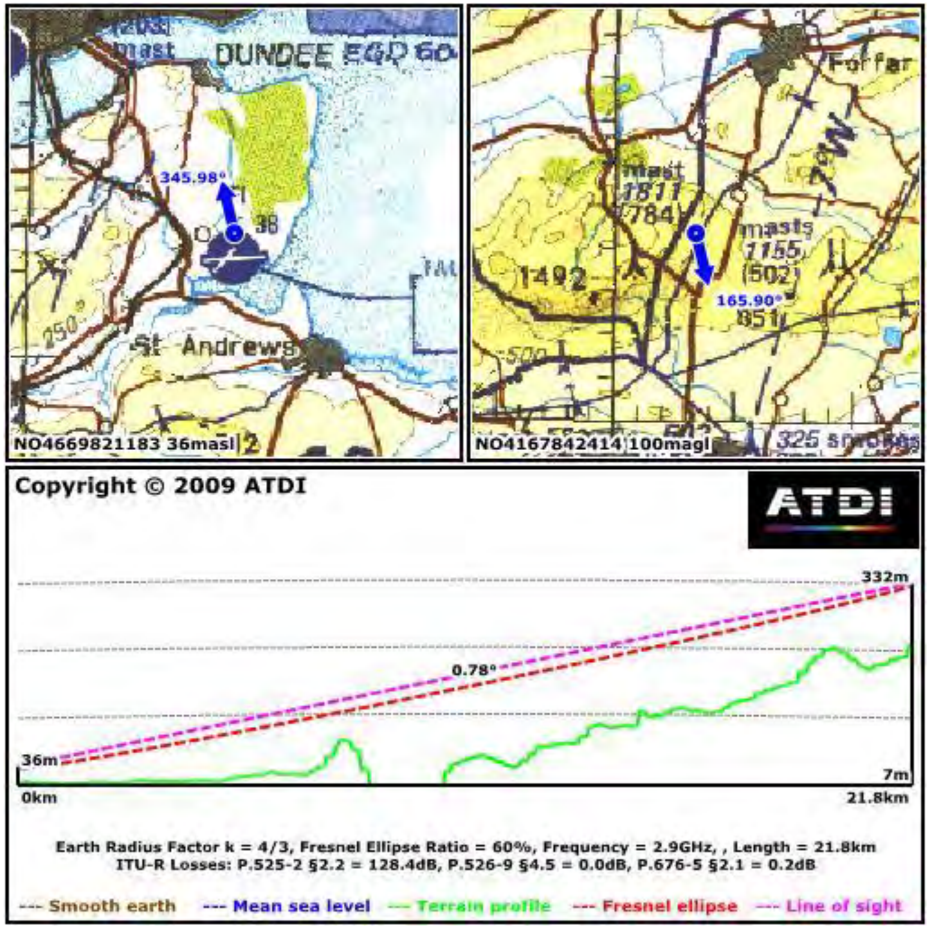

Figure 4: ATDI radar path profile from RAF Leuchars Watchman radar to Frawney Turbine 4

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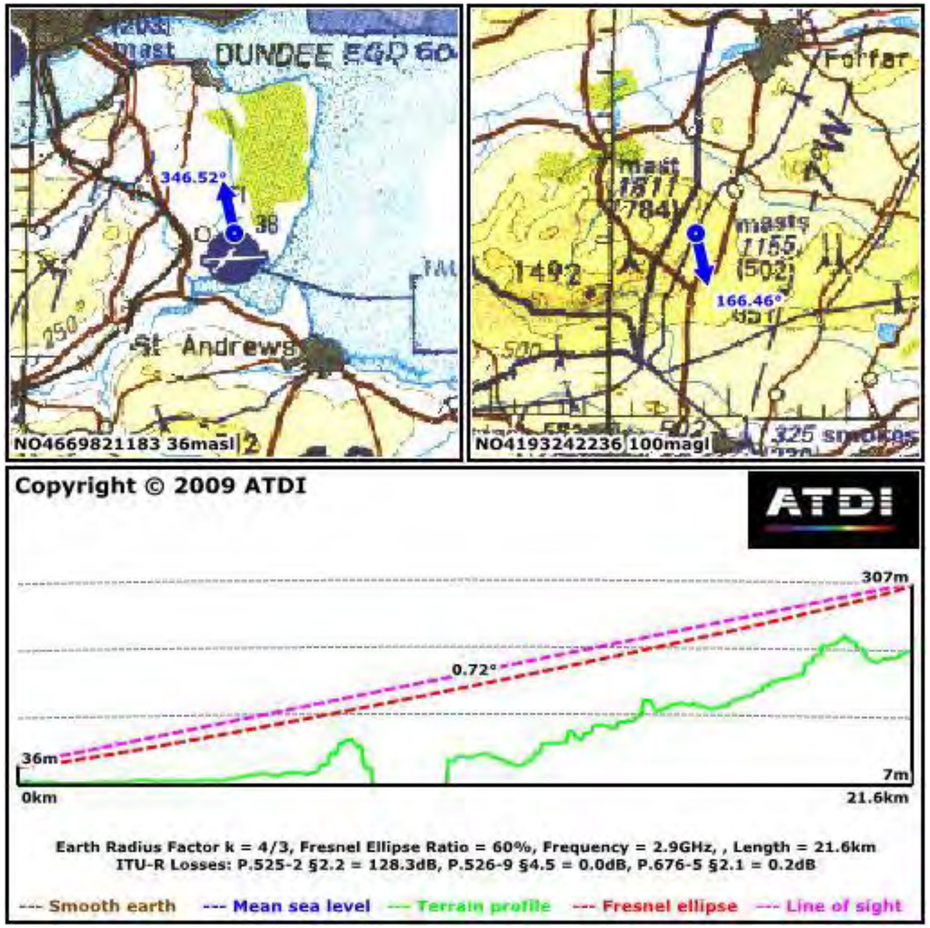

Figure 5: ATDI radar path profile from RAF Leuchars Watchman radar to Frawney Turbine 5

