A11. ORNITHOLOGY

A11.1 INTRODUCTION

The design of the proposed Viking Wind Farm has changed since the Section 36 application and its associated Environmental Statement were submitted in 2009. This chapter describes how these changes affect ornithological interests on the site. Before reading this chapter, please first read Addendum Chapter A1, the Introduction, and Chapter A4, the Development Description. It is important to read these two chapters carefully to avoid misunderstanding of the assessment work described in this chapter.

This addendum chapter assesses the predicted impacts of the revised Viking Wind Farm, and aims to address issues raised by statutory consultees in relation to the original ornithological 2009 assessment (summarised in Table A11.6). Whilst focussing on the impacts of the revised layout, the assessment, when relevant, also refers to the impacts reported in the original assessment in order to illustrate how impacts have changed. It also summarises how the design change process took account of impacts on birds.

The current assessment includes substantial additional material, in terms of new data, and revised analysis and assessment methods. The approach has been amended, with particular importance attached to implementing the assessment guidelines issued by SNH in 2006, and greater emphasis placed upon considering the ‘likely’ and more biologically realistic effects, as opposed to ‘worst case’ effects, as required by the Electricity Works (Environmental Impact Assessment) Scotland Regulations 2000.

For ease of reference, this addendum assessment effectively replaces the ornithology chapter of the 2009 ES. Readers should note that effects are now reported on a species by species basis, as opposed to effect by effect basis.

The methods used to establish the bird interest within and around the proposed windfarm are described, together with the process used to determine the nature conservation importance of the bird populations present. The ways in which birds might be affected by the development are explained and the magnitudes of the likely effects are predicted, taking into account mitigation measures and the Favourable Conservation Status of the species under consideration. The extent and nature of mitigation measures delivered through the Habitat Management Plan (HMP) have also changed greatly since the original 2009 ES.

The fieldwork, technical analysis and species advice was undertaken by Natural Research Projects (NRP) Ltd and this addendum chapter was written and produced by NRP and Alba Ecology Ltd.

The assessment draws upon and is supplemented by five appendices as follows:

- Appendix A11.1 Birds Technical Report
- Appendix A11.2 Estimation of Flight Activity
- Appendix A11.3 Estimation of Collision Risk
- Appendix A11.4 Deterministic Population Modelling
- Appendix A10.9 The Viking Habitat Management Plan

Some of the survey data and analysis relates to nest sites of sensitive protected species and, in accordance with guidance from SNH (2009) this information is presented in a separate confidential annex with restricted distribution.

A11.2 VIKING STUDY AREA

A11.2.1 Extent

The Viking Wind Farm site itself comprises four discrete quadrants: Collafirth (NE), Nesting (SE), Kergord (SW) and Delting (NW) (Figures A4.1.1 and A4.1.2). The proposed infrastructure in the Nesting quadrant is spread across two separate areas. All the previously proposed development within the Collafirth quadrant has now been removed for various reasons including ornithological concerns.

The extent of the area covered by ornithological baseline surveys varied according to the species being considered (Appendix A11.1 Birds Technical Report). This followed standard survey guidance (SNH 2005) which directs efforts to matching field survey requirements to the project information needs. "*Effort in assessing potential impacts, and hence the target bird species for field survey, should be focussed on those species for which there is potential for an impact which might be judged significant and adverse. In most circumstances the target species should be limited to those protected species and other species of conservation concern which, as a result of their flight patterns or response behaviour, are likely to be subject to impact from wind farms*".

A11.2.2 Physical environment

The topography within the application boundary for the Viking Wind Farm is predominantly gentle, undulating and upland in character. It ranges in altitude from sea level to 281m at Scalla Field on the West Kame ridge. Monthly average temperatures in Central Mainland vary from 3.3°C in February to 11.9°C in July and August and the mean rainfall ranges from 53mm in June to 117mm in November. These relatively benign but wet conditions are accompanied by the strength and persistence of the wind, which averages 'Force 4' on the Beaufort scale and there are gales (≥ Force 8 on the Beaufort scale) on an average of 58 days per year. Hill and sea fogs are also frequent (Berry and Johnston, 1980).

The importance of the Viking bird habitats is presented in Appendix A11.1.

A11.2.3 Wider area context

The Viking Wind Farm is unusual for two reasons and this makes it atypical in terms of the assessment of the potential effects on birds. The first reason is that it is a large development on an archipelago of relatively small size. As a consequence, compared to other windfarms in Scotland, it covers a relatively high proportion of the relevant SNH Natural Heritage Zone (the Shetland NHZ). Inevitably then, for species that are widespread, on average a relatively large proportion of the NHZ population occur within or close to the proposed development site. The second reason is that compared to uplands across mainland UK in general, Shetland as a whole is what might be termed 'good' for birds with even the poorer areas still supporting species of high conservation interest. This means that the usual approach to resolving bird-wind farm conflicts by avoiding bird sensitive areas through careful design can only ever be partially successful in Shetland as there are virtually no areas where there will be no potential conflicts with some species of conservation interest. Therefore, the approach taken to reduce potential conflicts with ornithological interests has been to prioritise species by importance and avoid areas of greatest sensitivity and conservation value.

The overall location for the proposed wind farm, which was identified following very early consultation with SNH, RSPB and Shetland Islands Council Planning Service, is discussed in Chapter A1.

A11.2.4 Designated sites

No part of the Viking development site is designated for its international ornithological interest, for example as a Special Protection Area (SPA) or Ramsar site. Three designated sites of national importance, Sites of Special Scientific Interest (SSSIs), are located near to the planned development:

- Dales Voe SSSI, an area of saltmarsh and intertidal sand and mud that supports locally important populations of feeding shorebirds, breeding ringed plover and Arctic tern.
- Kergord plantations SSSI, an area of mixed coniferous and deciduous woodland that provides a locally important habitat for feeding and breeding woodland birds.
- Sandwater SSSI, a shallow mesotrophic loch surrounded by dwarf shrub and acidic moorland that supports locally important populations breeding waterfowl and passage and wintering wildfowl.

Other SSSIs in the area include Laxo Burn SSSI and Burn of Lunklet SSSI. However, neither of these sites are designated for their ornithological interest.

A11.3 ASSESSMENT METHOD

A11.3.1 Introduction

The assessment approach draws on the relevant guidance, as follows:

- SNH 2005. Survey methods for use in assessing the impacts of onshore windfarms on bird communities;
- SNH 2006. Assessing significance of impacts from onshore windfarms on birds outwith designated areas;
- SNH 2005. Environmental Assessment Handbook: Guidance on the Environmental Impact Assessment Process; and
- IEEM 2006. Guidelines for Ecological Impacts Assessment in the United Kingdom.

This addendum describes both the approach to the assessment and the various techniques used for the overall ornithological assessment. These techniques encompass data collection, analysis and evaluation of effects.

A11.3.2 Limitations and data gaps

Where assumptions within the ornithological assessment are made these are explicitly identified and explained. Similarly, limitations in methods and uncertainty over parameter values and species' ecology are also identified and discussed, particularly where this is likely to affect the outcome of the assessments.

No gaps were identified in the baseline Viking data that would prevent assessments being undertaken. The previous data gap regarding the size of the national whimbrel population identified in the 2009 ES was filled by fieldwork undertaken in 2009 and 2010.

There is no published or agreed assessment of whether a species does or does not have Favourable Conservation Status (FCS), as articulated in the Habitats Directive, for bird populations in the Shetland NHZ. Yet the significance of any wind farm impact on a bird species will depend crucially on the conservation status of the species in the area, in terms of the robustness or fragility of its population and the adequacy of supporting habitats. Therefore, for the purpose of this assessment, it has been necessary to review recent evidence on population trends and assign a provisional conservation status to the Shetland population. A summary of the recent evidence is presented and its reliability discussed so that the objectivity of the interpretation is transparent.

A11.3.3 EIA context and overview

The evaluation approach is set in the context of:

- The statutory requirements of the Electricity Works (Environmental Impact Assessment) Scotland Regulations 2000, which define the information to be supplied within an ES;
- Scottish Planning Policy (The Scottish Government 2010) which includes guidance on how planning applications are to be considered; and
- PAN 58, Environmental Impact Assessment (Scottish Executive 1999) which includes general guidance on EIA.

Of particular pertinence to the current assessment is the requirement set out within the Electricity Works (Environmental Impact Assessment) Scotland Regulations 2000 – (Regulation 4(1)) to report:

- A description of the likely significant effects of the development on the environment;
- The main alternatives studied; and
- An indication of difficulties encountered.

Whilst considering a range of potential outcomes that could arise from implementation of the development, the assessment reports the effects that the assessors consider to be likely. It is these likely effects that the applicant is obliged to report, and that Scottish Ministers are obliged to consider – (Regulation 3(1), 4(1)).

The underlying approach comprises:

- Gathering and describing baseline data;
- Characterising impacts that are predicted to occur as a result of the development;

- Evaluating the significance of the predicted impacts on the species population at an appropriate geographical scale;
- Where significant effects are likely, to propose mitigation measures; and
- Re-evaluating the significance of effects to determine likely residual effects.

As with any Environmental Assessment there will be elements of uncertainty, and this was a difficulty encountered within the current assessment of the likely effects on birds. However, in accordance with Regulation 4(1) (Schedule 4 Part I, paragraph 6), these difficulties are identified and reported, along with the measures taken to reduce the level of uncertainty, assumptions made, and a commentary as to the likely extent that such difficulties affect the conclusions.

The level of certainty of impact prediction varies depending upon a range of parameters. For some elements, e.g. direct habitat take, it is relatively straightforward to assess and quantify the area of habitat that will likely be lost to wind farm infrastructure and so quantify potential impacts of land-take on birds. However, other impacts are uncertain because there can be a range of possible scenarios. The current assessment approach based on 'likely' effects has replaced the previous 'worst case' approach. Adopting a 'worst case' scenario approach for dealing with uncertainty is not advocated within PAN 58. A worst case effect is not necessarily the most likely effect. This is particularly the case where the magnitude of an impact is derived by multiple calculations involving a number of factors and there is a danger of worst case assumptions being compounded.

Further guidance on dealing with uncertainty is set out in SPP (2010) which states (Para 132) that '*planning authorities* (considered in this case to be Scottish Ministers) *should apply the precautionary principle where the impacts of a proposed development on nationally or internationally significant…. natural heritage resources are uncertain but there is sound evidence for believing that significant irreversible damage could occur*'. In circumstances where there is uncertainty and the precautionary principle may be relevant, we have used evidence, expert opinion, best practice guidance and professional judgement to evaluate what is biologically likely to occur if the proposed wind farm is consented. Where it is judged appropriate, cautious assumptions are made for the purpose of the assessment. Where relevant, the Addendum analyses whether there is sound evidence for believing that significant irreversible damage could occur.

A11.3.4 Effects assessed

Through scoping, potentially significant adverse effects on birds were considered likely to comprise:

- Direct loss of habitat to wind turbine bases, access tracks, site substation, converter station and ancillary infrastructure (so called 'land-take');
- Modification of habitats due to hydrological change resulting from the construction of access tracks, cable trenches, etc.;
- Indirect loss of habitat due to the displacement of birds by construction works and operation of the windfarm;
- Mortality due to collision with wind turbine blades; and
- Effects of windfarm infrastructure decommissioning.

Potentially significant beneficial effects on birds comprise:

- The direct benefits to bird species and their habitats delivered through the Habitat Management Plan.

A11.3.5 Scoping likely effects

Since the original 2009 ES there has been regular consultation with both SNH and RSPB regarding the likely effects of the wind farm on birds and how these should be prioritised, assessed and best dealt with in the addendum. This has focussed on agreeing priority species, how to assess potential effects in more realistic and scientifically robust ways (through agreed models) whilst recognising inevitable uncertainties and the scope and magnitude of measures in the Habitat Management Plan (Appendix A10.9) designed to offset adverse effects on birds. The consultation comments were taken into account as far as practical, both in the windfarm design changes and the assessment process.

An important element coming out of the consultation process was the recommendation that population models (i.e. mathematical descriptions of bird populations) should be constructed to help inform design changes and assessment. Models require information on the parameters that affect population processes and interactions between them. The better these are quantified and understood the greater the chance that a model can predict the consequences for a population arising from a given scenario. However, it is recognised that in all cases the population parameters and processes that affect the species of interest in Shetland are incompletely understood and, generally, are either poorly quantified or have never been quantified. For this reason, only relatively basic deterministic models were constructed for the key species. More sophisticated models, that incorporate density dependence and stochasticity, were not developed because there is insufficient knowledge of how these things affect the species under consideration. Guessing how these processes may affect a species would of course have been possible but could not be defended and in any case would have led to the danger of drawing false or potentially biased conclusions.

The assumptions underpinning the models and the results are presented in Appendix A11.4. The model results though useful are nevertheless subject to many limitations caused by various uncertainties in the data and assumptions which, it is recognised, have to be made (and were agreed with SNH). Caution is required in their use and an appreciation that they are only a tool to help inform good decision-making, rather than likely or accurate predictions of future population trajectories. The estimated operational effects of displacement and collision are now treated as being essentially additive (previously they were considered effectively mutually exclusive). The population models provide an effective way to integrate the effects of operational displacement and collision, together with construction activity effects in a single analysis.

A summary table of ornithological scoping issues and statutory consultee responses and where these are addressed in this chapter is presented at A11.5.

A11.3.6 Effects scoped out of assessment

In the 2009 ES submission, SNH objected to the potential impacts on the Sandwater SSSI, and they acknowledged that "*although not directly affected by the windfarm itself or associated infrastructure within the development boundary, the Sandwater SSSI is likely to be adversely affected by other associated works outwith the development boundary*". The potential impacts relate to changes at the A970/B9075 junction, upgrades to this road and its bridge and the location of a construction compound. In particular, releases of sediment and polluting materials, nutrient enrichment and possible changes to the flow reaching the Sandwater SSSI were issues of concern. All SNH comments in relation to the Sandwater SSSI will be accommodated by VEP and these changes are addressed (Table A1.3). Therefore, no significant impacts will occur on the breeding wildfowl of the Sandwater SSSI and this issue (and therefore impacts on designated sites) is scoped out of further consideration and assessment.

The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 require all likely significant effects (positive and negative) to be considered. This is usually taken to mean site specific related effects, although this is not as straightforward as it first appears to be. For example, the benefits to birds on the Viking site stemming from the contribution made by the windfarm towards countering climate change, both through renewable energy generation and through improvement to peatland carbon sequestration function, cannot yet be quantified at a local scale. Nevertheless it is clear that a large windfarm located on peatlands that are currently in a generally poor and dysfunctional condition will potentially make a relatively large beneficial contribution to meeting national CO_2 emission targets.

Climate change is widely perceived to be the single most important long-term threat to the global environment, particularly to biodiversity. Thus, the continued rise in mean global temperatures is predicted to affect the size, distribution, survival and breeding productivity of many British (and therefore Shetland) bird species (Huntley *et al* 2006, Huntley *et al* 2007, Robinson *et al.* 2005). For example, Zöckler and Lysenko (2000) predicted a reduction in the breeding range of Arctic species of between 5% and 93%, dependent on the species. High altitude species found in Scotland, such as dotterel and snow bunting, may experience loss of habitat as temperatures increase. More specifically, there is evidence that climate change causes changes to the phenology of the crane-fly life cycles leading to potential food shortages for northern breeding birds such as golden plover and thereby reducing breeding performance and habitat suitability. RSPB research found that higher late summer temperatures kill the cranefly larvae in peatland soils as the surface dries out, resulting in a drop of up to 95% in numbers of adult cranefly emerging the following spring (Pearce-Higgins *et al.* 2009). Moreover, sea-level rises may lead to the loss of areas of lowland coastal habitat, including salt marshes and mudflats, which are of particular importance to migratory waders. It has been estimated that 84% of migratory species face some threat from climate change (Robinson *et al.* 2005). Despite the overwhelming evidence, uncertainties regarding climate change predictions mean that it is not possible at present to carry out a quantitative assessment of the beneficial effects of the Viking development on birds. Therefore, these clearly important beneficial effects have been scoped out of further consideration within this chapter.

A11.3.7 Ornithological assessment approach

The proposed development is not located within, or in close proximity to, areas of designated European importance for birds (i.e. SPAs). Moreover, there is no expectation that birds forming part of the qualifying interest of SPAs visit the development site on a regular basis. Therefore, it is not considered likely that the proposed development would have a significant effect on SPA interests.

In view of the above, the magnitude of likely effects on the Wider Countryside ornithological interest is assessed, as set out in the SNH 2006 guidance '*Assessing significance of impacts from onshore windfarms on birds outwith designated sites*'. These effects are evaluated at the regional scale using an appropriate ecological unit, taken to be the Shetland NHZ, as defined by SNH (2002). Exceptionally, the number of birds present within the region may represent most or all of a national population. In these cases, magnitude is judged at the appropriate higher national scale. In making judgements on magnitude, consideration is given to the population status, trends and distribution of the potentially affected species, following the principles set out in SNH (2006) guidance. Crucial to this evaluation is whether or not the conservation status of a species is favourable (in terms of the robustness of its population and the adequacy of its supporting habitats), and whether the proposal would add substantially to the difficulty of taking action to reverse any decline and enable the species to achieve Favourable Conservation Status.

It is recognised that the term '*Favourable Conservation Status*' as articulated within the Habitats Directive is not used in the Birds Directive, but SNH advise (2006) on its context. Conservation status is favourable where:

- Population dynamics indicate that the species is maintaining itself on a long-term basis as a viable component of its habitat;
- The natural range of the species is not being reduced, nor is it likely to be reduced in the foreseeable future; and
- There is (and will continue to be) a sufficiently large habitat area to maintain its populations on a long-term basis.

According to SNH (2006), an impact should be judged as of concern where it would affect the FCS of a species, or stop a recovering species from reaching FCS, at international, national or regional population levels. Unfortunately, the existing conservation status of species within each NHZ is not defined (except for golden eagle) by SNH (favourable or otherwise). Therefore, to assess potential impacts against the FCS of a species requires the assessor to determine what the status currently is (see section 11.3.2) and what it is likely to become as a consequence of the impact of the proposed development. Within each Viking Wind Farm species account, the balance of evidence is considered and weighed up to suggest the predicted impact on FCS for all important Viking species using the three 'favourable' tests above.

(a) Methods used to evaluate nature conservation importance

The potential nature conservation importance of an avian receptor should be determined within a defined geographical context (SNH 2006). The following frames of reference are used following best practice guidance (IEEM 2006) and adapted to meet local circumstances. The classification is hierarchical, such that species that would qualify under more than one category are defined according to the highest class:

- International (e.g. >1% of EC population);
- UK/national (e.g. >1% of UK populations);

- Regional; and
- Local.

Given SNH (2006) advice, the top three geographical tiers (international, national and regional) are the most important within the context of the proposed Viking Wind Farm ES. The value attached to species can also be determined according to legislative status. All wild bird species are subject to a general level of protection through the Wildlife and Countryside Act 1981 (as amended) and the Birds Directive. However, according to IEEM (2006), legal protection should be considered separately from nature conservation value when undertaking ecological impact assessments.

(b) **Method used to evaluate effects**

Effect is defined as change in the assemblage (or population) of bird species present as a result of each phase of the development. Change can occur either during or beyond the life of the development. Where the response of a population has varying degrees of likelihood, the probability of these differing outcomes is considered, with particular emphasis focussed on likely effects. Magnitude of effects is influenced by a range of parameters, for example:

- Predictable or unpredictable;
- Direct or indirect;
- Positive or negative;
- Short, medium or long-term;
- Scale of effects;
- Individual or cumulative; and
- Biologically significant or not significant.

In determining the magnitude of effects, the behavioural sensitivity and ability to recover from temporary adverse conditions was considered in respect of each potentially affected population. Behavioural sensitivity was determined according to each species' ecological function and behaviour, using the broad criteria set out in Table A11.1. The judgement takes account of information available on the responses of birds to various stimuli (e.g. predators, noise and disturbance by humans). Behavioural sensitivity can differ even between similar species (Schueck *et al.* 2001) and, within a particular species, some populations and individuals may be more sensitive than others; further, sensitivity may change over time. Therefore, the behavioural responses of birds are likely to vary with both the nature and context of the stimulus and the experience and 'personality' of the bird. Sensitivity also depends on the activity of the bird. For example, a species is likely to be less tolerant of disturbance whilst breeding than at other times, and tolerance is likely to increase as breeding progresses (Holthuijzen 1985) because adults tend to have stronger parental 'bonds' to chicks than to eggs. As a result of these ambiguities species sometimes span more than one category of sensitivity.

Table A11.1: Determining factors for behavioural sensitivity

Sensitivity	Definition

High	Species or populations occupying habitats remote from human activities, or that exhibit strong and long-lasting reactions to disturbance events. Species those for reasons of morphology and/or behaviour are relatively vulnerable to collision.
Moderate	Species or populations that appear to be warily tolerant of human activities, or exhibit short-term reactions to disturbance events. Species that are moderately vulnerable to collision.
Low	Species or populations occupying areas subject to frequent human activity and exhibiting mild and brief reaction (including flushing behaviour) to disturbance events. Species that are at low risk of collision.

Effects on each bird species present are judged in terms of their magnitude in space and time (Regini 2000). There are many different ways in which these can be defined and it is important that whatever method is used that clear definitions are provided. In this assessment there are five levels of magnitude (Table A11.2) and four levels of temporal effect are used (Table A11.3).

Table A11.2: Scales of magnitude on receptor species (adapted from Regini 2000)

Magnitude	Definition
Very high	Total/near total loss of a bird population due to mortality or displacement. Total/near total loss of breeding productivity in a bird population due to disturbance. Guide: >50% of population affected.
High	Major reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 21-50% of population affected.
Moderate	Partial reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 6-20% of population affected.
Low	Small but discernable reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 1-5% of population affected.
Negligible	Very slight reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Reduction barely discernible, approximating to the “no change” situation. Guide: < 1% population affected.

Note: guidance assumes that effects are adverse.

Table A11.3: Scales of temporal effects

Effect	Definition
Permanent	Effects continuing indefinitely beyond the span of one human generation (taken as approximately 25 years – the planned approximate life of windfarm), except where there is likely to be substantial improvement after this period (e.g. the replacement of mature trees by young trees which need >25 years to reach maturity, or restoration of ground after removal of a development. Such exceptions can be termed long-term effects).
Long-term	Approximately 15 - 25 years or longer (see above)
Medium-term	Approximately 5 – 15 years
Short-term	Up to approximately 5 years

(c) **Methods used to evaluate significance**

In accordance with the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 – hereafter referred to as '*the EIA Regulations*', each likely effect is evaluated and classified as either **significant** or **not significant**. The results of deterministic population models developed for key species to help predict the overall effects of the proposed wind farm on the populations (Appendix A11.4) were also used in reaching judgements on the significance. The significance of potential effects was determined by integrating *nature conservation importance* of the avian receptors and *likely effects* as characterised by magnitude, extent, duration, reversibility, time and frequency in a transparent and reasoned way. In making judgements on significance, consideration was given to national and regional trends within potentially affected populations. Detectable changes in regionally or nationally important populations were automatically considered to be fundamental effects and therefore significant under the EIA Regulations (i.e. no distinction was made between differing levels of significance in so much as effects on the receptor being considered were either significant or not). Effects assessed as not being significant included all those which were likely to result in non-detectable changes in regionally or nationally important bird populations. If a potential effect was determined to be likely significant, mitigation measures to avoid, reduce or remedy the effect were identified wherever possible.

SNH's 2009 consultation response to the 2009 ES submission indicated that any new or revised assessment should be set in the context of the need to maintain Favourable Conservation Status of each species (or not impede the recovery of species already in decline and therefore not in favourable condition), as set out in their 2006 guidance. SNH also offered to provide further advice on the content of the ornithological assessment and this was taken up and used to develop the population models used in this new ornithological assessment.

A11.4 POLICY CONTEXT

The Planning Policies of relevance to ornithology are identified within Chapter A7 of the ES "Renewable Energy and Planning Policy Context" and are broadly summarised by topic area in Table A7.1 of the ES 'Summary of plans, policies and guidance'.

Chapter A7 of this ES addendum provides an update on planning policy and material considerations and the 'Viking Wind Farm Updated Planning Statement' provides an assessment of the proposed development against policy considerations.

In summary, the Shetland Development Plan has not undergone any significant change since the drafting of the 2009 ES (in relation to ornithology) and the policies identified remain relevant to the consideration to the proposed development.

As identified in Chapter A7, the primary change in terms of Scottish Government Policy, is the consolidation of Scottish Planning Policy into a single document "SPP" and the revocation of the majority of the wider planning policy series including NPPG 14 Natural Heritage which was previously considered to have relevance to the proposed development.

Planning Advice Notes (PAN's) remain relevant considerations. PAN 45 "Renewable Energy" and PAN 60 "Planning for Natural Heritage" remain relevant and PAN 58 "Environmental Impact Assessment" contains relevant considerations.

SNH's document 'Natural Heritage Futures Shetland' aims to "*guide the future management of natural heritage towards 2025*". The document (which was updated in 2009) contains a number of objectives of relevance which are detailed in Chapter A7 of the ES and assessed in "Updated Planning Statement".

The Viking Habitat Management Plan (Appendix A10.9) directly supports SNH's strategic aims and objectives for Shetland (i.e. SNH Natural Heritage Future 2002; amended 2009). Amongst these objectives are '*To reduce Shetland's contribution to the causes of climate change, in particular: Promote commercial, community and domestic renewable energy schemes*'. Of particular relevance to ecology, SNH want:

- To increase awareness and understanding of Shetland's natural heritage.
- To maintain diversity of habitats and species on in-bye land.
- To maintain and restore upland habitats, in particular:
    - Reducing stock numbers on the hill to sustainable levels;
    - Restoration (where possible) of heather moorland;
    - Halting further reseeding of unimproved heath;
    - Restoration of blanket bog; and
    - Research measures for restoring damaged upland habitats where natural recovery is unlikely, and develop demonstration schemes.
- To maintain freshwater habitats for important plant, fish and wildfowl populations.
- To restore locally endangered habitats and species, in particular:
    - Implement action for critical plant species, including native trees; and
    - Record locations of plant species of limited distributions and use them to inform development plans.

These objectives have informed many of the actions outlined in the Viking Habitat Management Plan (Appendix A10.9).

A11.4.1 Baseline methods

(a) Desk-top studies

Desk-top studies were undertaken to gather existing published and unpublished data, to be used to inform and supplement specific surveys undertaken as part of the EIA, and to provide geographical context.

The desk-based studies were based on the following information sources:

- Shetland Biological Records Centre (SBRC). SBRC is the custodian of bird records gathered by RSPB, SNH and local and visiting ornithologists. Data were first obtained in April 2003.
- The Wetland Bird Survey database (WeBS). Data were first obtained in August 2003.

- A long-term study of breeding red-throated divers in Shetland undertaken by D. Okill.
- Studies of breeding merlin in Shetland undertaken by P. Ellis, D. Okill and N. Dymond.
- Additional published scientific species studies.

These sources indicated that the main species likely to be affected by the development were:

- Breeding red-throated diver, merlin, golden plover, dunlin (*C. a. schinzii*) and Arctic tern (species listed in Annex 1 of the EU Birds Directive [79/409/EEC] on the Conservation of Wild Birds 1979 ['the Birds Directive']).
- Breeding whimbrel (listed in Schedule 1 of the Wildlife and Countryside Act (WCA) 1981, as amended).
- Breeding snipe, curlew, Arctic skua and great skua (important breeding species in a regional and, in some cases potentially national, context).
- Migratory and wintering whooper swan (listed in Annex 1 of the Birds Directive).

(b) **Field studies**

A review of the main bird sensitivities associated with the proposed development identified a range of field survey requirements with the following aims:

- Determine the distribution and abundance of moorland breeding birds, in particular merlins, waders (shorebirds), skuas and terns.
- Investigate the level of bird flight activity across the development site throughout the year, with emphasis on the breeding period (April-August) and migration periods (March-May and September-November).
- Identify freshwater bodies used by breeding and non-breeding red-throated divers and determine their relative importance in terms of maintaining the diver population.
- Quantify spatial and temporal patterns of flight activity by breeding and non-breeding red-throated divers across the site.
- Determine the distribution and abundance of migrant and wintering birds, in particular whooper swans.

Ornithological surveys to address these requirements were initiated in April 2003. The chronology of these surveys was as follows:

April 2003 to March 2004. Breeding bird, flight activity and autumn/winter bird surveys in eastern parts of the development site.

April 2005 to May 2006. Surveys of breeding red-throated diver and merlin within, and up to 2km from the development site (referred to as the Viking Diver Study Area (VDSA) and

Viking Merlin Study Area (VMSA) respectively (Appendix A11.1). Surveys of other breeding birds, flight activity, migratory bird movements and wintering birds in western parts of the development site. Systematic counts of whooper swans at potential feeding and staging sites within, and adjacent to, all parts of the development site. Monitoring of hen harriers using a communal roost site adjacent to the proposed development.

April 2006 to March 2007. Repeat surveys of breeding red-throated diver and merlin within the VDSA and VMSA, Repeat surveys of other breeding birds, flight activity, migratory bird movements and wintering birds in eastern parts of the development site.

April to August 2007. Repeat surveys of breeding red-throated diver and merlin within the VDSA and VMSA. Breeding bird surveys of eight small additional areas peripheral to the development site, made necessary by design modifications. Surveys to quantify the detection likelihood, flying height and diurnal variation in flight activity of selected species of conservation concern.

April to August 2008. Repeat surveys of breeding red-throated diver and merlin within the VDSA and VMSA. Breeding bird surveys of a further eight small additional areas peripheral to the site access tracks, made necessary by design modifications.

April to August 2009. Repeat surveys of breeding red-throated diver and merlin within the VDSA and VMSA.

May to July 2009. A national survey of breeding whimbrel was organised by Natural Research Ltd. This included undertaking surveys of Mainland Shetland and Yell. These survey data, alongside recent data collected on Fetlar and Unst by RSPB, provide an up to date estimate of the population size.

April to August 2010. Repeat surveys of breeding red-throated diver and merlin within the VDSA and VMSA. Breeding habitat condition was also measured at selected sites to inform where measures proposed for these species in the HMP should be deployed.

May to July 2010. Moorland Bird Surveys at selected sites within the development site to monitor whimbrel and Arctic skua numbers.

May to July 2010. Moorland Bird Surveys at selected sites in Central Mainland and West Mainland to inform site selection for the HMP.

Full details of the surveys are given in Appendix A11.1. Ornithological survey work undertaken followed SNH's (2005) advice and its guiding principle of matching field surveys to the information needs of the EIA process. Detailed survey work was undertaken in most cases for 5 years (as opposed to the standard 1-2 year minimum baseline), and the breeding cycles of the birds concerned were annually monitored for a period of at least 5 years. Given this array of work, it is considered that there are no baseline data gaps so large that they are likely to substantially affect the assessments. The data gap identified in the 2009 ES, that of uncertainty over the size of the UK whimbrel population, was filled by survey work commissioned by VEP and part funded by SNH and NRP in 2009.

(c) The '*do nothing*' scenario

According to PAN 58, baseline studies should identify the existing processes of change in the environment, which are likely to influence the character of the site or its surrounds, so that any changes that are predicted to occur due to the project can be distinguished from those which are expected to occur anyway. The predicted future environmental conditions which would exist if the proposed development did not materialise is known for EIA purposes as the '*do nothing scenario*'.

The '*do nothing scenario*' is considered for priority Viking birds within each species account. However, it is necessary to describe and summarise the current 'condition' of the Viking site habitats and, based on recent trends, predict the main influences and changes that are likely to occur in the future regardless of the wind farm. Addendum Chapter 14 and the HMP (Appendix A10.9) describe how much of the blanket bog in the Viking site is currently in poor condition (67.7%), with habitats destroyed and lost as a consequence of over-grazing and to a lesser extent by peat cutting.

For example, during the Viking survey work it became apparent that many breeding lochans used by red-throated divers are detrimentally affected by peatland erosion processes. Indeed, several lochans appear to have been destroyed or rendered unsuitable and more are threatened through erosion in the relatively recent past. Consequently, there is good reason to believe that there will be further losses or deterioration of important lochans as well as large scale releases of CO_2 over the life of the wind farm.

According to Laughton Johnston (1999) "*Unless steps are taken to balance the pressures on the hill, erosion and loss of heather* (in Shetland) *will continue to transform parts of the hill to an environment both unsuitable as a grazing resource and impoverished in terms of its wildlife*". Therefore, it is perhaps reasonable to predict that this decline in peatland habitats will continue over the next 25 years. However, should large numbers of grazing animals be removed from the hills in the future and heather and blanket bog recovery is substantial, then it is possible that habitats may stabilise and perhaps even start to recover. Nevertheless, whilst predictions of declines in the number of sheep and active crofters have been made, it is possible that the number of crofting units may consolidate and large 'ranch style' units develop due to economies of scale. Were this to happen, it is unlikely that large areas of heather and blanket bog would spontaneously recover to the benefit of most Viking bird species. Therefore, the likely '*do nothing scenario*' for the main habitats in Viking study area (and therefore most of their bird populations) is a continuing decline into the future or, at best, stabilising at current degraded levels.

A11.4.2 Impact prediction methods and assumptions

(a) Introduction

The methods used in defining, evaluating and determining potential wind farm impacts are outlined in the following sections. The next section identifies the specific impact prediction techniques used in the Viking assessment focussing on likely predicted-

(i) Habitat loss/modification;
(ii) Disturbance impacts;
(iii) Collision impacts; and
(iv) Significance evaluation of these combined effects on species of high and moderate conservation importance.

Consultees raised the issue that potential effects on birds may interact in complex ways. This was discussed with consultees, in particular the extent to which different potential effects on birds may be additive or mutually exclusive and how they could be reasonably assessed in combination. Collision and displacement effects are likely to be mutually exclusive to some extent, e.g. a bird that is displaced away from a windfarm will no longer be at risk of collision. The effects of habitat loss and disturbance are also likely to be mutually exclusive, e.g. a bird that has been displaced from a windfarm by habitat loss cannot also be displaced by disturbance.

So that their effects can be more easily combined, the likely affects of displacement if any (e.g. as predicted for breeding waders by Pearce-Higgins *et al* 2009) are now taken into account before predicting collision mortality. The deterministic population models were constructed so that all the various effects could be integrated together into a single analysis of the likely effects on the bird populations (Appendix A11.4).

(b) **Operational assumptions**

Construction of the site access tracks, turbine hard standings, site compound and control stations, and erection of the turbines is predicted to commence in late spring and last at least four years. The construction programme requires winter working, when conditions allow.

Prior to construction works commencing, sections of the site access routes within 250m of non-breeding lochs used by red-throated divers would be defined as sensitive zones in which no pedestrian access would be permitted and vehicular traffic would be prohibited from stopping. Signage to demarcate these sensitive zones would be established immediately following construction of the relevant section of track. All construction personnel would be instructed in the importance of complying with this measure, which would be supervised by the Ecological Clerk of Works (ECoW).

Final locations of site infrastructure will be micro-sited in relation to sensitive habitats of value to priority bird species to minimise impacts, with particular reference to blanket bog, burns, lochs and wet flush habitats. The construction team will adopt best practice techniques described in the Soil and Water chapter (A14) and the Site Environmental Management Plan (SEMP) (Appendix A14.6) aimed at minimising the magnitude and duration of likely negative effects on habitats.

All electrical cabling between the proposed turbines and the site substations would be underground and follow windfarm roads and tracks. Connection between the substations and the converter station in Upper Kergord would be mainly underground except for a proposed wooden pole mounted section of overhead line which follows an existing overhead line route along the A970 in Petta Dale. The connection between the converter station and the electrical grid is the subject of a separate planning application.

The 127 turbines would have a ground-to-tip height of up to 145m involving a nominal hub height of 90m and a nominal 110m rotor diameter. This would mean that the rotor swept height (RSH) was between 35 and 145m above ground level. Nine permanent meteorological masts would be constructed. These would be of a non-guyed lattice tower construction with diagonal struts to discourage perching birds (see Chapter A4 and Figure 4.7 from the 2009 ES). Bird collisions with masts of this design are unlikely to be an issue, therefore this is not considered further. In the event that temporary masts require the use of supporting guys these would be fitted with bird diverters of standard industry design[1] to reduce the likelihood of bird collisions.

A Bird Protection Plan would be drawn up each year and executed. The BPP would provide a mechanism that allows windfarm construction and other activities to comply with WCA legislation and ensure that disturbance to breeding Schedule 1 species is minimised. The BPP will identify the types and location of windfarm activities that are likely to disturb the nesting/chick rearing/roosting routine of Schedule 1 birds and, in consultation with SNH, identify appropriate temporary exclusion zones or other mitigation procedures to prevent such disturbance.

(c) **Land-take**

The total planning application area is 18,700ha (this has not changed from the 2009 ES despite the removal of the Collafirth quadrant to maintain consistency for comparison purposes). The maximum total area which will be affected during construction has been estimated at 232ha (Chapter A4.6), a loss of a very small component of the site. This is a 'worst' case estimate and is particularly prone to changes (i.e. reductions) in indicative borrowpit areas. Thus, the most likely scenario would be a smaller area (which cannot yet be quantified) of overall land take assuming the maximum extents of areas of search for borrow pits are not used. This construction estimate is based on the following parameters:

- 104.54km of track, 77.36km of single width and 27.18km of double width;
- 6m wide strip for single tracks plus 2m construction buffer each side;
- 10m wide strip for double tracks (was previously estimated at 12m), plus 2m each side;
- Maximum 13 borrowpit areas of search (87.14ha) and laydown areas plus 5m buffer; and
- Nominal 0.2ha for each turbine (includes construction buffer and spaces around crane pad).

The maximum total area which will be affected after construction areas recover has been estimated at 104ha (Chapter A4.6). This regards double tracks as returned to single width by covering with soil as 'restored', however it is not assumed that this will result in areas of blanket bog returning to 'active blanket bog' status. This estimate is based on the following parameters:

- 104.54km of track, all of which will be restored to 6m width strip;
- All turbine bases 0.2ha (includes construction buffer and spaces around crane pad); and
- Restored 12 (13 selected, only 12 used) borrowpit areas.

Based on the mean densities of breeding birds within 350-800m (distance depending on species' approximate territory size) of the proposed site infrastructure, direct habitat loss is predicted to result in the loss of some pairs (details in respective species accounts). Further details of these land-take effects on specific habitats can be found in Chapter A10. The potential effects of land-take impacts on hydrology and peat and soils are presented in Chapter A14. Bird species use habitats differently and so habitat loss/modification affects

[1] In recognition of the extremely high wind speeds in Shetland, diverters would be attached to the guy wires using the most robust method practicable.

different bird species in different ways. This is considered further in the species assessment accounts.

(d) Construction disturbance

It is likely that noise and visual disturbance associated with construction activities would temporarily displace some breeding and foraging birds and disrupt the routines of others. Effects would be confined to areas in the locality of borrow pits, turbines, tracks and other site infrastructure when work was taking place. The consequences of construction disturbance are likely to be greatest during the period when birds breed. Birds that are disturbed at breeding sites are vulnerable to a variety of potential effects, including the chilling or predation of exposed eggs and chicks, damage or loss of eggs and chicks caused by panicked adults and the premature fledging of young. Disturbed birds may also feed less efficiently and therefore breed less successfully. These effects may lead to a reduction in the productivity and ultimately survival of bird populations.

Few systematic attempts have been made to quantify the disturbance of birds due to activities of this type and much of the available information is contradictory. However, larger bird species, those higher up on the food chain, and those that feed in flocks in the open tend to be more vulnerable to disturbance than small birds living in structurally complex or closed habitats such as woodland (Hill *et al.* 1997).

(e) Operational disturbance

The presence and operation of wind turbines would potentially displace birds from nesting and foraging areas. These effects require further study, although existing information (e.g. Vauk 1990, Phillips 1994, Leddy *et al.* 1999, Madders and Whitfield 2006, Pearce-Higgins *et al.* 2009) and reviews of impacts (e.g. Crockford 1992, Benner *et al.* 1993, Winkelman 1994) suggest that most birds are affected only slightly. For example, early studies suggested breeding birds were not displaced at distances greater than 300m from a turbine (Gill *et al.* 1996, Percival 1998). However, wind turbines might displace birds from larger areas if they act as a barrier to bird movements, or if the availability of suitable habitat is restricted. Also, displacement effects may vary over time, as birds habituate to the operation of the turbines or site faithful individuals are lost from the population.

Given the limited empirical evidence on the subject, the assessment of displacement of breeding birds on the Viking Wind Farm (or any windfarm) inevitably involves some uncertainty. The previous 2009 ES considered displacement as a ‘worst’ case scenario, assuming that all breeding birds within an assumed displacement zone were displaced and that these failed to resettle elsewhere. However, in light of the improvement in the generic understanding of the displacement effects a more sophisticated and biologically realistic system for estimating likely displacement has been used.

Displacement of birds away from the near vicinity of turbines is expected to result in a corresponding reduction in collision risk and this is taken into account in the section dealing with collision effects by using the same values for displacement. Although there is some uncertainty over the magnitude of likely displacement on species, the fact that it is expected to act in an antagonistic way with collision risk means that a miscalculation in one will be tended to be compensated for by a miscalculation in the opposite direction of the other, i.e. an underestimate of displacement will tend to cause an overestimate of collision risk and *vice versa*. As a result, the assessment of the combined effects of potential displacement and potential collision mortality is likely to be relatively robust.

In the particular case of red-throated divers, a system was devised to assess the vulnerability of breeding lochs to disturbance from windfarm activities. This is explained in detail within the account of operational disturbance effects for this species.

Since submission of the 2009 ES, the results of a multi-site study by the RSPB into the effects of windfarms on the abundance of upland breeding birds has been published (Pearce-Higgins *et al* 2009). This study compared breeding bird abundance and distribution at operational windfarm sites with broadly comparable sites with no windfarms and showed evidence of apparent displacement in some wader and raptor species. To a limited extent, the RSPB study advances the understanding of displacement effects on breeding waders and hunting raptors and provides a basis for predicting the likely effects of the Viking windfarm on several species. The Viking assessment of displacement effects on breeding waders and skuas uses the RSPB study results as a starting point as to the likely magnitude of displacement, but it also takes into consideration other studies and experience of the species in Shetland and elsewhere. Where there is uncertainty, the assessment process acknowledges this and errs towards being more conservative. On account of the weight given to the RSPB study to the assessment of the effects of the proposed development on waders and skuas there follows a summary of the relevant findings and a discussion of potential uncertainties, flaws and limitations of the RSPB study.