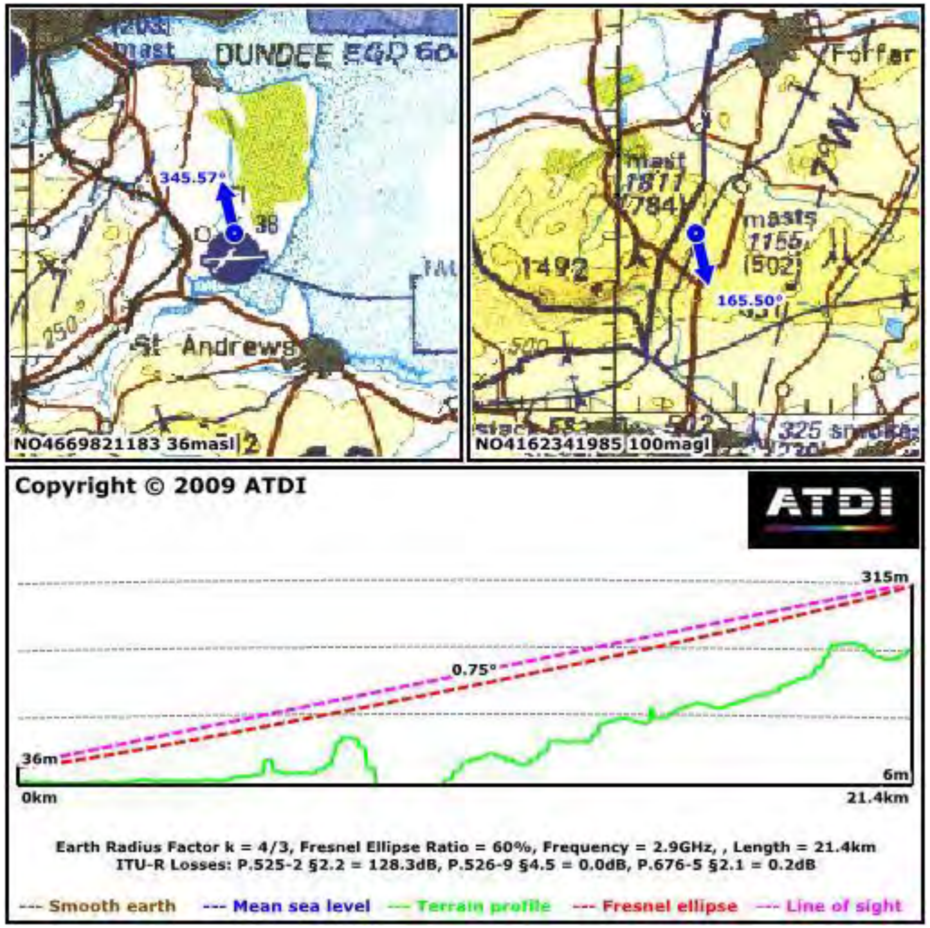

Figure 6: ATDI radar path profile from RAF Leuchars Watchman radar to Frawney Turbine 6

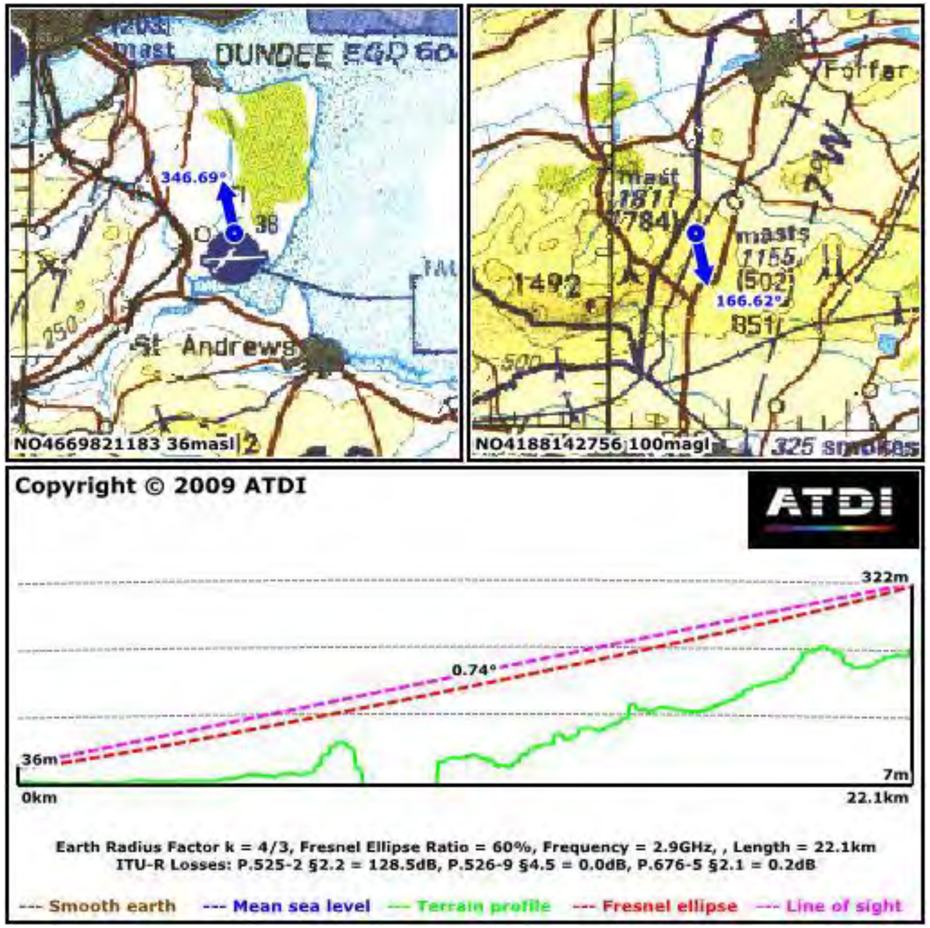

Figure 7: ATDI radar path profile from RAF Leuchars Watchman radar to Frawney Turbine 7