During the later stages of preparing this assessment results from three further studies into the effects of displacement by operational wind farms on breeding golden plover and curlew became available (Fielding and Haworth 2010, Douglas, Bellamy and Pearce-Higgins unpublished 2010, Whitfield *et al* 2010). The results of these studies contrast markedly with those from the RSPB predictive study; in short they found no convincing evidence of displacement occurring in these species.

Assessing operational displacement of wader and skua species

The main value of the RSPB study is its contribution to the generic understanding of the subject of displacement effects, rather than predicting displacement effects elsewhere. However, the results of this study also show differences between species and variation between sites. Furthermore, for most species looked at, the relationship between the degree of apparent displacement and distance from turbines showed an irregular pattern rather than a regular negative relationship that might be expected. The reasons for these inconsistent and irregular patterns most likely lie in the natural high variability of the data and low bird densities (i.e. sampling error and 'noise'), and the difficulty in finding truly comparable control sites. It should also be borne in mind that for several species the average breeding densities found on the Viking site are generally greater than the RSPB study sites and this may affect birds' displacement response. The value of the RSPB study is also limited because many of the species of concern on the Viking site did not occur in the RSPB study areas (e.g. merlin, whimbrel, dunlin, Arctic skua and great skua).

For breeding waders (golden plover, snipe, lapwing and curlew) the RSPB study showed a clear and consistent tendency for densities (likelihood of occurrence) to be lower in the immediate vicinity of turbines (0-200m away) compared to further away (200–1000m) and at control sites. On average the density in the 0-200m distance band of the four wader species examined was 35% lower than in the four other distance bands between 200 and 1000m from turbines (golden plover 41%, curlew 32%, snipe 55% and lapwing 14%), and 55% lower than densities at control sites (golden plover 54%, curlew 58%, snipe 73% and lapwing 35%). There was no clear trend for density to increase with distance from turbines across the 200 – 1000m range (four 200m-bands) as might be expected if turbines at these distances also had a displacement effect. However, on average the densities in the 200-1000m distance bands was 30% lower than at control sites, though confidence ranges are generally large. It is unclear if the difference in average densities to control sites genuinely indicates additional displacement (i.e. beyond 200m from turbines) or reflects some unaccounted for bias in the control sites.

The validity of the comparison with the control sites in the RSPB study is worth examining as there are several reasons why the control sites may have been biased towards recording higher densities. Unfortunately there was no temporal comparison element to the RSPB study (i.e. a before *vs.* after study), which could have served to overcome the potential problems of control sites. The control sites were generally much smaller than the windfarm sites and will therefore have inevitably experienced greater problems from edge effects, which tend to slightly inflate density estimates. Turbine locations at windfarms are not necessarily random with respect to bird distributions on the site because bird distributions commonly influence the layout, sometimes greatly so (i.e. areas of high ornithological sensitivity are avoided, such as at Viking), and because turbines are sited to optimise wind yield (e.g. hill tops) whereas birds select favoured habitat which is often different to those of turbine locations or track routes (e.g. wet valleys in the case of many wader species). For all these reasons the control sites in the RSPB study were likely to be biased towards areas with higher densities.

On balance the RSPB study provides some speculative evidence of moderate to strong (depending on species) displacement effects on breeding waders within 200m of turbines, but poor and equivocal evidence of weak displacement effects further away. It is biologically likely that the magnitude of displacement effects decreases with increasing distance from the disturbance source (e.g. turbine or access road).

The evidence for displacement of breeding waders by wind farms from the RSPB study contrasts with strong evidence for a lack of displacement effects, in two species at least, shown by the three recent studies using a more robust study design protocol. Two of these new studies examine the effects on the numbers and distribution of breeding golden plover using Before-After-Control-Impact (BACI) study frameworks, at Farr Wind Farm (Fielding and Haworth 2010) and Beinn Tharsuinn Wind Farm (Douglas, Bellamy and Pearce-Higgins 2010) respectively. In both cases no evidence of displacement effects were found. The third study (Whitfield *et al* 2010) examined evidence for displacement effects on breeding curlew at five wind farm sites, again using, where possible BACI protocols. This study found either no (four windfarms) or very limited and not confirmed (one wind farm) evidence of displacement having occurred. In general these studies showed that both curlew and golden plover numbers and distribution were unaffected by wind farms and provide multiple examples of these species continuing to use and even nest in close proximity (<200m) of turbines and other wind farm infrastructure.

For golden plover, curlew and lapwing the RSPB study provides a rough figure for the magnitude of displacement that might occur. However, the other studies referred to suggest that for curlew and golden plover, at least, the actual magnitude is likely to be considerably smaller and possibly zero, particularly at distances >200m from windfarm infrastructure. Given the lack of any convincing evidence from any study for displacement effects beyond 200m from infrastructure it is assumed for the purposes of assessment that all displacement effects are restricted to <200m. Based on the ball park figures from the RSPB study, and in line with adopting a cautious approach to assessment, where there is uncertainty, it is assumed that 50% of golden plover and curlew territories, and 25% of lapwing territories, within 200m of turbines and 100m of roads will be displaced. There are no data for the other species (whimbrel, dunlin and skua species). These are assumed to have the same sensitivity to disturbance as golden plover and curlew (Table A11.4).

Table A11.4. Assumed magnitude of displacement for breeding waders and skuas.

Species	**Percentage of territories displaced**	
	0-200m from a turbine	**0-100m from a wind farm road**
Dunlin	50%	50%
Golden plover	50%	50%
Lapwing	25%	25%
Whimbrel	50%	50%
Curlew	50%	50%
Arctic skua	50%	50%
Great skua	50%	50%

A11.4.3 Collision

Birds that collide with a wind turbine rotor are likely to be killed or fatally injured. This may in turn affect the maintenance of bird populations. Further studies are required to establish the extent to which birds are able to avoid collision with wind turbines. The indications from studies so far are that collisions are rare events and occur mainly at sites where there are unusual concentrations of birds and turbines, or where the behaviour of the birds concerned leads to high-risk situations (Winkelman 1994, Gill *et al.* 1996, Percival 1998). Examples include migration flyways, other situations where large numbers of birds may be flying at night or in poor visibility (e.g. tidal feeding movements) and areas where the food resource, and therefore level of bird activity, is exceptional.

Collision risk is assumed to be dependent on the amount of flight activity within the proposed development area; specifically, flights through the airspace within which the rotors of the proposed turbines would operate. Observations made during timed VP watches undertaken as part of the pre-construction baseline studies can give useful insight into the level of 'at risk' flight activity. However, in reality, the reliability of these data depends on:

- The ability of observers to detect flying birds;
- The extent to which birds are displaced by the development; and
- The ability of birds to take evasive action to avoid collision with the turbine rotor blades.

Care was taken in the Viking study to ensure, as far as practicable, the accuracy of measures of bird flight activity determined from the baseline surveys. For example, species-specific detection functions and calibration factors were used in estimates of activity per unit time and area (see Appendix A11.2 Estimation of Flight Activity and Appendix A11.3 Estimation of Collision Risk). Where required (wader and skua species) flight activity data were also corrected for spatial bias caused by differences in breeding bird densities between VP visible areas and the vicinity of turbines (explained in detail below).

For collision assessment purposes, it is assumed that there is some displacement of birds (except red-throated diver) away from the immediate vicinity of turbines (within 200m) and that this causes a proportional decrease in at-risk flight activity. The magnitude of this displacement is set to be the same as the magnitude used in the assessment of operational displacement. In all cases (except red-throated diver - see section A11.8) the displacement is assumed to be 50%, the choice of this figure is explained in the preamble to the section on Operational Disturbance. The allowance for displacement in the assessment of flight activity is a change from the previous 2009 ES. This change has been made following discussion with SNH and RSPB, with the aim of making the assessment of collision more biologically realistic. However, this means that the effects of collision and displacement need to be combined to assess the overall effect of operating the development on bird populations.

Finally, in the absence of detailed information, cautious and species-specific measures of turbine avoidance were assumed. The choice of avoidance rate values was discussed with SNH and RSPB. The true avoidance rates are unknown. A 99% avoidance rate has been approved by SNH for geese species and this value is used in the assessment for greylag goose. A 98% avoidance rate is used for all other species. A 98% rate is believed to be unnecessarily conservative and experience from operational wind farms elsewhere indicates that true rates are likely to be higher (Whitfield 2007). Furthermore, it makes no sense biologically for the avoidance rate of geese and eagles to be greater than that of smaller and more agile species (e.g. wader and skua species); on the contrary such species are likely to be more capable of avoiding turbine rotors.

Assessments with an avoidance rate of 95% have not been prepared although all assessments do reflect distance detection correction applied. The removal of distance detection correction would have a bigger magnitude of effect (decreasing the calculated collisions) upon the assessments than any change in avoidance rate to 95% (increasing the calculated collisions). Alternative assessments using 95% avoidance rates would be less biologically sound and in such assessments distance detection correction could not be fairly applied. While not calculated or presented, alternative assessments with a 95% avoidance rate and without distance detection correction would have lower collisions or impacts than the assessments presented.

Collision Risk Modelling

The baseline studies demonstrated conspicuous aerial activity by nine species of high /moderate nature conservation importance (red-throated diver, greylag goose, merlin, golden plover, dunlin, curlew, whimbrel, Arctic skua and great skua) overlapped with the areas where turbines are proposed. The Band collision risk model (CRM; Band *et al.*

2007) was used to determine quantitative estimates of collision risk for these species (see Appendix A11.3: Estimation of Collision Risk). Models were based on recorded flight activity levels and flight behaviour, proposed turbine numbers and specifications, and species' biometrics and flight characteristics. Modelling collision risk under the Band CRM is a two-stage process. Stage 1 estimates the number of birds that fly through the rotor swept disc. Stage 2 predicts the proportion of these birds that would be hit by a rotor blade. Combining both stages produces an estimate of collision fatality in the absence of any avoiding action by birds. In practice, as noted previously, birds do avoid flying through rotating blades, and avoidance rates appear to be very high (e.g. Gill *et al.* 1996). Both stages are prone to bias due the inclusion of relatively simplistic assumptions about bird behaviour.

An appraisal of the Band model (Chamberlain *et al.* 2005, 2006) noted that whilst it appears generally robust there is a strong influence of avoidance rates on estimated collision risk and that information on avoidance rates is scant, confirming Band *et al.*'s conclusions. Chamberlain *et al.* (2005) correctly express concern about this issue, as relatively little is known about avoidance rates, and suggested that until more is known about avoidance, collision risk modelling has limited value. However, they offer no suggestions as to alternative approaches to the problem, perhaps because alternative methods to assess collision risk provide even less comfort than collision risk modelling but are subject to the same or more potential biases (Madders and Whitfield 2006).

Estimating spatial differences in flight activity and collision risk

On mainland Scottish windfarm sites the focus of collision-risk attention is most often on large raptor and geese species. At Viking, the focus is on divers, skuas and waders. The standard approach developed to measure flight activity and inform collision risk (SNH 2005) is not well suited for most of the species (especially wader and skua species) of high or moderate conservation importance found on the Viking site so modified methods were developed to obtain realistic estimates of flight activity from the generic VP data available (estimation of flight fully explained in Appendix A11.2). The data collected on flight activity for all species except red-throated diver, swans and hen harrier does not allow for close examination of the spatial variation in activity across the study area. This is because the detection of flight activity by the species of concern seen from VPs declines with distance; depending on the species, relatively little activity is normally seen beyond 500-1000m away. As a result, the data collected have a high spatial bias, with flight activity much more likely to be observed in the near vicinity of VP locations. However, the VP flight activity data do allow for a reasonable estimate of the average flight activity by each species across the study area as a whole provided the assumption is made that the flight activity recorded from the VPs was representative for the prevailing densities of each species in the vicinity of the VP. This is likely to be a fair assumption because VPs were chosen at random with respects to bird distributions.

As explained above, for most species of interest, the generic flight activity data alone are not adequate to examine in detail how flight activity varies across the study area, yet some measure of spatial variation is required in order to evaluate how the potential collision risk varies between the different turbine locations. The only spatially unbiased data available across the study area to inform this are the results of Moorland Bird Survey (MBS). The MBS results are maps of the nominal territory centres (the average location where birds were seen over successive visits) of breeding birds in the year of survey (Appendix A11.1). The MBS results show that the density of each species varies across the study area. It follows that turbines proposed in locations where a species' breeding density is high pose a greater collision risk than those proposed where breeding densities are lower. It is likely that flight activity for a species, and thereby collision risk, is approximately directly proportional to breeding density. Therefore, breeding density can be used as a surrogate for relative flight activity and provides an unbiased basis to estimate the relative collision risk posed by different turbines. For further detail on estimation of flight activity see Appendix A11.2.

Having established that MBS results can, in principle, give information on spatial variation in relative flight activity to use alongside absolute measures flight activity from generic VPs, the next questions are how the MBS information is best used and over what spatial scale it should be translated into a density value. This requires information on how far from a territory centre the regular flight activity of an average breeding pair extends. This is unknown but can be estimated approximately from median nearest neighbour distances (the distance between two territory centres) (Table 11.5). In theory, if territories were closely packed across a landscape and the use of the airspace was exclusive to the territory holders, then flight activity by a pair would extend out from the territory centre to half the nearest neighbour distance and no further. In practice observations suggests there is some overlap in the airspace used by adjacent pairs, i.e. the air space of a territory is not exclusive. Furthermore, the assessment needs to err on the side of caution and recognise the inherent approximation of the MBS derived nominal territory centre locations. Therefore, it is reasonable to assume that regular flight activity by a pair extends over a greater distance from its nominal territory centre. For the purposes of analysis to inform collision risk it is assumed that it extends twice as far, i.e. to a distance from the nominal centre equal to the median nearest neighbour distance. This distance is to some extent arbitrary and therefore not ideal, however it does provide a reasonable basis for the analysis in the absence of better spatial data on flight activity. Furthermore, it is important to realise that the choice of value for this distance has no influence on determining the amount of flight activity over the windfarm, all it affects is the calculation of breeding bird density (and therefore relative flight activity) in the areas occupied by turbines and, thus how the total risk is divided up between turbines.

Table A11.5. Median nearest neighbour distances of selected species breeding species based on measurement of Moorland Bird Survey results.

Species	Median nearest neighbour distance (m)
Dunlin	341
Golden plover	416
Lapwing	230
Whimbrel	508
Curlew	359 (400m used in analysis)
Arctic skua	817
Great skua	537

For the purposes of assessing the risks posed by turbines the density of breeding pairs of each species in the vicinity of each turbine was calculated within a buffer equal to the median nearest neighbour distance for that species. The breeding density was also calculated in the areas overlooked by the VPs density. Thus if there were no nominal territory centres within the median nearest neighbour distance from a turbine the breeding density was taken to be zero and the relative collision risk estimated to be zero

A11.4.4 Population modelling

Deterministic population models have been developed for red-throated diver, merlin, whimbrel, curlew, golden plover, dunlin, Arctic skua and great skua. A deterministic model is one in which every set of variables is uniquely determined by parameters in the model and by sets of previous states of these variables. Therefore, deterministic models perform the same way for a given set of initial conditions. Appendix A11.4 explains how the models were developed and the assumptions which were made. It is worth emphasising from the outset that the model results do not accurately mimic the likely future trajectory of the populations. Building models that could do this would not be possible due to the various limitations of the input parameters, together with a lack of understanding of density dependence and stochastic factors for the populations of interest. Rather, the models seek to inform by way of comparison of different scenarios and show how the numbers might change in a hypothetical population with no spare carrying capacity, no density dependence and no stochasticity. The reasons for developing models of this type are set out previously in A11.3.5 and followed consultation on the subject with SNH. Of course the absence of all these, together with imperfect estimates of population parameters, means that the models lack realism, but that does not mean they are not helpful or informative. They are useful as they allow the magnitude of predicted adverse effects to be visualised and seen in the context of existing circumstances, and it allows for easy comparison of different scenarios. However, it does mean the model results need to be interpreted with caution and that they should be used alongside other evidence, such as direct studies into the effects of wind farms on birds, in forming a judgement on the likely effects of the proposed windfarm.

The model outcomes are sensitive to the baseline conditions in terms of a population's rate of decline or increase and, if stable, the extent of spare capacity (i.e. excess potential recruits) or density dependence. After discussion with SNH and RSPB it was agreed that deterministic models should be developed for baseline conditions where the production of young surviving to recruitment age exactly equals adult mortality, i.e. the baseline model population is exactly balanced (neither increasing nor declining) and has no spare capacity. Comparing wind farm scenarios that have any adverse effects whatsoever against a baseline situation (no wind farm) with no spare capacity inevitably results in a negative change in the modelled population. In reaching a conclusion about the likely effects of the wind farm the results of the modelling need to be considered alongside information on the actual status of the Shetland population and the likely extent of spare population capacity.

A11.4.5 Decommissioning

Decommissioning will be decided in consultation with the statutory authorities well in advance of the year of decommissioning to ensure that all natural heritage considerations will be taken into account. It should be noted that the management tools available and best practice guidance for decommissioning in 25 years time will likely be different to those now available. It is assumed that disturbance effects due to decommissioning activity would be temporary, reversible and of shorter duration than during the construction period. Apart from the shorter duration it is assumed that the type of effects on birds would be similar to those during construction (and dependent upon the time of year decommissioning works take place).

The assessment of magnitude of decommissioning effects is based around implementation of future unknown best practice procedures that will likely have superseded current best practice. Therefore, the level of certainty of potential decommissioning effects in 25 years is considered low (other than future best practice methods, whatever they may be, will be used). Nevertheless, these effects are judged likely to be **not significant** under the terms of the EIA Regulations, given the potential ability to conduct decommissioning works outwith the bird breeding season. Therefore, no detectable population level effects on the Shetland NHZ are predicted.

A11.5 RESPONSES FROM 2009 CONSULTATION

A wide range of responses were received from consultees in relation to the 2009 ES. Objections received from Statutory Consultees are listed in Table A1.2 of Chapter A1, the ES Addendum Introduction and other comments from Statutory Consultees are listed in Appendix A1.1. Of these responses, Table A11.6 summarises the main issues raised by SNH in relation to the then proposed 150-turbine layout and indicates in the Addendum where that issue is addressed in relation to the now proposed 127-turbine layout.

Table A11.6 Summary of SNH 2009 formal consultation responses in relation to ornithology (based on 2009 150-turbine layout).

Key:- Chapter A11 = Addendum Birds Chapter (for 2010 127-turbine layout), Appendix A11.1 = Bird Technical Report, Appendix A11.2 Estimation of Flight Activity, Appendix A11.3 Estimation of Collision Risk, Appendix A11.4 Deterministic Population Modelling, Appendix A10.9 The Viking Habitat Management Plan.

SNH letter to Scottish Government (24/07/09).	Reference to where issue addressed in Addendum
2.3 Object due to magnitude of predicted impacts on red-throated diver, merlin, golden plover, dunlin, whimbrel, Arctic skua, lapwing, curlew & great skua. From collision risk & displacement info presented, SNH considers Favourable Conservation Status of these species is likely to be adversely affected over the long-term at a regional scale, with red-throated diver & whimbrel likely to be adversely affected at a national scale. This comment is repeated later in letter (under 7.5).	• Magnitude of impacts on 9 ‘priority’ bird species reassessed in Chapter A11 species accounts, against 127-turbine layout. • The specific issue of Favourable Conservation Status is addressed in reassessed Chapter A11 species accounts.

5.4 Object in respect to the Sandwater SSSI (which lists breeding waterfowl as a feature). The potential impacts relate to changes at the A970/B9075 junction, upgrades to the B9075& its bridge & the location of a construction compound. SNH are concerned about potential release of sediment & pollution materials, nutrient enrichment & possible changes to the water flow reaching the SSSI.	• Sandwater SSSI issue specifically addressed in Chapter A4 & A14, & scoped out of further consideration in Chapter A11 as all issues raised by SNH fully addressed.
7.1 Wind farm infrastructure needs incorporating on the bird figures. Not possible to verify many of the calculations made, the judgement/discussion of analysis of significance scant & in some cases incorrect, & with exception of red-throated diver, there is no population modelling presented.	• Windfarm infrastructure added to all relevant Chapter A11figures. • Calculations on significance expanded & rationale fully explained in Chapter A11 & associated Appendices. • Population modelling carried out & fully explained in Chapter A11 & Appendix A11.4.
7.3 Does not agree with the conclusion that impacts will be of low or negligible significance for many of the species assessed. Predicted losses through displacement/collision risk are high enough to be of significant concern for red-throated diver, merlin, golden plover, dunlin, whimbrel, Arctic skua, lapwing, curlew & great skua. Scale of impacts predicted incompatible with maintenance of regional populations for these species. For Arctic skua & whimbrel recent population declines in Shetland mean impacts may impede any future recovery.	• Significance issues fully reassessed in Chapter A11. New residual effects presented for 127-turbine layout.
7.4 For red-throated diver & whimbrel there is a significant risk national population will be adversely affected.	• Issues fully reassessed in Chapter A11.8 & A11.17. New residual effects presented for 127- turbine layout.
7.6 May reconsider objection should concerns outlined in Annex III be addressed in the form of revised ornithological assessment. This should include, where possible, population modelling for each species, as well as more rigorous assessment of the significance of effects. The assessment should be set in the context of the need to maintain the favourable conservation status (FCS) of each species. The additive nature of impacts, & the benefits from the mitigation & compensation proposed should also be taken into account in the assessment.	• Fully revised ornithological assessment provided in Chapter A11, inc population modelling & rigorous assessment of 127-turbine layout effects on FCS in Chapter A11. • Additive nature of impacts considered & addressed, esp. in assessment of collision risk & displacement in Chapter A11 following informal discussions with SNH. • Benefits of mitigation fully explored in Chapter A11 & Appendix A10.9.
7.7 Happy to provide further advice on the content of a revised ornithological assessment. However, SNH's position may not change given the collision & displacement figures presented.	• Offer to provide additional feedback & advice taken up by on-going & informal discussions with specialists for example on population modelling, parameters etc.
1. SNH Annex III – general comments on ornithological sections & methods (24/07/09)	

1.1 ES chapter & Birds Technical Report well written & logically structured, but some crucial omissions & inadequacies.	• Omissions identified are addressed in Chapter A11 & associated appendices.
1.2 Wind farm infrastructure needs adding to bird maps. Disturbance to nesting birds is likely to be a significant challenge for application in relation to the requirements of the Wildlife & Countryside Act (1981) as amended.	• Windfarm infrastructure added to all relevant figures. • Bird Protection Plan (BPP) developed for site work, specifically to address WLC Act issues during breeding season.
1.3 Flight-line maps for more species would assist in assessing potential impacts on local concentrations on birds.	• Provided in Appendix A11.1.
1.4 The two Brown & Shepherd surveys undertaken rather than three (as per guidance) reduces reliability of data. More detail on the derivation of confidence limits would be appropriate.	• Explanation of approach adopted in Appendix A11.1. This provides full details of the survey methods used, comparisons made & survey confidence limits • Breeding bird surveys far exceeded standard guidance & continued for target species for 5 years. This was explained in original 2009 Birds Technical Report. • Natural Research followed the SNH 2006 Guiding Principle of matching field surveys to the information needs of the EIA process. "*There is no requirement of survey effort to be reached or exceeded. Survey requirements should flow from a clear view as to what knowledge is needed for the purpose of assessment. Different sites may require a different suite of methods*". Because of the detailed survey work which was going on in most cases for 5 years (as opposed to the standard 2 year baseline), the breeding cycles of the birds concerned were continually monitored during this period & known in some detail. The 2 B & S visits (to each area) were well timed to be sure of obtaining the maximum numbers of breeding pairs.
1.5-1.6 Extra information welcomed. Clarification of the method by which 'Effective Total Detection Distance' (ETDD) calculated is not described clearly & therefore cannot be verified. Equally, calculations used to correct flight activity records are not detailed in ES.	• Clarification & full explanation of how distance detection & flight activity were taken into consideration in Appendices A11.2 & A11.3.
1.9 Landform associated studies were carried out (for whimbrel & golden plover), but it is not clear the extent this informed final layout.	• Landform studies, based around' hot-spots' for whimbrel, were specifically used to target 127-turbine layout changes to reduce potential effects.

1.10-1.11 Clarification on Vantage Point coverage of actual envelope needed. Detailed reasoning why this is requested is provided & questions the extent of flight activity assessment in the at-risk areas, which impacts on confidence of collision risk calculations. Flight occupancy rates only presented for red-throated diver & merlin & not other species.	• How distance detection & flight activity were taken into consideration is explained in Appendices A11.2 & A11.3. • Vantage point figures are presented.
1.12 Uncertainty in ES reduces confidence of impact assessments, especially for peat disposal. If peat is spread or mounded along access tracks, then direct impacts on habitat loss & land take need revising.	• Fully revised peat disposal text reference discussed in Chapter A14 Soils & Water & provided in appendices A14.4 & A14.6. • Revised land-take assessments on birds provided in Chapter A11.4.2(c)
1.13 Impacts of permanent & temporary guyed meteorological masts from habitat loss & collision risk.	• Discussed in Chapter A11, section A11.4.2
1.14 It is not possible to verify collision risk calculations presented in ES due to unusual way described & lack of presentation of actual calculations.	• Clarification & full explanation of how collision risk was calculated in Appendix A11.3.
1.15-1.16 ES uses 98% avoidance rate for collision risk. This is contrary to SNH guidance (except for greylag goose) 98% rate has been agreed elsewhere for red-throated diver & 99% for hen harrier. SNH uses default 95% avoidance rate for all other species assessed in the ES. Predicted collision mortality risk is increased by a factor of 2.5 if calculated using 95% avoidance.	• Addendum addresses why arbitrary 95% avoidance rate is not used, section A11.4.3. • Chapter A11 uses biologically likely (although still conservative) 98% avoidance rate (or more when necessary). There is no scientific evidence to support use of 95% for any Viking species, as SNH recognise in their next comment.
1.17-1.18 SNH recognises that recent empirical evidence suggests 95% rate is too low & precautionary. SNH currently considering moving default avoidance rate from 95%. Nevertheless, significant doubt remains for several species (curlew, whimbrel, dunlin, lapwing, great skua & Arctic skua), where true avoidance rate is unknown because few large scale wind farms have been proposed or constructed in areas with these species. SNH's opinion is that no matter what avoidance rate is used (95 or 98%), the predicated mortality rates for golden plover, dunlin, Arctic skua, lapwing, curlew & great skua are at such a level as to be detrimental to regional populations & for red-t diver & whimbrel detrimental to regional & national populations.	• The assessment is made as per SNH 2006 & is informed by population models.
2. SNH Annex III – assessment of effects upon breeding bird species, including proposed mitigation (24/07/09)	

2.1 The Evaluation of significance of ES is well structured & logically argued, but categorisation of effects contains several elements that go well beyond what has been agreed between SNH & the industry. Therefore, SNH are unable to agree to provisions of paragraph 11.6.3. ('Methods used to evaluate the magnitude of effects'). The reasons why are expanded upon in comment 2.2 below	• Revised assessment, using clearly defined standard methods to evaluate significance of combined effects on regional/national populations are provided in Chapter A11. Specific issues addressed are summarised below.
2.2 Two major, generic problems with the way judgements on the significance of impacts (point 2.1) have been made: (i) disturbance & collision effects presented solely in terms of regional populations affected. There is little is any discussion of regional or national population status of species & whether predicted effects are likely to have deleterious population consequences at regional &/or national level. Approach used is too simplistic & contrary to SNH guidance, which advocates a population dynamics approach. (ii) for each species, significance of impacts is made in isolation, without consideration of additive impacts. Thus effects of land take, habitat modification, construction disturbance, operational disturbance & collision mortality are assessed individually. Caveat that disturbance & collision mortality act in opposition to one another, but this has not been considered. Operational disturbance & collision mortality effects should, where possible, be analysed together with population models to examine overall effect upon favourable conservation status of the regional & national populations.	• Geographical population elements have been fully incorporated within revised assessment & the population dynamics approach (as per SNH 2006) has been addressed through population modelling & consideration of regional/national populations. • Additive nature of impacts now fully considered in Chapter A11 by considering individually effects of land take, habitat modification, construction disturbance, operational disturbance & collision mortality & then potential disturbance & collision effects are combined through population modelling to examine overall effect upon FCS of regional & national populations.

2.3 SNH do not agree that impacts will be low or negligible significance for many species assessed within ES because: (i) predicted losses through disturbance &/or collision mortality in the ES are high enough to be of significant concern for: red-throated diver, merlin, golden plover, dunlin, whimbrel, Arctic skua, lapwing, curlew & great skua. SNH consider likely impacts to adversely affect national & regional populations of whimbrel & red-throated diver & regional populations of merlin, golden plover, dunlin, curlew, lapwing, Arctic skua & great skua. (ii) the Habitat Management Plan is unlikely to significantly reduce predicted impacts for these species & may actually work against golden plover & whimbrel which prefer relatively closely grazed areas. (iii) For these reasons, there is a strong likelihood that impacts will adversely affect long terms favourable conservation status of: red-throated diver, merlin, golden plover, dunlin, whimbrel, Arctic skua, lapwing, curlew & great skua.	• (i) Revised assessment for all species (inc FCS) provided Chapter A11. • (ii) Fully revised HMP (Appendix A10.9) focuses on significant bird species elements & quantifies likely effects. • Hierarchical approach to mitigation used (first avoid effects, then reduce effects & compensate or offset when effects cannot be avoided).
2.4 By way of comparison, predicted collision mortality figures are much higher than SNH has seen for other wind farms e.g. Lewis wind farm. Examples provided.	• Predicted collision values without distance detection correction are given where relevant for more valid comparison with other projects. • Although using distance detection factors is contrary to standard SNH guidance, it is considered biologically the most realistic scenario (the approach taken throughout assessment) & so is used.
3. SNH Annex III – species likely to be affected at a national & regional scale	

3.1 SNH considers red-throated diver & whimbrel will be adversely affected at a national level.	• Revised assessment provided in Chapter A11.8 & A11.17 • With the revised layout having removed turbines found to be causing the greater proportion of risk of effect, the Addendum presents a case of overall combined effects of windfarm land-take, construction & operation are predicted before mitigation to have long-term adverse effects of negligible magnitude on red-throated diver & it is judged that these effects would be not significant under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ (& hence national level). • With the revised layout having removed turbines found to be causing the greater proportion of risk of effect, the Addendum presents a case of: overall the effects of windfarm construction & operation before mitigation are predicted to have long-term adverse effects of low magnitude on whimbrel & it is judged that these effects would possibly be significant under the terms of the EIA Regulations, i.e. possible detectable population level effects on the Shetland NHZ (& hence national level) & which may hamper any population recovery. Mitigation to offset these possible population level effects is outlined in Appendix A10.9 leading to a residual assessment of no significant effect for whimbrel.
3.2 SNH considers combined effects of disturbance & collision risk mortality would poses a significant risk of causing long-term population decline for red-throated diver in Shetland & may cause a national decline.	• See comments above – not significant effects predicted on the Shetland & national population of red-throated diver.
3.3 SNH considers combined effects of disturbance & collision risk mortality would add substantially to the difficulty in reversing the decline in the national population of whimbrel.	• See comments above – with the revised layout having removed potential turbines found to be causing the greater proportion of risk of effect, the Addendum presents a case of possible significant effects (before mitigation) predicted on the Shetland & national population of whimbrel. These effects to be offset by mitigation as Appendix A10.9 leading to a residual assessment of no significant effects.
4. SNH Annex III – species likely to be affected at a regional scale	

4.1-4.2 SNH considers that merlin, golden plover, dunlin, curlew, lapwing, Arctic skua & great skua will be adversely affected at a regional level & provide a table of disturbance & collision mortality figures these species (using ES 98% figure).	• Revised assessment provided in Chapter A11 on all identified other species inc. Merlin, golden plover, dunlin, curlew, lapwing, Arctic skua & great skua • Overall combined effects of windfarm land-take, construction & operation are predicted to have long-term adverse effects of negligible magnitude on these species & it is judged that these effects would be not significant under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.
4.2 SNH states that there is a significant risk that the impacts of the wind farm will affect the favourable conservation status of the regional populations for: merlin, great skua, Arctic skua & for other species mentioned.	• See comment above. The wind farm is predicted to have long-term adverse effects of negligible magnitude on these species & it is judged that these effects would be not significant under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.6 DEVELOPMENT CHANGES

A11.6.1 Design change – bird considerations

Without pre-empting the revised assessment results it is useful to summarise the main changes and developments that have occurred since the original 2009 ES was produced, in terms of the proposed windfarm layout. For the full description of changes to the project see Chapter A4. The design change process is also discussed in Chapter A1.

The proposed development has been reduced to 127 turbines by deleting 23 turbines from the previous 150-turbine layout. The majority of the deletions reduce risks to priority bird species, in particular, whimbrel, red-throated diver, merlin and to a lesser extent Arctic skua. Turbines deleted on ornithological grounds were selected according to the predicted risk they posed to priority species. This was achieved by ranking disturbance and collision risk to each species on a turbine by turbine basis, thereby allowing the ‘highest risk’ turbines to be identified. This approach allowed turbines with disproportionate risk to be identified and theoretical points of diminishing return to be identified, i.e. where layout amendment would and would not deliver material reductions in predicted impacts. Turbines identified as holding higher levels of risk for several species were prioritised for consideration above turbines holding higher levels of risk for only a single priority species.

The deletions include all eight turbines in the Collafirth quadrant (where the most intact blanket bog was present), nine in the Delting quadrant, five from the Nesting quadrant and one from the Kergord quadrant. A 2.7km stretch of access road has also been deleted from the Kergord quadrant as well as all access roads from Collafirth. The locations of the remaining proposed turbines and access roads are the same apart from a few minor changes. Although the deletion of turbines primarily reduces potential effects on high priority species, it also results in substantial ‘gains’ for other key species of lower priority, for example golden plover, curlew and dunlin. The main benefits to birds stemming from these changes and more sophisticated analyses (compared to the 2009 ES) are as follows:

- Turbines deleted from whimbrel hot spots, reducing potential for collision by 77.8% and overall effects by ~56%;
- Turbines deleted from Arctic skua hot spots, reducing potential for collision by 79.1% and overall effects by ~59%;
- Turbines deleted from one merlin nest territory, reducing potential displacement of nesting merlin by 50%;
- Turbines deleted from vicinity of red-throated diver breeding sites and along flight routes, reducing potential displacement of breeding divers by ~ 50%, and reducing potential for collision to breeding divers by 46 % and non-breeding divers by 18%; and
- Gains to other species, in particular golden plover, curlew, and dunlin approximating to a reduction in and displacement potential for collision and displacement by ~40%.

The species accounts within this addendum provide a summary of the changes in layout in relation to impacts on the main priority bird species.

A11.6.2 Alternatives

The design change process involved several alternative layout designs, which would have resulted in potentially different assessments of impact. For example, a layout with 137 turbines was developed, partially assessed and modelled then shared with SNH and RSPB. The alternative layout designs were predicated upon ensuring adequate development to meet the considerable economic constraints associated with the proposals. This is consistent with PAN 58 (Para 71) which states "*It is accepted that the alternatives available will be constrained by economic and operational reasons. The planning authority should determine the planning application on the merits of the proposal before them and not on the merits of potential alternatives*".

Further alternative layouts and designs changes with regard to ornithology were no longer considered after revised designs (along with the effects of mitigation including the HMP) were predicted to have no significant adverse impacts.

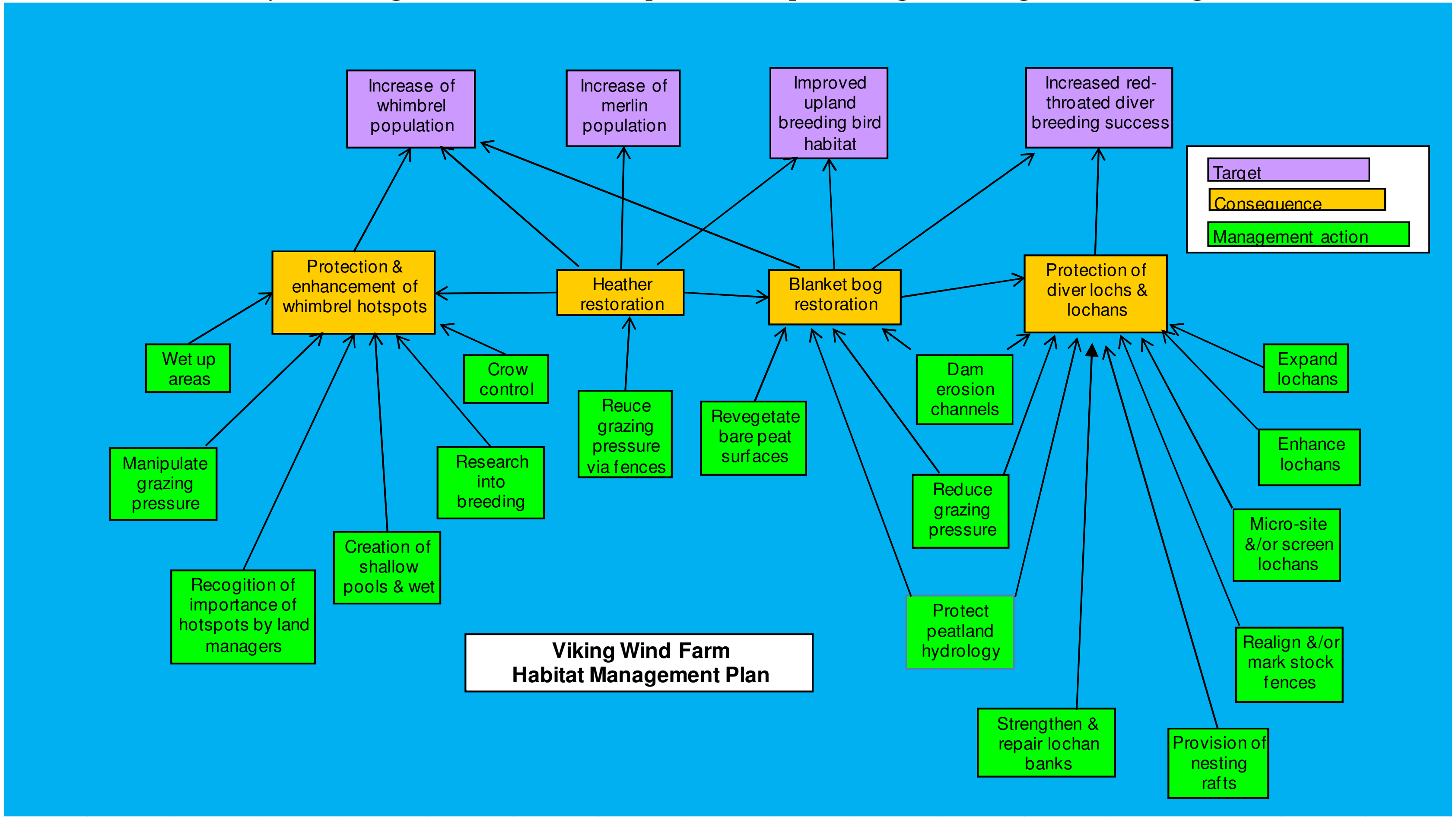
A11.6.3 Revised Habitat Management Plan

The purpose of the revised Viking Habitat Management Plan (Appendix A10.9) is to mitigate (offset and compensate) for likely significant adverse effects (following avoidance and minimisation) of the construction, operation and decommissioning of the Viking Wind Farm. It also reduces further certain non significant effects on birds through enhancement. A secondary objective of the HMP is to alleviate the ecological impacts arising from past and present land management practices with the intention of conserving, enhancing and restoring native habitats within the vicinity of the Viking Wind Farm.

The HMP is primarily concerned with habitat management and ensuring that predicted wind farm impacts are reduced to such an extent that Favourable Conservation Status is not significantly affected for the species and habitats under consideration (as per SNH 2006 guidance). Given the predicted impacts of the Viking Wind Farm 127-turbine layout, the

HMP has four main focuses: red-throated diver, merlin, whimbrel and blanket bog. It also includes a number of measures going beyond the offsetting of predicted windfarm impacts that aim to further the conservation of these three priority bird species and one priority habitat. The implementation of the HMP will draw upon a diverse range of expertise and knowledge and will be overseen by an independent advisory/monitoring group. Illustration A11.1 presents a summary of the targets, actions and consequences of implementing the Viking HMP.

Illustration A11.1. Summary of the targets, actions and consequences of implementing the Viking Habitat Management Plan



A11.7 SCOPE OF SPECIES BEING ASSESSED

The nature conservation importance of species potentially affected by the proposals (i.e. those which regularly use the site) was determined (following SNH 2006) using criteria set out in section A11.3.7. These include nine species of high importance and seven of moderate importance (Table A11.7). Little egret, barnacle goose, marsh harrier, honey buzzard, osprey, hobby, red-footed falcon, gyr falcon, peregrine and short-eared owl visit the area very infrequently and it is highly unlikely that the proposed development could have a material effect on their populations and so they are not considered further.

Table A11.7: Nature Conservation Importance of potentially affected species. Key: EC Birds A1= Birds Directive Annex 1 species, S1 = Wildlife and Countryside Act Schedule 1, Red L = Birds of Conservation Concern red list species, UK BAP = UK Biodiversity Action Plan species, Nat. nationally important, Reg.= regionally important and Loc.=locally important.

Species	Importance	Conservation listing
Red-throated diver (breeding)	High	A1, S1, Nat.
Whooper swan (breeding)	High	A1, S1, Nat.
Whooper swan (non-breeding)	High	A1, S1, Reg.
Greylag goose (breeding)	Moderate	Reg.
Merlin (breeding)	High	A1, S1, Reg.
Hen harrier (non-breeding)	High	A1, S1, Red L, Reg.
Golden plover (breeding)	High	A1, Reg.
Lapwing (breeding)	Low/Moderate	UK BAP, Loc
Dunlin (*schinzii*) (breeding)	Moderate	A1, Red L, Loc.
Black-tailed godwit (breeding)	High	S1, Red L, UK BAP, Nat.
Whimbrel (breeding)	High	S1, Red L, Nat.
Curlew (breeding)	Moderate	UK BAP, Reg
Arctic skua (breeding)	High	Red L, Nat
Great skua (breeding)	High	Loc.
Arctic tern (breeding)	Low/Moderate	A1, Loc.
All other species	Low	

With the exception of hen harrier, effects on these species are likely to be greatest during the breeding period (typically, April – August). Potentially significant effects on wintering birds are possible in the case of whooper swan and hen harrier only.

Based on the abundance and distribution of the breeding species present, the principal sensitive receptors are considered to be: red-throated diver, merlin, golden plover, dunlin, curlew, whimbrel and Arctic skua. Breeding whooper swan and black-tailed godwit were uncommon and occurred only peripherally to the proposed infrastructure and so are not considered as principal receptors. Greylag goose, lapwing, great skua and Arctic tern are breeding species of secondary concern.

Although the numbers of great skua potentially affected by the proposed development classifies as low nature conservation importance, this species is nevertheless treated as a species of high conservation importance on account of the global importance of the Shetland population.

Lapwing is not considered to be a species of high priority in the Viking context because it classifies as low/medium nature conservation importance, has small numbers only in the close vicinity of proposed turbines (7 pairs within 200m) and new evidence that this species is relatively tolerant of operational windfarms (Pearce-Higgins *et al.* 2009). It is assessed anyway because lapwing have been declining nationally and this species was also specifically mentioned by consultees.

Having determined the main regularly occurring ornithological receptors within the zone of effect, Table A11.8 identifies the geographical population estimates for them at i) Viking study area, ii) Shetland = regional, iii) Scottish, iv) UK and v) international levels, along with the most up to date reference.

Table A11.8. Geographical population estimates (pairs) for selected species occurring on the proposed development site. The Viking Study Area is the area covered by baseline surveys. For all species this covered a considerably larger area than that potentially affected by the proposed development.

Number of breeding pairs	Viking Study Area (local)	Shetland (regional)	Scotland	UK/Britain (national)	Europe (international)
Red-throated diver	48	407[1]	935-1,500[1]	935-1,500 (1,255) [1]	32,000-92,000
Whooper swan	1	11-16[4]	11-16[2]	11-16[2]	>65,000
Merlin	10	ca 20[2]	800[1]	1,100-1,500[1]	31,000-49,000
Whimbrel	64	ca 300[3]	ca 310[3]	ca 310[3]	160,000-360,000
Curlew	456	2,300-3975[2]	58,800[1]	99,500-125,000[1]	220,000-360,000
Golden plover	212	1,450[2]	15,000[1]	22,600[1]	460,000-740,000
Dunlin	100	1,700[2]	8,000-10,000[1]	9,150-9,900[1]	300,000-570,000
Lapwing	193	1,740 (1,650-3,839)[2]	71,500-105,600[1]	137,000-174,000	1,7000,000-2,800,000
Black-tailed godwit	1-2	3-4[4]	7-8[2]	59-66[2]	99,000-140,000
Arctic skua	50	1,128[2]	2,100 AOT	2136[1]	40,000-140,000
Great skua	104	6,874[2]	9,650 AOT	9,634[1]	16,000
References	NR Ltd surveys, ES chapter (Appendix A11.1)	[1]Smith *et al* 2006. [2]Pennington *et al* 2004, [3] NRP unpublished [4]Holling *et al.* 2008	[1]The Birds of Scotland, SOC 2007 [2]Holling *et al.* 2008, [3] NRP unpublished	[1]Baker *et al* 2006, [2]Holling *et al.* 2008, [3] NRP unpublished	Birds in Europe, Birdlife 2004

The behavioural sensitivity of the remaining species listed in the baseline description was determined using criteria set out in Table A11.1. Four regularly occurring species were judged to have high sensitivity, eight to have moderate sensitivity and one to have low sensitivity (Table A11.9).

Table A11.9: Behavioural Sensitivity of key species at proposed Viking Wind Farm. The choice of assumed distance thresholds and hence sensitivity for disturbance was based on information in Whitfield *et al* 2008 and experience of the response of birds gained during baseline survey work.

Species	Nature of sensitivity	Sensitivity level
Red-throated diver	Birds potentially vulnerable to collision with turbines when making flights between freshwater lochs and the sea (all birds), and between/around freshwater lochs (non-breeding birds) during breeding season. Breeding birds sensitive to human activity, visual disturbance and sudden noise events over large distances (~400m). However, some individuals appear to tolerate moderate levels of disturbance in some situations.	High
Whooper swan	Birds potentially vulnerable to collision with turbines when migrating or making short distance movements between feeding sites. Breeding birds sensitive to human activity, visual disturbance and sudden noise events over moderate distances (~250m).	
Merlin	Breeding birds potentially vulnerable to collision with turbines when displaying and mobbing avian intruders. Breeding birds sensitive to human activity, visual disturbance and sudden noise events over large distances (~500m). However, some individuals appear to tolerate moderate levels of disturbance in some situations.	
Hen harrier	Roosting birds potentially vulnerable to collision with turbines when gathering / interacting prior to roosting. Roosting birds sensitive to human activity, visual disturbance and sudden noise events over large distances (~500m).	
Golden plover Lapwing Dunlin Black-tailed godwit Curlew Whimbrel Arctic tern Arctic skua Great skua	Birds potentially vulnerable to collision with turbines when displaying, mobbing avian intruders, commuting between breeding and feeding areas and migrating. Breeding birds sensitive to human activity, visual disturbance and sudden noise events over moderate distances (~250 m).	Moderate

A11.8 RED-THROATED DIVER

A11.8.1 Background

The current Scottish breeding population is estimated at 935-1,500 pairs, and these are all the birds breeding in the UK (Smith *et al.* 2006). Red-throated diver is legally protected under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) and is a Birds Directive Annex 1 species. Its European conservation status has recently been evaluated as *Depleted*, with population estimates suggesting 32,000-92,000 pairs, which equates to 5-24% of the global population (Birdlife International 2004).

Red-throated divers are fairly common breeding summer visitors and scarce passage migrants and winter visitors to Shetland (Pennington *et al.* 2004). The most recent full census in 2006 (corrected for undetected pairs) estimated 407 pairs in Shetland, representing 31% of the 2006 UK total (Dillon *et al.* 2009, Smith *et al.* 2009). Red-throated divers breed on moorland lochs and lochans throughout Shetland.

A11.8.2 Assumed conservation status

Red-throated divers have been monitored in several study areas over the past few decades, so there is a good understanding of breeding status, productivity and site occupancy (Pennington *et al.* 2004). A repeat survey of breeding pairs undertaken in 2006 concluded that despite a small apparent decline of <4% since 1994, numbers in Shetland should be regarded as stable (Smith *et al.* 2009). Numbers in Central Mainland have increased since the 2006 survey by around 10% (Appendix A11.1). Therefore, on balance, the weight of recent evidence suggests that the Shetland red-throated diver population currently has a Favourable Conservation Status.

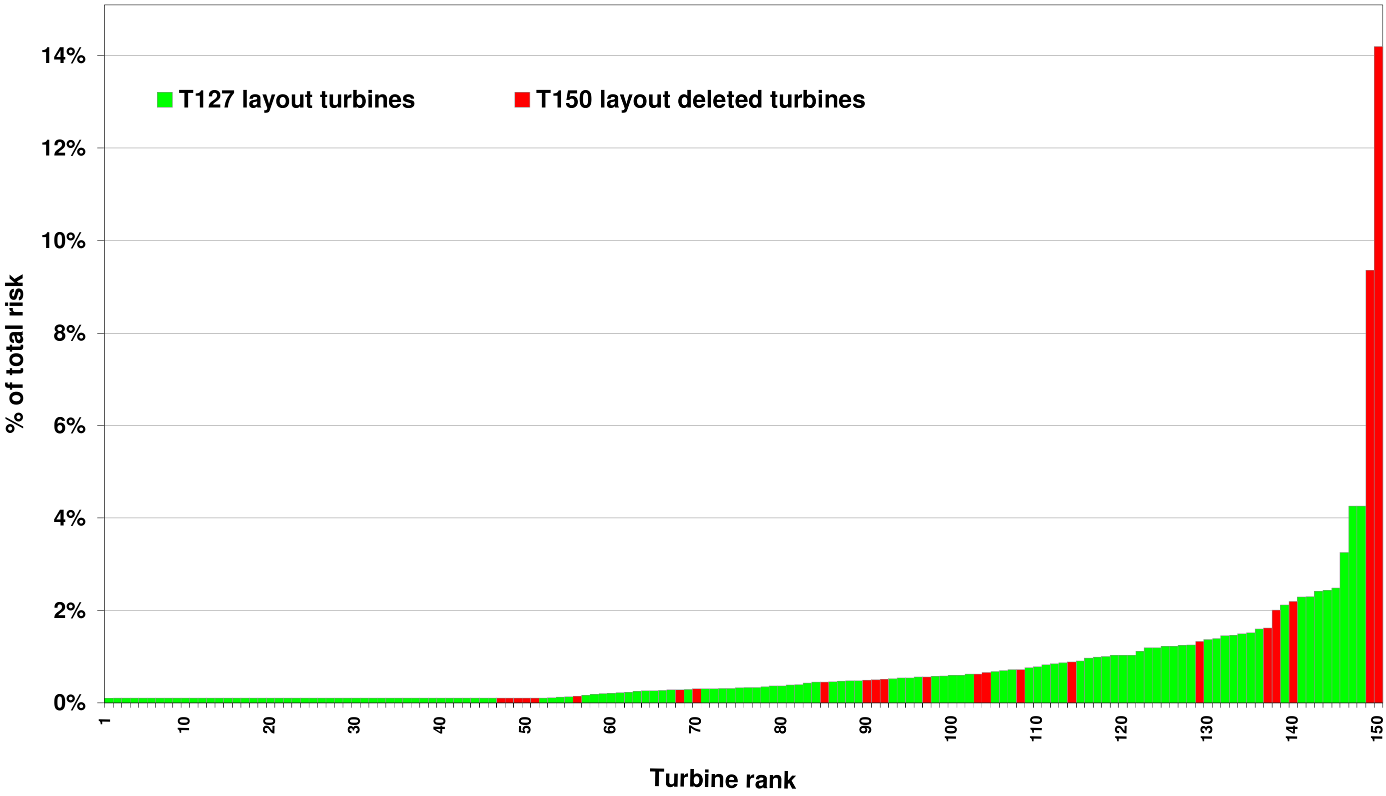
A11.8.3 Red-throated diver influences on design change

The 2009 ES layout largely avoided effects on breeding red-throated divers through careful design; infrastructure was kept away from lochs used by divers and their regular flight routes. However, red-throated divers are widespread throughout the Viking study area. As a consequence, it was not possible to design a windfarm of this scale in Central Mainland without some predicted effects on divers. The predicted effects of construction and operation of the wind farm arising from the now proposed layout are less than those previously predicted in the 2009 ES. This has been achieved by following the IEEM (2006) hierarchical approach to mitigation i.e. avoidance and reduction of effects prior to considering compensatory measures where effects are unavoidable.

Potential changes to the layout to benefit divers were informed by the flight activity map (Fig A11.6), the distribution of breeding sites (Fig confidential A11.1) and population modelling. In prioritising potential layout changes to benefit divers several aspects covering displacement and collision risk have been considered and discussed with SNH and RSPB during consultations.

For example, those turbines which pose a disproportionately high collision risk to divers and where removal would make a tangible impact in terms of risk reduction and significance were identified. Prioritisation was given to breeding birds as opposed to non-breeders.

Illustration A11.2. Turbine risk histogram for breeding red-throated diver



The predicted adverse affects caused by operational disturbance from the 2010 127-turbine layout are approximately one quarter of the adverse effects previously predicted for the 2009 ES layout i.e. a reduction of impacts by approximately three-quarters. This improvement was mainly achieved by the deletion of seven turbines considered to pose a particularly high displacement risk to divers at six breeding lochans and the beneficial effects of other turbine removals. Details of the full prioritisation process are provided in the Appendix A11.1 and Chapter A1.

A11.8.4 Baseline red-throated diver data

(a) Surveys undertaken

From the outset it was appreciated that the species was likely to be of particular concern in relation to the proposed windfarm. For this reason, additional studies on red-throated diver were undertaken and these went well beyond the level of detail recommended by SNH guidance (SNH 2005; 2006). Consequently, the quality of the information available on this species is greater than for any other species covered by the baseline survey programme. In particular, all breeding and non-breeding sites have been identified and their relative importance measured, regular flight routes determined through generic and focal VP watches and the key habitat features that make water bodies attractive to breeding birds determined. Details of these studies are provided in Appendix A11.1 and the results are summarised in the following sections.

(b) **Results**

Breeding sites

Allowing for inter-annual variation, approximately 21 pairs of red-throated diver breed within 1km of the proposed turbines, tracks and other features of site infrastructure[1] (there were 30 under the previously proposed 2009 ES layout) (Confidential Fig. 11.1). This represents 1.6% of the UK breeding population and 4.9% of the Shetland breeding population. These 21 pairs used 28 freshwater lochs and lochans for breeding (nesting and chick-rearing) during 2003 to 2010. On the basis of site occupancy and breeding performance over this period, sites were classified in terms of their relative importance (Appendix A11.1). The 28 sites are located across the Nesting, Kergord and Delting quadrants:

	Breeding loch importance				
Quadrant	**Low**	**Medium**	**High**	**V High**	**Total**
Delting	5	1	2	0	8
Kergord	2	1	1	2	6
Nesting (N)	1	3	0	2	6
Nesting (S)	4	2	2	0	8
Total	12	7	5	4	28

As a result of design changes to reduce disturbance effects only one breeding site is located <400m from proposed turbines. At nine sites nests were closer than 500m from proposed turbines (there were 12 such sites under the previously 2009 ES). The number and importance of these sites was as follows (loch code and distance to turbine is given parentheses): two Very High importance (BA 495m, BD 440m), one High importance (AX 415m), two Medium importance (BB 400m, DU 342m) and the four Low importance (AY 490m, BX 430m, HM 444m and LBE 485m) (Confidential Fig. A11.1; also, refer to Appendix A11.1: Confidential Annex Map C3).

Flight activity

Breeding red-throated divers flew to coastal waters to feed, generally using the most direct route possible. Breeding pairs were estimated to make on average 13.3 flights per day (outbound/inbound foraging flights and other flights) during the incubation period, rising to 24.4 flights per day during the chick rearing period (refer to Appendix A11.1: Table 50).

The development site and immediate surrounding area also supports a high population of non-breeding red-throated divers, estimated to comprise approximately one third of the adult-plumage individuals present in spring and summer. Seven freshwater lochs within

[1] Including temporary features such as construction compounds and borrow pits.

1km of the development, additional to those used for breeding, were identified as important gathering sites for non-breeding divers (Confidential Fig. A11.2). In addition to feeding flights between gathering lochs and coastal waters, non-breeding birds frequently visited breeding lochs, typically circling repeatedly around the loch. In the immediate vicinity (<500m) of breeding lochs annual flight activity levels by non-breeding birds were high, typically exceeding those of breeding birds.

Overall, flying red-throated divers were recorded 573 times during 1424 hours of generic vantage point (VP) observation [1], and a further 1899 times during 1560 hours of observation focussed on freshwater lochs (945 hours overlooking breeding lochs; 615 hours overlooking non-breeding lochs and other selected locations). Flight intensity varied across the site, being most concentrated in areas with multiple breeding lochs (Fig. 11.3). Data from generic VP watches indicated that approximately 67% of flight activity was 30m to 150m above the ground, corresponding to the Rotor Swept Height (RSH) of the proposed turbines (refer to Appendix A11.1: Table 26).

(c) **Do nothing scenario**

As previously described, the Shetland red-throated diver population is well studied and has been regularly monitored for many years. The 40% decline between 1983 and 1994 was attributed to changes in food availability, when abundant sandeels supplies available in the mid-late 1980s collapsed (Pennington *et al.* 2004).

Evidence collected during Viking baseline studies shows that peat erosion is having a serious and ongoing negative effect on the number and quality of lochans suitable for breeding red-throated divers in Central Mainland. Indeed, this issue is probably the most important threat to the long-term future of breeding divers in the area. Although there is some uncertainty regarding the rate of erosion, and therefore the timescale over which lochan suitability will change, there is good reason to believe that there will be significant losses or deterioration of lochans over the next 25 years. For example, the monitoring of divers on Central Mainland since 2003 has revealed that over this period erosion has led to two breeding lochans becoming unsuitable (and no longer used) and noticeable deterioration at several others. Therefore, if left unchecked peatland erosion is expected to lead to a decline in the numbers of breeding divers in Central Mainland over the life span of the wind farm.

[1] Note that the number of hours of generic VP observation quoted for red-throated diver is greater than for other species in line with the SNH guidance. This is because data for a larger area (and therefore greater number of VPs) were used in the case of divers. For all other species only data for VPs overlooking the development site were included. It is recognised that the summary statistics for diver flight activity given in the Baseline Description will differ slightly from values that would have been obtained employing a more restricted area, covering just the development site. However, this difference is unimportant since, unlike almost all of the other potentially affected species present, divers do not forage in flight and therefore the only relevance of flight activity metrics is to inform the assessment of collision risk. In the current evaluation, diver collision risk was determined from measures of flight activity within the development site at a resolution of 200 x 200m, in preference to using conventional (and less precise) values representing the mean flight activity recorded from each VP.

A11.8.5 Red-throated diver habitat loss/modification

(a) Habitat requirements

The breeding habitat requirements of breeding red-throated divers are well studied and were investigated thoroughly within the Viking study area. Details of their habitat requirements are fully described in Appendix A11.1. In brief, red-throated divers typically breed on small freshwater bodies, typically on blanket bog moors, and forage for fish in coastal waters up to approximately 10km away. In order to be suitable for breeding, water bodies need to have certain characteristics including suitable shorelines for nesting, sufficient depth for diving, open water for taking off and landing and a freedom from disturbance. Non-breeding immature divers, which form a substantial part of the Shetland population present in summer, predominantly use the larger freshwater lochs for gathering and socialising. They also feed in coastal marine waters.

(b) Land take effects

The impact of land-take effects (direct habitat loss and indirect habitat modification) is not predicted to change the physical characteristics of any lochs and lochans used by red-throated divers. There is a small theoretical indirect risk of increased sediment loads in running waters (refer to Chapter A14: Soil and Water), which could result in additional sediment being deposited in the larger lochs, including some used by non-breeding divers. However, this is unlikely to materially affect their use by divers (and most divers nest on isolated lochans without burns anyway), so the likely magnitude of any adverse land-take effect would be negligible and it is judged these effects would likely be **not significant** in terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

No significant beneficial effects are predicted to result from habitat modification caused by activities associated with windfarm construction. The beneficial effects of habitat modification undertaken as part of the HMP are discussed in Appendix A10.9.

Table A11.10: Characterising the likely magnitude of habitat modification on red-throated divers.

Parameter	Assessment
Extent	Potential sediment release to diver lochs. Most diver lochans do not have inflow burns
Effect	Direct
Duration	Short one-off event (e.g. 1-2 days)
Reversibility	Non reversible
Frequency	Very rare accidental occurrence
Probability	Very low, given implementation of pollution prevention plan & lack of inflow burns to most diver lochans

A11.8.6 Red-throated diver disturbance impacts

(a) Construction disturbance

Through instigation of the BPP (Section 11.4.2.(b)) measures would be undertaken to avoid disturbance of nesting red-throated divers present at the time of construction works (see Pre-commencement Surveys). Therefore, it is assumed that no breeding divers would be directly affected by construction activities. Disturbance at construction sites would potentially displace breeding divers from energetically efficient flyways to and from feeding areas. However, there is no evidence for such effects occurring, as evidenced by divers commonly passing directly over observers engaged in baseline surveys, and traffic using Shetland's trunk roads. Similarly, a pair that bred within 350m of Scatsta airport was observed to make regular flights to and from the breeding loch, regardless of human and aircraft activity (D. B. Jackson, *pers. obs.*).

Construction works could potentially temporarily displace red-throated divers from non-breeding lochs. Observations made during baseline surveys of the behaviour of non-breeding birds indicates that they are generally highly tolerant of road traffic and people, at least to within 100m of loch shores (they are generally much more tolerant to disturbance than breeding divers). For the purposes of this assessment it is assumed that red-throated divers would be temporarily displaced from non-breeding lochs within 500m of construction work sites. This is likely to be highly cautious. Baseline surveys indicate that divers regularly use nine non-breeding lochs within the assumed construction displacement zone, all in the Nesting and Kergord quadrants (Confidential Fig. A11.2). Construction works would proceed in a phased manner across the development site and, therefore, it is unlikely that many non-breeding lochs within the assumed zone would be subject to disturbance in more than one year. Vehicular movements along the constructed tracks are likely to have few if any adverse effects on non-breeding divers due to 'soft' measures to minimise disturbance in sensitive zones (see Project Assumptions and Operational Constraints – 11.4.2.(b)). In view of the above it is assumed that up to four non-breeding lochs would be affected in any one year. This is greater than a simple proportionate calculation (number of lochs divided by number of years) would suggest and is therefore likely to overestimate the actual number affected. Continuing on a cautious basis, it is assumed that affected non-breeding lochs would not be used by divers during the year of disturbance. No longer-term consequences are anticipated. The numbers of non-breeding divers using a non-breeding loch varies greatly day to day and so it is assumed that individuals must wander relatively widely and use multiple sites. Several alternative large lochs are located in the Nesting and Kergord quadrants, more than 500m from the proposed construction sites. Therefore, the temporary loss of the use of up to four lochs due to construction works is unlikely to have a material effect on the non-breeding diver population.

Table A11.11. Characterising the likely magnitude of construction disturbance on red-throated divers.

Parameter	Assessment
Extent	None on breeding birds if BPP measures adhered to
Effect	Direct
Duration	Short-term

Reversibility	Reversible & able to mitigate if disturbance occurs
Frequency	None on breeding birds if BPP measures adhered to
Probability	Unlikely due to BPP

Summarising, it is considered that disturbance from construction works would have short-term adverse effects of negligible magnitude on red-throated diver. Although red-throated diver is a species of high nature conservation importance (see Table 11.7) it is judged that these effects would likely be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

(b) **Operational disturbance**

Red-throated divers are judged to have high sensitivity to disturbance (Table 11.9) and therefore operation of the development would potentially displace some divers from breeding lochs and lochans, possibly resulting in a reduced and less productive site population (see Impact prediction techniques approach A11.4.2). However, observations on Shetland and Orkney (Natural Research, unpublished data) strongly suggest that breeding divers can tolerate vehicular traffic, and most types of human activity, to within a few hundred metres of their nests. Nevertheless, it is not known if all individuals are able to tolerate such disturbance, what role the breeding site (in particular loch size) might play in this process, or how long it takes birds to habituate. At Burgar Hill Windfarm, Orkney, red-throated divers regularly breed, without any obvious behavioural anomalies, on a small loch situated within 150m of two wind turbines and within 20m of a public viewing station. However, the birds respond anxiously if people closely approach (<30m) the loch shore. The apparently relaxed behaviour towards humans shown by the Burgar Hill birds contrasts markedly with the wary responses exhibited by most divers breeding on the Viking site, where people are rare visitors.

Diver Disturbance Vulnerability Index. To inform the reduction of the potential adverse disturbance effects on divers of the 2009 ES layout and to assess the potential effects of the revised layout, diver breeding lochans within 500m of proposed windfarm infrastructure were systematically examined for potential vulnerability to ground-based and rotor disturbance. This involved calculating in a systematic way a Disturbance Vulnerability Index (DVI) that quantified the magnitude of potential disturbances from human activity along access roads and around turbine bases, and from turbine rotors. These were considered to be the three likely yet distinct sources of potential disturbance that may occur at an operational windfarm. Separation distances (nest site to infrastructure) greater than 500m were considered implausible on the basis of direct experience of the responses of birds on the development site and the findings of a study on tolerances by birds to human disturbance (Whitfield, Ruddock and Bullman 2008). Direct experience indicated that only exceptionally did red-throated divers show any detectable response to the approach of a walking surveyor at distances above 400m away. The median distance derived from expert opinion that breeding red-throated divers are reported as showing alert behaviour towards a source of disturbance was 225m (Whitfield, Ruddock and Bullman 2008). Therefore the use of a 500m threshold for the DVI is likely to be highly cautious, perhaps unnecessarily so.

DVI values were calculated for each of the three potential sources and then summed to give a Total DVI.

Total DVI = DVI for access roads + DVI for turbine base + DVI for turbine rotors.

The severity of potential disturbance associated with access roads, turbine bases and turbine rotors was assumed to be correlated with proximity (distance from lochan), potential visibility from a lochan and lochan size (access roads and turbine bases only). These assumptions are based on experience of how breeding divers react to disturbance gained during baseline surveys. For access roads and turbine bases potential visibility (visible =1, not visible = 0) was determined for 2m elevation above access road/base level. This was undertaken in a GIS environment using Topos software (43D Ltd) and an Ordnance Survey Profile DTM (10m post spacing) elevation model. Two metres above ground level was chosen as it approximates to the maximum height above ground level of pedestrians and maintenance vehicles.

Divers nesting on small lochans (<50m long) are more susceptible to disturbance from ground-based human activity than those at larger lochs. Birds are more likely to fly off and temporarily leave small lochans in response to being disturbed and less likely to 'sit tight' than birds at larger lochans. The DVI was weighted for lochan size according to three size categories: small (<50m maximum length) weighting score = 3; medium, (50-250m) weighting score = 2; and large (>250m) weighting score = 1. Although somewhat arbitrary this weighting system is designed to reflect the differences, albeit not quantified, in the average responses of birds observed during baseline fieldwork. Distances in metres between infrastructure and lochans were measured to the nearest shore, or in the case of larger sites (>100m) to the traditional nest site.

The DVI calculations were as follows:

- DVI for access roads = (500 – closest distance) x visibility x lochan size weighting.
- DVI for turbine bases = (500 – distance from base) x visibility x lochan size weighting.
- DVI for turbine rotors = (500 – distance from base) x visibility.

The use of DVI values enabled the potential vulnerability of sites to disturbance to be assessed in a standard way and summarised as a single measure, the benefits of possible layout changes to be evaluated and the need for mitigation measures to be identified. Using the DVI values as a measure of the potential for disturbance is a more sophisticated and realistic system than the simple threshold distance method (i.e. within 500m from turbines and 250m from access roads) used in 2009 ES assessment. Nevertheless, as stated earlier, there is a paucity of information on how breeding divers respond to windfarm activities and so inevitably there has to be an element of judgement based on experience. Of particular relevance is the experience during baseline studies and observations of the responses of breeding divers to windfarms in Orkney (Burgar Hill - Jackson *et al.*, submitted) and Norway (Halley and Hopshauh 2007).

For the purposes of assessment the Total DVI value for a lochan was assumed to affect occupancy and breeding success as shown in Table 11.12. The use of Total DVI values and the assessment thresholds in Table 11.13 are designed to more accurately reflect the likely response by divers to disturbance than the system used in the 2009 ES yet still be highly cautious when viewed alongside other evidence. In view of the limited data available on the tolerance and response by divers to disturbance, the assessment criteria are inevitably somewhat arbitrary and rely on expert judgement.

Table 11.12. Assumed changes in site occupancy and breeding success by red-throated divers at breeding lochs in response different magnitudes of potential disturbance estimated by Total DVI values.

Total DVI value	Assumed reduction in occupancy	Assumed reduction in breeding success
<500	None	25%
500 - <1000	None	50%
1000 - 1500	50%	50%
>1500	100%	100%

Table 11.13: Red-throated diver breeding lochans potentially affected by operational disturbance.

Loch code	Breeding importance category	Closest visible access road (m)	Closest turbine (m)	Turbine base visible	Lochan size	Total DVI value
AX	High	>500	415	No	Medium	170
AY	Low	>500	490	No	Medium	10
BA	V. High	495	495	Yes	Medium	30
BB	Medium	400	400	Yes	Medium	600
BD	V. High	>500	440	No	Medium	120
BX	Low	>500	430	No	Small	210
DU	Medium	342	342	No	Small	1088
HM	Low	245	444	Yes	Small	1101
LBE	Low	485	485	Yes	Large	45

Assessment. Using the assessment process described above the Total DVI value for two breeding lochans (DU and HM, rated as having Medium and Low importance respectively) is judged sufficiently high to result in a likely displacement risk to breeding divers. It is considered that for the purposes of assessment these lochans have a 50% likelihood of experiencing operational disturbance of such a level as to cause them not to be occupied when they otherwise would be. Seven other lochans have total DVI values that, for the purposes of assessment, are considered sufficiently high to result in a potential reduction in breeding performance. At one lochan (BB) the potential for disturbance is judged likely to lead on average to a reduction by 50% in productivity and at six lochans (AX, AY, BX, BA, BX and LBE) to a reduction by 25% in productivity.

These potentially affected lochans vary in their importance in terms of baseline occupancy rates and productivity output and this has to be taken into account in determining the potential effects of operational disturbance on the regional (Shetland) population. After taking baseline occupancy rate into consideration, a 50% reduction in the occupancy of lochans DU and HM (the only breeding lochans predicted to be so affected) is equivalent to the long-term loss of approximately 0.60 of a breeding pair, representing <0.15% of the regional population. To be cautious, it is assumed that displaced birds would not re-establish and breed on alternative (and equally suitable) lochans elsewhere.

After taking baseline occupancy into consideration the predicted reduction in productivity of the nine affected lochans is equivalent to the loss of production from 2.2 breeding pairs per annum, or approximately 1.6 fewer young reared per year (Table 11.14). This represents approximately 0.53% of the average annual regional production.[1]

The predicted adverse affects caused by operational disturbance from the 127-turbine layout are approximately one quarter of the adverse effects previously predicted for the 2009 ES layout. This improvement was mainly achieved by the deletion of seven turbines (D3, D8, D20, C35, C36, C37 and N146) considered to pose a particularly high displacement risk to divers at six lochans.

In view of the uncertainty discussed above it has been considered prudent to make very cautious assumptions in relation to the effect of operational disturbance. It is probable that, as a result of those assumptions, the actual effect has been overestimated. However, even using those conservative assumptions, the results of the assessment are such that the effect on red-throated diver is not considered to be a likely significant effect.

It is possible that divers would be displaced from the most efficient flyways between breeding and feeding areas. However, observations at Burgar Hill indicate that, whilst divers exhibit avoidance towards individual turbines, they continue to fly between turbines (Jackson *et al*, submitted). Although the proposed development comprises many more turbines than are present at Burgar Hill, the spacing between the turbines is similar. Furthermore, the maintenance of unobstructed flyways to and from diver breeding lochs was an important constraint in the design of the development, in order to reduce collision likelihood. In view of the above, it seems reasonable to assume that the turbines would likely not materially impede diver movements.

Operation of the development would also potentially displace divers from non-breeding lochs. Experience gained during baseline surveys showed that non-breeding divers are much more tolerant of human disturbance than breeding birds. Furthermore, the sites they use to gather on are mostly sizeable lochs and so they normally have opportunities to move away from a disturbance should they choose. For the purposes of this assessment it is assumed that divers would be displaced from non-breeding lochs within 250m of operating turbines and from areas within 100m of tracks. It was further assumed that displaced divers would not move to alternative (and equally suitable) non-breeding lochs. Baseline surveys indicate that no non-breeding lochs are within 100m of windfarm access roads (though several are within 100m of public highways). The assumed 250m-operational displacement zone around turbines slightly overlaps (<10% of the area) two non-breeding lochs (Truggles Water and Maa Water) regularly used by divers (refer to Confidential Fig.

[1] Assuming that productivity within the Viking Diver Study Area is representative of Shetland as a whole.

A11.2). Without a greater understanding of the importance of non-breeding lochs to red-throated diver ecology it is not possible to evaluate the likely consequence of this effect with any certainty. However, no direct effects on productivity or survival are likely and it seems reasonable to assume that any indirect effects would be subtle. On this basis, and in view of the very small number of potentially affected lochs, it is considered that operational disturbance of non-breeding lochs is unlikely to have a material adverse effect on red-throated divers.

Table A11.14. Characterising the likely magnitude of operational disturbance on red-throated diver.

Parameter	Assessment
Extent	Displacement of up to 2.2 pairs (loss of 1.6 young) p.a. Habituation may reduce effect with time.
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning (if assume pairs do not move elsewhere).
Frequency	On-going effect during breeding season
Probability	Possible

Summarising, it is considered that disturbance due to operation of the development would have long-term adverse effects of borderline negligible/low magnitude on red-throated diver. However, in recognition of the importance of this species and taking a cautious and conservative approach for the purposes of assessment the magnitude is classed as low. Although red-throated diver is a species of high nature conservation importance it is judged that these effects are likely to be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.8.7 Red-throated diver collision impacts

Red-throated divers are potentially vulnerable to collision with turbines when making flights between freshwater lochs and the sea, moving between freshwater lochs, and circling around freshwater lochs. The latter two behaviours are especially relevant to non-breeding birds. Studies at Burgar Hill Windfarm, Orkney, demonstrated that red-throated divers can exhibit a high level of avoidance (98% or more) of collision with turbines located between breeding and feeding sites (Jackson *et al.* submitted). Two of the Burgar Hill turbines are located less than 300m from the loch centre, yet, within a four year study period at least, there was no evidence of collisions by breeding or non-breeding birds. However, the studies at Burgar Hill were conducted more than 20 years after the windfarm was built and divers may have become accustomed the presence of the turbines. It is not known whether divers without previous experience of turbines would show more or less avoidance.

CRM models for red-throated diver were constructed for each and every turbine, using measures of flight activity calculated for an array of 200x200m grid cells covering the development site and wider area (Appendix A11.3). The size of cell was chosen as a compromise between the conflicting requirements to maximise spatial resolution and minimise potential errors in flight recording accuracy due to the effects of parallax. Within each grid cell, separate flight activity values (expressed as kilometres flown per year) were available for breeding and non-breeding divers. In order to make the data as relevant as possible, values were determined for new 200x200m cells centred on each proposed turbine. This was done by calculating a mean value for each 'turbine cell', weighted according to the contribution of each original cell overlapped.

Flight activity values for each turbine cell were then adjusted to represent the amount of time spent at RSH using flight height data (i.e. values for total flying time were multiplied by 67.1%, refer to Appendix A11.1: Table 26).[1]

Turbines were assumed to be inoperative for 15% of the time due to wind speed and maintenance activities. Red-throated diver biometrics were averaged across the sexes, and a flight speed of 17.5m/s was used (mean of values given in Provan and Whitfield 2006). Based on the findings of post-construction studies at Burgar Hill, Orkney, an avoidance rate of 98% was used in red-throated diver CRM, a figure that is likely to be highly cautious.

The Stage 2 (Band) calculation for the probability of collision gave a value of 6.8% for the proposed turbines (see Appendix A11.3). These results applied across all runs of the red-throated diver CRM. The combined Stage 1 and Stage 2 calculations gave two sets of mortality rates, one for breeding birds and one for non-breeding birds. Combined predicted breeding and non-breeding annual mortality ranged from zero to 0.17 per turbine. Overall, mortality estimates were 1.3 breeding birds per year and 2.7 non-breeding birds per year. The predicted numbers of birds killed annually represents 0.16% and 0.50% of the regional (Shetland) breeding and non-breeding populations respectively.

These potential losses should be viewed in the context of likely levels of background mortality in red-throated divers. Data presented by Hemmingsson and Eriksson (2002) suggests that annual survival rates are in the order of 61% for birds aged less than two years old, and 84% thereafter. In Shetland it is estimated that most divers commence breeding at five years of age (D. Okill, *pers. comm.*). Therefore, plausible annual survival rates in Shetland would be 84% for breeding birds and 75% for non-breeding birds. Thus, out of a breeding population of 407 pairs, approximately 130 divers (814 x 0.16) would be expected to die annually. This suggests that the proposed development would potentially elevate the existing mortality of breeding divers by about 0.3% (or, expressed another way, annual survival would decline by 0.16% to ~83.84%). A similar calculation can be done for non-breeding divers; a UK-wide survey (RSPB 2007, Smith *et al* 2009) found that approximately 40% of the summering population did not breed. If this metric is applied to Shetland this suggests there is a summering population of ~1356 birds, including 542 non-breeders. Out of this non-breeding population approximately 135 divers (542 x 0.25) would be expected to die annually. This suggests that the proposed development would potentially elevate the existing mortality of non-breeding divers by about 2.0%, i.e. annual survival would decline by 0.5% to ~74.5%.

[1] Flying time estimated to occur within the 10-50m, 51-100m and 101-150m recording bands was used to determine the period that red-throated divers were at risk of collision with the turbine rotors. The RSH of the proposed turbines is 35-145m. Therefore data for the 10-50m recording band was adjusted by allocating flight time equally into 10m height bins and summing data for bins representing 30-50m height. Overall, therefore, data for flights 30-150m above the ground were used in the models.

Compared to the 2009 ES the predicted collision deaths for the 127-turbine layout are 46% less for breeding divers and 18% less non-breeding birds. Approximately three quarters of this reduction is a consequence of turbine deletions and changes to turbine positions. The remainder of the reduction is caused by taking into account breeding site occupancy rates in the calculation of average annual flight activity at turbine locations. Previously it was assumed for the purpose of calculation and for the production of the flight activity map (Fig A11.6) that all breeding lochs were occupied each year. This overestimates flight activity in the vicinity of breeding sites that are occupied less than annually. Since the 2009 ES, two additional years of occupancy data have been collected and there are now data available for 5-7 years for all sites, a reasonable sample to estimate long-term average occupancy rates.

The predicted collision mortality risks to breeding birds are spread between 16 breeding lochans and involve 58 proposed turbines (Table 11.15). The number of proposed turbines contributing to collision risk at these sites varies from 1 to 21. The risk to the breeding birds at these lochans is not evenly spread, with three sites (AZ, HO and HL) bearing approximately 52% of the total risk. The relatively high risk that breeding birds at these lochans are predicted to experience is a consequence of the combined small individual risks from several turbines. Sixty-nine proposed turbines present no collision mortality risk to breeding divers (i.e. no flight lines by breeding birds were seen at these locations). The predicted collision mortality risks to non-breeding birds are spread between 86 turbines.

Table 11.15. The number of CRM predicted collision events associated with breeding red-throated diver sites and the estimated number of turbines contributing to the collision risk. Estimates are corrected for site variation in site occupancy.

Breeding lochan	Importance category	Estimated collisions/yr	No. of turbines contributing to risk
AZ	High	0.33	21
HO	Medium	0.18	6
HL	Low	0.18	6
DU	Medium	0.05	6
DW	High	0.05	3
CO	High	0.05	1
BD	Very high	0.05	3
BA	Very high	0.05	4
DT	Medium	0.05	4
BB	High	0.05	3
BX	Low	0.05	4
HM	Low	0.04	4
CN	High	0.03	1
BO	Low	0.02	2
BP	High	0.02	2
CU	Low	0.02	2

The predicted collision mortality rates for red-throated divers presented above use data that were corrected for distance-detection effects (Appendix A11.2). If this correction had not been made the predicted average annual collision mortality would be reduced to 0.64 breeding birds and 1.0 non-breeding birds (i.e. 48% and 37% respectively of predictions based on the corrected data). These values provide a basis for comparison with other wind farm assessments where data were not corrected for detection effects.

Evidence from the Burgar Hill windfarm on Orkney suggest that the predicted numbers of collision deaths for the 127-turbine Viking layout based on a 98% avoidance rate are likely to be overestimated, possibly considerably so. The average estimated RSH flight activity in the vicinity of the proposed Viking turbines (127-turbine) is 63 secs/ha/year for breeding birds and 127 secs/ha/year for non-breeding birds. The corresponding figures calculated using the same methods for the two operational turbines closest to the breeding loch at Burgar Hill are approximately 17 times and 34 times greater respectively (Natural Research unpublished data). Collision rate modelling of these data also using a 98% avoidance rate predicts that the two Burgar Hill turbines should kill on average 1.5 divers annually. However, in four years (2006-2009) of systematic regular searches of these turbines no dead divers have been found (Natural Research unpublished data, Andrew Upton *pers. comm.*), nor have any been noted incidentally in previous years despite high levels of public access to the area. The most likely reason for the lack of dead birds found at Burgar Hill is that the actual avoidance rate is considerably greater than 98%. For this reason it is likely that the actual number of diver collision deaths at Viking will be considerably lower than the average of ~4 per year predicted using 98% avoidance. If a 99% avoidance rate is used, the numbers of predicted collision mortality would be reduced by 50% (i.e. to ~2 birds p.a.).

Table A11.16. Characterising the likely magnitude of collision on red-throated diver.

Parameter	Assessment
Extent	1.3 breeding birds p.a., 2.7 non-breeding birds p.a. (98% avoidance rate and with distance-detection correction applied)
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Possible

Summarising, it is considered that collision mortality with the turbine rotors would have long-term adverse effects of negligible-low magnitude on red-throated diver. Although red-throated diver is a species of high nature conservation importance it is judged likely that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ. However, the possible death of tens of divers over the lifetime of the windfarm is considered undesirable for a Schedule 1 breeding species. With this in mind, measures would be implemented to offset any adverse not significant effects to the population caused by collision mortality (see A11.8.8).