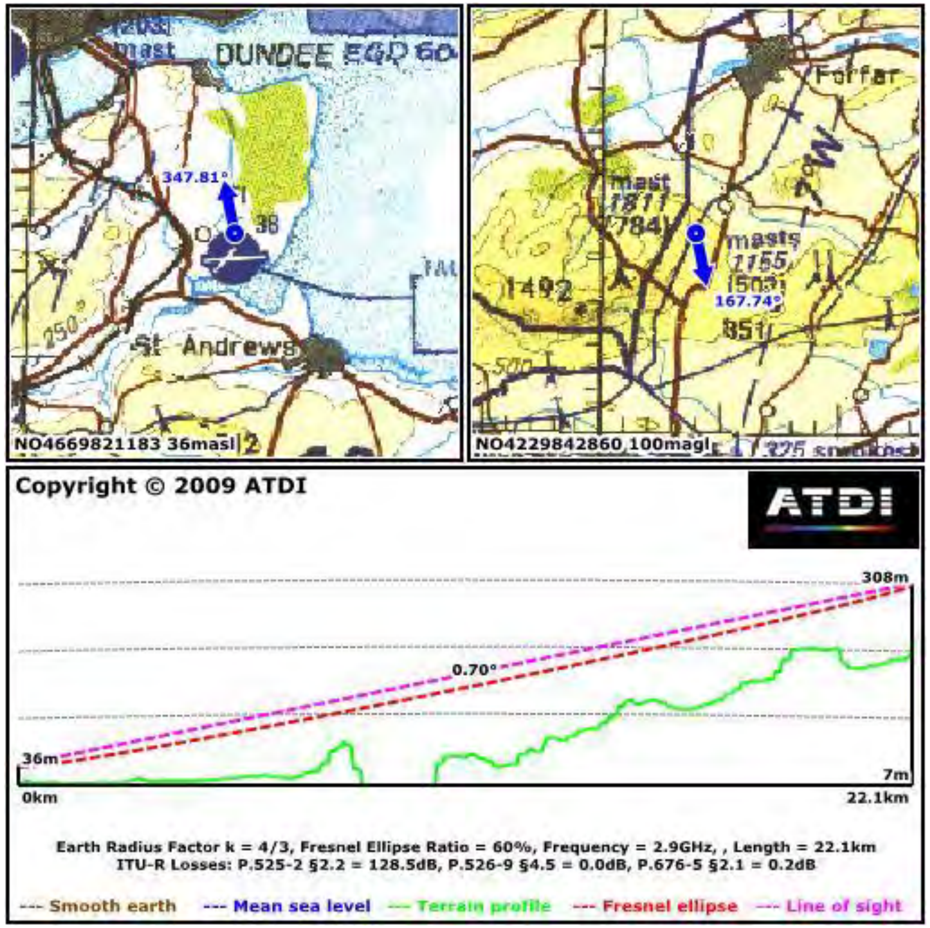

Figure 8: ATDI radar path profile from RAF Leuchars Watchman radar to Frawney Turbine 8

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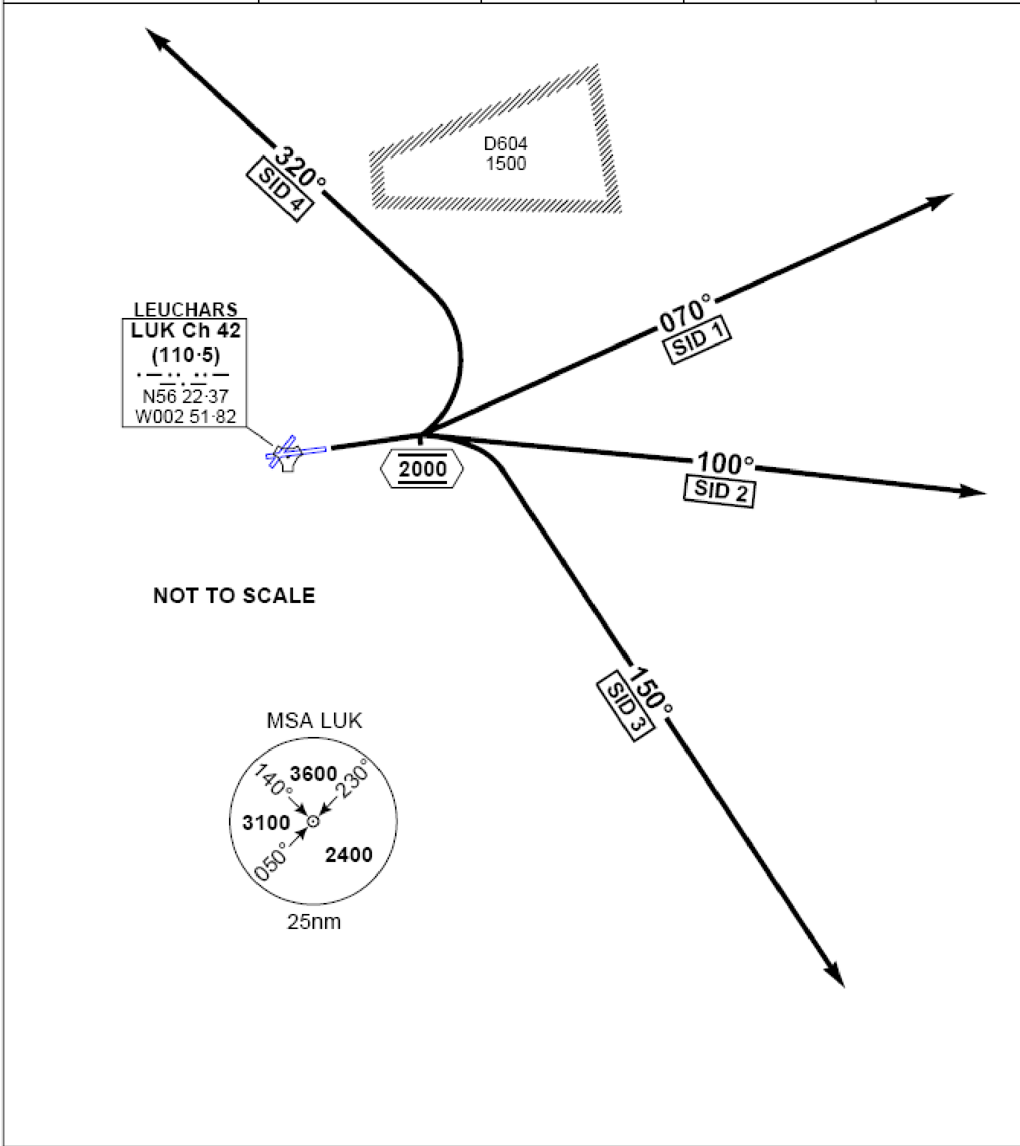
Rwy 09 SID LEUCHARS

Elev **38**	Var 4°W	TA **3000**	TRL ATC			**G1**

LEUCHARS GROUND	TOWER	DEPS/LARS	DIRECTOR	ATIS
275·375 122·1	**293·825 122·1**	**255·400 126·5**	**389·525**	**369·250**

EGQL/ADX SCOTLAND



Changes: DEPS/LARS

MINIMUM CLIMB RATE – APATC–1 (MIL)

1. Obstacles close to the end of the rwy exceed APATC–1 (MIL) criteria. Acft are to achieve 50ft by departure end of rwy.

SID	RWY	ROUTEING (Including Mnm Noise Routes)
SID 1	09 086°M	Ahead to **2000**, then left onto Tr 070° climbing to **FL150**.
SID 2		Ahead to **2000**, then right onto Tr 100° climbing to **FL150**.
SID 3		Ahead to **2000**, then right onto Tr 150°, climbing to **FL150**.
SID 4		Ahead to **2000**, then left onto Tr 320° climbing to **FL100**.