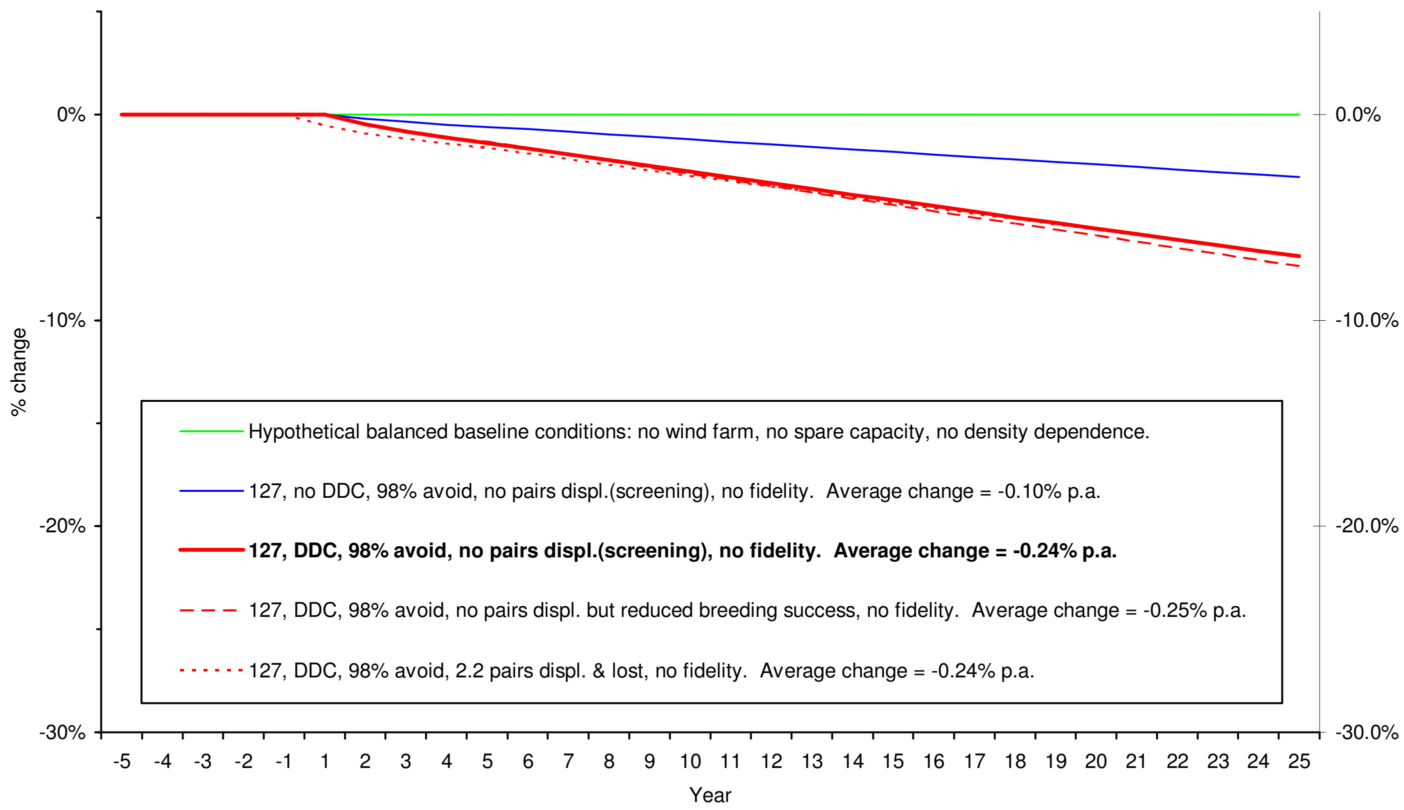
A11.8.8 Significance evaluation – combined effects on red-throated diver

In summary:

- Negligible land-take effects.
- Construction disturbance, no significant effects on breeding divers as potentially adverse disturbance will be prevented by measures in the BPP. Negligible effect on non-breeding divers also.
- Operational displacement judged likely to affect two lochans, amounting on average to long term loss of 0.6 of breeding pair (1.2 birds). Operational disturbance judged likely to affect productivity at nine lochans resulting on average approximately 1.6 fewer young reared per year. Evidence from elsewhere indicates that both these predictions are likely to be highly cautious and conservative and therefore not likely to occur. Furthermore, it is likely that these adverse effects can be avoided or reduced through mitigation. Negligible effects are predicted on non-breeding divers.
- CRM for a 98% avoidance rate predicts that 1.3 breeding birds and 2.7 non-breeding birds would be killed per annum. There is strong evidence that these figures are likely to be an overestimate.

Deterministic modelling indicates that the combined effects of operational disturbance and collision mortality could cause a regional population decline rate averaging 0.26% per annum over the lifetime of the windfarm if the baseline population was perfectly balanced and there was no spare capacity (Appendix A11.4).

Illustration A11.3. Deterministic population model for red-throated diver



Mitigation measures aimed to reduce disturbance at breeding lochs could reduce this by approximately 10% to an average decline rate of 0.23% per annum. Mitigation measures aimed at increasing productivity would completely offset the potential decline if on average they resulted in the production of six additional young divers per year.

The extent of any spare capacity in the Shetland red-throated diver population is not known for certain. It is known that the population is broadly stable (evidence of a small recent increase in the Viking Diver Study Area of Central Mainland), has good breeding success (assuming monitored sites are representative of Shetland as a whole) and contains a relatively high proportion of non-breeding birds. Taken together, these factors indicate that it is highly likely that the population does have a small to moderate degree of spare capacity. Furthermore, the magnitude of the adverse effects have been predicted using cautious and conservative assumptions and therefore the actual magnitude of effects is likely to be smaller.

In view of the above, the likely overall combined effect of windfarm land-take, construction and operation is predicted to have long-term adverse effects of negligible magnitude on red-throated diver and it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the conservation status in the Shetland NHZ.

Although significant effects are not predicted, opportunities have nevertheless been identified to further reduce the impacts on red-throated divers. Specifically there is strong evidence that peat erosion is causing a steady decline in the suitability of breeding lochans across the Viking site. This is an issue that the HMP seeks to address and is fully explored in the HMP (Appendix A10.9).

A11.8.9 Mitigation/Enhancement

It is predicted that nine lochans used by breeding divers are potentially vulnerable to disturbance as predicted by their Total DVI values and cautious assessment assumptions. Overall, these effects are predicted to be of negligible magnitude and judged to be **not significant**. The magnitude of the potential disturbance risk varies markedly between the nine lochans, as does the relative importance of the lochans to sustaining the regional diver population. Since much of this disturbance is potentially avoidable, measures to avoid this predicted disturbance for this important and specially protected species are planned and outlined in the HMP (Appendix A10.9).

The geography at each of these diver breeding sites has been examined using GIS digital terrain software and field visits to assess if mitigation measures could reduce potential disturbance. Mitigation measures would aim to make potential ground-based disturbance (people and vehicles on track and at turbine bases) invisible from breeding lochans. This exercise showed that at four lochans (BA, HM, BB and DU) minor changes (i.e. micro-siting) to track routes would achieve this aim relatively easily. The exercise also showed that at four lochans (BA, DU, HM and LBE) screening of 0.5-1.5m in height along verges would effectively hide from view ground-based activities along access road (3 lochans) or around turbine bases (2 lochans). In total, approximately 700m of screening would be required. Ground-based activities (at 2m elevation) are not visible at four of the lochans (AY, AX, BD and BX); the potential for disturbance at these is due to the visibility of the rotors only. In all four cases these turbines are >400m away from the lochan, more than twice the separation distance of the turbines at the Burgar Hill windfarm on Orkney, which have been shown to have no detectible effects on the breeding divers. Five of the nine lochans (AY, AX, BA, BD and LBE) identified as being at potential risk of experiencing disturbance effects have very low Total DVI values (<200) and in reality are unlikely to be adversely affected anyway (i.e. they are identified as being at risk only because the assessment procedure uses precautionary assumptions).

The need for, location of and design of screening would be agreed in consultation with SNH. Most likely it would take the form of earth peat banks or otherwise acceptably structured screens that are sensitively profiled to blend into the landscape as far as possible and covered with moorland vegetation. The use of earth-bank screening to hide human activity from breeding divers has been successfully used by RSPB at Burgar Hill, where an embankment of approximately 50m length and 2m height screens the approach of visitors to a diver observation hide. Minor changes to access road routes and screening would potentially avoid the great majority of the potential disturbance to breeding divers. It would reduce the summed total DVI values by 89% and cause the magnitude of operational disturbance to be rated as negligible.

The operation of the windfarm is also predicted to have adverse effects of low magnitude on red-throated diver caused by collision. Although judged to be **not significant**, collision affects are highly undesirable given the interest in and conservation importance of this iconic Shetland species. Measures set out in the HMP will safeguard (from peat erosion), restore and enhance approximately 20 peatland lochans, and provide six lochs with nesting rafts (Appendix A10.9). These measures are designed to more than fully offset the potential adverse effects of operating the windfarm by increasing the number of breeding pairs and breeding success. In addition, they aim to tackle the poor and declining condition of many of the existing peatland lochans used by breeding divers caused by peat erosion. Left alone, it is predicted that the suitability of these lochans will steadily decline, ultimately leading to a shortage of good quality diver breeding sites in Central Mainland.

As a consequence of the above analysis, mitigation and in particular enhancement are considered necessary. This is fully explored in the HMP (Appendix A10.9) and is summarised below. The primary aim of planned HMP work is relatively straightforward: create conditions on lochans conducive to the protection/enhancement/restoration of breeding red-throated divers.

Red-throated diver HMP goals

- Regular breeding by divers on at least five 'new' sites, i.e. sites with no recent history of regular breeding;
- In so far as is possible, all existing regularly used breeding sites to continue to be so;
- Threats from erosion to all high and medium importance diver breeding lochans in Central Mainland significantly reduced and where possible removed;
- Reduce to negligible the potential for ground-based wind farm activities to adversely disturb divers on breeding lochans;

- Reduce the potential for human disturbance and nest site availability to constrain breeding by divers at six selected lochs in Central Mainland through the provision of floating islands (nesting rafts);
- Minimise existing (i.e. non-windfarm) collision risks to flying divers throughout Central Mainland; and
- Promote in general the greater appreciation and conservation requirements of divers breeding in Central Mainland.

It is recognised that during the initial stages of executing the HMP many lessons on lochan protection/enhancement/restoration will be learned. The experience and knowledge initially gained will help direct future delivery of targets and be fed back into restoration measures at other lochans. It is likely, given uncertainties, that not all restoration work will achieve diver gains. For this reason, we have not proposed to offset a minimum like for like loss and gain in relation to potential wind farm impacts. The proposed scale of diver works described above will far exceed that required to offset the predicted wind farm effects and will also tackle the main existing conservation issue for divers in Central Mainland (peat erosion destroying nesting lochans). Therefore, in this context, planned red-throated diver HMP actions are a part of, and not separate from, wider Viking blanket bog/peatland restoration work.

<u>Planned red-throated diver HMP actions</u>

- Breeding lochan protection/enhancement/restoration measures;
- Provision of nesting rafts at selected lochs;
- Earth bank screening of tracks and turbine bases that are potentially visible from and within 500m of breeding diver lochans. The need for and final design of any screening measures will be decided in consultation with SNH. Note, in the first instance tracks and turbines will be micro-sited to minimise their visibility from diver breeding lochs;
- Minimise existing collision risks to flying divers throughout Central Mainland by the realignment of stock fences in the immediate vicinity of breeding lochans where they pose a clear risk; and
- Red-throated divers will be a key species in Viking Wind Farm publicity and promotional material. This should be taken advantage of to educate people about divers and their conservation needs. There is a possibility of providing a carefully selected public viewing facility for breeding divers in Central Mainland along the lines that RSPB have used in Orkney. Whether this is realised will depend on circumstances and consultation with SNH and RSPB.

To ensure these plans are taken forward timeously the following actions are being undertaken in 2010. The results are not yet available and analysed so are not included in the addendum:

- Compile a short-list of approximately 30 candidate lochans for further investigation and begin landowner liaison/negotiation – *completed*

- Visit each site, identify extent of area to be managed (largely based on hydrology) and determine what specific management work is required. Produce an outline management work plan for each site – *underway*;
- Continue baseline monitoring of diver use and physical characteristics (all sites have already been monitored for several years) - *underway*. Begin baseline monitoring of aquatic vegetation, invertebrates and physical characteristics (perhaps in 2011);
- Secure long-term landowner agreement for planned site management – negotiations and agreements for lochan management - *underway*; and

Subject to consent, the followings action will be undertaken in 2011 and beyond:

- At selected lochans, begin management through carefully planned trials of different methods including;
    - Management of erosion-damaged sites through restoration measures of the surrounding peatlands and lochan banks;
    - Stock fence realignment where existing diver collision risk is considered high; and
    - Creation/expansion of existing pools.
- Establish regular monitoring of changes caused by management;
- Progress diver work plan in liaison with independent monitoring and advisory group and in light of information from trials, new guidance and any changes in circumstances.
- Liaise with SNH and SEPA as required.

A11.8.10 Residual effects on red-throated diver

It is considered that the magnitude of the residual effects on red-throated diver due to windfarm land-take, construction and operational activities is likely to be negligible. Although red-throated diver is a species of high Nature Conservation Importance, the likely residual effects after mitigation are judged to be **not significant** under the terms of the EIA Regulations, i.e. there will be no detectable regional population level effects and so the FCS of the Shetland NHZ will not be adversely affected. Therefore, if the Viking Wind Farm is built, the available information indicates that FCS will not be affected because:

- Red-throated diver will likely maintain itself on a long-term basis as a viable component of its habitat in Shetland;
- The natural range of red-throated diver in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain red-throated diver populations on a long-term basis should the wind farm be built. However, recent studies suggest that existing peat erosion threatens

many diver nesting lochs/lochans and therefore its future Favourable Conservation Status is by no means secure without intervention.

Therefore, successful HMP mitigation for red-throated diver could shift residual effects in a positive direction i.e. the Central Mainland population could significantly benefit from the Viking Wind Farm.

A11.9 WHOOPER SWAN

A11.9.1 Background

Whooper swans are large water birds that are very scarce resident breeders and fairly common passage migrant and winter visitors to Shetland (Pennington *et al.* 2004). The species is legally protected under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) and is a Birds Directive Annex 1 species.

Approximately 3-7 pairs breed annually in the UK, all in Scotland, and mostly in Shetland (Forrester *et al.* (eds) 2007). The Scottish wintering population has been estimated at 4,142 birds with variable numbers wintering in Shetland. The birds wintering in Shetland are believed to come from the Icelandic breeding population (Forrester *et al.* (eds) 2007). The European conservation status has recently been evaluated as *Secure*, with population estimates suggesting >65,000 pairs, which equates to 50-74% of the global population (Birdlife International 2004).

A11.9.2 Assumed conservation status

The number wintering in Shetland has undergone a decline since the beginning of the 1990s, but this is attributed to possible survey timings and/or migrating birds rapidly moving southwards to food provided on reserves further south in Britain (Pennington *et al.* 2004). There have been annual breeding attempts by whooper swan in Shetland since 1994, which appear to be slowly increasing. The location of breeding lochs is kept confidential, but sites have been on both Shetland Mainland and some of the smaller islands. In 2008 there were 7 breeding attempts of which 5 pairs hatched 14 young (Shetland Bird Club 2009). The weight of recent evidence suggests that the Shetland whooper swan breeding population currently has a Favourable Conservation Status.

A11.9.3 Whooper swan influences on design change

The 2009 ES layout avoided potential whooper swan issues through design planning. No additional specific whooper swan mitigation has influenced the 2010 127-turbine layout.

A11.9.4 Baseline whooper swan data

(a) Surveys undertaken

Information about whooper swan presence on and around the Viking Wind Farm site was gathered from pre-baseline data sources in 2003. Breeding whooper swan were surveyed by the moorland bird survey programme across the Viking survey area. Surveyors also recorded any whooper swans seen during the annual red-throated diver surveys, which covered all suitable breeding habitat over a much wider area (the VDSA). Flight activity was recorded by generic VP watches and migration VP watches. Specific surveys of passage and overwintering whooper swan using the Viking survey area were made in autumn/winter 2005-2006 by regularly driving a route that covered suitable lochs and lowland feeding habitat. Further details on all survey methods are provided in Appendix A11.1.

(b) Results

Breeding sites

Single pairs of whooper swan have bred, less than annually (twice in eight years) at two freshwater lochs within 2km of the development (Appendix A11.1: Confidential Annex, and Figure Confidential A11.3). In both cases the nests have been >1km from proposed turbines, and >500m from tracks and other features of site infrastructure. There are currently believed to be 5-10 pairs breeding annually in Shetland, and these represent the majority of the UK breeding population.

Flight activity

No whooper swans flights were recorded during 1374 hours of generic VP observation covering the calendar year.[1] The site does not appear to lie on a route used regularly by migratory swans, or wintering swans making local movements. Thus, only one flight, involving four whooper swans, was recorded during 524 hours of migratory VP observations in spring and autumn 2005-06 (362 hrs overlooking the western part of the development site and 162 hrs covering the eastern part). The swans flew at 15-40m above the ground, i.e. for the most part were below the RSH of the proposed turbines.

Wintering birds

Small numbers of migrant and wintering whooper swan use various lochs and pasture fields adjacent to the proposed development. These birds are present from October to April, with peak numbers in March and April when up to 12 birds are present. Potential whooper swan sites were surveyed on 34 dates stratified across the winter of 2005-06 (Appendix A11.1: Tables 11 and 32). This showed that six sites within 750m of the proposed turbines, tracks and other features of site infrastructure were used by swans. The monthly maxima for this sub-set of lochs ranged from 0-12 birds (mean = 5.9). With the exception of Mill Loch (Delting quadrant), the sites are broadly located along Pettadale, i.e. between the Kergord and Nesting quadrants. All except one site are within 200m of regularly used public roads.

[1] Data for VPs overlooking the development site.

(c) **Do nothing scenario**

The number of breeding pairs of whooper swan in Shetland has increased slowly over the past decade, and it reasonable to assume that the most likely 'do nothing' scenario is for the population size to either stabilise or continue increasing. There is no evidence that the types of lochs used by breeding whooper swan are threatened by peatland erosion processes or current agricultural practices.

A11.9.5 Whooper swan habitat loss/modification impacts

(a) **Habitat requirements**

The nesting requirements of whooper swans in Scotland are poorly known due to the small number and sporadic nature of breeding attempts. Large shallow freshwater lochs with plenty of aquatic vegetation seem to be preferred.

(b) **Land take effects**

The 127-turbine layout poses no threat to whooper swan breeding habitat and consequently it is predicted that there will be no change to whooper swan habitats due to the proposed windfarm direct land-take or indirect habitat modification. Therefore, these works would have short-term adverse effects of negligible magnitude on whooper swan. Although whooper swan is a species of high nature conservation importance, it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.9.6 Whooper swan disturbance impacts

(a) **Construction disturbance**

No breeding whooper swans have attempted to breed within 500m of any proposed windfarm infrastructure since 2005 and so the issue of potential disturbance to this species during construction may not arise. Were breeding whooper swans to be present at the time of construction works appropriate measures would be undertaken to avoid disturbance under the BPP (see Pre-commencement Surveys). Therefore, it is assumed that no breeding whooper swans would be directly affected by construction activities.

Wintering whooper swans, and migrant birds that 'stage' on freshwater lochs and/or feed close to the proposed development would be potentially at risk of disturbance by construction works. Wintering and migrant whooper swans frequently occupy sites within 200m of busy public roads and are therefore not obviously affected by noise of vehicular traffic. In view of this apparent habituation, it seems reasonable to assume that potentially adverse effects on whooper swans would be limited to birds occupying sites within 250m, at most, from construction work sites. One site (Sand Water) is just within this distance. Baseline surveys indicated that up to five swans use Sand Water during winter and therefore might plausibly be affected. However, it seems reasonable to assume that disturbance caused by construction works would be secondary to that caused by existing traffic using the A970 and B9075 roads, which are located much closer to the loch and run along the northern and eastern shores. Even in the event that swans were displaced, it is unlikely this would have a material effect on the Shetland populations of wintering or migratory whooper swans.

Table A11.17. Characterising the likely magnitude of construction displacement on whooper swans.

Parameter	Assessment
Extent	None
Effect	Direct
Duration	Short-term
Reversibility	Reversible & able to mitigate if disturbance occurs
Frequency	Regular disturbance when working close to occupied site
Probability	Unlikely due to BPP

In view of the above, it is considered that disturbance from construction works would have short-term adverse effects of negligible magnitude on whooper swan. Although whooper swan is a species of high nature conservation importance, it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

(b) **Operational disturbance**

Breeding whooper swans are judged to have high sensitivity to disturbance (Table 11.8) and therefore operation of the development would potentially displace some birds from suitable nesting sites, possibly resulting in reduced site productivity. See Impact prediction techniques approach (A11.6.2).

For the purposes of this assessment, and using a strongly cautious approach, it is assumed that whooper swans would be displaced from breeding/feeding sites within 500m of operating turbines and from areas within 250m of new tracks. Baseline surveys indicate that whooper swans are unlikely to breed within these assumed displacement zones (Appendix A11.1: Confidential Annex). Operation of the development would also potentially displace whooper swans from lochs used by migratory and wintering whooper swans. Some parts of one loch used by such birds (Sand Water) are just within 250m of the access track network. However, as discussed previously (see Construction Disturbance, above), Sand Water is flanked by two busy public roads and therefore the relatively small volume of additional traffic using one of the access tracks is unlikely to contribute materially to overall disturbance.

Table A11.18. Characterising the likely magnitude of operational displacement on whooper swans.

Parameter	Assessment
Extent	Displacement of no pairs
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Likely no pairs will be affected

In view of the above, it is considered that disturbance due to operation of the development would have long-term adverse effects of negligible magnitude on whooper swan. Although whooper swan is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.9.7 Whooper swan collision impacts

As noted previously, the site does not appear to lie on a regularly-used flight route. Thus, only one flight, involving four whooper swans, was recorded during baseline surveys. This flight was, for the most part, below the RSH of the proposed turbines. A quantitative estimate of collision mortality was not attempted because it was obvious that CRM would have inevitably concluded the level of risk was very low, probably less than one bird during the lifetime of the development.

Table A11.19. Characterising the likely magnitude of collisions on whooper swans.

Parameter	Assessment
Extent	No collisions of breeding, migrant or wintering birds predicted.
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect year round
Probability	Likely

In view of the above, it is considered that collisions with the turbine rotors would have long-term adverse effects of negligible magnitude on whooper swan. Although whooper swan is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulation, i.e. no detectable population level effects on the Shetland NHZ.

A11.9.8 Significance evaluation – combined effects on whooper swan

The combined overall effects of construction and operational activities are negligible and judged to be **not significant** (i.e. no detectable population level effects on the Shetland NHZ). Consequently, no population modelling was conducted for this species.

A11.9.9 Mitigation/Enhancement

As a result of no significant effects on whooper swan being predicted, specific mitigation or enhancement was considered unnecessary.

A11.9.10 Residual effects on whooper swan

It is considered that the magnitude of the residual effects on whooper swan due to windfarm construction and operational activities is likely to be negligible. Although whooper swan is a species of high Nature Conservation Importance, the likely residual effects after mitigation are judged to be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects and so the FCS of the Shetland NHZ will not be adversely affected. Therefore, if the Viking Wind Farm is built, the available information indicates that FCS will not be affected because:

- Whooper swan will maintain itself on a long-term basis as a viable component of its habitat in Shetland;
- The natural range of whooper swan in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and

- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain whooper swan populations on a long-term basis.

A11.10 GREYLAG GOOSE

A11.10.1 Background

Greylag goose is a common resident bird in Scotland with two breeding populations, a native population in the north and west (est. at 20,000 post breeding birds) and a naturalised feral one in south and east (est. at 5,000 post breeding birds). Estimates of the population of native breeders showed an increase at 12% per annum between mid 1980s and 1997. The Scottish wintering population has been estimated at least 85,000 birds (Forrester *et al.* (eds) 2007). Its European conservation status has recently been evaluated as *Secure*, with population estimates of 120,000-190,000 pairs and increasing, which equates to 25-49% of the global population (Birdlife International 2004).

Greylag geese are resident breeders, passage migrants and winter visitors to Shetland (Pennington *et al.* 2004). The colonisation of Shetland by breeding greylag geese, probably by birds of Icelandic origin, occurred in the 1970s and may have been linked to the nearly threefold increase in the area of improved pasture in Shetland. Birds feeding on improved pasture have brought the species into conflict with crofters in some areas (due to grazing competition with sheep) (Pennington *et al.* 2004).

A11.10.2 Assumed conservation status

The actual size of current the Shetland population is unknown (informal BTO estimates suggest between 500-1000 pairs) but its trend is strongly increasing, with the most recent BBS survey indicting a 5 year high of 0.37 pair/square in 2008 (Shetland Bird Club 2009). Therefore, on balance, the weight of recent evidence suggests that the Shetland greylag goose population currently has a Favourable Conservation Status.

A11.10.3 Greylag goose influences on design changes

Greylag goose has not influenced the 127-turbine layout.

A11.10.4 Baseline greylag goose data

(a) Surveys undertaken

Baseline information on abundance and distribution of breeding greylag goose was collected from the programme of Moorland Bird Survey across the Viking Study Area. Flight activity was quantified through the programmes of generic and migration VP watches. Further details on survey methods, areas covered and years of survey are provided in Appendix A11.1.

(b) Results

<u>Breeding sites</u>

Approximately 43 pairs of greylag geese breed within 500m of the proposed turbines, tracks and other features of site infrastructure (there were 49 under the 2009 ES layout) (Fig. A11.7). This represents 0.1% of the UK breeding population and approximately 34% of the expanding Shetland breeding population. However, the apparent regional importance of this species is almost certainly an artefact of the greater level of survey effort within the development site compared with other parts of Shetland. An island wide survey in 1999 (Pennington 2000) indicated that Central Mainland (including the development site) held about 11% of Shetland total. This is almost certainly a more reliable indication of their relative abundance. A large proportion of the Shetland population appears to vacate the islands by October, returning in late March. As a result few birds are present within the development site area during the winter.

The breeding territories are located mostly in the Delting quadrant:

Quadrant	**Territories**
Delting	20
Kergord	10
Nesting (N)	8
Nesting (S)	5
Total	43

Fifteen territory centres were located within 250m of the proposed turbines.

Flight activity

During 1374 hours of generic VP observation flying greylag geese were recorded for 1.0% of the time (0.9% after correction for monthly variation in observation effort). The recorded activity varied seasonally, from a low of less than 0.5% in winter (September-February), to a approximately 1.2% during the period March-August. Approximately 60% of flight activity was at the RSH of the proposed turbines. Detection trials indicated that less than half of flights by greylag geese beyond 1km were detected by observers (refer to Appendix A11.1). Allowing for this bias and considering data only from VPs overlooking the 127-turbine layout, the mean annual flight activity at RSH was estimated to be 393 bird secs/ha/yr.

During an additional 524 hours of VP observation to detect movements by migratory wildfowl and waders, 18 greylag goose flights (7 in spring, 11 in autumn), involving a total of 217 birds, were seen (refer to Appendix A11.1: Tables 27 and 28). No regular flight corridors were apparent. Half of the recorded flights were estimated to be at the RSH of the proposed turbines. It was unclear if the greylags seen during these watches were local breeders, migrants from the north, or a mixture of both.

(c) **Do nothing scenario**

As recent trends have shown a large increase in the numbers of breeding pairs of greylag geese in Shetland, it is perhaps reasonable to assume that this increase would continue regardless of the proposed development. The detrimental effects of sheep grazing on upland habitats (including some lochs and lochans) do not appear to directly threaten existing greylag goose habitats. Therefore, the most likely ‘do nothing’ scenario is for the Shetland greylag goose breeding population to continue to increase. However, if the potential conflict with crofters over grazing competition intensifies, it is possible numbers might stabilise or even reduce if significant culling efforts are made to control greylag geese.

A11.10.5 Greylag goose habitat loss/modification

(a) Habitat requirements

Most greylag goose nests are in heather, usually on a knoll or slope with a good view of the surrounding area. Adults and chicks feed mostly on pasture, including reseeds, and wet flushes. They also commonly use lochs and lochans for resting and roosting. Family parties may wander widely from nest sites and sometime aggregate to form large crèches.

(b) Land take effects

Based on the mean density of breeding greylag geese within 500m of the proposed site infrastructure, it is estimated that direct habitat loss caused by windfarm infrastructure land-take would result in the potential loss of 1.5 pairs of greylag geese. Construction, in particular the access tracks, is predicted to result in localised modest hydrological change in the peatland habitats. The indirect modification of small components of moorland habitat mosaics as a consequence of infrastructure construction is not considered important for greylag geese, which readily seek out and utilise human modified habitats and are not sensitive to slight localised changes in hydrology. Indeed, it may be the situation that greylag geese might benefit from the grit from the windfarm tracks. The maximum total area affected by land-take has been estimated at 232ha of the planning application area reducing to 104ha after temporary construction areas recover. In view of this, it is considered that direct land-take and indirect habitat modification would have long-term adverse effects of negligible magnitude on greylag goose and these effects would likely be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.10.6 Greylag goose disturbance impacts

(a) Construction disturbance

Breeding greylag geese are judged to have low-moderate sensitivity to disturbance and therefore construction works could potentially disturb some birds, possibly resulting in reduced site productivity. However, it is also clear that greylag geese can show a high tolerance to disturbance as shown by pairs breeding on moorland/in-bye land edge, which is regularly disturbed by machinery/vehicles, crofters and livestock. This common and increasingly abundant breeding species is becoming a problem/pest species.

For the purposes of this assessment it is assumed that greylag geese nesting within 250m of construction work sites would be temporarily disturbed, but that as a result they would not experience any reduction in breeding performance.

Table A11.20. Characterising the likely magnitude of construction displacement on greylag geese.

Parameter	Assessment
Extent	Negligible
Effect	Direct
Duration	Short-term
Reversibility	Reversible & able to mitigate if disturbance occurs
Frequency	Regular disturbance when working

	close to occupied site
Probability	Likely

In view of the above, it is considered that disturbance from construction works would have short-term adverse effects of negligible magnitude on greylag goose. Greylag goose is a species of low nature conservation importance and it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

(b) **Operational disturbance**

Greylag geese utilise human modified and managed habitats, landscapes and features throughout the year and in a Shetland context appear, to an extent, to be tolerant of people. Once operational, little direct human disturbance is likely, aside from occasional routine and emergency maintenance, of which the former can be scheduled for the non-breeding season. Greylag geese appear to habituate well to human constructs, for example they are often seen feeding close to roads, farm buildings and agricultural equipment. Greylag geese are susceptible to being disturbed when in flocks, but this tends to occur outwith the breeding season, which is when the birds are largely absent from the Viking site.

Table A11.21. Characterising the likely magnitude of operational displacement on greylag geese.

Parameter	Assessment
Extent	Negligible
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Likely no pairs will be affected

In view of the above, it is considered that disturbance due to operation of the development would have long-term adverse effects of negligible magnitude on greylag geese. As greylag goose is a species of low nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.10.7 Greylag goose collision impacts

Employing data collected during timed VP observations (corrected for detection bias) and assuming 99% avoidance, CRM estimated that 2.4 greylag geese per year would be killed (Appendix A11.3). This would represent 0.9% of the published and now out of date regional population of estimate 125 pairs, but it is likely that the regional population is currently at least twice this figure. Predicted collisions per turbine were on average three times greater in the Delting quadrant than in the Kergord and Nesting quadrants). The numbers potentially killed annually are expected to change in direct proportion to any change in numbers that breed on the windfarm.

The predicted collision rates presented above use data that were corrected for distance-detection effects (Appendix A11.2). If this correction had not been made the predicted average annual collisions would be reduced to 0.99 birds (i.e. 41 % of the prediction based on the corrected data). This value provides a basis for comparison with other windfarm assessments where data were not corrected for detection effects.

Table A11.22. Characterising the likely magnitude of collisions on greylag goose.

Parameter	Assessment
Extent	2.4 collisions p.a. (99% avoidance rate and with distance-detection correction applied)
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Probable

Summarising, it is considered that collisions with the turbine rotors would have long-term adverse effects of negligible magnitude on greylag goose. Greylag goose is a species of low nature conservation importance and it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.10.8 Significance evaluation – combined effects on greylag goose

The combined effects of construction and operational activities are negligible and judged to be **not significant**, i.e. no detectable population level effects on the Shetland NHZ. Consequently, no population modelling was conducted for this species.

A11.10.9 Mitigation/Enhancement

As a result of no significant effects on greylag goose being predicted, specific mitigation and enhancement was considered unnecessary.

A11.10.10 Residual effects on greylag goose

It is considered that the magnitude of the residual effects on greylag goose due to windfarm construction and operational activities is likely to be negligible. Greylag goose is a species of low Nature Conservation Importance, and the likely residual effects after mitigation are judged to be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects and so the FCS of the Shetland NHZ will not be adversely affected. Therefore, if the Viking Wind Farm is built, the available information indicates that FCS will not be affected because:

- Greylag goose will maintain itself on a long-term basis as a viable component of its habitat in Shetland;
- The natural range of greylag goose in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain greylag goose populations on a long-term basis.

A11.11 MERLIN

A11.11.1 Background

Merlins are small diurnal raptors that are mostly breeding visitors and passage migrants to Shetland (Pennington *et al* 2004). The species is legally protected under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) and is a Birds Directive Annex 1 species.

Merlin is a widespread and locally abundant breeding bird in the British uplands (Gibbons *et al*. 1993) at altitudes varying from 75m to 700m a.s.l. Figures suggest a considerable increase in the Scottish population between surveys carried out in 1983-84 and 1993-94, which is now estimated at 800 pairs (Forrester *et al* (eds) 2007). Populations in the UK are stable or increasing with 1,100-1,500 pairs estimated (Rebecca and Bainbridge 1998). Its European conservation status has recently been evaluated as *Secure*, with population estimates suggesting 31,000-49,000 pairs, which equates to 5-23% of the global population (Birdlife International 2004).

Since 1987, the number of breeding merlins has apparently declined in Shetland to 15-20 pairs (Pennington *et al.* 2004, Etheridge *et al* 2008). The loss of breeding merlin from several historical sites in Shetland has coincided with significant habitat degradation. Notably, patches of deep heather required for nesting have been lost through reseeding for agricultural purposes, over-grazing by sheep and defoliation by insect larvae. It has also been suggested (but with no conclusive link established) that mercury and chemical contamination may have contributed to the decline (Pennington *et al* 2004). Importantly, merlins show high site fidelity returning in successive years to nest in the same preferred area. Ellis and Okill (1990) reported on the breeding biology of merlins in Shetland during the period 1976-1987. Adults return to breeding territories in April and eggs are laid in the middle of May. Previous work on Shetland's merlins provide a good basis for comparison in the future.

A11.11.2 Assumed conservation status

As indicated above, the conventional wisdom regarding merlin status (e.g. Pennington *et al.* 2004) suggests that the number of merlin pairs breeding has declined substantially, perhaps implying that the Shetland population is not in Favourable Condition. Closer examination of research indicates that the only area recently thoroughly surveyed is the Viking Study Area, which holds just as many as it ever did (indeed perhaps more). There are two likely explanations for this: (i) there has not been a genuine long-term widespread decline as claimed, and/or (ii) birds move around and shift nest location more than people realise, which means apparent status could relate to survey effort. In 1974, the first merlin survey found 20 pairs, but estimated up to 30 pairs in total. According to Pennington *et al.* 2004 it appears that about 10-11 of these were on Unst, Fetlar and Yell (in 1980s) and it is these that have declined to a few pairs.

The Pennington *et al.* 2004 estimate of 20 pairs (the situation up to ca. 2002) includes data from Central Mainland where there were only 4-5 pairs recorded/known per year in 1996-2002. However, since then (when detailed and intensive Viking survey effort has been conducted) the annual number has approximately doubled to 9-11 pairs. Thus, in the only large area properly surveyed in the last decade there has been a full recovery (indeed possibly expansion), and there is no reason to think that other parts of Mainland have not fared equally as well. The latest published figure is for 2008 (Shetland Bird Club 2009) and this indicates that 19 pairs are known: nine of these on Viking and, away from Mainland one on Yell and one probably pair on Unst. This 2008 figure (derived in a non-survey year) is only one less pair known than found in 1974 when thorough surveying was carried out across Shetland. Consequently, the evidence for Shetland suggests merlin are perhaps doing as well as ever known, with the possible exception of the small islands.

Therefore, the evidence suggests that the size of apparent decline is not sufficient to be classified as Unfavourable. On balance, the weight of evidence suggests that the Shetland breeding merlin population currently has Favourable Conservation Status (at least in the important Central Mainland area). This directly accords with overall UK merlin status as stable or increasing.

A11.11.3 Merlin influences on design change

The 2009 ES layout reduced potential merlin issues through design planning. However, despite this, two territories were predicted to be potentially affected by displacement from nest sites and critical hunting ground, and by high collision risk. The data on merlin flight behaviour away from nest sites were too sparse to quantify how risk varied between proposed turbine locations. Therefore, for the purposes of assessment, it was assumed that all turbines posed an equal risk to general flight activity by merlin, i.e. that associated with hunting away from nest sites. For this reason no histogram of relative risk is shown. Focal VP observations at merlin nest sites indicated there was greater flight activity (compared to background hunting activity) within 500m of nest sites. On this basis, three proposed turbines in the 2009 ES 150-turbine layout were identified as posing additional risk to merlin. Of these, two were deleted (those affecting Territory K) and one remains (that potentially affecting Territory C).

A11.11.4 Merlin baseline data

(a) Surveys undertaken

Information about merlin presence on and around the Viking Wind Farm site was gathered from pre-baseline data sources in 2003 which helped inform a series of annual surveys between 2003 and 2010.

Since 2005, all merlin territories in the Viking Merlin Study Area (almost the whole of Central Mainland) were monitored annually for occupancy, by pairs or singles, and breeding performance measured. Surveying methods for merlins were as per Hardey *et al* 2009. Flight activity was quantified during generic VP watches and focal watches at selected nest sites. Full details of the survey methods and dates are provided in Appendix A11.1.

(b) Results

Breeding sites

Over the period 2005-2010 up to nine pairs of merlin in one year have bred within 2km of the proposed windfarm infrastructure (Confidential Fig. A11.4). This represents 0.7% of the UK breeding population and approximately 45% of the Shetland breeding population (i.e. NHZ population). Eleven breeding territories have been used during this time, located in the Delting, Kergord and Nesting quadrants. In most years from 2005-2010 usually one and sometimes two territories were apparently occupied by a single adults.

Quadrant	Territories
Delting	5
Kergord	3
Nesting (N)	0
Nesting (S)	3
Total	11

Most of these territories are peripheral to the development site (see Appendix A11.1: Confidential Annex), perhaps because merlins favour locations close to the interface between moorland and farmland since edge habitats tend to hold the highest prey densities. There are further historical records since the mid-1980's of four additional merlin breeding territories within the 2km buffer.

Table A11.23: Merlin productivity 2005-2010 in territories within 2km of development infrastructure.

Territory	Mean young per year
B	0.8
C	2.8
D	1.7
E	1.2
F	1.8
G	2.2
K	2.5
L	3.3
M	2.7
O	0.8
R	2.8
Average	2.1

The average annual breeding success from 2005 to 2010 at territories within 2km from proposed infrastructure varied from 0.8 to 3.3 well-grown chicks (Appendix A11.1: Table 57).

Baseline surveys indicate that one pair of merlin, located in Territory C, routinely breed within 500m of the proposed turbines. The base of the proposed turbine closest to Territory C is elevated by approximately 60m of height above the regular nest sites. Other merlin territories are located further away from development infrastructure, partly as a result of design iterations to reduce possible adverse effects (refer to Chapter A1: Introduction). In particular, since the 2009 ES Territory K has benefited from the deletion of two of the originally proposed turbines that were both within 500m of the regular nest sites.

Flight activity

Merlins were recorded in flight 30 times for a total of 1527 seconds during 1374 hours of generic VP observation overlooking the development site. Approximately 31% of this activity was at the RSH of the proposed turbines. However, merlins are particularly difficult to detect due to their relatively small size, fast flight and low elevation above the ground (Madders and Whitfield 2006). Indeed, distance detection trials indicated that less than 40% of the merlin flight activity that occurred further than 750m from an observer was detected, and it was unusual for any activity beyond 1250m away to be detected Appendix A11.1: Table 25). Allowing for this bias, mean annual flight activity at RSH was estimated to be 16 bird secs/ha/yr. A further 68 flights totalling 2857 seconds were recorded during 33 hours of additional observation focussed on six breeding attempts (Appendix A11.1: Table 54). These data indicated that much greater levels of flight activity occurred close to the nest, with an estimated 1263 adult secs/ha/yr at RSH within 200m of the nest.

Flight activity within the development site varied spatially between years, according to the occupancy and success of breeding territories. Overall, the data indicate that, away from their nest sites, merlins were not particularly active within areas occupied by the proposed turbines. This is probably because merlins spend most time foraging in low-lying moorland and farmland habitats peripheral to the proposed development. A small number of merlins use the Viking study area in winter and approximately 50% of the flight activity observed in baseline surveys occurred outwith the breeding season (September to February). This activity therefore may relate to migrant birds e.g. from Iceland, rather than Shetland breeding birds.

(c) **Do nothing scenario**

Between 1987 and 2005 (the most recent year for a Shetland wide estimate) there was a moderate decline in number of breeding pairs of merlin in Shetland (Pennington *et al.* 2004). It is perhaps reasonable to assume that this decline would continue regardless of the proposed development. However, the 2005-2010 baseline surveys of the Viking Merlin Study Area study area show that the population in Central Mainland, at least, has recovered slightly and is now stable. The situation elsewhere in Shetland is less clear. Should grazing pressure on moorland be reduced and heather recovery occur, then it is possible that the number of breeding merlins will increase. However, whilst general predictions of declines in the number of sheep in the Scottish uplands have been made, it is possible that there may be a trend towards larger ‘ranch style’ grazing units. Were this to happen, it is unlikely that large areas of over-grazed heather would be able to recover. Therefore, the most likely ‘do nothing’ scenario is for the Shetland merlin population to remain approximately stable, albeit below the size recorded in the 1980s.

A11.11.5 Merlin habitat loss/modification

(a) **Habitat requirements**

In Shetland merlins nest on the ground typically in an old crow’s nest in deep heather, often on a steeply-sided stream valleys or other sheltered slopes. Small song birds, such as meadow pipits, form the principal prey species, and these are hunted for over extensive hunting grounds over moorland, blanket bog and grasslands.

(b) Land take effects

The nesting areas in none of the merlin territories are predicted to be affected by direct habitat loss or indirect habitat modifications resulting from proposed windfarm infrastructure.

Breeding merlins have large foraging ranges (several km^2), and the proportion of feeding territories potentially affected by land take to infrastructure is negligible (<1%). Similarly the proportion of the hunting ranges potentially affect by habitat modification is also negligible. As merlins hunt over a wide variety of habitats, the small-scale changes of one foraging habitat component for another as a consequence of construction (e.g. a small strip of heather moorland or grassland for track) means that the term ‘habitat loss’ is not very relevant for merlins in this foraging context. Furthermore, merlin prey habitat, and therefore prey abundance is unlikely to be adversely affected by habitat modification. Indeed, wheatear and skylark may benefit from the creation of unsealed wind farm access roads as these species frequently use bare and sparsely vegetated ground. It is therefore considered that habitat modification will result in neither loss of breeding merlins, nor reduction in productivity, and is not therefore considered further within this assessment.

Overall, the most likely magnitude of any adverse effects on merlin due to habitat modification would be negligible. No significant beneficial effects are predicted to result from habitat modification caused by construction of the windfarm infrastructure. The beneficial effects of habitat modification undertaken as part of the HMP are discussed in Appendix A10.9.

Table A11.24. Characterising the likely magnitude of land take on merlins.

Parameter	Assessment
Extent	Tiny part of feeding territory habitats
Effect	Direct
Duration	Life of Windfarm, 25 years
Reversibility	Irreversible
Frequency	One-off event
Probability	Likely-certain

It is considered that habitat loss/modification would have negligible long-term adverse effects on the Favourable Conservation Status of merlin. Therefore, it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.11.6 Merlin disturbance impacts

(a) Construction disturbance

Merlin is listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended). Therefore, appropriate measures must be taken to avoid disturbance of merlins in the vicinity of any occupied nest sites present at the time of construction works. Pre-construction surveys will be undertaken to identify occupied nesting sites prior to work in an area commencing. Measures to prevent disturbance would be set out in the Bird Protection Plan (see 11.4.2.b) and implementation of this would be overseen by an

Ecological Clerk of Works. Therefore, it is assumed that no breeding merlin would be directly affected by construction activities in the vicinity (within 500m) of their nest sites.