No1 Aeronautical Information Documents Unit EGQLG1

LEUCHARS **Rwy 09 SID**

APATC–1

Figure 9: Standard Instrument Departure routes from runway 09 at RAF Leuchars

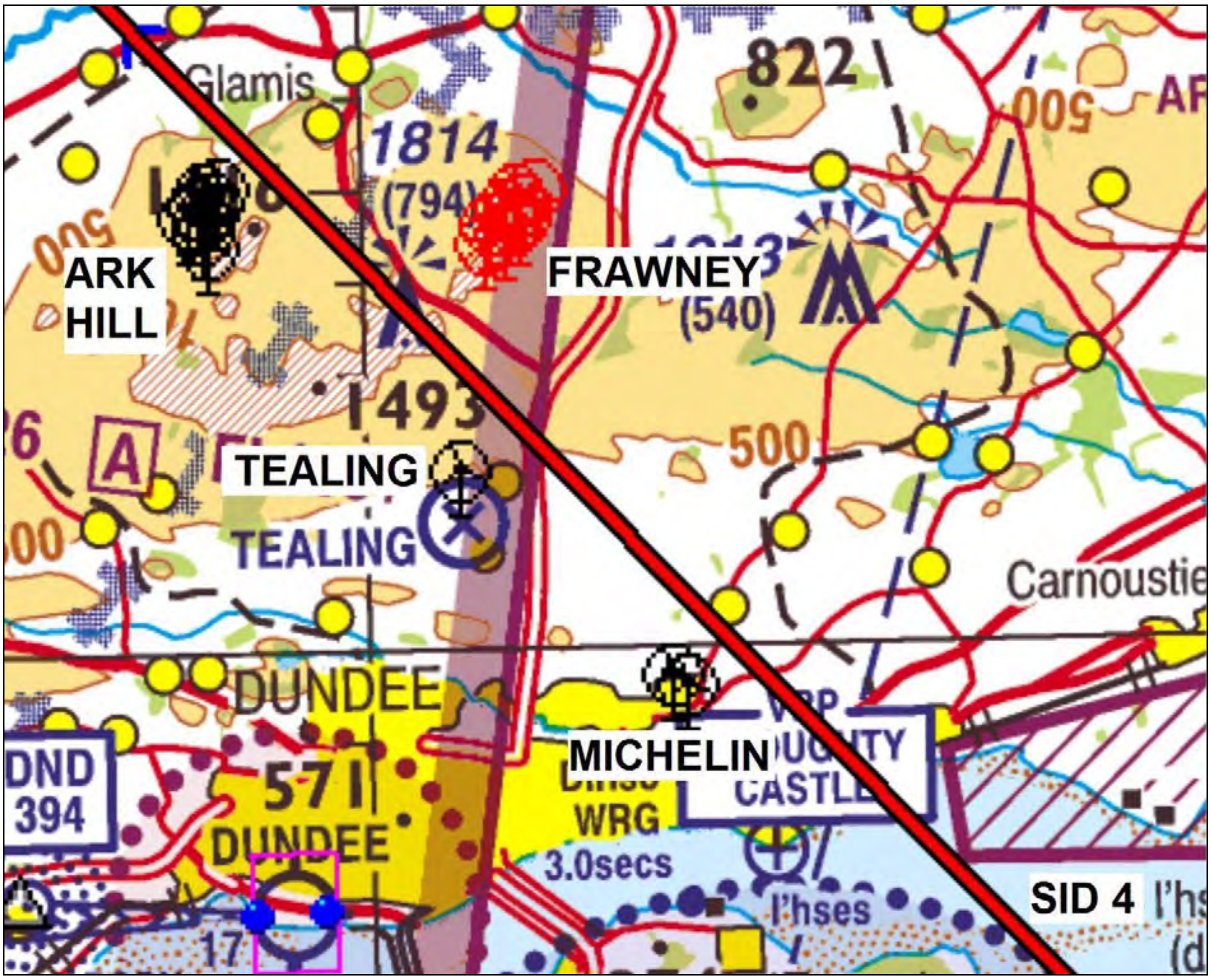


Figure 10: Leuchars runway 09 SID 4 and wind farms

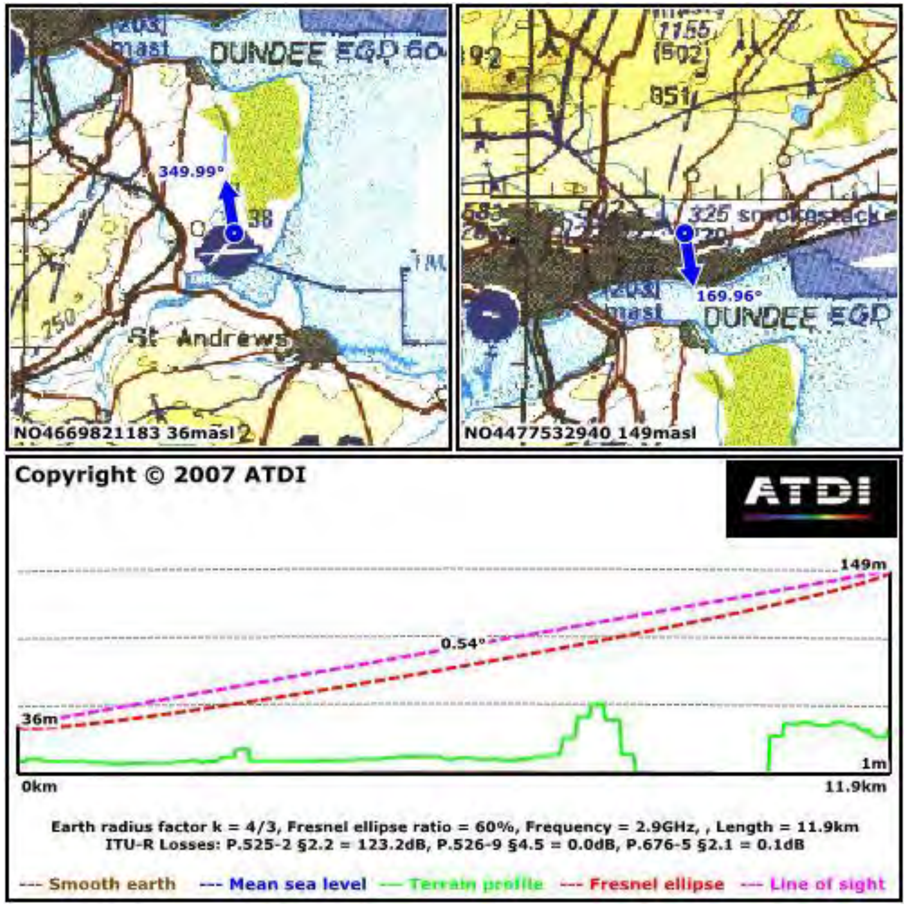


Figure 11: ATDI radar path profile from RAF Leuchars Watchman radar to Michelin Turbine 1