Breeding merlins would be potentially displaced from foraging areas in the vicinity of construction work sites. Although alternative foraging areas exist these are more distant and therefore likely to be energetically less efficient for merlins that nest in the vicinity of the development. The ranging behaviour of breeding merlins has not been studied in detail in the UK but radio-tracking of urban Canadian merlins indicates that birds use areas that are inversely proportionate in size to the abundance of prey (Sodhi 1993). An indication of the extent of merlin hunting ranges in the UK may be given by the distances between nest sites of neighbouring pairs, which is typically 3–4km in the highest density areas (Parr 1991), meaning a crude estimate of range area may be given by a circle of 2km around the nest (the criterion used by SNH in drawing up SPA boundaries involving a merlin interest). Hunting ranges of neighbouring birds, however, can have a large degree of overlap (Sodhi and Oliphant 1992) so even a 2km radius around a nest site is likely a conservative measure of the extent to which birds may travel in search of prey. This is confirmed by the only quantified measures of the distance travelled by breeding merlins in Scotland, presented by Rebecca *et al.* (1990) which were a minimum distance of 3.8km from the nest. This paper also reported on an unpublished radio telemetry study in Wales in which merlins hunted up to at least 4km from the nest.

For the purpose of this assessment, hypothetical ‘core’ foraging ranges, assumed to contain food resources critical to successful breeding, were represented by circles of 2km radius defined around each territory centre (i.e. the mid-point of each cluster of nest locations identified in 2005-08). Thus, each core range measured 12.6km^2. This indicated that the development site might provide some critical foraging for merlin breeding in 10 territories. It is assumed that 50% of merlin foraging activity would be temporarily displaced from areas within 250m of construction work sites. Given that merlin are observed to have a high tolerance of vehicle traffic and that at the construction stage the turbines are not operational, the choice of a 50% displacement within 250m is likely to be highly conservative. The overlap between the assumed displacement zone and hypothetical core foraging ranges varies between territories, from 2% to 49% (mean 22%). Therefore, the assumed displacement would equate to the potential temporary loss of 1% to 22.5% (mean 11%) of the assumed critical foraging area. The effective loss of critical foraging area exceeds 20% at one territory (Territory C, refer to Appendix A11.1), 20% being taken to be a likely threshold at which to expect material effects on nest provisioning.

Construction works would proceed in a phased manner across the development site. Therefore, with the possible exception of vehicular movements along the new tracks, it is unlikely that merlin within the assumed construction disturbance zone would be affected in more than one year. Furthermore, in any year some of the effected territories will not be occupied. Vehicular traffic appears to have little or no effect on merlin nest placement (Confidential Fig. A11.4) and therefore it seems reasonable to assume that it would have a similarly slight effect on foraging behaviour. In view of the above, it is considered likely that foraging efficiency in one merlin territory (Territory C) at most, would be materially affected and then only in one year assuming that the territory is occupied. It is assumed that effects of reduced foraging opportunities at Territory C would prevent young being successfully reared during the year of construction disturbance. On the basis of this analysis, construction works would, at worst, result in the loss of productivity from

Territory C for one year. Territory C has been one of the more productive territories in Shetland in recent years accounting on average for approximately 5% of the estimated regional production of young. No longer-term consequences are anticipated.

Outside the breeding period merlins would continue to be potentially displaced from foraging areas localised around the construction site for the remainder of the year. Most merlins leave their breeding haunts for lower ground with some migrating south from Shetland. The Shetland wintering population is known to be supplemented by birds from Iceland (Wernham *et al.* 2002). There are no studies of non-breeding range use in merlins in the UK, although even on simple considerations (e.g. the absence of a nest site to constrain activity to a focal point, lower prey supplies) non-breeding birds are liable to range over a considerably greater area than breeding birds. Research on merlins in Canada confirms that range area in non-breeding birds is much larger (Sodhi and Oliphant 1992, Warkentin and Oliphant 1990) and studies of other resident raptors confirm that non-breeding ranges are larger (e.g. Marquiss and Newton 1981, Marzluff *et al.* 1997). In view of the above evidence it seems reasonable to assume that any displacement of non-breeding merlins due to construction disturbance is highly unlikely to have a material effect on migratory or wintering populations at the regional scale.

Table A11.25. Characterising the likely magnitude of construction displacement on merlins.

Parameter	Assessment
Extent	Disturbance of one productive territory (Territory C)
Effect	Indirect
Duration	Short term (one breeding season)
Reversibility	Reversible once construction stops
Frequency	One off effect
Probability	Possible

It is considered that construction works would cause (at worst) a short-term, one-off adverse effect of low magnitude on one pair of merlin for one breeding season. Therefore, it is judged that these disturbance effects would be considered **not significant** under the terms of the EIA Regulations (i.e. no detectable population level effects on the Shetland NHZ).

(b) **Operational disturbance**

Operation of the development would potentially displace nesting and foraging merlins. Merlins have not been studied with respect to their sensitivity to displacement by wind farms, when nesting or foraging. A review of disturbance tolerance by birds reported that the median expert-opinion threshold at which breeding merlin show a response to human disturbance was 225m during the incubation stage and 400m during chick-rearing (Whitfield *et al* 2008). However, based upon review of other raptors, Madders and Whitfield (2006) suggest that it is highly unlikely that merlins will be displaced by operational wind farms. Although there are no specific data on displacement for merlin, there are data for kestrel, a similarly sized small falcon. The study by RSPB into the effects of upland wind farms on birds found a reduction by approximately 40% in kestrel flight activity within 250m of wind farm infrastructure of (Pearce-Higgins *et al.* 2009). In view of the limited information on displacement available to date, it is conservatively assumed for the purpose of this assessment that nesting merlins would be displaced from areas within 500m of operating turbines and foraging birds from areas within 100m. It should be noted this is not necessarily considered a most 'likely' scenario, but a conservative one given the predicted typical disturbance responses (Whitfield *et al* 2008) of approximately 400m. See Impact prediction techniques approach (A11.4.2).

Breeding

Baseline surveys indicate that one pair of merlin typically nest within the assumed operational displacement zone (Territory C; refer to Confidential Fig. A11.4). Recent nest sites at this territory have been 200–300m from the base of one of the proposed turbines, which is located, together with the access road on a ridge raised approximately 60m higher than the nest site. However, the base of the turbine and all wind farm access roads (determined for 2m elevation) are not visible, i.e. nesting birds will not be able to see human activity on the ridge. If it is assumed, on a cautious basis, that this pair does not relocate and nest elsewhere, then this results in a reduction of approximately 4% in the regional breeding population. Based on data for the period 2005-2010, mean annual productivity in the territory potentially affected was 2.8 young, slightly greater than the mean for all territories associated with the development site (that is 2.1 young as per Table 11.23). This difference is largely explained by the high annual occupancy rate (83%) of Territory C in recent years. Annual monitoring results for the entire Shetland merlin population over a period of 25 years have been compiled by P. Ellis (RSPB), and these data indicate that, although some territories are more likely to be occupied than others, long-term occupancy cannot be reliably predicted from short runs of data, e.g. covering six consecutive years. Thus, it cannot be assumed that the relatively high productivity observed in Territory C during baseline surveys will be sustained in the future. Indeed, this territory was vacant in 2010 for the first time in several years.

As a result of the deletion of two turbines from the previous 2009 ES to reduce potential effects on merlin, birds breeding at Territory K are no longer considered likely to be at significant risk of displacement due to operational disturbance. The birds at this territory have nested at various locations along 1km of a small ravine. One recent nest site out of five recorded was just within the assumed 500m displacement zone (425m from a proposed turbine position).

To conclude, using conservative assumptions, it is predicted that operational disturbance would potentially displace one pair of nesting merlins. After taking into consideration the average occupancy rate at this territory (83%) this would be equivalent to approximately a 4% decline in the regional breeding merlin population. In view of the above, it is considered that operational disturbance would have a material effect on the regional merlin breeding population and therefore potentially on its Favourable Conservation Status. This is highly cautious because it is likely that if the birds were upset the near proximity of the wind farm infrastructure they would continue to occupy the site but choose to nest further away from the turbine as nesting habitat at the site is not considered limiting. There is an extensive area of suitable heather for nesting at Territory C and thus providing clear opportunities for these birds to relocate further from the turbine within suitable nesting habitat if they choose to.

Foraging

As noted previously, the development site probably provides some critical foraging habitat for ten pairs of breeding merlin. Plausible displacement effects were calculated using the same approach followed under Construction Disturbance (see above), but a displacement zone extending 100m around the operational turbines was assumed. This analysis indicates that nine territories would be potentially affected. However, the overlap between core foraging and assumed displacement did not exceed 5% in any territory (range 0.2% to 4.1%; mean = 1.9%). Thus, under the envisaged scenario, it is unlikely that reductions in core foraging would be sufficient to have a material effect on the occupancy or productivity of any territory, and this effect is not considered further.

Table A11.26. Characterising the likely magnitude of operational displacement on merlins.

Parameter	Assessment
Extent	Possible displacement of 1 pr
Effect	Indirect
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Unlikely but possible

In view of the possibility of displacement of breeding birds (i.e. of one pair in Territory C), it is considered that operational disturbance of the development would have long-term adverse effects of low/moderate magnitude on merlin. Some degree of displacement is considered to be likely (e.g. based on data for kestrel), but the extent and severity of that effect is not well understood – therefore highly cautious assumptions as to the potential nature of the effect have been adopted. Merlin is a species of high nature conservation importance and the long-term abandonment of a territory would be measurable. Therefore, it is judged that, if these effects occurred, without mitigation they would be **significant** under the terms of the EIA Regulations (i.e. a potentially detectable population level effect on the Shetland NHZ).

A11.11.7 Merlin collision impacts

Merlins have not been studied with regard to collision vulnerability at operational wind farms. However, the RSPB study into the theoretical effects of upland wind farms on birds found a reduction by approximately 40% in kestrel in flight activity within 250m of wind farm infrastructure of (Pearce-Higgins *at al* 2009). Detailed observations of foraging merlins in the UK uplands are scarce, but most anecdotal observations refer to merlins flying low over the ground, well below turbine RSH. Prey (mainly small songbirds) is captured after fast aerial chases close to the ground or surprised in the ground vegetation at close range. Less commonly, merlin stoop on their prey from greater heights with a fast direct flight, or 'ring up' after prey (typically, skylark). When 'ringing up' the prey attempts to gain height by climbing in circles above the merlin, which follows. The merlin may give up the chase at any stage, but if not, and after up to several hundred metres of conjoined skyward flight, the lark descends earthwards rapidly with the merlin following closely and making repeated short stoops on the lark. While such spectacular hunts have been recorded commonly (Cresswell 1994), it would appear that they are rare relative to other hunting techniques. Thus, aerial pursuits at the RSH of the proposed turbines are likely to be quite rare; indeed, none was observed during baseline surveys (refer to Appendix A11.1).

Other exceptions to merlins' characteristically low flying elevation occur during territorial displays, 'mobbing' flights to drive away potential avian nest predators, and practice flights by juveniles (Rae 2006). However, these behaviours are typically restricted to within 500m or so of the nest (Rae 2006). One territory identified in baseline surveys is regularly located within this distance of the proposed turbines (Territory C); (refer to Confidential Fig A11.4).

CRM models for merlin were constructed employing flight data gathered during baseline generic flight activity studies, covering the entire development site, corrected for detection bias (Appendix A11.3). A 50% reduction in flight activity during operation due to displacement in the vicinity of turbines was also allowed for, based on results for kestrel, the only species of small falcon for which there is published results (Pearce Higgins *et al.* 2007)

Merlin biometrics were averaged across the sexes, and a flight speed of 14 m/s was used (Provan and Whitfield 2006). In the absence of any guiding empirical data an avoidance rate of 98% was used in merlin CRM. The Stage 2 (Band) calculation for the probability of collision gave a value of 5.3% for the proposed turbines for a 50% displacement of flight activity in the vicinity of turbines.

This CRM estimated that on average 0.11 merlin would be killed each year assuming that no birds are displaced from breeding territories (refer to Appendix A11.2). This is equivalent to one bird killed every 9 years. If all the birds at risk of collision were local breeding individuals this would represent approximately 0.3% of the regional population. However, this is not likely because approximately 50% of the flight activity observed in baseline surveys occurred outwith the breeding season (September to February), when immature birds and overseas migrants are likely to form a large proportion of the birds present. On average approximately 14 adult merlins in the regional breeding population can be expected to die annually due to existing causes of mortality (assuming a 35% annual adult mortality rate – Appendix A11.4).

The predicted collision mortality rates presented above use data that were corrected for distance-detection effects (Appendix A11.1). If this correction had not been made the predicted average annual collisions would be reduced to 0.03 birds (i.e. 28% of the prediction based on the corrected data). These values provided a basis for comparison with other wind farm assessments where data were not corrected for detection effects.

CRM models were also constructed for 'core' areas of merlin breeding territories, using flight data gathered during focal watches of nesting areas (refer to Appendix A11.1: Part 2, Merlin). These analyses demonstrated that, unsurprisingly, collision likelihood would decline with distance from a nest. It was estimated that if an operational turbine was located 200-300m from a nest it would result in one of the breeding pair being killed every nine years. Similarly, if the turbine was located 300-400m away it would result in the loss of a bird every 13 years.

Only one of the 127-turbine proposed turbine locations is within 400m (predicted disturbance distance - Whitfield *et al* 2008) of recorded merlin nest sites. That turbine is approximately 250m from the average nest location in Territory C. This turbine location is on a ridge elevated approximately 60m above the recent nest sites. Should merlins attempt to breed at these nest sites in the future, this elevation difference is likely to reduce the potential for collision because merlins mainly use relatively low airspace. There is an extensive area of suitable heather for nesting at Territory C providing clear opportunities for these birds to relocate further from the turbine if they choose to.

It is unlikely that merlin flight activity (and therefore collision risk) would increase as a result of changed habitat conditions due to construction of the development. Similarly, the HMP and associated mitigation (see Chapter A10: Ecology and Appendix A10.9) proposed as part of the development does not aim to shift the distribution of suitable nesting habitat closer to the turbines. This is important because, as noted previously, collision likelihood is greatest in the vicinity of nest sites.

Based on the current favourable conservation status of merlin in Shetland, it is concluded that the predicted level of collisions would not have a material effect on the regional merlin population.

Table A11.27. Characterising the likely magnitude of collisions on merlins.

Parameter	Assessment
Extent	<0.28 collisions p.a. (98% avoidance rate and with distance-detection correction applied)
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Probable

In view of the above, it is considered that collisions with the turbine rotors would have long-term adverse effects of <u>negligible</u> magnitude on the Favourable Conservation Status of merlin. Although merlin is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations (i.e. no detectable population level effects on the Shetland NHZ). However, the possible loss of several merlins (<7 birds over 25 years: both Shetland breeding birds and overseas migrants) over the lifetime of the wind farm is considered undesirable: even in the context of an average 14 natural adult mortalities every year for other reasons. With this in mind, and recognising the uncertainties inherent in the CRM process, measures would be implemented to offset the effects of collisions by merlins.

A11.11.8 Significance evaluation – combined effects on merlin

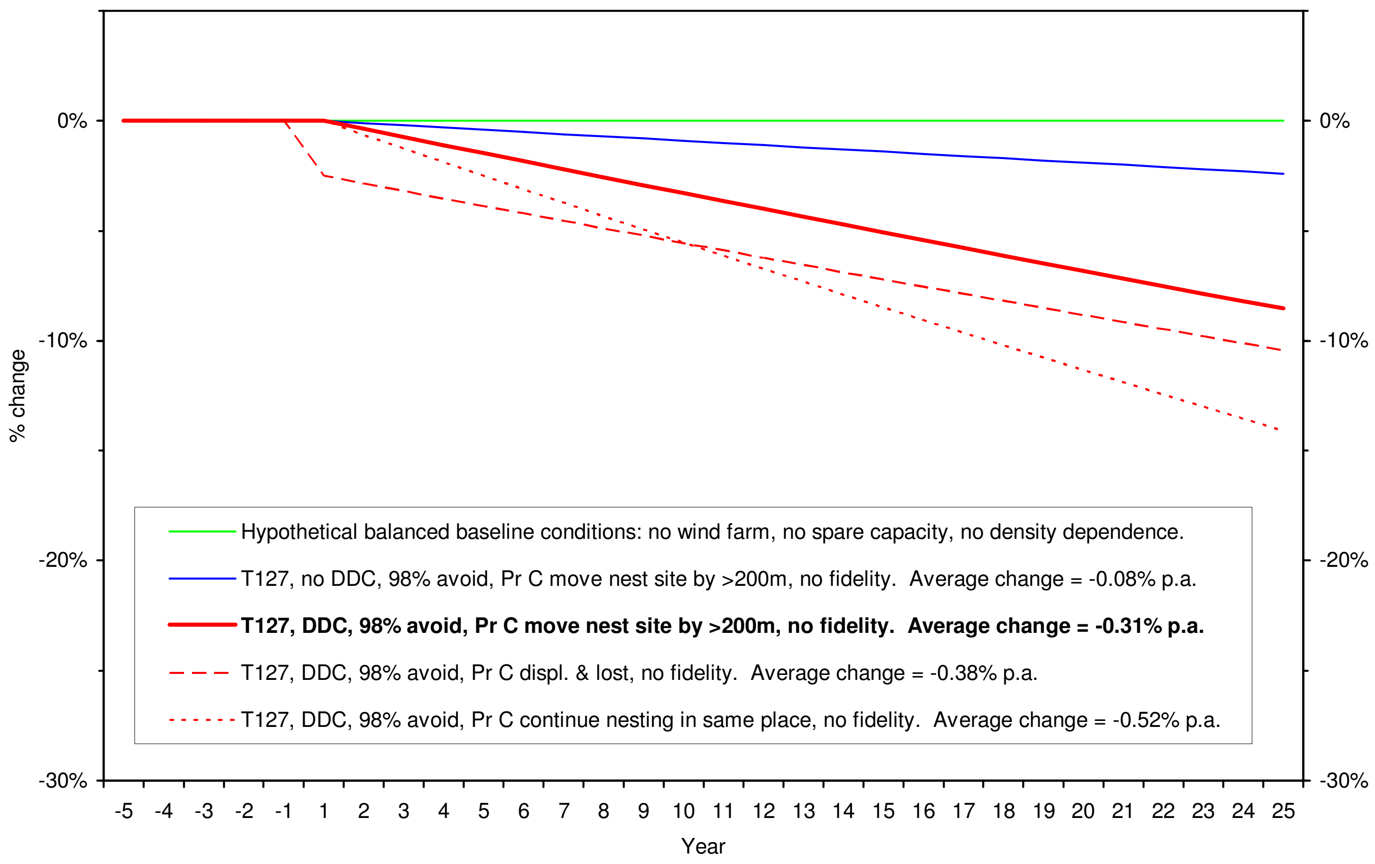
In summary:

- Habitat modification/loss – negligible effect.
- Construction disturbance, critical foraging area effectively reduced at one territory to an extent that may possibly lead to breeding failure in one year, thereby causing a temporary one-off 5% reduction in regional young production.

- Operational disturbance is judged likely to affect one nesting territory and possibly cause approximately a 4% decline in the regional breeding merlin population.
- CRM for a 98% avoidance rate and allowing for a 50% displacement of flight activity in the vicinity of turbines predicts that 0.11 merlin killed per year. A substantial proportion (up to 50%) of the few predicted collision deaths are likely be of birds that are not part of the regional breeding population.

Deterministic modelling indicates that the combined effects of operational disturbance and collision mortality could cause a regional population decline rate averaging 0.50% per annum over the lifetime of the wind farm if the baseline population was perfectly balanced and there was no spare capacity (Appendix A11.4). Collision risk and displacement are not additive because if the birds are displaced from areas close to turbines, they will not be at risk from collision with turbines.

Illustration A11.4. Deterministic population model for merlin



The extent of any spare capacity in the Shetland merlin population is not known for certain. It is known that the population within the Viking Merlin Study Area is currently broadly stable and has good breeding success (assuming monitored sites are representative of Shetland as a whole). Taken together, these factors indicate that it is likely that the population does have a small to moderate degree of spare capacity. Furthermore, the magnitude of the adverse effects has been predicted using cautious assumptions and therefore the actual magnitude of effects is likely to be smaller.

In view of the above, it is predicted that the overall likely combined effects of wind farm construction and operation will be of low-moderate magnitude. The extent and severity of these predicted combined effects are largely down to how the single pair of merlins in Territory C respond to the wind farm, i.e. one pair out of the Shetland population of ca. 20 pairs only. If this pair is not displaced the adverse effects on the Shetland merlin population would be judged not significant. However, if it was displaced and did not resettle elsewhere there would be a measurable 5% decline in the Shetland merlin population and effects would be judged significant.

Thus, the assessment of combined effects is sensitive to the behaviour of a single pair of birds. In recognition of the uncertainty as to how this pair will respond a cautious approach is adopted whereby it is assumed they are displaced. Therefore, it is judged that the overall effects on the merlin population before mitigation would be **significant** under the terms of the EIA Regulations (i.e. a potentially detectable population level effect on the Shetland NHZ). Adoption of less pessimistic (and probably more realistic) assumptions (e.g. a higher collision avoidance rate and no displacement) would result in a not significant pre-mitigation impact.

Merlins are afforded special legal protection (Wildlife and Countryside Act Schedule 1 and Birds Directive Annex 1) and are a much valued species in Shetland and, therefore, any adverse effects should be avoided where possible. For these reasons it is desirable that adverse effects are minimised and additional conservation measures set in place to ensure the long term availability of suitable breeding sites, as set out below (also see HMP Appendix A10.9).

A11.11.9 Mitigation/ Enhancement

(a) Construction

In order to reduce the magnitude of construction disturbance, measures would be implemented to ensure that the overlap between predicted displacement zones around construction works (extending to 250m from each work site) and the hypothetical core foraging range of Territory C does not exceed 20%. This degree of overlap is assumed to be the threshold at which material effects on nest provisioning might occur. Reduction in the size of the overlapped area would be achieved by restricting construction works in some ‘merlin sensitive’ parts to the months of August to March, i.e. outside the merlin breeding period. However, this and any other potential disturbance to (new) nest sites will be assessed prior to work commencing to ensure that knowledge of merlin sensitivities is up to date and can inform construction works and the Bird Protection Plan.

(b) **Operation**

HMP work will be aimed at enhancing the quality of stands of heather for nesting merlins (Appendix A10.9). Management will be implemented at historical nesting territories that no longer support regular breeding and where there is evidence of a shortage of high quality heather. Merlins are highly site faithful and if suitable habitat conditions can be re-established at these former sites, it is likely they may become regularly used again.

The planned HMP work is relatively straightforward and simple: create conditions conducive to the restoration of deep heather at (former) traditional merlin nesting sites. Specific management measures are likely to be centred on stock exclusion fencing to allow heather regeneration to occur over sufficiently large areas (at least a few hectares at each territory) to be attractive to nesting merlin. Assuming heather restoration occurs within a few years (and there is anecdotal evidence from Shetland that this is a reasonable assumption e.g. ESA management prescriptions), subsequent grazing management within the fenced areas is likely to be eventually required to keep heather at the optimal height and structure for nesting merlins, i.e. not too tall and dense but not too short either.

In order to have a high probability of success of achieving this, the HMP works will take place in five traditional nesting sites in Central Mainland where there is evidence of a lack of suitable nesting cover. Candidate site selection has been confined to Central Mainland as this area has the best information on previous site use (from monitoring by VEP and before then by RSPB). Therefore, searches have been undertaken in 2010 throughout Central Mainland and candidate sites selected. The HMP provides further details of merlin HMP site selection.

There is some uncertainty in both the response of merlins to the conservation measures, and the likely response of merlins to potential disturbance at Territory C. For example, heather management would be implemented as quickly as possible following consenting of the development, but it is inevitable that there will be a lag of a few years before heather has the appropriate structure to attract nesting merlins. Nevertheless, the predicted adverse effects on merlin are small (and may not even materialise), and it would take only one of the five heather management sites to become regularly used by breeding merlins to fully offset the predicted adverse effects. If breeding merlins regularly used more than one of the five heather management sites then planned mitigation/enhancement measures would exceed predicted adverse effects.

Merlin HMP goals

- Regular breeding by merlins on at least one formerly occupied traditional site.

Merlin HMP work timetable

The following HMP actions for merlin are being undertaken in 2010:

- Identify and compile a list of traditional sites in Central Mainland – *completed*;
- Begin landowner liaison/negotiation for selected sites – *completed*;

- Visit merlin sites and assess quality and extent of existing heather and determine which five sites would benefit most from HMP work – *completed*;
- Visit the five short-listed merlin sites to assess and map the areas to be stock fenced – *underway*;
- Undertake monitoring of merlin occupancy and breeding success at all sites in Central Mainland – *ongoing* (continuing the annual monitoring VEP has undertaken since 2005);
- Secure long-term landowner agreement for site management (stock fencing and initial stock removal) negotiations and agreements for merlin management - *underway*;
- Undertake surveys of vegetation at the five selected sites – *completed*; and

Subject to consent for the project, the following HMP actions for merlin are planned for 2011 and beyond:

- Where possible, erect stock-proof fencing and remove stock. To be discussed and agreed with land managers once baseline monitoring is completed and assessed.
- Complete erection of stock-proof fencing and remove stock (i.e. sites not treated in 2010);
- Annual monitoring of vegetation caused by stock removal and fencing;
- Annual monitoring of merlin occupancy and breeding success;
- Progress merlin work plan in liaison with independent monitoring and advisory group and in light of information from trials, new guidance and any changes in circumstances; and
- Adjust grazing regime as appropriate.

These HMP measures will provide enough new areas of nesting and foraging habitat for merlin in the long-term, to offset predicted impacts on one pair of merlins.

(c) **Research**

Alongside detailed monitoring and reporting of HMP implementation, the occupancy and breeding performance of merlin across the VMSA (i.e. most of Central Mainland) will continue to be undertaken annually from 2011.

A11.11.10 Residual effects

It is considered that the magnitude of the residual effects on merlin due to windfarm construction and operational activities is most likely to be negligible. Although merlin is a species of high Nature Conservation Importance, the likely residual effects after mitigation are judged to be **not significant** under the terms of the EIA Regulations, i.e. there will be no detectable regional population level effects and so the FCS of the Shetland NHZ will not be adversely affected. Therefore, if the Viking Wind Farm is built, the available information indicate that FCS will not be affected because:

- Merlin will maintain itself on a long-term basis as a viable component of its habitat in Shetland;
- The natural range of merlin in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain merlin populations on a long-term basis.

Furthermore, successful HMP mitigation for merlin could shift residual effects in a positive direction i.e. populations of this species would significantly benefit from the Viking Wind Farm.

A11.12 HEN HARRIER

A11.12.1 Background

Hen harriers are diurnal raptors that are scarce passage migrants and rare winter visitors to Shetland (Pennington *et al.* 2004). These birds are probably from the Scandinavian breeding population. The species receives special legal protection under Schedule 1 of the Wildlife and Countryside Act (1981; as amended) and is a Birds Directive Annex 1 species. There are no suggestions of breeding having ever occurred in Shetland, despite breeding on Orkney, and this has been attributed to an absence of small mammals, especially voles (Pennington *et al.* 2004).

Hen harrier is a widespread but scarce upland breeding bird, mainly in the north and west of Britain (Gibbons *et al.* 1993; Hardey *et al.* 2009). Recent surveys have indicated increases in breeding populations in some areas and declines in others. The increases are associated with the growing use of non-moorland habitats and the declines are associated with continued and intense illegal persecution in moorland habitats. The Scottish breeding population is estimated at 633 pairs, with a wintering population of 1,050-1,540 individuals (Forrester *et al.* (eds) 2007). Its European conservation status has recently been evaluated as *Depleted*, with population estimates suggesting 32,000-59,000 pairs, which equates to 5-24% of the global population (Birdlife International 2004).

A11.12.2 Hen harrier influences on design change

The 2009 ES layout avoided potential roosting hen harrier issues through design planning. No additional specific hen harrier mitigation has influenced the 2010 127-turbine layout.

A11.12.3 Baseline hen harrier data

(a) Surveys

In the course of survey work undertaken in autumn 2005, it became apparent that a small number of hen harriers were roosting in the vicinity of Sand Water. As a consequence of this, additional VP observations, focussed on the roost area, were undertaken during the winter 2005-2006 (Appendix A11.1). The aim was to determine the number of harriers using the roost each month, establish the directions from which birds approached the roost and identify any specific areas used for social pre-roost gathering activity.

The programme of generic VP watches quantified flight activity across the Viking Study Area. Full details of survey methods are provide in Appendix A11.1.

(b) Results

Flight activity

Exceptionally, in the winter of 2005-06 at least three hen harriers roosted communally adjacent to the development site, with a maximum of two harriers present on any one date. The roost site is approximately 375m from the A970 trunk road and nearest proposed access track, and over 1km from the nearest proposed turbine (see Appendix A11.1). Intensive observations focussed on the roost indicated that the birds did not arrive from, or disperse towards, areas occupied by the proposed turbines. Birds typically flew less than

10m above the ground when foraging, although in the vicinity of the roost a small number of flights were at the RSH of the proposed turbines.

Hen harriers were observed just eight times during generic VP watches (A11.1). Flying birds were recorded for 0.05% of the time. All records were during the non-breeding period.

(c) **Do nothing scenario**

The irregular occurrence of small numbers of migrant and wintering hen harriers in Shetland is expected to continue. The lack of suitable small mammal prey means that breeding is considered unlikely.

A11.12.4 Hen harrier habitat loss/modification

(a) **Habitat requirements**

Hen harriers require open moorland and rough grassland for hunting (which in Shetland will be concentrated on small birds). Hen harriers may roost communally in the winter, generally in rank ground vegetation of lowland marshes or heather moorland (Hardey *et al.* 2009).

(b) **Land take effects**

The 127-turbine layout poses no threat to the hen harrier roosting sites identified in baseline surveys and consequently it is predicted that no roosting habitat modification or habitat loss will occur due to the proposed windfarm. In view of this, it is considered that construction works would have short-term adverse effects of negligible magnitude on wintering hen harrier. Although hen harrier is a species of high Nature Conservation Importance, these effects are judged to be **not significant** under the terms of the EIA Regulations.

A11.12.5 Hen harrier disturbance impacts

(a) **Construction**

Appropriate measures would be undertaken to avoid disturbance of hen harrier roosts present at the time of construction works (see Pre-commencement Surveys). Therefore, it is assumed that no roosting hen harriers would be directly affected by construction activities.

Wintering hen harriers would be potentially displaced from foraging areas in the vicinity of construction sites. However, few harriers winter in Shetland and the development site supports few prey likely to attract them at this time of year (no small mammals and only very low densities of moorland passerines). Therefore, it seems reasonable to assume that the potential displacement of hen harriers (if any) as a result of construction works would have little or no effect on the birds' foraging efficiency.

Table A11.28. Characterising the likely magnitude of construction displacement on hen harriers.

Parameter	Assessment
Extent	Possible disturbance of roosting site
Effect	Direct

Duration	Short-term
Reversibility	Reversible
Frequency	Regular disturbance when working close to occupied roost site
Probability	Unlikely due to BPP and less than annual use of roost site.

In view of the above, it is considered that construction works would have short-term adverse effects of negligible magnitude on wintering hen harrier. Although hen harrier is a species of high Nature Conservation Importance, these effects are judged to be **not significant** under the terms of the EIA Regulations.

(b) **Operational**

Roosting hen harriers are judged to have high sensitivity to disturbance (Table 11.9) and therefore operation of the development could potentially displace birds from roost sites, possibly resulting in reduced winter survival (see Impact prediction techniques approach (A11.4.2).

For the purposes of this assessment it is assumed that hen harriers would be displaced from roost sites within 500m of operating turbines and from areas within 250m of tracks. Baseline surveys indicate that no hen harriers roost within the assumed displacement zone. Therefore, it is highly unlikely that operational disturbance would have a measurable effect on roost occupancy or behaviour.

Foraging birds would be potentially displaced from localised areas around operational wind turbines. Hen harriers are present in the non-breeding period only. However, the level of foraging seen over the wind farm area during non-breeding season baseline surveys does not suggest that it is critical to harriers. Moreover, as noted previously birds are not constrained by nest site location at this time and therefore it is reasonable to expect that they would be able to accommodate any displacement by moving to alternative areas further from infrastructure. Thus, it is highly unlikely that the operational disturbance would have a measurable effect on the non-breeding population.

Table A11.29. Characterising the likely magnitude of operational displacement on hen harriers.

Parameter	**Assessment**
Extent	None or negligible
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during winter
Probability	No effect likely

Summarising, it is considered that disturbance due to operation of the development would have long-term adverse effects of negligible magnitude on hen harrier. Although hen harrier is a species of high nature conservation importance (see Table 11.7) it is judged that these effects would be **not significant** under the terms of the EIA Regulations.

A11.12.6 Hen harrier collision impacts

Examination of previous studies of hen harrier mortality at operational windfarms indicates that lethal strikes are rare, even at a windfarm where mortality rates of some raptors are renowned for being particularly high (e.g. Altamont, USA) (Whitfield and Madders 2006).

It is worth noting with respect to this finding that observed harrier activity levels at the proposed Viking windfarm were several orders of magnitude lower than has been documented at those operational windfarms where collision mortality has been studied and illustrated to be negligible or absent (Whitfield and Madders 2006).

Hen harriers were recorded flying at 10-50m elevation above the ground for a total of 161 secs during 1374 hours (<0.01%) of generic VP observation in 2003-07, and for a total of 159 secs during 43 hours (0.1%) of winter roost observation in 2005-06 (Appendix A11.1). No flight activity at higher elevations was recorded. Most of the recorded activity would have occurred below the RSH of the proposed turbines (see Whitfield and Madders 2006; Fig. 2). Very little of the flight activity seen during baseline surveys was in areas where turbines are proposed (Appendix A11.1 Figs 77 and 89). Furthermore the winter roost observations did not indicate that the proposed windfarm area was used for roosting or as a gathering site (when they are more likely to fly at RSH) prior to roosting.

Table A11.30. Characterising the likely magnitude of collisions on hen harriers.

Parameter	Assessment
Extent	Very low
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during winter
Probability	No likely effect

In conclusion, taking into account the low vulnerability of hen harriers to turbine collision apparent from previous studies and the small amount of time that birds would be potentially at risk from the proposed development, it is considered that potential collision mortality would have long-term adverse effects of negligible magnitude on hen harrier. Although hen harrier is a species of high nature conservation importance, it is judged that these effects would be **not significant** under the terms of the EIA Regulations.

A11.12.7 Significance evaluation – combined effects on hen harrier

The combined effects of land-take, construction and operational activities are negligible and judged most likely to be not significant (i.e. no detectable population level effects – although it should be noted that the Shetland NHZ does not have a population of hen harriers, so a FCS assessment cannot be conducted). Consequently, no population modelling was conducted for this species.

A11.12.8 Mitigation/Enhancement

As a result of no significant effects on hen harrier being predicted, additional mitigation and enhancement was considered unnecessary. However, roost site disturbance avoidance measures will be implemented during construction if pre-commencement surveys show any birds to be roosting within 500m of construction activity.

A11.12.9 Residual effects on hen harrier

It is considered that the magnitude of the residual effects on hen harrier due to windfarm construction and operational activities is most likely to be negligible. Although hen harrier is a species of high Nature Conservation Importance, the likely residual effects are judged to be **not significant** under the terms of the EIA Regulations.

A11.13 GOLDEN PLOVER

A11.13.1 Background

Golden plovers are medium-sized waders that are common breeding summer visitors, very common passage migrants and fairly common winter visitors to Shetland (Pennington *et al.* 2004). They are widespread breeding birds in the uplands of Scotland, particularly in the Highlands and Islands. The current Scottish breeding population is estimated at 15,000 pairs, which represents 80% of the British breeding population (Forrester *et al*. (eds) 2007). The national conservation status of golden plover is judged to be currently favourable, with the BTO 2009 Breeding Bird Survey report showed the greatest year on year species increase was 58% for golden plover. Its European conservation status has recently been evaluated as *Secure*, with population estimates suggesting 460,000-740,000 pairs, which equates to 50-74% of the global population (Birdlife International 2004).

The only estimate of the Shetland golden plover population was made following a series of moorland surveys in the late 1980s. It concluded with a total population estimate of 1,450 pairs, approximately 6% of the British population (Pennington *et al.* 2004).

The main threats to breeding golden plover in the UK are related to conversion of moors to grass and predation (Forrester *et al*. (eds) 2007). The effects of climate change on the phenology of crane-fly life cycles has also been suggested as a potential threat as this could lead to food shortages and reduced breeding performance (Pearce-Higgins *et al.* 2009).

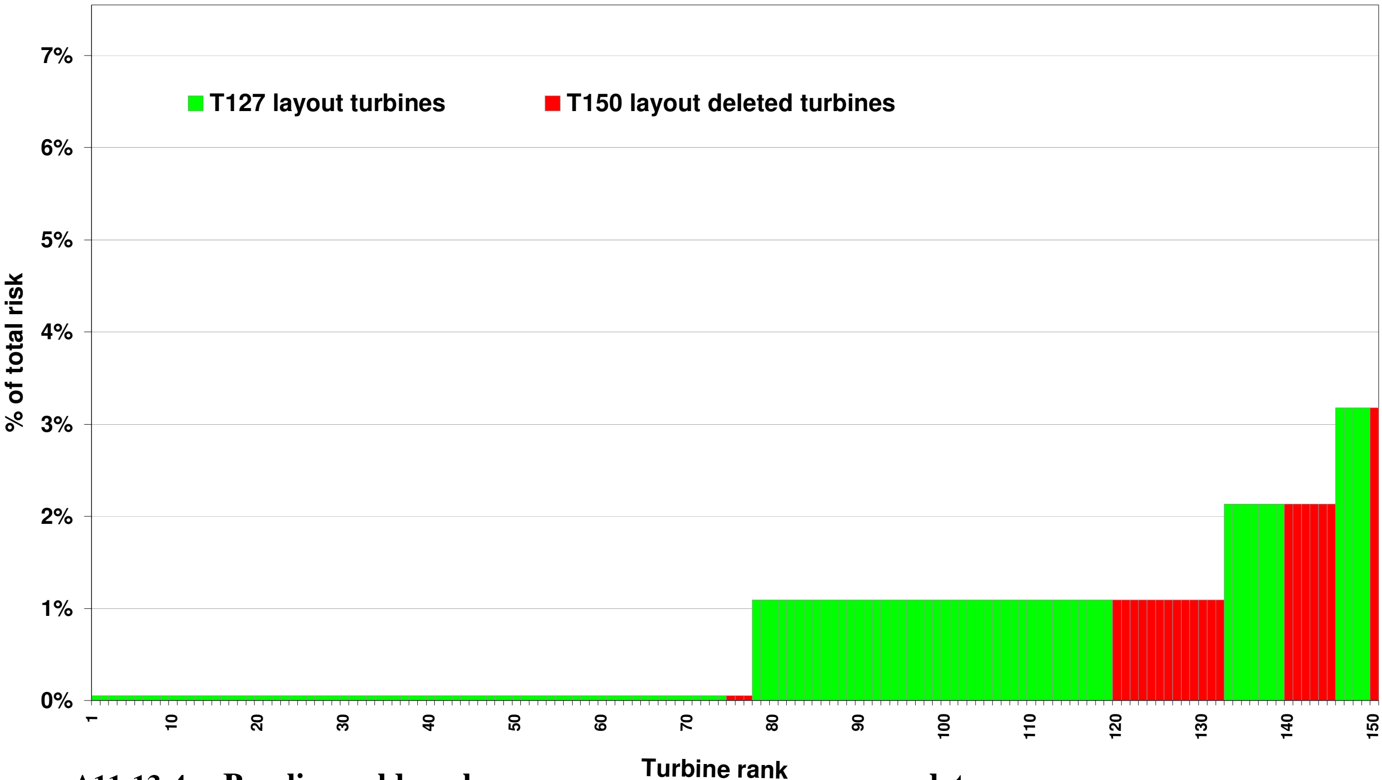
A11.13.2 Assumed conservation status

On balance, the weight of recent evidence suggests that the Shetland golden plover population currently has a Favourable Conservation Status, with the most recent BBS survey indicting at 7 year high of 0.58 pair/square in 2008 (Shetland Bird Club 2009).

A11.13.3 Golden plover influences on design change

The 2009 ES layout avoided some potential golden plover issues through design planning. However, golden plover are common across almost all parts of the Viking study area. As a consequence, it is not possible to build a large-scale windfarm without some golden plovers potentially being affected. Therefore, golden plovers were a secondary design factor in terms of layout changes rather than a primary one. The predicted effects of construction and operation of the windfarm arising from the 127-turbine layout are less than those previously predicted in the 2009 ES. For example, the predicted annual collision deaths of golden plover for the 127-turbine layout are 28.4% of those that were predicted for the 150-turbine layout in the 2009 ES. The primary reasons for this reduction are the deletion of 23 turbines (e.g. including the entire Collafirth quadrant) and taking into account displacement effects. Furthermore, recent evidence from properly designed before and after studies have shown little or no effects of operational wind farm infrastructure on golden plover distribution and numbers (e.g. Fielding and Haworth 2010), so it could be argued that there is no particular need take them into account when carrying out design changes.

Illustration A11.5. Turbine risk histogram for golden plover



A11.13.4 Baseline golden plover data

(a) Surveys

Breeding golden plover were surveyed by generic moorland bird surveys. Flight activity was quantified by the programme of generic VP watches. Full details on all baseline surveys work for golden plover is provided in Appendix A11.1.

(b) Results

Most golden plovers using the Viking survey area are either breeding visitors or passage migrants. A very few birds use the development site during the winter, when they prefer lowland pasture (Appendix A11.1).

<u>Breeding sites</u>

Approximately 81 pairs of golden plover breed within 500m of the proposed turbines, tracks and other features of site infrastructure (Fig. 11.8) (there were 90 under the previous 2009 ES layout). This represents 0.4% of the UK breeding population and 5.6% of the Shetland breeding population. The breeding territories are located mostly in the Delting and Kergord quadrants:

Quadrant	Territories
Delting	29
Kergord	30

Nesting (N)	12
Nesting (S)	10
Total	**81**

Nineteen nominal territory centres were located within 250m of the proposed turbines, with the nearest as close as approximately 50m.

Flight activity

During 1374 hours of generic VP observation overlooking the development site flying golden plover were recorded for 3.9% of the time (2.4% after correction for monthly variation in observation effort). Approximately one third of the annual flight activity observed occurred outside the breeding season (taken to be mid March to end of July) and birds present at these times are likely to be passage or wintering birds from different breeding populations. Approximately 62% of flight activity was at the RSH of the proposed turbines (Appendix A11.1: Table 26). Detection trials indicated that less than one third of flights by golden plovers beyond 500m were detected by observers (Appendix A11.1: Table 25). Allowing for this bias and considering data only from VPs overlooking the 127-turbine layout, the mean annual flight activity at RSH was estimated to be 3021 bird secs/ha/yr.

(c) **Do nothing scenario**

With only one published breeding golden plover population estimate (Pennington *et al.* 2004) it is not possible to determine trends in the Shetland golden plover population. However, routine monitoring by the BTO BBS shows that numbers in Scotland, including samples from Shetland, have increased in recent years.

In Shetland, it possible that the degradation of blanket bog habitats by over-grazing may have caused golden plover to decline. However, there is no direct evidence to support this and golden plovers do not seem to be sensitive to moderate peatland erosion. Rather, a reduction in moorland sheep density, something that has been predicted for the future but which might not occur due consolidation of crofting units, may cause the average sward height of moorland vegetation to increase, possibly to the detriment of golden plover, a species that requires relatively short vegetation. However, in Shetland, the short moorland vegetation this species favours may result from high wind in the most exposed areas as well as grazing pressure. Therefore, the likely 'do nothing' scenario is for the Shetland golden plover population to maintain itself at current levels or possibly decline either as a result of widespread increases to vegetation height (if sheep grazing is significantly reduced) or climate induced changes to food supply.

A11.13.5 Golden plover habitat loss/modification

(a) **Habitat requirements**

In Shetland, golden plovers predominantly breed on blanket bog and other moorland, and on serpentine heaths on Unst and Fetlar. Breeding birds prefer relatively short moorland vegetation, especially flat areas and hill summits. Breeding birds may also use short lowland pasture for feeding though this was not commonly observed on Central Mainland during baseline surveys. Passage birds predominantly occur on pasture and low altitude short moorland.

(b) **Land take effects**

Based on the mean density of breeding birds within 250m of the proposed site infrastructure, it is estimated that habitat loss would result in the potential loss of two pairs of golden plover, at most. This represents approximately 0.1% of the regional population. However, golden plover do not appear to be particularly sensitive to localised reductions in the water table, or even moderate peat erosion. Indeed, breeding golden plover use many types of moorland habitat including dry areas and show a preference for short vegetation (Whittingham *et al* 2000, Pearce-Higgins and Grant 2006). Therefore, the most likely magnitude of any adverse effects on golden plover due to habitat loss would be negligible. It is therefore judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

Table A11.31. Characterising the likely magnitude of land take on golden plovers.

Parameter	Assessment
Extent	Small losses equivalent to the size of two territories
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Irreversible
Frequency	One-off event
Probability	Likely

Construction, in particular the access tracks, is predicted to result in modest, localised hydrological change in the adjacent peatland habitats. Golden plover do not appear to be particularly sensitive to localised reductions in the water table, or even moderate peat erosion. Indeed, breeding golden plover use many types of moorland habitat including dry areas and show a preference for short vegetation (Whittingham *et al* 2000, Pearce-Higgins and Grant 2006). Therefore, the likely magnitude of any adverse effects on golden plover due to habitat modification would be negligible. It is therefore judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

A11.13.6 Golden plover disturbance impacts

(a) **Construction disturbance**

Golden plovers are judged to have moderate sensitivity to disturbance (Table 11.9) and therefore construction works would potentially displace some birds from suitable nesting areas, possibly resulting in reduced site productivity. For the purposes of this assessment it is assumed that golden plovers nesting within 250m of construction work sites would experience some disturbance from construction activities. This is likely to be cautious. Baseline surveys indicate that 58 pairs typically breed within this assumed displacement zone (refer to Fig. A11.8). Construction works are expected to proceed in a phased manner across the development site a four year period. Therefore, with the possible exception of vehicular movements along the new tracks, it is unlikely that golden plover within the assumed construction disturbance zone would be affected in more than one year. For the purposes of this assessment it is assumed that ~15 pairs would be affected in any one year, representing approximately 1% of the regional population. It is assumed that affected territories would experience a 50% reduction in breeding performance during the year of disturbance. This analysis suggests that construction works would result in a reduction by approximately 0.5% in the regional (Shetland) young production for a period of four years. No longer-term consequences are anticipated. In view of the above, it is considered unlikely that construction disturbance would have a material effect on the regional population of breeding golden plover.

Migrant foraging and roosting birds would be potentially displaced from localised areas around construction work sites during the spring and autumn. However, the characteristics of the development site are typical of many upland areas in Shetland and it is reasonable to expect that migrant golden plovers would find alternative foraging and roosting habitat, free from disturbance, elsewhere in the Shetland NHZ. Moreover, most migrant golden plovers are likely to use lower elevation pasture habitats, peripheral to the development site. In view of the above, it is considered unlikely that construction disturbance would have a material effect on populations of migrating golden plover.

Table A11.32. Characterising the likely magnitude of construction disturbance on golden plovers.

Parameter	Assessment
Extent	Some disturbance of up to 15 pairs per year leading to reduced breeding success
Effect	Direct
Duration	Over a 4 year period
Reversibility	Reversible once construction stops (if assume pairs do not move elsewhere)
Frequency	One off effect
Probability	Possible

Summarising, it is considered that construction works would have short-term adverse effects of low magnitude on golden plover. Although golden plover is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

(b) **Operational disturbance**

Golden plovers are judged to have moderate sensitivity to disturbance and therefore it is possible that some breeding birds would be displaced by the operation of the development (see Impact prediction techniques approach A11.4.2). Pearce-Higgins *et al* (2008) found that the density of breeding golden plover was apparently lower at operational windfarms than at similar sites without windfarms, and that habitat within 200m of operational turbines was used significantly less than comparable habitat further away. There was additional evidence for avoidance of tracks, although this effect was less strong.

Three studies at three different UK windfarms have examined how the numbers and distribution of breeding golden plover have changed over a series of years following windfarm construction (Percival 2000, Fielding and Haworth 2010, Douglas, Bellamy and Pearce-Higgins 2010). These studies all used a Before-After-Control-Impact study design framework to establish how golden plover have responded to individual wind farm developments. This approach overcomes some of the limitations inherent in the RSPB multi-site study (Pearce-Higgins *et al* 2009), which lacked any before *vs.* after component. The results of the three studies are consistent with each other but contrast with the results of the RSPB study. In two of three studies the number of golden plover increased during the operation of the wind farm, and in the third numbers remained unchanged. All studies found no evidence for any disturbance effects with regard to the distribution of territories and nest sites (where examined) with respect to turbines or other infrastructure, and no evidence that there was either immediate or delayed displacement effects. Overall, the conclusion from these studies was no biologically significant decline in the number of golden plover or change in distribution patterns related to windfarm infrastructure and operation. The reason why these studies found no evidence for displacement effects whereas the RSPB study did find evidence of displacement is unknown, though the limitations in the RSPB study (discussed previously) may have contributed to the discrepancy. As noted by Douglas, Bellamy and Pearce-Higgins (2010), the results clearly indicate that under some circumstances, at least, golden plover can be more tolerant of windfarm infrastructure than suggested by results in Pearce-Higgins *et al* 2009. This would mean that results on the response of golden plover at one site are not a reliable predictor of how they respond at another site. However, overall the consistency of the three studies undertaken with a more robust study design strongly suggest that golden plover are less affected by displacement than the suggested by the RSPB study. Indeed, on the basis of the results from the three studies the proposed Viking windfarm is likely to have no biologically significant displacement effects on golden plover.

For the purposes of this assessment it is assumed that 50% of golden plovers would be displaced from areas within 200m of operating turbines and 100m of tracks. Baseline surveys indicate that this would equate to the displacement of 8 pairs of golden plover (refer to Fig. A11.8). If it is assumed, on a cautious basis, that the pairs occupying these territories do not relocate and breed elsewhere then this suggests that operational disturbance would result in a reduction of approximately 0.6% in the regional (Shetland) breeding population. The studies at Farr and Beinn Tharsuinn wind farms (Fielding and Haworth 2010, Douglas, Bellamy and Pearce-Higgins unpublished 2010) found no evidence of displacement of golden plover. Therefore, the actual magnitude of displacement for golden plover is likely to be less than indicated, possibly greatly so.

The breeding success of golden plover nesting outside the assumed displacement zone would be potentially affected if birds were displaced from critical foraging/chick rearing habitat. However, no aggregations of feeding golden plover were located within the development site during baseline surveys, and chick rearing areas are likely to be close to the identified territory centres. Therefore, it seems reasonable to assume that the magnitude of this displacement effect is likely to be negligible.

Foraging and roosting migrant golden plover would be potentially displaced from localised areas during the spring and autumn. The indirect loss of habitat due to operational disturbance would be less than that during the construction period (see above). Studies at operational windfarms indicate that migrant golden plover are little affected by operational turbines. Indeed, at Penrhyddlan and Llidiartywaun (central Wales) migrant golden plovers occupied the southern part of the windfarm, apparently in preference to the surrounding moorland and grazed pastureland (ScottishPower, 2008). Similarly, at Hare Hill Windfarm, Ayrshire, activity by up to 230 migrant golden plover was found to be focussed on the operational windfarm, with groups of up to 40 birds roosting at the base of the operating turbines (Shepherd 2002, 2003). Moreover, as noted previously, most migrant golden plovers are likely to occupy pasture habitats, peripheral to the development site. Overall, it is considered highly unlikely that operation of the development would have a material effect on migrant golden plovers passing through Shetland.

The proposed access tracks could in theory result in greater human activity associated with agriculture and recreation within the development site. Human disturbance has been shown to have a negative effect on golden plovers. For example, Finney *et al* (2005) found evidence of avoidance extending up to 200m from heavily used footpaths, but also that birds habituated to disturbance. However, any additional use is likely to involve infrequent vehicular traffic, and this is unlikely to have a material effect on golden plovers. Similarly, it is not envisaged that the currently low levels of recreational and agricultural use would increase appreciably as result of the development.

Table A11.33. Characterising the likely magnitude of operational disturbance on golden plovers.

Parameter	Assessment
Extent	Highly cautious estimate of up to 8 pairs displaced. Habituation may reduce effect with time.
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning (if assume pairs do not move elsewhere)
Frequency	On-going effect during breeding season
Probability	Possible

Summarising, it is considered that disturbance due to operation of the proposed development would have long-term adverse effects of <u>negligible</u> magnitude on golden plover. Although golden plover is a species of high nature conservation importance the numbers potentially affected by displacement are well below the threshold for regional importance. Therefore, it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.13.7 Golden plover collision impacts

Employing data collected during timed VP watches (corrected for detection bias) and assuming 98% avoidance, CRM estimated that 17.8 golden plover per year would be killed (Appendix A11.3). This represents 0.61% of the regional breeding population. The numbers potentially killed annually are expected to change in direct proportion to any change in numbers that breed on the windfarm. However, approximately one third of the annual flight activity observed occurred outside the breeding season (taken to be mid March to end of July) and birds present at these times are likely to be passage or wintering birds from different breeding populations. Therefore, the actual percentage of the breeding population affected by collision is likely to be proportionately less, approximately 0.5%. On average approximately 522 adult golden plover in the regional breeding population die annually due to existing causes of mortality, based on an adult survival rate of 82% (Piersma *et al.* 2005).

The predicted annual collision deaths of golden plover for the 127-turbine layout are 28.4% of those that were predicted for the 150-turbine layout in the 2009 ES. The primary reasons for this large reduction are the deletion of 23 proposed turbines and allowing for displacement by assuming a 50% reduction in flight activity in the vicinity of turbines. Small reductions also result from using a more accurate method for accounting for distance detection effects and from accounting for differences in the breeding bird density in the areas overlooked by VPs and the vicinity of turbines (Appendix A11.1).

The predicted collision rates presented above use data that were corrected for distance-detection effects (Appendix A11.2). If this correction had not been made the predicted average annual mortality would be reduced to 2.0 birds (i.e. 11.3 % of prediction based on the corrected data). This value provides a basis for comparison with other windfarm assessments where data were not corrected for detection effects.

Collision deaths of golden plover (and other wader species) are probably far rarer events than predicted by CRM using a 98% avoidance rate as the true avoidance rate is likely to be greater, possibly substantially so (Whitfield 2007). The 98% avoidance rate is not based on empirical evidence but is a little better than a cautious guess that SNH have indicated is acceptable to use. Attempts have been made to calculate avoidance rates for some other species based on observational data and these show that true avoidance rates are greater than previously assumed. For example, SNH have accepted the use of a 99% avoidance rate for geese and eagles, groups of birds species that clearly have poorer agility in flight than waders. It is likely, and would be consistent with empirical evidence, that the actual avoidance rates by waders substantially exceeds 99%.

Table A11.34. Characterising the likely magnitude of collision on golden plover.

Parameter	**Assessment**
Extent	Up to ca 12 birds p.a. (98% avoidance rate and with distance-detection correction applied)
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during year
Probability	Probable

Summarising, it is considered that collisions with the turbine rotors would have long-term adverse effects of negligible/low magnitude on golden plover. Although golden plover is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

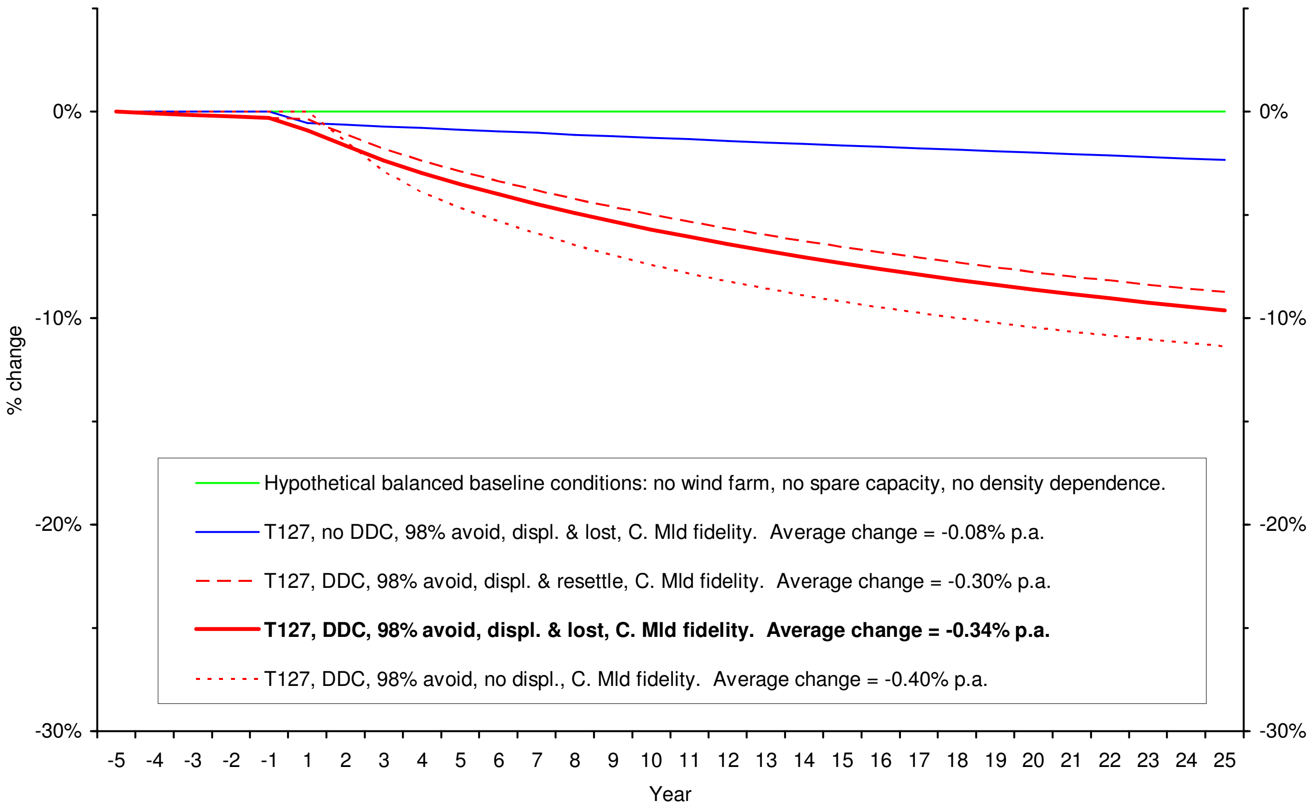
A11.13.8 Significance evaluation – combined effects on golden plover

In summary:

- Habitat loss/modification as a consequence of land take is predicted to cause the loss of two territories.
- Construction disturbance is predicted to reduce the regional (Shetland) young production by approximately 0.5% in for a period of four years.
- Operational disturbance resulting in the long-term displacement of 8 pairs, approximately 0.6% in the regional (Shetland) breeding population. For the purposes of this assessment displaced birds are assumed not to successfully resettle elsewhere. This is cautious and perhaps unrealistic as there is little evidence that habitat is limiting the regional population size.
- CRM for a 98% avoidance rate and allowing for a 50% reduction in flight activity in the vicinity of turbines due to displacement predicts that 17.8 golden plover per year would be killed, representing 0.5% of the regional breeding population.

Deterministic modelling indicates that the combined effects of operational disturbance and predicted collision mortality could cause a regional population decline rate averaging 0.34% per annum over the lifetime of the windfarm if the baseline population was perfectly balanced i.e. it has no spare capacity (Appendix A11.4).

Illustration A11.6. Deterministic population model for golden plover



The extent of spare capacity in the Shetland golden plover population is unknown as are long-term population trends. However, had there been a large recent decline (e.g. as there has been for whimbrel and arctic skua) then this would have become apparent during baseline survey work. Nationwide the BTO Breeding Bird Survey results for the period 1995 to 2009 show a non-significant small decline in golden plover numbers, indicating that numbers are approximately stable. There is no evidence that the trend for the Shetland population has been different. Although it is likely that the regional golden plover population has some spare capacity this may not be sufficient to fully offset the effects of collision mortality predicted above.

The magnitude of effects has been predicted using cautious assumptions. The recent BACI studies from Farr and Beinn Tharsuinn wind farms indicate that golden plover may be far more tolerant of windfarms than previously assumed and suggested by the Pearce-Higgins *et al.* (2009); at neither site was there any evidence of an effect on the windfarm population. Furthermore, collision mortality, the effect that contributes most to the overall effect was estimated using an assumed avoidance rate value of 98%, a value that is likely to be well below the true value and which is essentially a conservative guess, albeit one that SNH have indicated would be acceptable to use. Therefore, the actual magnitude of adverse effects on golden plover at Viking is most likely to be considerably smaller than predicted by the assessment protocol.

Population models show that the main driver of the overall predicted effect of the windfarm on golden plover is collision mortality and not displacement. The main reason why predicted collision mortality is relatively high compared to predictions from other windfarms is because the flight data were corrected for distance-detection biases (and not because golden plover densities are unusually high). Making this correction effectively causes a nine fold increase in the predicted collisions. Whereas as it is clearly desirable to correct for known bias the effect of doing so needs to be weighed against other bias remaining, in particular the bias caused by using an inappropriately cautious avoidance rate. Had flight activity data not been corrected for detection bias the magnitude of all effects combined on the regional population would be rated as negligible (see population model graph).

On the basis of the size of affects predicted by the assessment protocol (using what appear to be highly cautious assumptions) the predicted effect of the windfarm and assuming that any spare capacity is insufficient to fully offset the effect then the windfarm could cause a regional population change of 1-5% over the lifetime of the windfarm. This would warrant classification as an effect of low/moderate magnitude. However, in light of the evidence from Farr and Beinn Tharsuinn wind farms combined with the clear inappropriateness of a 98% avoidance rate (Whitfield 2007) this is judged to be unrealistically pessimistic. More realistically, the magnitude of the effect on the regional population is likely to be at the lower end or below the range indicated. This would mean overall the magnitude of effects would be judged as low and be unlikely to be detectable. Given the uncertainties over recent population trends and extent of spare capacity it is unknown how a small adverse effect would affect Favourable Conservation Status, but any affect is likely to be small at most.

In view of the above, the overall the effects of windfarm construction and operation are predicted to have long-term adverse effects of low magnitude on golden plover and it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.13.9 Mitigation/Enhancement

As a result of no significant impacts on golden plover being predicted, additional mitigation and enhancement was considered unnecessary. Certain not-significant effects are reduced further by habitat restoration and management measures and in particular crow control measures set out in the HMP. Hooded crows are currently at their highest ever levels according to the most recent BBS in 2008 (Shetland Bird Club 2009). These HMP measures are expected to fully offset the adverse, but not significant, effects caused by the windfarm (Appendix A10.9).

A11.13.10 Residual effects on golden plover

It is considered that the magnitude of the residual effects on golden plover due to windfarm construction and operational activities is likely to be negligible. Although golden plover is a species of moderate Nature Conservation Importance, the residual effects after mitigation are judged to be **not significant** under the terms of the EIA Regulations, i.e. there will be no detectable regional population level effects and so the FCS of the Shetland NHZ will not be adversely affected. Therefore, if the Viking Wind Farm is built, the available information indicates that FCS will not be affected because:

- Golden plover will maintain itself on a long-term basis as a viable component of its habitat in Shetland;
- The natural range of golden plover in Shetland will not be reduced by the wind farm, nor will it become it likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain golden plover populations on a long-term basis.

Furthermore, HMP measures for waders (particularly crow control, see Appendix A10.9) could shift residual effects in a positive direction i.e. the population of this species would benefit from the Viking Wind Farm.

A11.14 LAPWING

A11.14.1 Background

Lapwings are medium-sized waders, which are common breeding visitors and passage migrants, and fairly common winter visitors to Shetland (Pennington *et al*. 2004). They are common and widespread residents and migrants in Scotland, in winter moving to lower ground and estuaries, some emigrating to Ireland and the continent. The Scottish breeding population is estimated at 71,500-105,000 pairs, 52-66% of the UK total (Forrester *et al.* (eds) 2007). Its European conservation status has recently been evaluated as *Vulnerable*, with population estimates suggesting 1.7-2.8 million pairs despite declines, which equates to 50-74% of the global population estimate (Birdlife International 2004).

Three estimates have been made of lapwing populations in Shetland, using different methods and these show no clear trends with estimates varying from 1,740 to 2,600 pairs (Pennington *et al.* 2004). Elsewhere, lapwing abundance and breeding success have been well studied and shown to be significantly affected by land management practices and predation, but causes are complex and often vary across sites (e.g. Jackson 2004, Ausden *et al.* 2009, Bodey *et al.* 2010).

A11.14.2 Assumed conservation status

On balance, the weight of recent evidence suggests that the Shetland lapwing population is probably stable and so currently has a Favourable Conservation Status, with the most recent BBS survey indicting slight decline in recent years, but at similar levels to 2002 of 1.38 pair/square in 2008 (Shetland Bird Club 2009).

A11.14.3 Lapwing influences on design change

No specific lapwing mitigation has influenced the 2010 127-turbine layout, although the decrease in number of turbines and track length has reduced the number of pairs of lapwing potentially affected by the Viking Wind Farm.

A11.14.4 Baseline lapwing data

(a) Surveys

Breeding lapwing were surveyed by generic moorland bird surveys. Flight activity was quantified by the programme of generic VP watches. Full details on all baseline surveys work for lapwing is provided in Appendix A11.1.

(b) **Results**

Lapwings are mostly breeding visitors to the Viking development site, present during the period February-October.

Breeding sites

Approximately 54 pairs of lapwing breed within 500m of the proposed turbines, tracks and other features of site infrastructure (Fig. 11.9) (there were 65 under the 2009 ES layout). This represents less than 0.1% of the UK breeding population and 3.1% of the Shetland breeding population.

Quadrant	Territories
Delting	11
Kergord	25
Nesting (N)	8
Nesting (S)	10
Total	54

Only four territory centres were located within 250m of the proposed turbines, with the nearest as close as 140m.

Flight activity

Flying lapwings were recorded for 4.8% of generic VP observation time (3.6% after correction for monthly variation in observation effort)[1], mainly during the period May-July. Most of these flights were in low level areas (valley bottoms) away from potential turbine locations.

(c) **Do nothing scenario**

The recent population trend for breeding lapwing in Shetland is unclear due to the conflicting results of past surveys and the use of different survey methods. There is some evidence that there have been localised declines in the past (probably linked to agricultural intensification) but there is no evidence that this continues. It is perhaps reasonable to assume that the lapwing population will remain stable if land management practices remain unchanged. Widespread agricultural intensification would likely to lead to population decline.

A11.14.5 Lapwing habitat loss/modification

(a) **Habitat requirements**

Lapwings breed on damp pasture, in-bye land and wet moorland. Lapwings typically avoid nesting in better drained and intensely grazed pasture land, as this provides little cover or invertebrate food for chicks (Pennington *et al.* 2004).

(b) **Land take effects**

Based on the mean density of breeding lapwings within 500m of the proposed site infrastructure, it is estimated that habitat loss caused by windfarm infrastructure land-take would result in the potential loss of 1.6 pairs of lapwing. This represents <0.1% of the Shetland lapwing population. It is therefore considered that the most likely magnitude of adverse effects on lapwing due to direct habitat loss would be negligible, and it is judged these effects would most likely be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

Construction, in particular the access tracks, is predicted to result in modest, localised hydrological change in the adjacent peatland habitats (the majority of habitat affected). Lapwings are not particularly sensitive to localised reductions in the water table, or even moderate peat erosion (preferring non-peatland habitats) and indeed are found across a wide variety of human modified habitats Therefore, the likely magnitude of any adverse effects on lapwing due to indirect habitat modification would be negligible. It is therefore judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

A11.14.6 Lapwing disturbance impacts

(a) Construction disturbance

Breeding lapwings are judged to have moderate sensitivity to disturbance (Table 11.9) and therefore construction works could potentially disturb some birds, possibly resulting in reduced site productivity. It is also clear that lapwing can show a high tolerance to machinery disturbance as shown by pairs breeding on arable farmland, which are regularly disturbed by farm machinery, and within 50m of busy roads both in Shetland and elsewhere in Scotland.

For the purposes of this assessment it is assumed that lapwings nesting within 250m of construction work sites would be temporarily disturbed and that as a result these would experience a 50% reduction in breeding performance. This is likely to be highly cautious. Baseline surveys indicate that 24 pairs typically breed within this assumed displacement zone (Fig A11.9). It is unlikely that lapwing territories within the disturbance zone would be affected in more than one year. For the purposes of this assessment it is assumed that ~6 pairs would be affected in any one year and experience a 50% reduction in breeding performance.

This analysis suggests that at most, construction works would result in the regional (Shetland) productivity of lapwing being reduced by up to 0.2% for a period of four years. No longer-term consequences are anticipated.

Table A11.35. Characterising the likely magnitude of construction disturbance on lapwings.

Parameter	Assessment
Extent	Some disturbance of up to 6 pairs per year potentially leading to reduced breeding success
Effect	Direct
Duration	Over a 4 year period
Reversibility	Reversible once construction stops
Frequency	One off effect
Probability	Possible

In view of the above, it is considered that construction works would have short-term adverse effects of negligible magnitude on lapwing. Although lapwing is a species of low/moderate nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

(b) **Operational disturbance**

Breeding lapwings are judged to have moderate sensitivity to disturbance and therefore operation of the development would potentially displace some birds from suitable nesting areas, possibly resulting in reduced site productivity (see Impact prediction techniques approach A11.4.2). The RSPB study into the affects of windfarms on upland birds indicated that lapwings were only slightly affected by displacement and less so than the other species of wader studied (Pearce Higgins *et al* 2009).

For the purposes of this assessment it is assumed that 50% of nesting and foraging lapwing would be displaced from areas within 200m of operating turbines and from areas within 100m of tracks. Baseline surveys indicate that this would equate to the displacement of 3.5 pairs of lapwing (refer to Fig. A11.9). Following the example of golden plover, this suggests that operational disturbance would result in a reduction of approximately 0.2% in the regional (Shetland) breeding population.

Table A11.36. Characterising the likely magnitude of operational disturbance on lapwings.

Parameter	Assessment
Extent	Up to 3.5 pairs displaced. Habituation may reduce effect with time.
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning (if assume pairs do not move elsewhere)
Frequency	Throughout each breeding season
Probability	Possible

In view of the above, it is considered that disturbance due to operation of the development would have long-term adverse effects of negligible magnitude on lapwing. Although lapwing is a species of low/moderate nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.14.7 Lapwing collision impacts

Very little flight activity was recorded during timed generic VP watches in locations with proposed turbines, consequently the likelihood of collision was considered negligible. This reflects that few breeding territories are located close to proposed turbine locations; most of the lapwings located in baseline surveys were at low elevations. No CRM was carried out as this was considered unnecessary given the lack of flight activity within the potential turbine zone. It is judged that collision effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.14.8 Significance evaluation – combined effects on lapwing

In summary:

- Construction disturbance, predicted to reduce regional (Shetland) young production by approximately 0.2% for a period of four years.
- Operational disturbance resulting in the long-term displacement of up to 3.5 pairs of lapwing, approximately 0.2% in the regional (Shetland) breeding population. Displaced birds are, for the purpose of this assessment, assumed not to successfully resettle elsewhere. This is cautious as there is little evidence that habitat is limiting the regional population size.
- Collision mortality was considered negligible due to a lack of flight activity within the vicinity of proposed turbines.

The combined likely effects of land-take, construction and operational activities are negligible and judged to be **not significant**, i.e. no detectable population level effects on the Shetland NHZ. Consequently, no population modelling was conducted for this species.

A11.14.9 Mitigation/Enhancement

As a result of no significant impacts on lapwing, specific mitigation and enhancement was considered unnecessary. However, several of the measures set out in the HMP, in particular crow control, are expected to benefit lapwing and fully offset the not significant adverse effects caused by the windfarm (Appendix A10.9). Hooded crows are currently at their highest ever levels according to the most recent BBS in 2008 (Shetland Bird Club 2009).

A11.14.10 Residual effects on lapwing

It is considered that the magnitude of the residual effects on lapwing due to windfarm construction and operational activities is likely to be negligible. Although lapwing is a species of low-moderate Nature Conservation Importance, the likely residual effects after mitigation are judged to be **not significant** under the terms of the EIA Regulations, i.e. there will be no detectable regional population level effects and so the FCS of the Shetland NHZ will not be adversely affected. Therefore, if the Viking Wind Farm is built, the available information indicate that FCS will not be affected because:

- Lapwing will maintain itself on a long-term basis as a viable component of its habitat in Shetland;
- The natural range of lapwing in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain lapwing populations on a long-term basis.

Furthermore, HMP measures for waders (particularly crow control) could shift residual effects in a positive direction i.e. the Shetland lapwing population could significantly benefit from the Viking Wind Farm.

A11.15 DUNLIN

A11.15.1 Background

Dunlin are small waders that in Scotland, including Shetland, are common summer breeding visitors to blanket bog and short native grassland and common passage migrants and winter visitors from the Arctic to estuaries and bays (Pennington *et al.* 2004). Dunlin breeding in the UK are of the sub-species known as 'southern dunlin' (*Calidris alpine schinzii*) and this sub-species is listed on Annex 1 of the Birds Directive. This sub-species overwinters in West Africa.

The current Scottish breeding population is estimated at 8,000-10,000 pairs, which represents 85% of the UK breeding population (Forrester *et al.* (eds) 2007). The European conservation status of dunlin (no distinction is made for *Calidris alpine schinzii*) has recently been evaluated as *Depleted*, with population estimates suggesting 300,000-570,000 pairs, which equates to 25-49% of the global population estimate (Birdlife International 2004).

In 1987, the Shetland dunlin population was estimated at 1,700 pairs. In Shetland, dunlin breed on blanket bog, particularly in the northern half of Mainland and in the north isles. Most dunlins arrive back on territory in early-mid May. The first eggs are laid from mid May to mid June on blanket bog habitats and the first chicks hatch in early June. Dunlins have left the breeding grounds by mid-August (Pennington *et al.* 2004).Threats to breeding dunlin include predation and habitat degradation and loss (Forrester *et al.* (eds) 2007).

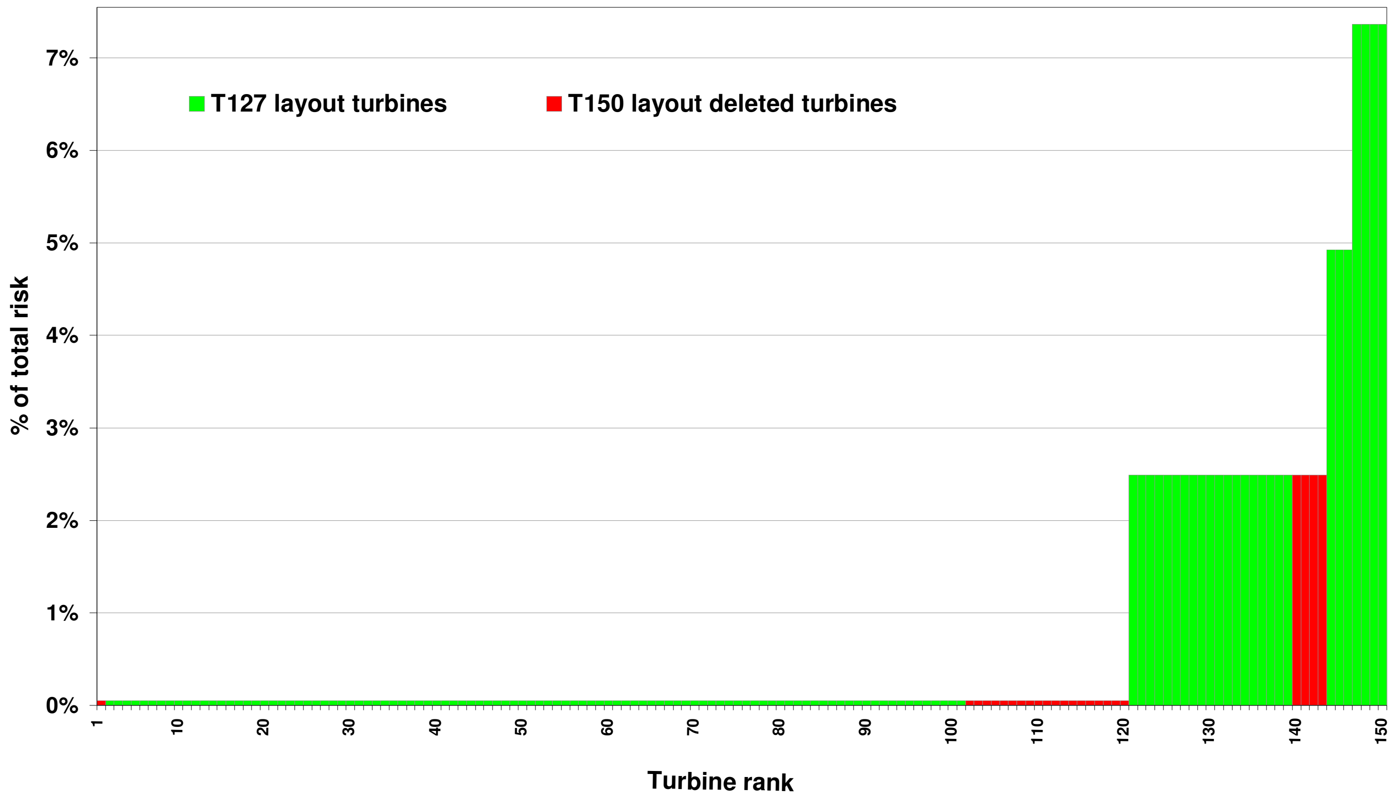
A11.15.2 Assumed conservation status

On balance, the weight of recent evidence suggests that the Shetland dunlin population is probably stable or possibly increasing and so has a Favourable Conservation Status, with the most recent BBS survey indicting at 7 year high of 0.31 pair/square in 2008 (Shetland Bird Club 2009).

A11.15.3 Dunlin influences on design change

The 2009 ES layout avoided some potential dunlin issues through design planning. However, dunlin are common across the Viking study area. As a consequence, it is not possible to build a large-scale windfarm without some dunlins potentially being affected by the layout. Therefore, dunlin were a secondary design factor in terms of layout changes rather than a primary one. The predicted effects of construction and operation of the windfarm arising from the 127-turbine layout are less than those previously predicted in the 2009 ES. For example, the predicted annual collision deaths of dunlin for the 127-turbine layout are 8% of those that were predicted for the 150-turbine layout in the 2009 ES. The primary reasons for this 92% reduction are the deletion of 23 turbines from areas used by dunlin (e.g. including the entire Collafirth quadrant) and properly accounting for displacement effects and differences in breeding density between areas over looked by VPs and areas close to turbines.

Illustration A11.7. Turbine risk histogram for dunlin



A11.15.4 Baseline dunlin data

(a) Surveys

Breeding dunlin were surveyed by generic moorland bird surveys. Flight activity was quantified by the programme of generic VP watches. Full details on all baseline surveys work for dunlin is provided in Appendix A11.1.

(b) Results

All dunlin seen during baseline surveys were breeding visitors and were present between late April and July only.

<u>Breeding sites</u>

Approximately 48 pairs of dunlin breed within 500m of the proposed turbines, tracks and other features of site infrastructure (Fig. A11.10) (there were 57 under the 2009 ES layout). This represents 0.5% of the UK breeding population and 2.8% of the Shetland breeding population. The breeding territories are located mostly in the Kergord and Nesting quadrants:

Quadrant	Territories
Delting	8
Kergord	16

Nesting (N)	11
Nesting (S)	13
Total	48

Twenty territory centres were located within 250m of the proposed turbines, with the nearest as close as 50m.

Flight activity

Flying dunlins were recorded for 0.3% of generic VP observation time (0.1% after correction for monthly variation in observation effort), almost all of which was recorded during the main breeding period (May-July). Approximately 22% of flight activity was at the RSH of the proposed turbines (refer to Appendix A11.1: Table 26). Detection trials indicated that less than one fifth of flights beyond 125m were detected by observers (refer to Appendix A11.1: Table 25). Allowing for this bias and considering data only from VPs overlooking the 127-turbine layout, the mean annual flight activity at RSH was estimated to be 258 bird secs/ha/yr.

(c) **Do nothing scenario**

With only one thorough dunlin survey to date (Pennington *et al.* 2004) it is not possible to determine trends in dunlin populations in Shetland. However, it possible that the degradation of blanket bog habitats by over-grazing across the Viking site and other areas of Central Mainland may have caused dunlin populations to decline – although there is no direct evidence to support this. Intact wet blanket bog habitats conditions develop where the water table is high, and the habitat is therefore highly sensitive to changes that result in increased drainage, such as erosion caused by sheep activity.

Should large numbers of grazing animals be removed from the hills in the future and blanket bog recovery is substantial, then it is possible that the number of breeding dunlin may start to increase. However, whilst predictions of declines in the number of sheep and active crofters have been made, it is possible that the number of crofting units may consolidate and large 'ranch style' units develop due to economies of scale. Were this to happen, it is unlikely that large areas of heather and blanket bog would spontaneously recover to the benefit of breeding dunlin. Therefore, the likely 'do nothing' scenario is for the Shetland dunlin population to decline into the future or at best stabilise at current likely historical low levels.

A11.15.5 Dunlin habitat loss/modification

(a) **Habitat requirements**

In Shetland, breeding dunlins are closely associated with areas of wet blanket bog containing pools, typically found on the flat summits and saddles of the hills.

(b) **Land take effects**

Based on the mean density of breeding birds within 250m of the proposed site infrastructure, it is estimated that direct land-take habitat loss would result in the potential loss of two pairs of dunlin, at most. This represents approximately 0.1% of the regional population. Overall, the likely magnitude of adverse habitat loss caused by construction of windfarm infrastructure land-take on dunlin would be negligible. It is therefore judged that these direct land-take effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

Table A11.37. Characterising the likely magnitude of land take on dunlin.

Parameter	Assessment
Extent	Small losses equivalent to the size of two territories
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Irreversible
Frequency	One-off event
Probability	Likely

Construction, in particular the access tracks, is predicted to result in modest, localised hydrological change in the adjacent peatland habitats. Dunlin do appear to be sensitive to localised reductions in the water table and might receive some benefits from positive hydrological changes caused by the construction of some stretches of access track, although the magnitude of this is likely to be negligible. Based on the mean density of breeding birds within 250m of the proposed site infrastructure, it is estimated that habitat modification would result in the potential loss of up to two pairs of dunlin, at most. This represents approximately 0.1% of the regional population. These potential losses would be more than offset by a combination of design measures aimed at impeding surface drainage, i.e. those incorporated in the design construction of the access tracks. It is therefore judged that these indirect habitat modification effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

A11.15.6 Dunlin disturbance impacts

(a) Construction disturbance

Breeding dunlins are judged to have moderate sensitivity to disturbance and therefore construction works would potentially disturb some breeding birds possibly resulting in reduced site productivity. For the purposes of this assessment it is assumed that dunlins breeding within 250m of construction work sites would be disturbed. This is likely to be highly cautious. Baseline surveys indicate that 35 pairs typically breed within this assumed displacement zone (refer to Fig. 11.10). Following the example of golden plover it is unlikely that dunlin territories within the disturbance zone would be affected in more than one year. For the purposes of this assessment it is assumed that up to 8 pairs would be affected in any one year and experience a 50% reduction in breeding performance.

This analysis suggests that at most, construction works would result in the productivity of regional (Shetland) dunlin population being reduced by up to 0.5% for a period of four years. No longer-term consequences are anticipated.

Table A11.38. Characterising the likely magnitude of construction disturbance on dunlin.

Parameter	Assessment
Extent	Disturbance of up to 8 pairs per year leading to reduced breeding success
Effect	Direct

Duration	Over a 4 year period
Reversibility	Reversible once construction stops
Frequency	One off effect
Probability	Possible

In view of the above, it is considered that construction works would have short-term adverse effects of negligible magnitude on dunlin. Although dunlin is a species of moderate nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

(b) **Operational disturbance**

Breeding dunlins are judged to have moderate sensitivity to disturbance and therefore operation of the development would potentially displace some birds from suitable nesting areas, possibly resulting in reduced site productivity (see Impact prediction techniques approach A11.4.2). For the purposes of this assessment it is assumed that 50% of nesting and foraging dunlins would be displaced from areas within 200m of operating turbines and 100m of tracks. Baseline surveys indicate that this would equate to the displacement of 4.5 pairs of dunlin (refer to Fig. A11.10). This suggests that operational disturbance would result in a reduction of approximately 0.26% in the regional (Shetland) breeding dunlin population.