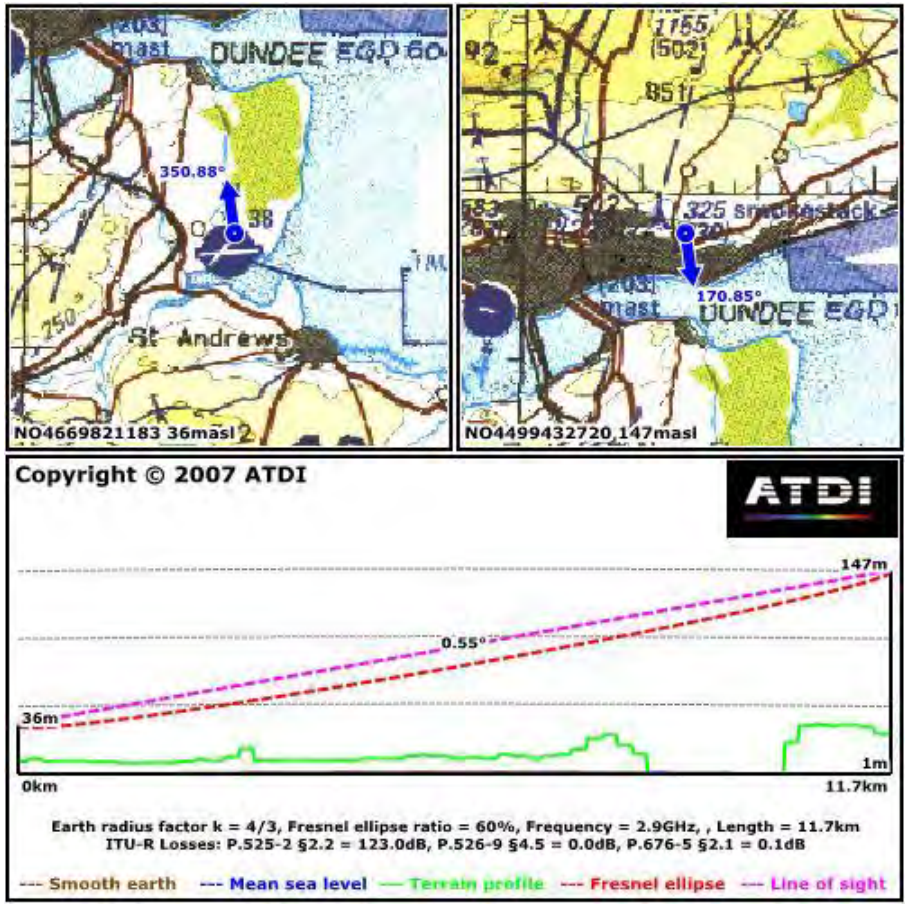


Figure 12: ATDI radar path profile from RAF Leuchars Watchman radar to Michelin Turbine 2

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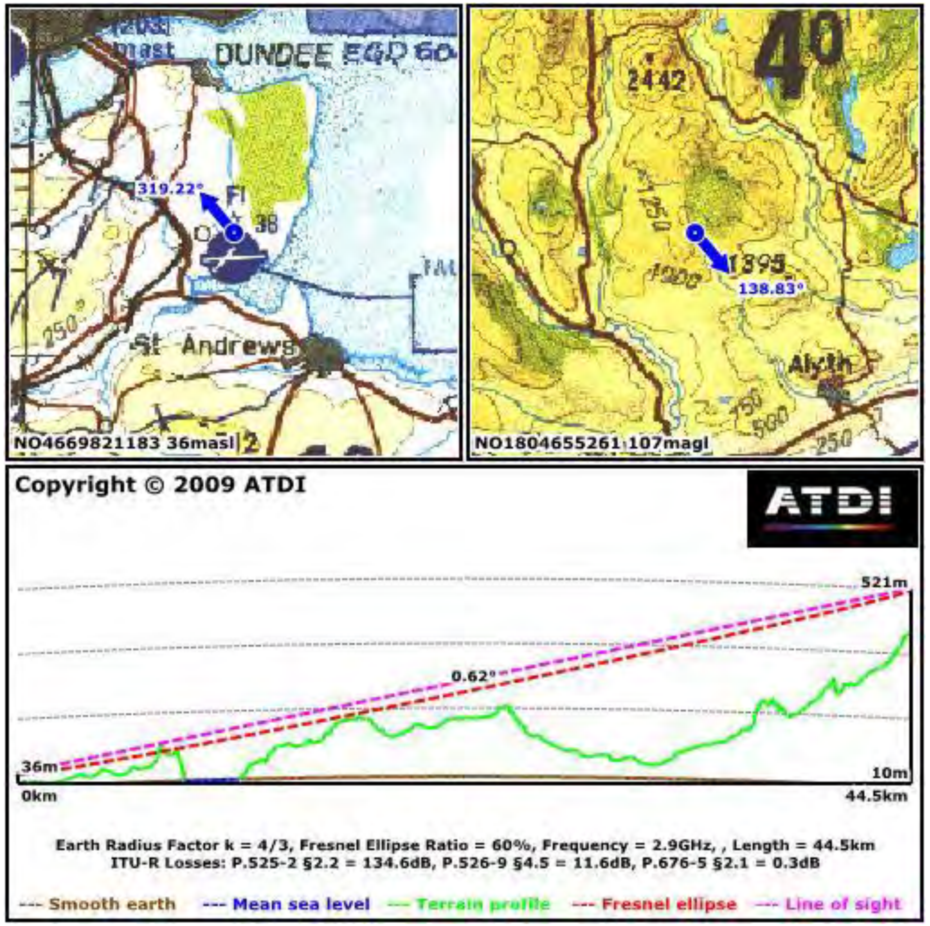

Figure 13: ATDI radar path profile from RAF Leuchars Watchman radar to Drumderg Turbine 3