Table A11.39. Characterising the likely magnitude of operational disturbance on dunlin.

Parameter	Assessment
Extent	Up to 4.5 pairs displaced. Habituation may reduce effect with time.
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Possible

In view of the above, it is considered that disturbance due to operation of the development would have long-term adverse effects of negligible magnitude on dunlin. Although dunlin is a species of moderate nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.15.7 Dunlin collision impacts

Employing data collected during timed VP observations (corrected for detection bias) and assuming 98% avoidance, CRM estimated that 1.1 dunlin per year would be killed initially (Appendix A11.3). This represents <0.05% of the regional breeding population. The numbers potentially killed annually are expected to change in direct proportion to any change in numbers that breed on the windfarm. On average, approximately 660 adult dunlin in the regional breeding population die annually due to existing causes of mortality, based on an adult survival rate of 80.6% (Jackson 1988).

The predicted annual collision deaths of dunlin for the 127-turbine layout are 8% of those that were predicted for the 150-turbine layout in the 2009 ES. The reasons for this 92% reduction are the deletion of 23 proposed turbines and allowing for displacement by assuming a reduction in flight activity in the vicinity of turbines by 50%. Reductions also result from using a more accurate method for accounting for distance detection effects and from accounting for differences in the breeding bird density in the areas overlooked by VPs and the vicinity of turbines (Appendix A11.1).

The predicted collision rates presented above use data that were corrected for distance-detection effects (Appendix A11.2). If this correction had not been made the predicted average annual collisions would be reduced to 0.01 bird per year (i.e. ca 1% of the prediction based on the corrected data). This value provides a basis for comparison with other windfarm assessments where data were not corrected for detection effects.

The predictions of collision mortality are based on an avoidance rate of 98%. For the same reasons discussed under golden plover, this rate is likely to be overly precautious for dunlin (Whitfield 2007).

Table A11.40. Characterising the likely magnitude of collision on dunlin.

Parameter	Assessment
Extent	1.1 collisions p.a. initially (for 98% avoidance rate and with distance-detection correction applied)
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Probable

In view of the above, it is considered that collisions with the turbine rotors would have long-term adverse effects of negligible magnitude on dunlin. Although dunlin is a species of moderate nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.15.8 Significance evaluation – combined effects on dunlin

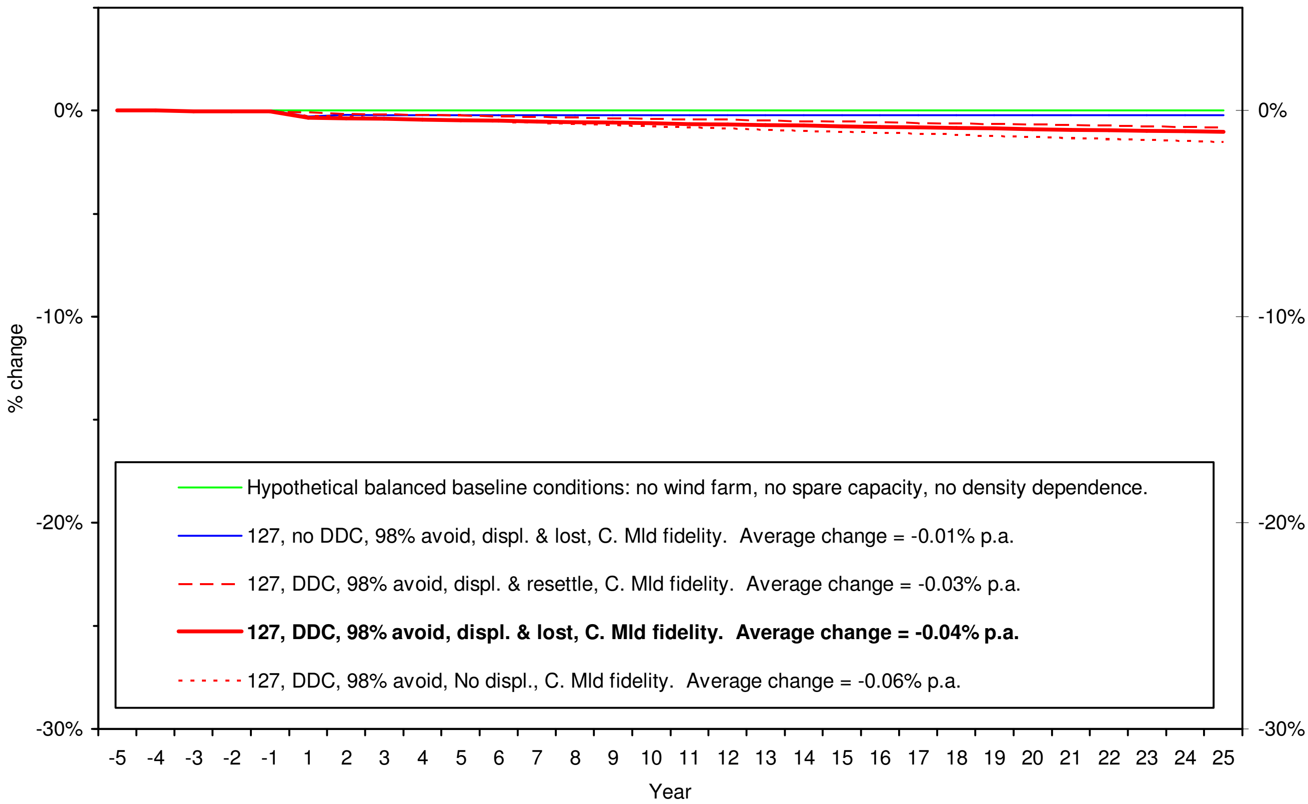
In summary:

- Construction disturbance, predicted to reduce the regional (Shetland) young production by approximately 0.5% for a period of four years.
- Operational disturbance resulting in the long term displacement of 4.5 pairs, approximately 0.26% in the regional (Shetland) breeding population. Displaced birds, for the purposes of this assessment are assumed not to successfully resettle elsewhere. This is conservative as there is little evidence that habitat is limiting the regional population size.
- CRM for a 98% avoidance rate and allowing for a 50% reduction in flight activity in the vicinity of turbines due to displacement predicts that 1.1 dunlin per year

initially would be killed, representing <0.05% of the regional breeding population.

Deterministic modelling indicates that the combined effects of operational disturbance and predicted collision mortality could cause a regional population decline rate averaging 0.08% per annum over the lifetime of the windfarm if the baseline population was perfectly balanced i.e. it has no spare capacity (Appendix A11.4).

Illustration A11.8. Deterministic population model for dunlin



The extent of any spare capacity in the Shetland dunlin population is unknown. However, there is no evidence that the population has declined and it is therefore assumed to be approximately stable. Furthermore, the magnitudes of the adverse effects have been predicted using cautious assumptions and therefore the actual magnitude of effects is most likely to be smaller. In particular, the true avoidance rate is likely to be substantially greater than 98% (Whitfield 2007), a value that is essentially a conservative guess. It is likely that the regional dunlin population has some spare capacity and that this is more than sufficient to offset the effects of collision mortality. On balance the effect of the windfarm is likely to cause a regional population change of <1%.

In view of the above, the overall effects of windfarm construction and operation are predicted to have long-term adverse effects of negligible magnitude on dunlin and it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.15.9 Mitigation/Enhancement

As a result of no significant impacts on dunlin being predicted, additional specific mitigation and enhancement was considered unnecessary. In all cases habitat restoration and management, and crow control measures set out in the HMP are expected to fully offset the not-significant adverse effects caused by the windfarm (Appendix A10.9). Hooded crows are currently at their highest ever levels according to the most recent BBS in 2008 (Shetland Bird Club 2009).

A11.15.10 Residual effects on dunlin

It is considered that the magnitude of the residual effects on dunlin due to windfarm construction and operational activities is negligible. Although dunlin is a species of moderate Nature Conservation Importance, the residual effects after mitigation are judged to be **not significant** under the terms of the EIA Regulations, i.e. there will be no detectable regional population level effects and so the FCS of the Shetland NHZ will not be adversely affected. Therefore, if the Viking Wind Farm is built, the available information indicate that FCS will not be affected because:

- Dunlin will maintain itself on a long-term basis as a viable component of its habitat in Shetland;
- The natural range of dunlin in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain dunlin populations on a long-term basis.

Furthermore, HMP measures for waders (particularly crow control) could shift residual effects in a positive direction i.e. the Shetland dunlin population would significantly benefit from the Viking Wind Farm.

A11.16 BLACK-TAILED GODWIT

A11.16.1 Background

Black-tailed godwit is a very scarce breeding summer visitor and passage migrant to Shetland (Pennington *et al.* 2004). The species is specially legally protected under Schedule 1 of the Wildlife and Countryside Act (1981; as amended).

Black-tailed godwit is a very rare breeding species in Scotland generally, with a few pairs breeding regularly in the Northern Isles and occasionally on the mainland. There are also small numbers (<50 pairs) breeding in England. The species is associated with lowland wet grasslands, and lake shores and formerly bred widely across Britain. Drainage, egg-collecting and shooting are blamed for its extinction in the 19th Century. Re-colonisation began in East Anglia in the 1930s from mainland Europe (nominate race) and Scotland in 1949 from Iceland (subspecies = '*islandica*') (Gibbons *et al.* 1993; Forrester *et al.* (eds) 2007).

The Scottish breeding population is estimated at 7-11 pairs, and the wintering population at 300-600 birds (Forrester *et al.* (eds) 2007). The European conservation status of black-tailed godwit (both subspecies) has recently been evaluated as *Vulnerable*, with total population estimates of 99,000-140,000 pairs (both races), which equates to 50-74% of the global population (Birdlife International 2004).

A11.16.2 Assumed conservation status

On balance, the weight of recent evidence suggests that the Shetland black-tailed godwit population is slowly increasing and so currently has a Favourable Conservation Status.

A11.16.3 Black-tailed godwit influences on design change

The 2009 ES layout avoided potential black-tailed godwit breeding issues through design planning. No additional black-tailed godwit mitigation has influenced the 127-turbine layout.

A11.16.4 Baseline black-tailed godwit data

(a) Surveys

No specific black-tailed godwit surveys were carried out, as this species is well covered using standard breeding moorland bird survey methods and vantage point surveys. Surveyors also recorded any black-tailed godwit seen during the annual red-throated diver surveys, which covered a much wider area. Further details on all survey methods are provided in Appendix A11.1.

(b) **Results**

Breeding sites

One to two pairs of black-tailed godwit probably bred (confirmed breeding in two years) in the Nesting quadrant every year between 2007 and 2010 at two locations approximately 1 and 2km, respectively, from the nearest proposed turbine, track or other feature of site infrastructure(ref to Confidential fig A11.5). One pair represents approximately 2% of the UK breeding population and approximately 25-33% of the Shetland breeding population, which was 3-4 pairs between 1999-2008 (Shetland Bird Club 2009).

Flight activity

No flight activity by this species was recorded during the timed VP watches.

(c) **Do nothing scenario**

This rare species appears to be increasing slowly as a breeding bird in Shetland and is unlikely to be at capacity. Therefore, provided the existing suitable habitat remains attractive this species is likely to continue to increase its breeding population in Shetland over the next 20 years.

A11.16.5 Black-tailed godwit habitat loss/modification

(a) **Habitat requirements**

In Shetland, black-tailed godwits favour base-rich or neutral mires. and rank wet-grassland for breeding. They also commonly feed around the margins of well vegetated lochs. Broods are occasionally taken some distance from the nest site to lusher, wetter mires or even improved grassland (Pennington *et al.* 2004).

(b) **Land take effects**

The 127-turbine layout poses no threat to black-tailed godwit breeding habitat and consequently it is predicted that there will be no change to black-tailed godwit habitats due to the proposed windfarm land-take or habitat modification and so the magnitude of threat is considered negligible. It is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.16.6 Black-tailed disturbance impacts

(a) **Construction and operational disturbance**

The 127-turbine layout poses no threat to black-tailed godwit breeding habitat and so it is assumed that no breeding black-tailed godwits would be disturbed either by construction or operational activities and so the magnitude of threat is considered negligible. It is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.16.7 Black-tailed godwit collision impacts

As no flight activity was recorded during the timed VP watches, the likelihood of collision is considered negligible. It is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.16.8 Significance evaluation – combined effects on black-tailed godwit

The combined effects of land-take, construction and operational activities are negligible and judged to be **not significant** (i.e. no detectable population level effects on the Shetland NHZ). Consequently, no population modelling was conducted for this species.

A11.16.9 Mitigation/Enhancement

As a result of no significant effects on black-tailed godwit being predicted, specific mitigation and enhancement was considered unnecessary. However, work to benefit waders breeding on wet grassland habitats is planned within the Viking HMP, and this may to help the small Shetland black-tailed godwit population increase further.

A11.16.10 Residual effects on black-tailed godwit

It is considered that the magnitude of the residual effects on black-tailed godwit due to windfarm construction and operational activities is negligible. Although black-tailed godwit is a species of high Nature Conservation Importance, the residual effects are judged to be **not significant** under the terms of the EIA Regulations, i.e. there will be no detectable regional population level effects and so the FCS of the Shetland NHZ will not be adversely affected. Therefore, if the Viking Wind Farm is built, the available information indicate that FCS will not be affected because:

- Black-tailed godwit will maintain itself on a long-term basis as a viable component of its habitat in Shetland;
- The natural range of black-tailed godwit in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain black-tailed godwit populations on a long-term basis.

Furthermore, HMP measures for waders (particularly crow control) could shift residual effects in a positive direction i.e. the Shetland black-tailed godwit population would significantly benefit from the Viking Wind Farm.

A11.17 WHIMBREL

A11.17.1 Background

Whimbrel are medium sized waders that are fairly common breeding summer visitors and passage migrants to Shetland (Pennington *et al.* 2004). The current published Scottish breeding population is estimated at 400-500 pairs, which represents 100% of the British population (Forrester *et al.* (eds) 2007). As part of the Viking baseline studies, a Shetland-wide survey was undertaken in 2009 to provide an up-to-date estimate of the size of the Shetland population. Additional survey information from the other parts of the Scottish breeding range was also obtained. The 2009 survey indicates that the Scottish population has declined to approximately 300 pairs of which approximately 95% are in Shetland.

The whimbrel's European conservation status has recently been evaluated as *Secure*, with population estimates suggesting 160,000-360,000 pairs, which equates to 50-74% of the global population (Birdlife International 2004).

A11.17.2 Assumed conservation status

The 2009 survey has provided clear evidence that the Shetland whimbrel population is currently not in Favourable Conservation Status.

A11.17.3 Whimbrel influences on design change

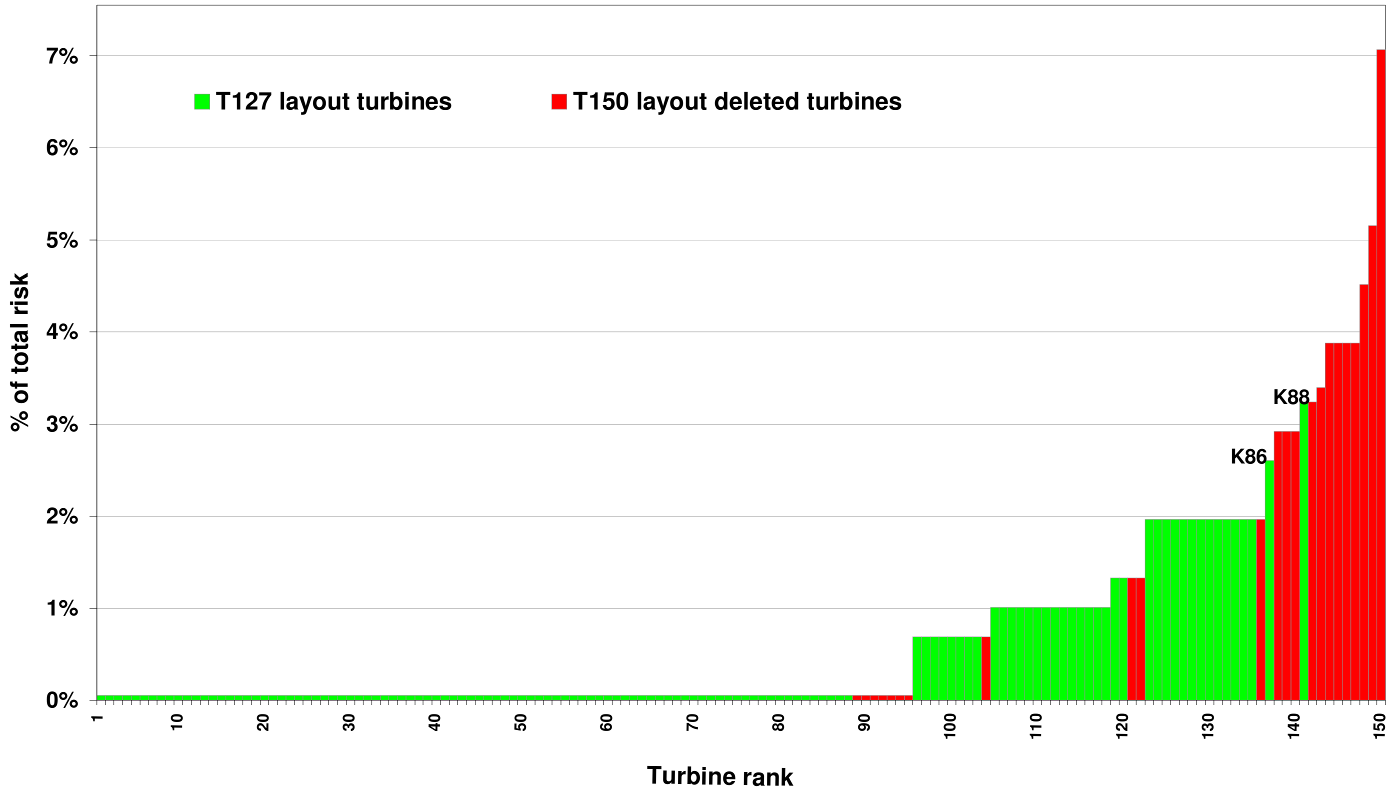
The 2009 ES layout avoided some potential whimbrel issues through design planning. However, whimbrel occur in many parts of the Viking study area. As a consequence, it is not possible to build a large-scale windfarm without some whimbrels potentially being affected by the layout.

Whimbrel were treated as one of three highest priority bird species for influencing the windfarm layout redesign process. The focus of design changes to benefit whimbrel was to avoid locating turbines in areas where whimbrel regularly occur at moderate to high density. This was informed by calculating the relative risk posed by each proposed turbine and by identifying whimbrel 'hot spots' (see 'Breeding sites' below) using baseline survey information from a number of years (Fig A11.11). This is consistent with IEEM (2006) guidance on mitigation; which recommends a hierarchical approach of avoidance then reduction, then compensatory measures where effects are unavoidable.

Proposed turbine locations (and associated tracks) from the 2009 ES (150-turbine) layout were deleted if doing so caused a substantial reduction in predicted risk or if they were located inside a hot spot (there was of course much overlap). Those in the core part of hot spots were prioritised over those close to the periphery.

Several turbines (K84-K87) on the Mid Kame ridge were initially predicted to pose a relatively high risk but upon closer examination the actual risks appear to be lower. This was partly due to elevation differences and partly due to habitat suitability considerations (the proposed turbines locations are raised on the ridge approximately 100m above the area of good whimbrel habitat in the valley below). For these reasons, and after discussion with SNH and RSPB, these turbine locations were not deleted.

Illustration A11.9. Turbine risk histogram for whimbrel



Overall, the layout changes result in the CRM predicted annual collision deaths of whimbrel based on 98% avoidance reducing to 22.2% of those that were predicted for the 150-turbine layout in the 2009 ES, i.e. a reduction of more than three quarters.

A11.17.4 Baseline whimbrel data

(a) Surveys

Breeding whimbrel were surveyed by generic moorland bird surveys. Flight activity was quantified by the programme of generic VP watches. A Shetland-wide survey using stratified sampling approach and using moorland bird survey field methods was undertaken in 2009. Full details on all baseline surveys work for whimbrel are provided in Appendix A11.1.

Additional work in 2010 is focused on measuring population trends, breeding performance and habitat requirements in selected whimbrel hot spots. These in depth studies are required to better understand the whimbrel ecology and inform the details of HMP.

(b) **Results**

Whimbrel are breeding visitors and passage migrants, present within the Viking development site during the period April-August.

Breeding sites

On average approximately 23 pairs of whimbrel breed within 500m of the proposed turbines, tracks and other features of site infrastructure (Fig. 11.11) (there were 40 under the previously 2009 ES layout). This figure is calculated from the average number found for all years that survey information is available since 2005. This represents approximately 7.7% of the UK breeding population and 7.9% of the Shetland breeding population, based on the 2009 survey data.

Whimbrel are unevenly spread across the Viking site, mostly in the Kergord and Nesting quadrants. They favour wide flat-bottomed valleys on blanket bog habitat and show a high degree of overlap with the distribution of breeding Arctic skuas.

Baseline survey results showed that areas used by breeding whimbrel tended to fall into two categories:

(i) Regularly used high density locations where more than one pair is typically present; and
(ii) Locations where a single pair only occurs and which typically are not occupied each year.

The first of these are referred to as hot spots. These were defined by drawing a polygon around regularly occupied territories within 600m of each other and buffering this to 200m. The concept of breeding hot spots is useful for this species' assessment, prioritising relatively discrete areas that year-on-year attract the majority of breeding pairs (refer to Appendix A11.1 and Fig. A11.11).

Quadrant	**Territories**
Delting	5
Kergord	12
Nesting (N)	2
Nesting (S)	4
Total	23

On average six territory centres were located within 250m of the proposed turbines, with the nearest as close as approximately 60m.

Flight activity

Flying whimbrel were recorded for 1.2% of generic VP observation time (0.7% after correction for monthly variation in observation effort). The recorded activity varied from 0.2% in migratory periods (March-April and August) to 2.6% during the breeding period (May-July). Approximately 41% of flight activity was at the RSH of the proposed turbines

(Appendix A11.1: Table 26). Detection trials indicated that less than one quarter of flights beyond 500m were detected by observers (Appendix A11.1: Table 25). Allowing for this bias and considering data only from VPs overlooking the 127-turbine layout, the mean annual flight activity at RSH was estimated to be 560 bird secs/ha/yr.

(c) **Do nothing scenario**

The most recent (unpublished) 2009 population estimate shows that there has been a decline of around 40% in breeding whimbrel number in Shetland over the past 20 years or so. This equates to an average decline of around 2.5% per annum. The magnitude varies geographically. For example, Unst and Fetlar have declined severely whilst numbers in Central Mainland appear to be little changed. The reasons for the decline are unproven. There is strong circumstantial evidence of a link with the increases in the number of great skua but there are other possible reasons as well including habitat change.

Preliminary results from surveys of Central and Western Mainland hot spots undertaken in 2010 indicate that numbers are around 20% greater than in 2009, giving some cause for optimism. However, caution should be exercised as full analysis of the latest survey data has yet to take place.

On balance, the likely '*do nothing*' scenario is that whimbrel numbers will continue to decline however, the rate of decline may reduce as overlap between great skua and whimbrel nesting areas decreases and whimbrel 'retreat' to the most suitable areas remaining.

A11.17.5 Whimbrel habitat loss/modification

(a) **Habitat requirements**

The habitat requirements of whimbrel on Mainland Shetland are relatively poorly understood. To address this information gap a study was commenced in 2010 aimed at understanding the species habitat and management requirements. Initial results show three features appear to be important. First, whimbrel typically select locations in wide flat-bottomed valleys and on adjacent gentle slopes. Second, they show a preference for short and relatively dry blanket bog vegetation, especially with a high component of moss (*Raccomitrium* and *Sphagnum* species) and lichen (*Cladonia sp.),* interspersed with small patches of wet bog vegetation. Third, many pairs show a tendency to nest in association with other breeding species (e.g. Arctic skua, common gull and other waders), probably because the mobbing behaviour of these species affords them some protection from aerial predators such as crows and large gull species. Further detail on these habitat associations are provided in the HMP (Appendix A10.9).

Studies of whimbrel habitat use on the island of Unst in Shetland in the mid 1980s (Grant 1991; 1992; Grant *et al* 1992 a & b) and more recently on Central Mainland by Natural Research Ltd provide a broad understanding of which habitat characteristics are negatively and which are positively correlated for whimbrel. It is important to note that Grant's detailed Shetland studies were carried out in atypically high breeding concentrations on mainly serpentine heath habitats in Unst and Fetlar. Thus, several variables may have been significantly influenced by density dependent factors e.g. access to some habitats blocked by other territorial birds etc, a situation not necessarily present at lower densities on Shetland Mainland.

(b) Land take effects

Based on the mean density of breeding whimbrel within 500m of the proposed site infrastructure, it is estimated that direct habitat loss caused by windfarm infrastructure land-take would result in the potential loss equivalent to up to 0.5 pair of whimbrel. This represents approximately 0.16% of the regional population. Overall, the most likely magnitude of adverse effects on whimbrel due to direct habitat loss caused by windfarm construction land-take would be negligible**.** Although whimbrel is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

Table A11.41. Characterising the likely magnitude of direct habitat loss on whimbrel.

Parameter	Assessment
Extent	Loss of 0.5 pairs
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Irreversible
Frequency	One-off event
Probability	Likely

Construction, in particular the access tracks, is predicted to result in modest, localised hydrological change in the adjacent peatland habitats (the majority of habitat affected). The design changes identified above (A11.17.2) have resulted in the avoidance of whimbrel sensitive areas and so it is not envisaged that any subtle habitat modification along tracks will impact on important whimbrel areas. Therefore, the magnitude of any adverse effects on whimbrel due to indirect habitat modification would be negligible. It is therefore judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

The beneficial effects of habitat modification undertaken as part of the HMP are discussed in Appendix A10.9.

A11.17.6 Whimbrel disturbance impacts

(a) Construction disturbance

To comply with legislation, appropriate measures through the Bird Protection Plan (see Pre-commencement Surveys) would be undertaken to avoid disturbance of breeding whimbrel (as it is a WCA Schedule 1 species) present within say 500m (distance threshold to be agreed with SNH) of construction works. Compared with the previous 2009 ES layout, under the 127-turbine layout there is a greatly reduced overlap between regular whimbrel territories and the windfarm, both with the windfarm footprint in general and the turbine footprint in particular. For this reason, the number and spatial extent of restrictions placed on construction activity under the BPP are expected to be modest and practicable. It is therefore assumed that there will be no disturbance to breeding whimbrel by construction activities.

Table A11.42. Characterising the likely magnitude of construction disturbance on whimbrel.

Parameter	Assessment
Extent	Disturbance of no pairs per year
Effect	Direct
Duration	Over a 4 year period
Reversibility	Reversible (if any effects at all) once construction stops
Frequency	One off effect
Probability	Unlikely due to BPP

In view of the above, it is considered that construction works would have short-term adverse effects of negligible magnitude on whimbrel. Although whimbrel is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

(b) **Operational disturbance**

Breeding whimbrel are judged to have moderate sensitivity to disturbance and therefore operation of the development would potentially displace some birds from suitable nesting areas, possibly resulting in reduced site productivity. In the absence of any specific information on the response of whimbrel to operational windfarms it is assumed that their response is similar to curlew, a closely related species (see Impact prediction techniques approach A11.4.2). Anecdotal observations of the reaction of whimbrel to human disturbance (e.g. surveyors and vehicles) obtained during baseline surveys shows that they are typically more tolerant of potential disturbance than curlew. Therefore, the adoption of the distance thresholds used to assess curlew is likely to result in a cautious assessment.

However, it is recognised that whimbrel and curlew have behavioural differences. Breeding whimbrel commonly perch on the top of telegraph posts located in their breeding territory, a behaviour not usually associated with curlew, redshank or oystercatcher on Shetland (D Jackson personal observation). Furthermore, whimbrel regularly perch on tall structures such as overhead wires on their wintering grounds (Palmer 1993; Tutt 1997) and roost in trees. Whimbrel on Shetland also nest in close proximity to power lines (two nests were found on the Viking site in 2010 within 100m of power lines). These anecdotal observations provide limited evidence that whimbrel show a natural tolerance to relatively tall structures.

For the purposes of this assessment it is assumed that 50% of nesting and foraging whimbrel would be displaced from areas within 200m of operating turbines and 100m from tracks. Baseline surveys indicate that this would equate to the displacement of 1.8 pairs (refer to Fig. 11.11). Following the example of golden plover and assuming a national population of ~300 pairs this suggests that operational disturbance would result in a reduction of just over 0.6% in the national (Shetland) breeding population.

This prediction is likely to be overly cautious because it assumes that displaced birds would not resettle and breed with equal success elsewhere. However, it is likely that some displaced birds, at least, would be able to do so because there appears to be suitable vacant habitat available. The evidence for this is that the population has declined across Shetland despite no obvious changes to habitat. Some former breeding sites may have become less suitable due to colonisation by great skua, but this is not the case at all sites where declines have been documented.

Table A11.43. Characterising the likely magnitude of operational disturbance on whimbrel.

Parameter	Assessment
Extent	Displacement of up to 1.8 pairs. Habituation may reduce effect with time.
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Possible

In light of the above, and erring towards a conservative view, it is considered that disturbance due to operation of the development would have long-term adverse effects of low magnitude on whimbrel. This assumes that displaced birds do not resettle elsewhere i.e. they are effectively lost from the population. The extent and severity of this effect is not well understood. Therefore, highly cautious assumptions as to the potential nature of the effect have been adopted (whimbrel is of high nature conservation importance with nationally important numbers present on the development site) and it is judged that, if these disturbance effects occurred without mitigation, they would at worst be marginally **significant** under the terms of the EIA Regulations, i.e. a potentially detectable population level effect on the Shetland NHZ.

Were displaced birds to successfully establish on vacant habitat elsewhere, which is arguably the more likely scenario, then it is judged that the affects of displacement would then be not significant under the terms of the EIA Regulations. Either way, any adverse effects on whimbrel are undesirable and this is why considerable attention is given in the HMP to measures that will benefit this species.

A11.17.7 Whimbrel collision impacts

Employing data collected during timed VP observations (corrected for detection bias) and assuming 98% avoidance, CRM estimated that up to 2.3 whimbrel per year would be killed initially (Appendix A11.3). The numbers potentially killed each year would be expected to change in direct proportion to any change in numbers that breed on the windfarm hence why the figure stated applies only to initial conditions. Analysis of whimbrel flight data gathered in six sample areas (refer to Appendix A11.1) showed that flight activity was not random with respect to landform. Whimbrel flights were more concentrated over valleys than would be expected, yet turbines positions tended to be on hill tops. When this was taken into consideration the predicted collision risk reduces by approximately 8% to 2.1 birds per year initially. This represents approximately 0.35% of the 2009 regional breeding population estimate. On average, approximately 108 adult whimbrel in the Shetland breeding population die annually due to existing causes of mortality, based on an adult survival rate of 82% (Appendix A11.4). If a more realistic avoidance rate value of 99% is used, the numbers of predicted collisions would be reduced by 50% (i.e. to ~1 bird p.a.).

The predicted annual collision deaths of whimbrel for the 127-turbine layout based on 98% avoidance are 22.2% of those that were predicted for the 150-turbine layout in the 2009 ES. The primary reasons for this reduction are the deletion of 23 proposed turbines and allowing for displacement by assuming a reduction in flight activity in the vicinity of turbines by 50%. Small reductions also result from using a more accurate method for accounting for distance detection effects and from accounting for differences in the breeding bird density in the areas overlooked by VPs and the vicinity of turbines (Appendix A11.1).

The predicted collision rates presented above use data that were corrected for distance-detection effects (Appendix A11.2). If this correction had not been made the predicted average annual collisions would be reduced to 0.15 birds (i.e. only 7.2% of the prediction based on the corrected data). This value provides a basis for comparison with other windfarm assessments where data were not corrected for detection effects.

The predictions of collision mortality are based on an avoidance rate of 98%. For the same reasons discussed under golden plover, this rate is likely to be overly conservative for whimbrel (Whitfield 2007).

Table A11.44. Characterising the likely magnitude of collision on whimbrel.

Parameter	Assessment
Extent	2.1 collisions p.a. initially (for 98% avoidance rate and with distance-detection correction applied)
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Probable

In view of the above and the current unfavourable status of the whimbrel population it is considered that collisions with the turbine rotors could have long-term adverse effects of <u>low</u> magnitude on whimbrel (based on a population size of 300 pairs and using thresholds appropriate to national populations, see 11.3.7.(a)). Although whimbrel is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ. Nevertheless, beneficial measures can be undertaken and this is why the HMP focuses significant efforts and resources on measures aimed to promote whimbrel conservation.

A11.17.8 Significance evaluation – combined effects on whimbrel

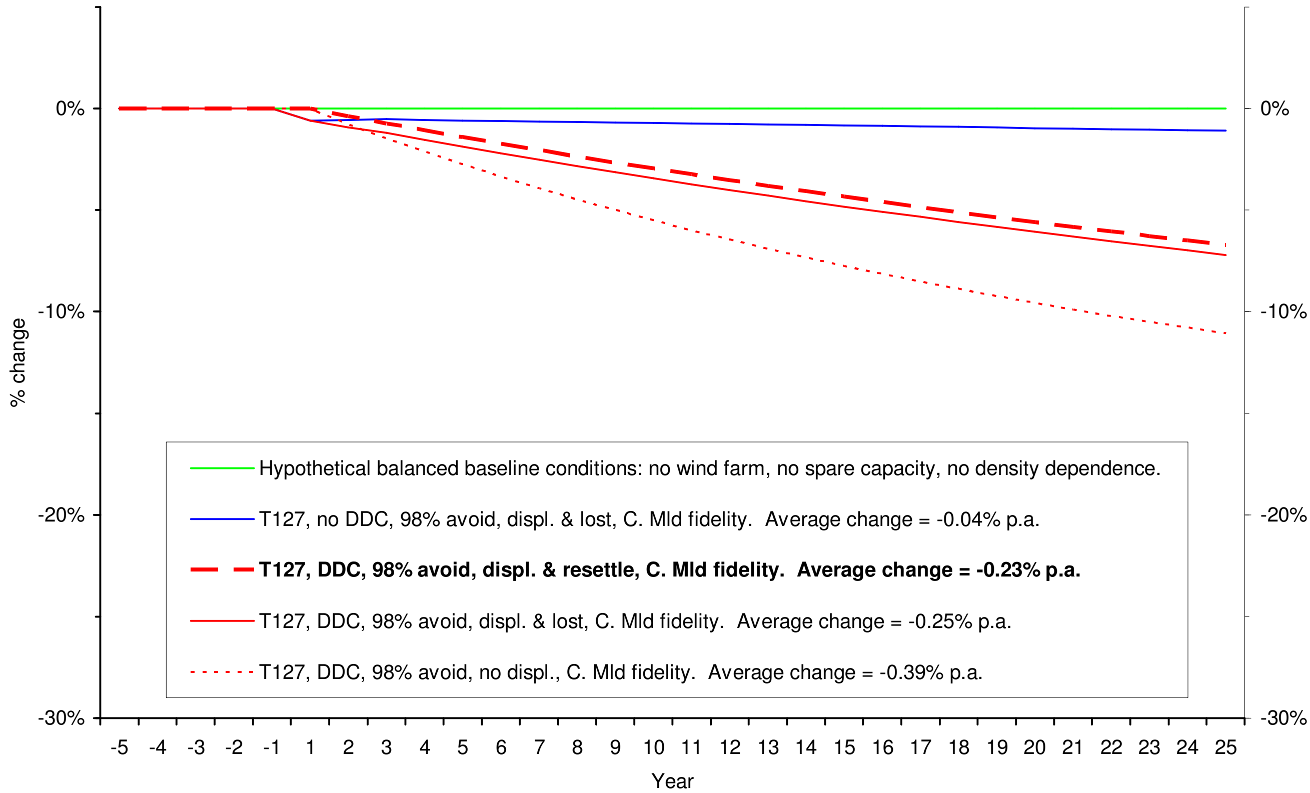
In summary:

- Negligible land-take effects.
- Construction disturbance, no effects on breeding whimbrel as potentially adverse disturbance will be prevented by measures in the BPP.

- Operational disturbance resulting in the long term displacement of 1.8 pairs, approximately 0.6% in the regional and national breeding population. However, displaced birds may be able to successfully resettle elsewhere, at least to some extent, because there is evidence of vacant habitat following the recent population decline.
- CRM for a 98% avoidance rate and allowing for a 50% reduction in flight activity in the vicinity of turbines due to displacement predicts that 2.1 whimbrel per year would be killed (initially), representing approximately 0.35% of the regional breeding population.

A deterministic model based on a baseline population size of 300 pairs and the assumption that displaced birds do not resettle elsewhere indicates that the combined effects of operational disturbance and predicted collision mortality could cause a regional population decline rate averaging 0.25% per annum over the lifetime of the windfarm if the baseline population was perfectly balanced i.e. it has no spare capacity (Appendix A11.4). A second model using the same parameter values but which allows displaced bird to successfully resettle elsewhere predicts a decline rate averaging 0.23% per annum (Appendix A11.4).

Illustration A11.10. Deterministic population model for whimbrel



The population processes of Shetland whimbrel are poorly understood. The observed decline in numbers over the past 20 years, averaging approximately 2.5% per annum, indicates that that over this period the population has had no spare capacity. Indeed, it seems that the production of potential recruits has fallen well short of that was required to balance adult mortality. Nevertheless, the provisional results from surveys at selected sites in 2010 also provides evidence that in some years at some sites, at least, the birds do well. The magnitude of the predicted adverse effect on the population are small (approximately ten times smaller, at least) when compared to the magnitude of the existing average rate of decline. The magnitude of the adverse effect has been predicted using cautious assumptions and therefore the actual magnitude is most likely to be smaller. In particular, the true avoidance rate is most likely to be substantially greater than 98% (Whitfield 2007), a value that is essentially a conservative guess.

The likely extent and severity of these predicted combined effects are not well understood because wind farms have not been built previously in areas with breeding whimbrel. Their likely response has therefore had to be inferred from knowledge of how other wader species respond, in particular curlew, a closely related species. In view of the above, and erring towards a conservative view, it is considered that the overall predicted combined effects of wind farm construction and operation on whimbrel, before mitigation would be long-term and of low magnitude. The Unfavourable Conservation Status of whimbrel together with the fact that a relatively large proportion of the UK population breeds within or close to the proposed wind farm are reasons why a cautious approach to judging the significance of effects on this species is justified. Therefore, the potential adverse effects identified, which are based on highly cautious assumptions, before mitigation, would be **significant** under the terms of the EIA Regulations. Were the predicted effects realised there would potentially be detectable changes to the Shetland NHZ population and, to a small extent, they could hamper population recovery.

Adoption of less pessimistic (and arguably more realistic) assumptions (e.g. a higher collision avoidance rate) would have resulted in combined effects being judged not significant.

A11.17.9 Whimbrel Mitigation/Enhancement

Mitigation and in particular enhancement are considered necessary. The proposed measures are fully described in the HMP (Appendix A10.9) and are summarised below.

Whimbrel HMP goals

The primary HMP focus will be to protect whimbrel hot spots and manage these in ways that will lead to:

- Improved whimbrel breeding success across Viking study area;
- Increased whimbrel breeding densities across Viking study area; and
- Protection and recognition of the importance of these sites for whimbrel and thereby lessen the likelihood that insensitive incidental future management (e.g. through agricultural change) will be deleterious to whimbrel.

Of particular importance is the scale of the proposed HMP whimbrel actions. The magnitude of planned management is not only sufficient to offset any adverse effects from the wind farm but to also make a significant improvement to the regional/national conservation status of the species. The HMP measures will covers areas that support 50-100 breeding pairs (the actual number will depend on final agreements with landowners and other stakeholders), i.e. up to a third of the Shetland/UK whimbrel population. Modelling work on whimbrel population dynamics suggests that a relatively small increase in breeding success could reverse the recent population decline provided a good proportion of the population were involved (Appendix A11.1).

An integral element of the HMP is research aimed at understanding whimbrel habitat requirements and how, through management, to achieve conditions that promote increased breeding success. The research programme will be developed in consultation with other organisations, in particular SNH and RSPB. The results of the research will feed into management prescriptions, which in turn would be monitored when implemented. Moreover, regardless of the proposed Viking Wind Farm, understanding whimbrel ecology and reasons for their decline are valuable in their own right for informing much needed wider conservation measures.

The management techniques used to benefit whimbrel will include:

- Grazing intensity management of extensive moorland areas;
- Wetting up small areas (e.g. barriers across erosion and drainage features);
- Widespread crow control;
- Protection and sensitive management of important breeding areas e.g. no fertiliser, reseeding and appropriate grazing intensity; and
- Creation of shallow pools with marshy edges to encourage the settlement of breeding waders in general. This should benefit whimbrel through by creating the ‘many eyes’ and ‘protective umbrella’ conditions that result from multi-species vigilance and anti-predator mobbing behaviours.

Full details of the methods and rational behind for each of these are presented in the HMP (Appendix A10.9).

<u>Whimbrel HMP work timetable</u>

The following summary HMP action is considered necessary in 2010:

- Identify potential whimbrel HMP hot spot sites (both within and outside Viking study area) and begin landowner liaison/negotiation – *completed*;
- Visit potential sites and identify extent of area to be managed – *completed*;
- For each potential site undertake a provisional assessment of gross management requirements, identifying those parts to remain unchanged (i.e. the first priority ‘best’ parts) and which are to be restored or enhanced (i.e. the second priority poorer parts) – *underway*;
- Select sites for inclusion in HMP based on results from first 3 bullet points above– *underway*;
- Undertake baseline monitoring (birds, predators and vegetation) – *completed*;

- Secure long-term landowner agreement for site management – negotiations and agreements for whimbrel management - *underway*;
- Agree management regime for each site (complex task which may need to be reviewed annually) – to be discussed with land managers once baseline monitoring is completed and assessed; and
- Investigate licensing issues around crow control and discuss with relevant authorities - *underway*.

2011 and beyond:

- Commence practical actions of management as agreed for each site;
- For example this may include:
    - Grazing management/manipulation focussing on short heathland vegetation;
    - Restoration of suitable habitat features;
    - Reduction on predation on nests and during crucial 14 day post fledging period (when 80% of chick losses occur). Suitable habitat management may reduce predation, but so may control of hooded crows during the key nesting period; and
- Establish regular monitoring of vegetation, invertebrates and birds at HMP sites and controls.