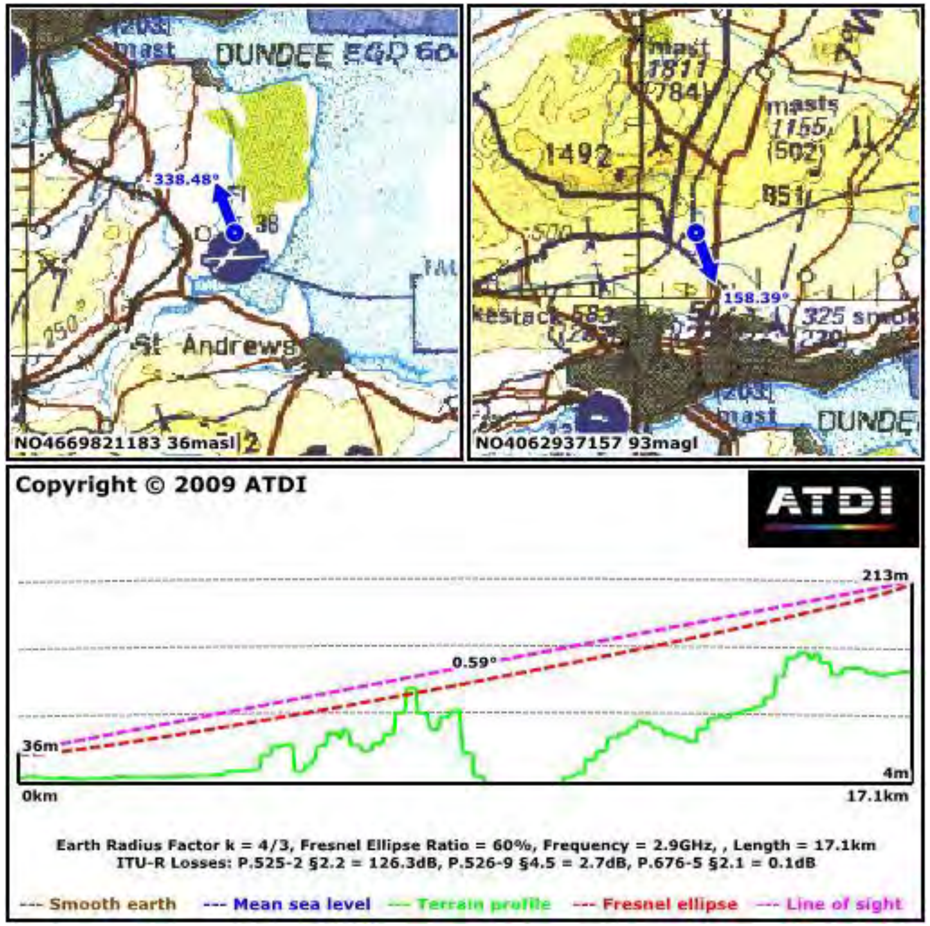

Figure 14: ATDI radar path profile from RAF Leuchars Watchman radar to Tealing turbine

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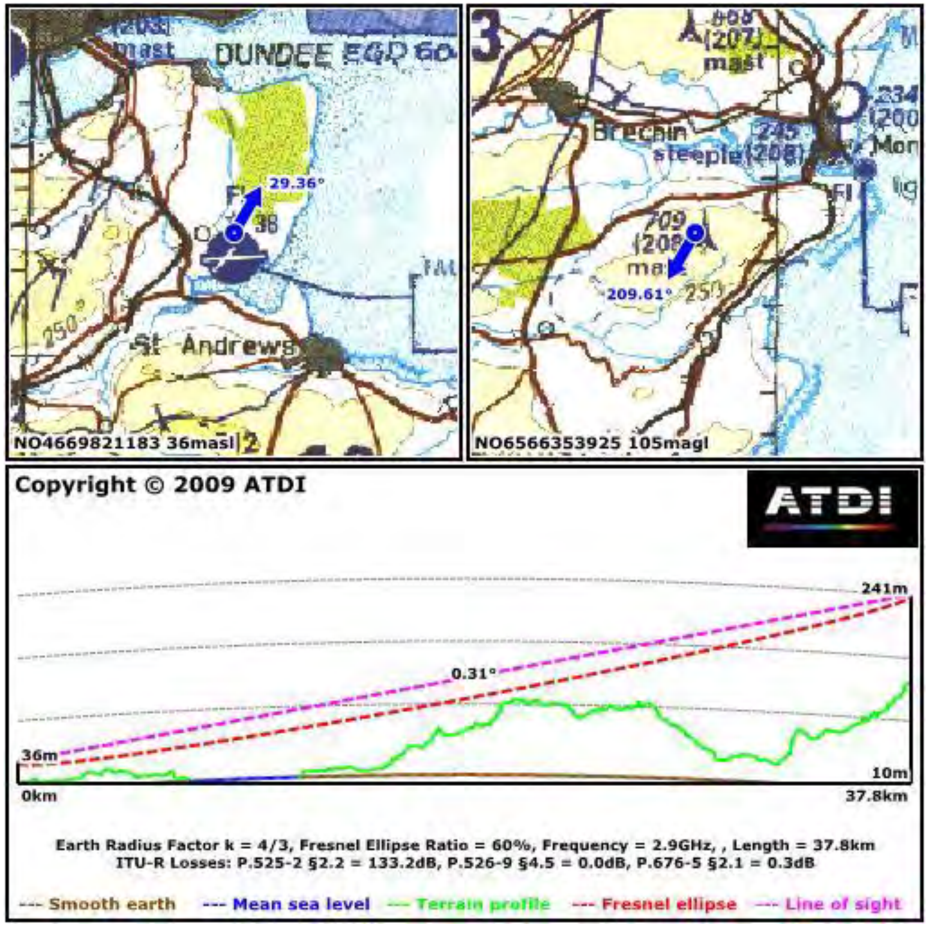

Figure 15: ATDI radar path profile from RAF Leuchars Watchman radar to Mountboy Turbine 3

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TABLE 2: UK MILITARY ATC RADARS WITH EXISTING WIND TURBINES WITHIN LINE OF SIGHT

Airfield/radar (listed north to south)	*Wind farm*	*No. of turbines*	*Turbine tip height (m agl)*	*Date operational*	*Distance from radar head (km)*
RAF Lossiemouth	Beatrice	2	148	Aug 07	45.7
	Buolfruich[4]	15	68	Oct 05	65.8
	Paul's Hill	24	100	Apr 06	29.1
	Rothes	22	100	May 05	18.1
RAF Kinloss (SSR only)	Findhorn	1+3	32/44	Oct 89/Mar 06	3.7
RAF Leuchars	Michelin factory, Dundee	2	100	May 06	11.7
RAF Spadeadam (Deadwater Fell)	Bow Beat	24	76	Sept 02	59.8
	Craig	4	100	Sept 07	32.4
	Dun Law	26	63.5	Jul 00	62.4
	Great Orton	6	68.5	Jan 00	53.7
	High Hedley Hope	3	71	Dec 01	76.6
	High Pow	3	95	Mar 07	65.8
	Holmside Hall	2	100	May 04	74.3
	Kirkheaton	3	66.5	May 00	43.4
	Tow Law	3	71	Dec 01	76.3
	Wharrels Hill	8	76	Aug 07	74.7
RAF Spadeadam (Berry Hill)	High Pow[5]	3	95	Mar 07	49.8
	Wharrels Hill	8	76	Aug 07	59.2
RAF Leeming	Hare Hill	2	100	Sep 04	52.8
	High Hedley Hope	3	71	Dec 01	54.1
	High Volts	2	100	Dec 03	47.2
	Tow Law	3	71	Dec 01	53.5
	Walkway	7	110	Nov 07	42.1
	Knabs Ridge	8	98	Feb 08	33.4
RAF Linton-on-Ouse	Knabs Ridge	8	98	Feb 08	26.1
RAF Valley	Llyn Alaw	34	53	Oct 97	12.4
RAF Waddington	Gedney Marsh	6	100	Jul 06	55.0
	Bicker Fen	13	101	Jan 09	31.9

4 Visibility to Buolfruich may be restricted by a hangar on the north side of the airfield.

5 Visibility to High Pow may be restricted by terrain and trees immediately SW of the radar head. Antenna height of 12m agl has been assumed.

RAF Coningsby	Deeping St Nicholas	8	100	Jul 06	39.8
	Gedney Marsh	6	100	Jul 06	33.5
	Bicker Fen	13	101	Jan 09	18.0
RAF Cranwell	Deeping St Nicholas	8	100	Jul 06	35.9
	Gedney Marsh	6	100	Jul 06	44.8
	Bicker Fen	13	101	Jan 09	20.4
RAF Coltishall[6]	Blood Hills	10	43.5	Dec 92	21.1
	Somerton	1	100	Jul 00	20.2
RAF Cottesmore	Deeping St Nicholas	8	100	Jul 06	27.4
	Bicker Fen	13	101	Jan 09	34.5
	Gedney Marsh	6	100	Jul 06	51.1
	Glass Moor	8	100	Jun 06	44.5
	Longhill	1	107	Mar 05	52.9
	Ranson Moor	3	107	May 07	52.1
	Stags Holt/Coldham	17	100	Nov 05/Oct 07	56.1
	Whittlesey	3	125	Dec 07	37.1
RAF Marham	Swaffham	1+1	120	Oct 99/Jul 03	8.9
	North Pickenham	8	125	Nov 06	10.7
RAF Honington	North Pickenham	8	125	Nov 06	30.7
QinetiQ Aberporth	Blaen Bowi	3	76	Jul 02	18.1
RAF Brize Norton	Westmill	5	81	Mar 08	15.4
RAF Lyneham	Lynch Knoll	1	63	Dec 96	28.4
	Westmill	5	81	Mar 08	27.3
RN Hartland Point	Bears Down	16	57	Sep 01	68.7
	St Breock	11	53	May 94	64.8
RAF St Mawgan[7]	Bears Down	16	57	Sep 01	6.5
	Carland Cross	15	49	Aug 92	9.4
	Delabole	10	49	Nov 91	31.5
	Four Burrows	15	45.5	Mar 95	16.9
	St Breock	11	53	May 94	13.3
RNAS Culdrose	Goonhilly	14	47	Apr 93	6.5

6 RAF Coltishall closed in November 2006.

7 RAF St Mawgan became Newquay Cornwall Airport in December 2008.

Excerpt from e-mail from David Jones, Senior Safeguarding Officer, Defence Estates, to Malcolm Spaven of Spaven Consulting on 17 July 2009:

"(a) The way Leuchars deals with the Michelin Turbines is as follows:

Currently wind turbines are deemed by HQ Air as to not be 'permanent echos' or 'areas of poor radar performance' due to the 'moving' appearance created by the wind farm returns. IAW current ATC policy (CAA, NATS and MOD) this has the result that all aircraft under a RAS (now Deconfliction Service) will be offered avoiding action in order to achieve 5nm lateral separation on all unknown primary radar returns, which includes the Michelin Wind Turbine primary radar returns.
Additionally aircraft in receipt of a RIS (Traffic Service) or FIS (Basic Service) will be informed of the Michelin wind Turbines in the form of a traffic information call.

Therefore, the targets produced by the Michelin turbines are dealt with as any target produced by an aircraft. The targets that will be produced by the [Frawney]* proposal would have the same impact on the controllers affected."

* Original e-mail referred to another project here; however the question asked by Spaven Consulting referred to the possibility of the Michelin procedure being applied equally to this and the Frawney development.

Excerpt from e-mail from Defence Estates to Spaven Consulting on 18 August 2009:

'Malcolm,
I get the impression that there was a misunderstanding between us in our communication regarding the provision of ATC services with reference to turbines to the north of Leuchars.

There is no 'michelin mitigation' technique used by ATC at Leuchars to alleviate the impact of the Michelin turbines on ATC services to aircraft in this location. Furthermore, there are no other similar mitigation techniques used by UK based Military ATC. Controllers deal with the targets on radar caused by these turbines like they do any other radar target, whereby they apply the service, in accordance with regulations, agreed with each individual aircraft.

What I did discuss was a controlling technique that could be used when controlling IFR aircraft flying in VMC, an extremely rare occurrence, with the chance that the turbines could be visually acquired by the IFR pilot and therefore no separation would be subsequently required, if agreed by the pilot. However, aircraft pilots operating in Class G airspace are more pragmatic when requesting a service from ATC with the high majority requesting DS when IMC or when likely to encounter IMC conditions. Therefore, it would be extremely unlikely that visual acquisition of turbines could be achieved with an avoiding turn then being required.

I apologize for the unintended 'crossing of wires', but must conclude that as there is no operational michelin mitigation, it therefore obviously cannot be applied to the Black Sluice Drainage or Finlarg/Frawney developments'.

MINISTRY OF DEFENCE

Claire Duddy
Assistant Safeguarding Officer

Safeguarding - Wind Energy
Defence Estates
Kingston Road
Sutton Coldfield
West Midlands
B75 7RL

Cyranne Taylor: 0121 311 2195
Claire Duddy: 0121 311 3714
Facsimile: 0121 311 2218
E-mail: cyranne.taylor@de.MOD.uk
E-mail: claire.duddy@de.MOD.uk
Internet Site: www.defence-estates.MOD.uk

Mr Malcolm Spaven
Spaven Consulting

Your Reference:
Our Reference: DE/C/SUT/43/10/1/6986

19 August 2009

Dear Mr Spaven

DE Reference Number: 6986

Site Name: FINLARG/FRAWNEY WIND FARM

Thank you for your email dated 01 July 2009.

I am writing to confirm that we have the following concerns with your proposal. This has been assessed on the grid references below (as submitted in your email) for 8 turbines at 100 metres to blade tip height.

Turbine	100km Square letter	Easting	Northing
1	NO	41216	41777
2	NO	42020	42562
3	NO	41411	42108
4	NO	41678	42414
5	NO	41932	42236
6	NO	41623	41985
7	NO	41881	42756
8	NO	42298	42860

We will look at suggested mitigations that you may wish to propose. However, the Ministry of Defence (MOD) will object if you apply for planning permission without addressing these concerns to our satisfaction.

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Air Traffic Control (ATC) radar

The turbines will be 21 km from; in line of sight to; and will cause unacceptable interference to the ATC radar at RAF Leuchars. Following trials carried out in 2005, it has been concluded that wind turbines can affect the probability of detection of aircraft flying over or in the vicinity of wind turbines. Due to this, the RAF would be unable to provide a full Air Traffic Radar service in the area of the proposed wind farm.

If the developer is able to overcome the issues stated above, we will request the turbines be fitted with 25 candella aviation lighting.

Defence Estates Safeguarding wishes to be consulted and notified of the progression of planning applications and submissions relating to this proposal to verify that it will not adversely affect defence interests.

I hope this adequately explains our position on this matter. If you require further information or would like to discuss this matter further please do not hesitate to contact me.

Yours sincerely

[redacted]

Claire Duddy
Assistant Safeguarding Officer – Wind Energy
Defence Estates

SAFEGUARDING SOLUTIONS TO DEFENCE NEEDS

Appendix 13-2: NATS Craigowl Hill Assessment

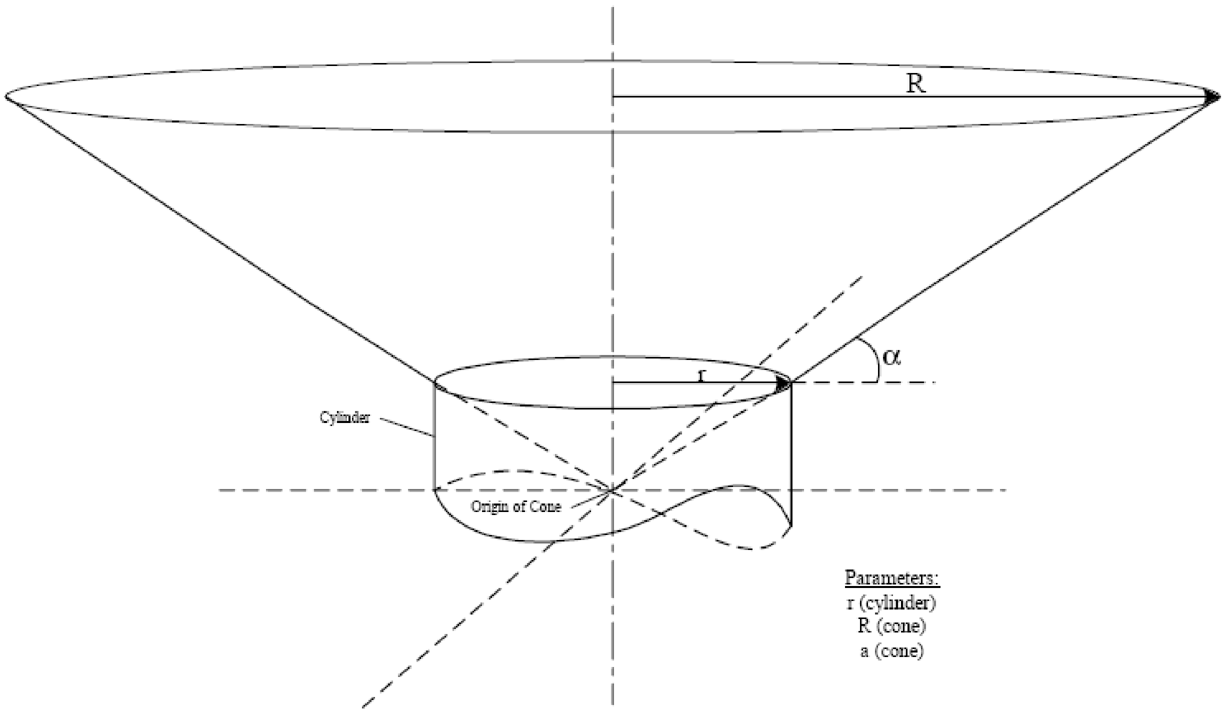
OUTLINE ASSESSMENT OF IMPACT OF FRAWNEY WIND FARM ON NATS CRAIGOWL HILL VHF/UHF TRANSMITTER/RECEIVER FACILITIES

1. Protection zone criteria

The protection zones to be applied around aeronautical radio facilities are set out in an International Civil Aviation Organization document *European Guidance Material on Managing Building Restricted Areas* (ICAO EUR DOC 015).

The shape of the protection zone around omni-directional facilities is shown below.

Figure 2: Omni - Directional BRA Shape



For omni-directional communication facilities (such as Craigowl Hill) the dimensions of the zone to be safeguarded are:

α = 1° above horizontal, from ground level at base of antenna
R = 2000 metres

2. Assessment of Craigowl Hill site

The assessment of the proximity of the Frawney turbines to the NATS VHF/UHF transmitter/receiver site on Craigowl Hill is set out in the table below. This is based on the NATS transmitter/receiver being the closest mast on the Craigowl Hill site, at E337742 N740040. Terrain elevation at that location is 450m AOD.

It will be seen that all the Frawney turbine blade tips are lower than ground level at the Craigowl Hill site – the angles from the site to the blade tips range from -1.35° to -1.77° (column H).

All the turbines are also well beyond the recommended 2km radius horizontal distance from the facility (column G).

If the recommended +1° cone was extended laterally beyond the 2km radius, the height of the cone above the turbine blade tips would be between 177.5 and 225.5 metres (column I). There is therefore a large buffer between the blade tips and the extended cone.

A	B	C	D	E	F	G	H	I
Turbine	Easting	Northing	Terrain elevation (m AOD)	Tip height (m AOD)	Distance from Craigowl transmitter (m)	Distance beyond 2km radius cone (m)	Elevation angle from grnd lvl at Craigowl to blade tips	Height of 1° cone above blade tips (m)
1	341216	741777	220	320	3884	1884	-1.77	187.8
2	342020	742562	209	309	4966	2966	-1.51	217.7
3	341411	742108	236	336	4212	2212	-1.41	177.5
4	341678	742414	232	332	4597	2597	-1.35	188.2
5	341932	742236	207	307	4731	2731	-1.61	215.6
6	341623	741985	215	315	4341	2341	-1.65	200.8
7	341881	742756	222	322	4951	2951	-1.37	204.4
8	342298	742860	208	308	5358	3358	-1.41	225.5