The programme of habitat management and crow control set out in the HMP will benefit whimbrel through enhancing habitat quality and increasing breeding performance over large areas of Central and Western Mainland. (Appendix A10.9). This would potentially more than offset the predicted adverse effects of the windfarm. For example, a reasonable and realistic aim would be to increase the numbers and breeding success at HMP sites by 10%. Even if the HMP sites hold only 50 pairs at the start this would translate to an additional 5 breeding pairs and around 10 additional young fledged each year. More likely, the HMP measures will cover sites holding around 100 pairs (this is less than the number of pairs covered by 2010 survey aimed at identifying candidate sites), in which case the gains would be doubled. The intention is that the HMP will bring land containing a substantial proportion (up to a third) of the Shetland whimbrel population under some form of management agreement specifically tailored to meeting the birds' requirements.

Quantifying the benefits of HMP to whimbrel

Given cautious assumptions, the predicted impacts of the proposed Viking Wind Farm are significant, it is considered necessary to examine whether the planned HMP aims are likely to be met and therefore quantify what is necessary in terms of conservation action.

There is a lack of experience of applying conservation measures to breeding whimbrel and therefore the magnitude of the likely response is uncertain. Nevertheless, studies elsewhere on other breeding wader species indicate that positive responses of a magnitude that make a difference are a reasonable expectation. The population dynamics of whimbrel are poorly understood and this further limits the ability to predict likely population change in response to conservation measures. Against this uncertainty it is possible to make some rough estimates of what might be achieved by making certain assumptions. This is useful as it can demonstrate whether the aims stated above are likely to be achieved.

The Shetland whimbrel population has declined from approximately 500 pairs to approximately 300 pairs over the past two decades or so. This equates to an average decline rate of about 2% per annum. Although the reason(s) for the decline are not fully understood there is increasing evidence that poor breeding success is at least partly to blame and that predation by crows (at least in Central and Western Mainland) is a common cause of breeding failure. The most recent BBS survey indicates the highest number of breeding pairs of hooded crow ever, with the population at 0.20 pair/square in 2008 (Shetland Bird Club 2009). This is not to say that crows alone are to blame for the declines, indeed this is unlikely. However, unlike other sources of predation, there are well established and legal methods for reducing crow predation that have been shown to benefit wader breeding performance. Work in 2010 on whimbrel habitat selection indicates strong relationships which will inform how best to manage habitat, in particular to promote high chick survival.

If it is assumed that survival rates of breeding adults and birds in their 2nd and 3rd year of life is 88% p.a. (based on colour-ringing), and that survival over the first year following fledging is 50%, then on a minimum average breeding success rate of 0.620 chicks fledged per breeding pair would be required for a stable population. An average success rate of 0.608 fledglings per breeding pair would result in a recruitment shortfall and lead to a 2% p.a. decline in breeding numbers. This suggests that a population of 300 pairs would need on average to fledge 186 chicks per year to be stable, but a production averaging 182 chicks, just 4 less, would result in a 2% decline p.a. Even if the actual survival rates are somewhat greater or smaller than indicated above, the point remains that potentially it takes relatively little additional production to stem the decline and move towards recovery. The population processes will of course be more complex than this simple examination, in particular there are likely density dependent processes in operation that may cause a non-linear response and prevent full population recovery (for example some former habitat may no longer be tenable for sustainable breeding due to the presence of great skuas). Nevertheless, it is reasonable to assume that an increase in production is likely to lead to an improvement to the birds' fortunes.

Habitat management and crow control measures to benefit whimbrel are proposed for sixteen sites in Central and West Mainland. Between them these sites contain approximately 100 whimbrel territories (based on survey work in 2009 and 2010), i.e. about one third of the population total. Negotiations with landowners and tenants over agreements to implement the HMP measures have met with a favourable response. So far, agreement in principle has been reached for areas containing at least 75 whimbrel territories (25% of the UK population) and possibly as many as 100 territories and discussions are on-going with the remaining landowners and tenants.

The HMP measures are aimed to increase whimbrel productivity by enhancing egg survival through lethal crow control and enhancing chick survival through promoting habitat conditions that provide good and safe feeding areas. A pessimistic assessment would be to assume that the HMP measures will increase average production of whimbrel inside HMP sites by just 15%, from 0.61 fledged chicks/pair to 0.70. An optimistic assessment would be to assume that breeding success increases by 60%, to 0.97 chicks per pair (note this is still well below the theoretical maximum of around 3.5 chicks per pair, and below the rate documented for other wader species). A more realistic assessment, perhaps, would be to say that average breeding success increases by a modest 30% to 0.79 chicks per pair p.a.

The assessments show (Table A11.45) that under pessimistic scenarios of 15% improvement in average breeding success the HMP measures would be sufficient to offset any adverse effects of the wind farm, but would be unlikely to lead to widespread population recovery. The suggested more realistic scenario of 30% improvement in average breeding success would more than offset any windfarm effects and potentially allow for a slow and partial recovery of the population. The optimistic scenario of a 60% improvement in average breeding success could result in sufficient surplus potential recruits to cause a full recovery of the population within the life time of the wind farm, assuming that surplus Central and West Mainland birds dispersed to the other parts of Shetland.

As explained earlier, the preceding analysis is necessarily speculative in nature. However, it demonstrates that the planned HMP measures are likely to be large enough to have a high likelihood of more than off-setting any adverse effects of the windfarm, and a reasonable likelihood of causing the Shetland whimbrel population to partially and possibly fully recover over the life time of the Viking Wind Farm.

Table A11.45. Possible magnitude of benefits to whimbrel resulting from HMP

No. pairs benefiting from HMP	Change in productivity	Extra fledged young produced p.a.	Population change rate p.a. (no wind farm)	Population change rate p.a. with wind farm
None (Existing conditions)	No change (existing conditions)	0	-2.0% (assumed)	-2.3%
70 (Agreement secured)	15% increase (pessimistic)	6.4	+0.2%	-0.1%
70	30% increase (realistic)	12.8	+0.6%	+0.3%
70	60% increase (optimistic)	25.5	+1.4%	+1.1%
100 (Agreement likely)	15% increase (pessimistic)	9.1	+0.3%	+0.1%
100	30% increase (realistic)	18.2	+0.9%	+0.6%
100	60% increase (optimistic)	36.5	+2.1%	+1.8%

A11.17.10 Residual effects on whimbrel

It is considered that the magnitude of the residual effects on whimbrel due to windfarm land-take, construction and operational activities, including collision is most likely to be negligible. Although whimbrel is a species of high Nature Conservation Importance, the likely residual effects after mitigation are judged to be **not significant** under the terms of the EIA Regulations, i.e. there will be no detectable regional population level effects. Therefore, if the Viking Wind Farm is built, the available information indicates that FCS will not be adversely affected because:

- Whimbrel will maintain itself on a long-term basis as a viable component of its habitat in Shetland;

- The natural range of whimbrel in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain whimbrel populations on a long-term basis.

Given there is clear evidence that the Shetland whimbrel population is not in Favourable Conservation Status, it is important that the Viking Wind Farm not only avoids adverse population level effects, but also avoids hindering potential population recovery. The Viking HMP mitigation and enhancement measures for whimbrel could shift residual effects in a positive direction i.e. they could more than fully offset any (not significant) adverse effects. Indeed, due to the large geographic scale of the intended HMP measures, the net effect could be to reverse the existing decline and facilitate population recovery benefits accruing to the Shetland population (and by implication the national population also), i.e. nationally important populations could significantly benefit from the Viking Wind Farm by it facilitating species recovery over large areas of Mainland Shetland.

A11.18 CURLEW

A11.18.1 Background

Curlews are common breeding residents or summer visitors, passage migrants and winter visitors to Shetland (Pennington *et al.* 2004). Curlew is one of Scotland's most widespread breeding birds of farmland and upland habitats, occurring in almost 90% of 10km squares. Surveys since the 1990s estimate a breeding population of 59,000 pairs in Scotland. The Scottish population represents 55% of the UK breeding population of 107,000 pairs (Forrester *et al.* (eds) 2007). Its European conservation status has recently been evaluated as *Declining*, with population estimates suggesting 220,000-360,000 pairs, which equates to 50-74% of the global population estimate (Birdlife International 2004).

There have been four surveys of breeding curlews in Shetland since 1987. Unfortunately, due to the use of differing survey methods, the population trend over the past two decades is unclear. The population estimates vary from 2,300 to 3,975 pairs. Agricultural intensification, including drainage and reseeding may have had some deleterious effects on habitat quality. In Orkney, studies on breeding performance identified raven and hooded crows as the main nest predators (Forrester *et al.* (eds) 2007).

A11.18.2 Assumed conservation status

On balance, the weight of recent evidence suggests that the Shetland curlew population is probably stable and so currently has a Favourable Conservation Status, with the most recent BBS survey indicting a slight decline in recent years, but at the same levels as 2004 of 1.62 pair/square in 2008 (Shetland Bird Club 2009).

A11.18.3 Curlew influences on design change

The 2009 ES layout avoided some potential curlew issues through design planning. However, curlews are very common and almost omni-present across the Viking study area. As a consequence, it is not possible to build a wind farm in Shetland without some curlews potentially being affected by the layout. Therefore, curlew were a secondary design consideration in terms of layout changes rather than a primary one. The predicted effects of construction and operation of the windfarm arising from the 127-turbine layout are less than those previously predicted for 150-turbine. For example, the predicted annual collision deaths of curlew for the 127-turbine layout are 14.5% of those that were predicted for the 150-turbine layout in the 2009 ES. The primary reasons for this 85.5% reduction are the deletion of 23 proposed turbines and reduction in track length from areas used by curlew (e.g. including the entire Collafirth quadrant), changes to the method used to correct for distance detection bias (see later), and accounting for displacement effects and differences in breeding density between areas over looked by VPs and areas close to turbines.

A11.18.4 Baseline curlew data

(a) **Surveys**

Breeding curlew were surveyed by generic moorland bird surveys. Flight activity was quantified by the programme of generic VP watches. Full details on all baseline survey work for curlew are provided in Appendix A11.1.

(b) **Results**

Most curlews are breeding visitors to the development site and few birds are present outside the main breeding period March-August (Appendix A11.1).

<u>Breeding sites</u>

Approximately 193 pairs of curlew breed within 500m of the proposed turbines, tracks and other features of site infrastructure (Fig. 11.12) (there were 227 under the previously 2009 ES). This represents 0.2% of the UK breeding population and 4.9-8.4% of the Shetland breeding population depending on which of the four recent population estimates is used. However, the apparent importance of this site for curlew within a regional context may be an artefact of greater survey effort within the development site compared with other parts of Shetland.

Quadrant	**Territories**
Delting	68
Kergord	74
Nesting (N)	15
Nesting (S)	36
Total	**193**

Fifty-five territory centres were located within 250m of the proposed turbines, with the nearest as close as 50m.

<u>Flight activity</u>

Flying curlew were recorded for 16.8% of generic VP observation time (10.7% after correction for monthly variation in observation effort), almost wholly recorded during the breeding period March-August. Based on a small sample of observations from detection trials, it was estimated that less than 3% of flights beyond 1km were detected by observers (refer to Appendix A11.1). Assuming this is an accurate reflection of bias and considering data only from VPs overlooking the 127-turbine layout, mean annual flight activity at RSH is approximately 1120 bird secs/ha/yr.

(c) **Do nothing scenario**

The variable results and different methods used to assess the curlew population in Shetland mean that recent trends are unclear. However there is no compelling evidence of a decline, nor has there been any obvious recent changes to breeding habitat. Therefore, it is perhaps reasonable to assume that the curlew population will remain stable if land use remains broadly similar.

A11.18.5 Curlew habitat loss/modification

(a) Habitat requirements

Curlews are a common and widespread breeding species in Central Mainland. They nest on a wide variety of rough moorland and grassland habitats including heather, blanket bog, moorland edges, mires, meadows and rushy pasture. Chicks are sometime moved considerable distances to lower (presumably richer) ground, particularly around mires but also to reseeded grassland. (Pennington *et al.* 2004).

(b) Land take effects

Based on the mean density of breeding curlew within 500m of the proposed site infrastructure, it is estimated that habitat loss caused by windfarm infrastructure land-take would result in the potential loss of up to four pairs of curlew. This represents <0.1% of the regional population. It is considered that the likely magnitude of adverse effects on curlew due to habitat loss caused by infrastructure land-take would be negligible, and it is judged these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

Table A11.46. Characterising the likely magnitude of land take on curlews.

Parameter	Assessment
Extent	Loss of 4 pairs
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Irreversible
Frequency	One-off event
Probability	Likely

Construction, in particular the access tracks, is predicted to result in modest, localised hydrological change in the adjacent peatland habitats (the majority of habitat affected). Curlews are not particularly sensitive to small hydrological changes and indeed are found across a wide variety of human modified habitats. Therefore, the likely magnitude of any adverse effects on curlew due to indirect habitat modification would be negligible. It is therefore judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

Due to the extensive nature of the HMP measures (Appendix A10.9), especially crow control, there are likely to be benefits to a substantial part of the Central Mainland curlew population.

A11.18.6 Curlew disturbance impacts

(a) Construction disturbance

Breeding curlews are judged to have moderate sensitivity to disturbance and therefore construction works would potentially disturb some breeding birds, possibly resulting in reduced site productivity. It is also clear that curlew can show a relatively high tolerance to human activity including machinery as shown by the large number of pairs breeding on farmland throughout much of Scotland. In Shetland breeding birds are commonly seen close (<50m) to busy roads and tracks on active crofts and will nest successfully within 15m of occupied buildings (D Jackson *pers. obs.*).

For the purposes of this assessment it is assumed that curlews would experience some disturbance within 250m of construction work sites. This is likely to be a cautious assumption. Baseline surveys indicate that 122 pairs typically breed within this assumed disturbance zone (refer to Fig. 11.12). It is unlikely that curlew territories within the disturbance zone would be affected in more than one year. For the purposes of this assessment it is assumed that ~31 pairs would be affected in any one year and experience a 50% reduction in breeding performance for that year.

This analysis suggests that at most, construction works would result in the productivity of regional (Shetland) curlew population being reduced by up to 0.6% for a period of four years. No longer-term consequences are anticipated.

Table A11.47. Characterising the likely magnitude of construction disturbance on curlews.

Parameter	Assessment
Extent	Some disturbance of up to 31 pairs per year leading to reduced breeding success
Effect	Direct
Duration	Over a 4 year period
Reversibility	Reversible once construction stops
Frequency	One off effect
Probability	Unlikely

In view of the above, it is considered that construction works would have short-term adverse effects of low magnitude on curlew. Although curlew is a species of moderate nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

(b) **Operational disturbance**

Breeding curlews are judged to have moderate sensitivity to disturbance and therefore operation of the development would potentially displace some birds from suitable nesting areas, possibly resulting in reduced site productivity (see Impact prediction techniques approach A11.4.2).

The recent study by Whitfield *et al* (2010) examined how the numbers and distribution of breeding curlew changed at five wind farms over a series of years following windfarm construction using various study designs including, where possible, a Before-After-Control-Impact framework. The results from the five wind farms examined by Whitfield *et al* are broadly consistent with each other and with results present by Thomas (1999) but contrast with the results of the RSPB study. In four of the five sites there was no evidence of an immediate displacement effect, though there was inconclusive evidence of such an effect at the fifth site. At three sites it was shown that there was no tendency for gradual displacement to occur following construction, indeed at one site territories shifted closer to turbines. Overall, the study found little evidence of displacement of breeding curlew by windfarm infrastructure even at only 200m proximity from turbines and concluded that breeding curlew are predominantly not sensitive to displacement. Whitfield *et al* (2010) examine why their study and that by Thomas (1999) found little evidence of displacement of curlew at windfarms in contrast to the results presented by Pearce-Higgins *et al* using an Impact-Reference study design. They show that the extreme magnitude of apparent displacement (up to 800m from infrastructure) reported by Pearce-Higgins is inconsistent with expectations of a gradient effect and difficult to explain biologically. Furthermore, the Pearce-Higgins *et al* study found no effect of displacement when data were examined at a fine spatial scale, the effect only being apparent when the data were examined at a large spatial scale. Whitfield *et al* conclude that the apparent long-distance displacement effect reported by Pearce-Higgins *et al* is likely the result of an analytical anomaly, i.e. it may be spurious, and therefore, does not constitute evidence of displacement. On the basis of the results presented by Whitfield *et al* (2010) and Thomas (1999) the proposed Viking Wind Farm is likely to have no biologically significant displacement effects on curlew. A recurrent finding of the studies undertaken to date is that curlews frequently breed within 250m or so of operational turbines.

Despite the evidence above, for the purposes of this assessment it is assumed that 50% of nesting and foraging curlews would be displaced from areas within 200m of operating turbines 100m from tracks. Baseline surveys indicate that this would equate to the displacement of 19.5 pairs (refer to Fig. A12). Following the example of golden plover, this suggests that operational disturbance would result in a reduction of less than 0.5% to 0.8% in the regional (Shetland) breeding population depending on which population estimate is used.

Table A11.48. Characterising the likely magnitude of operational disturbance on curlews.

Parameter	Assessment
Extent	Displacement of up to 19.5 pairs (based on highly precautionary assumptions, contradicted by recent research). Habituation may reduce effect with time.
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Possible

In view of the above, it is considered that disturbance due to operation of the development would have long-term adverse effects of low-moderate magnitude on curlew. Although curlew is a species of moderate nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.18.7 Curlew collision impacts

Employing data collected during timed VP observations (corrected for detection bias) and assuming 98% avoidance, CRM estimated that up to 8.5 curlew per year would be killed initially (Appendix A11.3). The numbers potentially killed each year would be expected to change in direct proportion to any change in numbers that breed on the windfarm. This represents approximately 0.1- 0.2% of the regional breeding population depending on which population estimate is used. However approximately 7% of the annual flight activity observed occurred outside the breeding season (taken to be March to mid August) and birds present at this time are likely to be passage or wintering birds from different breeding populations. Therefore, the actual percentage of the breeding population affected by collision is likely to be proportionately less. On average approximately 920 to 1590 adult curlew in the regional breeding population die annually due to existing causes of mortality, depending on which population estimate is used.

The predicted annual collision deaths of curlew for the 127-turbine layout are 14.5% of those that were predicted for the 150-turbine layout in the 2009 ES. The reasons for this reduction are the deletion of 23 proposed turbines, allowing for displacement by assuming a 50% reduction in flight activity in the vicinity of turbines, using a more accurate method for accounting for distance detection effects and from accounting for differences in the breeding bird density in the areas overlooked by VPs and the vicinity of turbines (Appendix A11.1).

The predicted collision rates presented above use data that were corrected for distance-detection effects (Appendix A11.2). If this correction had not been made the predicted average annual collision mortality would be reduced to 1.3 birds (i.e. 15% of the prediction based on the corrected data). This value provides a basis for comparison with other windfarm assessments where data were not corrected for detection effects.

The predictions of collision mortality are based on an avoidance rate of 98%. For the same reasons discussed under golden plover, this rate is likely to be overly precautious for curlew (Whitfield 2007).

Table A11.49. Characterising the likely magnitude of collision on curlews.

Parameter	Assessment
Extent	17.6 collisions p.a. (for 98% avoidance rate and with distance-detection correction applied)
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during year
Probability	Probable

In view of the above, it is considered that collisions with the turbine rotors would have long-term adverse effects of low magnitude on curlew. Although curlew is a species of moderate nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

Far fewer distance-detection data were collected for curlew than for the other species considered. As a consequence there is greater uncertainty as to how detection of this species changes with distance, with knock on uncertainty to the predicted collision rates. The distance detection correction used for curlew assumed that their detection pattern was intermediate between whimbrel (a species that is relatively similar in appearance but is somewhat smaller) and Arctic skua (a species that is slightly larger but also predominantly brown in colour). A less biologically sound but more conservative approach would be if the whimbrel distance-detection correction value is used to correct curlew flight activity instead of an intermediate value then the predicted number of curlew collision deaths is 16.3 per year (initially), i.e. almost double that predicted above. This is not considered likely, as curlews larger size will mean that on average they are more easily detected at distance. Nevertheless, this alternative calculation helps put the uncertainty regarding the predicted curlew collision deaths into context. Furthermore, even if this figure is used for assessment purposes, the number killed per year would represent only 0.2- 0.4% of the regional breeding population (depending on which population estimate is used), and this level of effect would also give an assessment of **not significant** under the terms of the EIA Regulations.

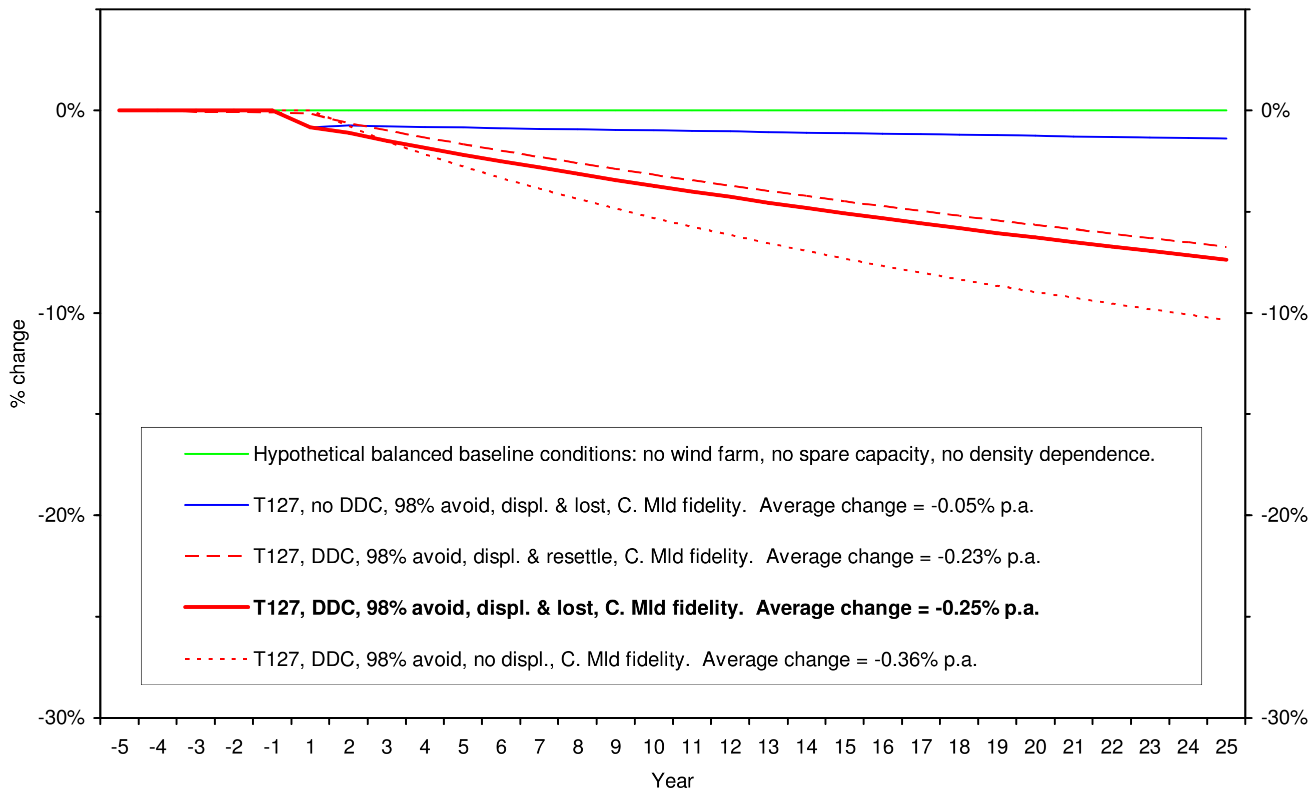
A11.18.8 Significance evaluation – combined effects on curlew

In summary:

- Construction disturbance, predicted to reduce the regional (Shetland) young production by approximately 0.6 % for a period of four years.
- Operational disturbance resulting in the long term displacement of up to 37.5 pairs, approximately either 0.94 or 1.6% in the regional (Shetland) breeding population (depending upon which population baseline is used). Displaced birds are, for the purposes of this assessment, assumed not to successfully resettle elsewhere. This is cautious as there is little evidence that habitat is limiting the regional population size.
- Collision mortality for a 98% avoidance rate and allowing for a 50% reduction in flight activity in the vicinity of turbines due to displacement predicts that 8.5 curlew per year would be killed, representing approximately 0.1-0.2% of the regional breeding population.

Deterministic modelling based on a baseline regional population size of 2,300 pairs indicates that the combined effects of operational disturbance and predicted collision mortality could cause a regional population decline rate averaging 0.28% per annum over the lifetime of the windfarm if the baseline population was perfectly balanced i.e. it has no spare capacity. However, if the baseline regional population is set at 3,120 pairs (the mean of recent surveys) then this figure drops to 0.20% decline per annum.

Illustration A11.11. Deterministic population model for curlew



The extent of any spare capacity in the Shetland curlew population is unknown. Although there have been four surveys of the numbers breeding in Shetland since 1987 these show no clear trend with estimates varying from 2,300 to 3,975 pairs. This variation is likely to reflect methodological differences and the difficulties in counting this species at high densities, as much as genuine population changes. Overall, there is no evidence of a long-term decline and it is likely that the population is approximately stable. Furthermore, the magnitudes of the adverse effects have been predicted using cautious assumptions and therefore the actual magnitude of effects will most likely be smaller. In particular, the true avoidance rate is most likely to be substantially greater than 98% (Whitfield 2007), a value that is essentially a conservative guess. It is likely that the regional curlew population has some spare capacity and that this is more than sufficient to offset the adverse effects of the windfarm.

In view of the above, the overall effects of windfarm land-take, construction and operation are predicted to have long-term adverse effects of low magnitude on curlew and it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.18.9 Mitigation/Enhancement

The operation of the windfarm (disturbance and collision) is predicted to have adverse effects of low magnitude on curlew, though these effects are judged to be **not significant**. In all cases habitat restoration and management, and crow control measures set out in the HMP are expected to fully offset the not significant adverse effects caused by the windfarm (refer to Appendix A10.9). Hooded crows are currently at their highest ever levels according to the most recent BBS in 2008 (Shetland Bird Club 2009).

A11.18.10 Residual effects on curlew

It is considered that the magnitude of the residual effects on curlew due to windfarm construction and operational activities is likely to be negligible. Although curlew is a species of moderate Nature Conservation Importance, the residual effects after mitigation are judged to be **not significant** under the terms of the EIA Regulations, i.e. there will be no detectable regional population level effects and so the FCS of the Shetland NHZ will not be adversely affected. Therefore, if the Viking Wind Farm is built, the available information indicate that FCS will not be affected because:

- Curlew will maintain itself on a long-term basis as a viable component of its habitat in Shetland;

- The natural range of curlew in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain curlew populations on a long-term basis.

Furthermore, HMP measures for waders (particularly crow control) could shift residual effects in a positive direction i.e. populations of curlew could significantly benefit from the Viking Wind Farm.

A11.19 ARCTIC SKUA

A11.19.1 Background

Arctic skuas are medium sized seabirds that are common breeding summer visitors and scarce passage migrants to Shetland (Pennington *et al.* 2004). In Scotland, Arctic skua is a localised breeding species and coastal passage migrant. The Scottish population was most recently estimated at 2,100 apparently occupied territories ('pairs') though this figure now almost certainly too high (see below). The Scottish birds represent the entire UK breeding population and between 6-14% of the north-east Atlantic population (Mitchell *et al* 2004). Its European conservation status has recently been evaluated as *Secure*, with population estimates suggesting 40,000-140,000 pairs, which equates to 5-24% of the global population estimate (Birdlife International 2004).

There have been five surveys to estimate the size of the Shetland breeding population between 1969 and 2000, with the last published estimate (Seabird 2000 survey, 1998-2002) showing a 40% decline in numbers from previous survey, to 1,120 apparently occupied territories (Mitchell *et al* 2004). At the time, this equated to 52% of the UK population.

A11.19.2 Assumed conservation status

Recent (2009) unpublished estimates by RSPB based on surveys at selected colonies indicate that numbers breeding on Shetland have since declined further to probably <600 pairs (RSPB unpublished). Arctic skua declines have been linked to changes in food availability (especially sandeels) and to competition and predation by the expanding great skua population (Pennington *et al.* 2004). Therefore, this unpublished data provides clear evidence that the Shetland Arctic skua population is not in Favourable Conservation Status.

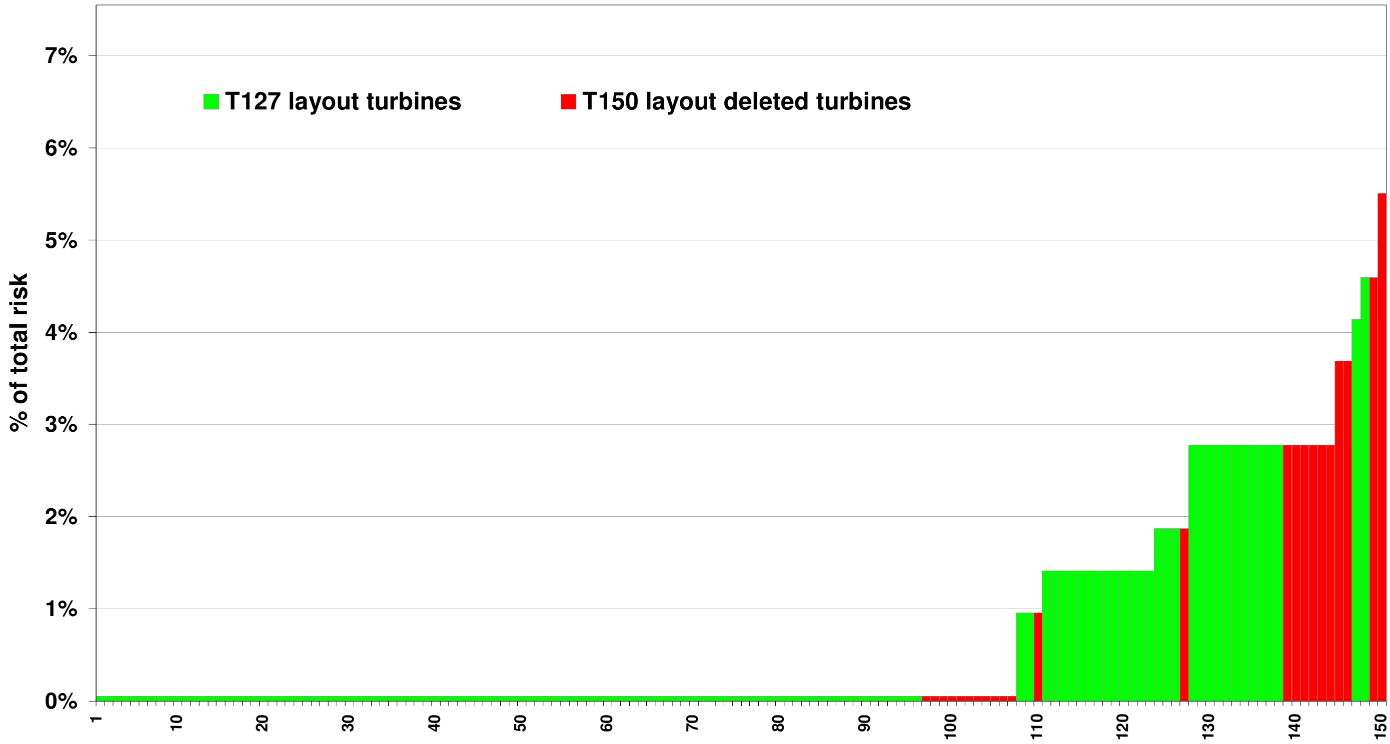
A11.19.3 Arctic skua influences on design change

The 2009 ES layout avoided some potential Arctic skua issues through design planning. However, Arctic skua are present widely across the Viking study area and the 2009 ES layout overlapped in places with sensitive areas for this species.

Arctic skua was given the fourth highest priority amongst species (after red-throated diver, merlin and whimbrel) in considering layout changes to benefit birds. In practice, because of the strong positive correlation between the occurrence of whimbrel and Arctic skua territories, this species inevitably benefited greatly from design changes primarily aimed at benefiting whimbrel.

The predicted effects of construction and operation of the windfarm arising from the 127-turbine layout are much less than those previously predicted in the 2009 ES. The predicted annual collision deaths of Arctic skua for the 127-turbine layout are 18.4% of those that were predicted for the 150-turbine layout in the original ES. The primary reasons for this 81.6% reduction are the deletion of 23 proposed turbines, accounting for displacement effects and differences in breeding density between areas over looked by VPs and areas close to turbines.

Illustration A11.12. Turbine risk histogram for Arctic skua



A11.19.4 Baseline data Arctic skua

(a) **Surveys**

Breeding Arctic skua were surveyed by generic moorland bird surveys. Flight activity was quantified by the programme of generic VP watches. Full details on all baseline survey work for Arctic skua are provided in Appendix A11.1.

Breeding Arctic skua were also recorded during the 2009 Shetland-wide sample survey of whimbrel and the 2010 surveys of whimbrel hot spots.

(b) **Results**

Arctic skuas are breeding visitors, present within the Viking development site during the period April-August.

Breeding sites

Approximately 25 pairs of Arctic skua breed within 500m of the proposed turbines, tracks and other features of site infrastructure (Fig. 11.13). This represents 1.2% of the UK breeding population and 2.2% of the Shetland breeding population based on comparison with published population estimates. However, if the more recent (2009) unpublished surveys by RSPB are used as a basis for comparison the numbers present within 500m of proposed infrastructure may represent up to 4% of the Shetland population.

Arctic skuas are unevenly spread across the Viking site, mostly in the Kergord and Nesting quadrants. They favour wide flat-bottomed valleys on blanket bog habitat and show a high degree of overlap with the distribution of breeding whimbrel. The concept of breeding hot spots is also useful for this species; relatively discrete areas that year-on-year attract the majority of breeding pairs.

Quadrant	**Territories**
Delting	3
Kergord	12
Nesting (N)	2
Nesting (S)	5
Total	**25**

Five territory centres were located within 250m of the proposed turbines, with the nearest as close as approximately 80m.

Flight activity

Flying Arctic skuas were recorded for 3.0% of generic VP observation time (1.7% after correction for monthly variation in observation effort). The recorded activity varied from 1.0% during March-April and August to 6.0% during the main breeding months (May-July). Approximately 32% of flight activity was at the RSH of the proposed turbines (refer to Appendix A11.1: Table 26). Detection trials indicated that less than one half of flights beyond 750m were detected by observers (refer to Appendix A11.1: Table 25). Allowing for this bias and considering data only from VPs overlooking the 127-turbine layout, the mean annual flight activity at RSH was estimated to be 404 bird secs/ha/yr.

(c) **Do nothing scenario**

The most recent population trends (RSPB unpublished) suggest a dramatic, significant and sustained decline in Arctic skua breeding numbers in Shetland; a decline of approximately 70% over two decades. Whether the decline will continue or recovery take place in the years ahead is unknown. This will probably be driven by broad-scale marine ecosystem factors and the fortunes of great skuas. Shetland seabirds in general have been going through a prolonged period of poor breeding performance and (in most cases) declining populations. Although there has been the occasional year of moderate to good productivity there have been many others where productivity has been poor or bad. The causes of this are complex but are undoubtedly linked to marine food supply which in turn may be being affected by long-term climate change effects. If climate change is the primary driver any recovery to former conditions is unlikely. It is unclear if the widespread peatland habitat degradation could be having an adverse effect on Arctic skua numbers.

On balance, the likely '*do nothing*' scenario is that Arctic skua numbers in Shetland will continue to decline into the future though the rate of decline is likely to slow.

A11.19.5 Arctic skua habitat loss/modification

(a) Habitat requirements

Arctic skuas in Central Mainland choose similar locations to whimbrel for breeding, especially wide flat-bottomed moorland valleys, which may be well away from the coast. Although two or three pairs may nest is the same valley, the pairs breeding on the moors of Central Mainland are not truly colonial. These pairs appear to undertake some of their foraging over the moorland habitat where they breed, and are therefore probably less dependent on marine food than those breeding in coastal colonies. Elsewhere in Shetland they also breed on coastal heaths close to seabird colonies, usually in loose colonies of several pairs. Despite Arctic skuas kleptoparasitizing (stealing) food from birds, other ground nesting species, including whimbrel, commonly nest in close proximity to Arctic skuas.

(b) Land take effects

Based on the mean density of breeding within 800m of the proposed site infrastructure, it is estimated that habitat loss would result in the potential loss of approximately 0.5 pairs Arctic skua. This represents <0.1% of the regional population. Overall, it seems reasonable to assume that the most likely magnitude of adverse effects on Arctic skua due to habitat loss would be negligible. It is therefore judged these effects would most likely be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

Table A11.50. Characterising the likely magnitude of land take on Arctic skuas.

Parameter	Assessment
Extent	Loss of 0.5 pairs
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Irreversible
Frequency	One-off event
Probability	Likely

Construction, in particular the access tracks, is predicted to result in modest, localised hydrological change in the adjacent peatland habitats (the majority of habitat affected). The design changes identified above (A11.17.3) have resulted in the avoidance of whimbrel and hence Arctic skua sensitive areas and so it is not envisaged that any subtle habitat modification along tracks will impact on important Arctic skua areas. Therefore, the likely magnitude of any adverse effects on Arctic skua due to indirect habitat modification would be negligible. It is therefore judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

Due to the extensive nature of the HMP measures (Appendix A10.9), especially crow control, there are likely to be benefits to a substantial part of the Central Mainland Arctic skua population. However, Arctic skua population issues may be prominently marine-based, in which case HMP efforts may make little overall difference to this species' fortunes.

A11.19.6 Arctic skua disturbance impacts

(a) Construction disturbance

Breeding Arctic skuas are judged to have moderate sensitivity to disturbance and therefore construction works would potentially disturb some breeding birds, possibly resulting in reduced site productivity. Several regular breeding territories on Central Mainland are within 250m of main roads. For the purposes of this assessment it is assumed that Arctic skua would be disturbed within 250m of construction work sites. This is likely to be highly cautious. Baseline surveys indicate that 13 pairs of Arctic skua typically breed within this assumed displacement zone (refer to Fig. A11.13). It is unlikely that Arctic skua territories within the construction disturbance zone would be affected in more than one year. For the purposes of this assessment it is assumed that up to 4 pairs would be affected in any one year and experience a 50% reduction in breeding performance. Due to the high degree of coincidence between Arctic skua and whimbrel, measures implemented to reduce disturbance of breeding whimbrel under the BPP are likely to also reduce disturbance to Arctic skua and so the actual magnitude of disturbance is likely to be less than assumed above.

This analysis suggests that at most, construction works would result in the productivity of regional (Shetland) Arctic skua population being reduced by up to 0.3% for a period of four years. No longer-term consequences are anticipated.

Table A11.51. Characterising the likely magnitude of construction disturbance on Arctic skuas.

Parameter	Assessment
Extent	Some disturbance of up to 4 pairs per year leading to reduced breeding success
Effect	Direct
Duration	Over a 4 year period
Reversibility	Reversible once construction stops
Frequency	One off effect
Probability	Unlikely due to BPP

In view of the above, it is considered that construction works would have short-term adverse effects of <u>negligible</u> magnitude on Arctic skua. Although Arctic skua is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

(b) Operational disturbance

Breeding Arctic skuas are judged to have moderate sensitivity to disturbance and therefore operation of the development would potentially displace some birds from suitable nesting areas, possibly resulting in reduced site productivity (see Impact prediction techniques approach A11.4.2). In the absence of any specific information on the response of Arctic skuas to operational windfarms it is assumed that their response is similar to the most sensitive wader species studied such as golden plover and curlew. There is anecdotal evidence from Burradale Wind Farm in Shetland that great skua, a closely related species, are relatively unaffected by the presence of turbines, regularly choosing to fly within 200m of operational rotors (D Jackson *pers. obs.*). Detailed studies from Shetland island populations, has shown Arctic skuas get 'pushed' into peripheral areas by great skuas and that displaced birds have moved to other parts of the islands studied (Pennington *et al.* 2004).

Anecdotal observations obtained during baseline surveys of the reaction of breeding Arctic skuas to human activity and vehicles indicates levels of tolerance broadly similar to species such as golden plover, with individuals typically showing no detectable response at distances above 200m and often considerably less than this. Several pairs of Arctic skua in Shetland are known that breed within 200m of busy public highways. Arctic skuas appear to habituate well to benign human disturbance. For example on Handa Island Nature Reserve, Sutherland, they allow visitors to approach within 50m before showing any detectable response (D Jackson *pers. obs.*). This anecdotal information suggests that the response of Arctic skuas to windfarm activities is unlikely to be more severe than that of wader species. For this reason, the same distance thresholds are adopted to assess operational disturbance as adopted for golden plover and curlew.

For the purposes of this assessment it is assumed that 50% of breeding Arctic skuas would be displaced from areas within 200m of operating turbines and 100m from tracks. Baseline surveys indicate that this would equate to the displacement of <0.5 pairs (i.e. one pair less than annually) (refer to Fig. A11.13). Following the example of golden plover this suggests that operational disturbance would result in a reduction by <0.05% in the size of regional breeding population (using the published 1120 pairs figure). If, based on the most recent survey work, the predicted magnitude of operational disturbance is put into the context of a provisional revised population estimate for Shetland of approximately 600 pairs (RSPB unpublished report to SNH), the numbers of Arctic skuas potentially displaced by the development could represent up to <0.1% of the regional population.

The large declines in Arctic skua numbers have been linked to problems in the marine environment. It is therefore likely that there is considerable vacant moorland breeding habitat currently available. This would mean that there are large opportunities for displaced birds to successfully resettle elsewhere. Relocation of established breeding birds has been shown to occur on studied island populations (Pennington *et al.* 2004). If displaced birds were to successfully resettle the effects of displacement on the regional population would be negligible.

Table A11.52. Characterising the likely magnitude of operational disturbance on Arctic skuas.

Parameter	Assessment
Extent	Displacement of up to 0.5 pairs, but these are likely to resettle elsewhere.
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Possible

Overall, in view of the above, it is considered that disturbance due to operation of the development would have long-term adverse effects of negligible/low magnitude on Arctic skua. Although Arctic skua is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.19.7 Arctic skua collision impacts

Employing data collected during timed VP observations (corrected for detection bias) and assuming 98% avoidance, CRM estimated that 1.9 Arctic skua per year would be killed initially (Appendix A11.3). The numbers potentially killed each year would be expected to change in direct proportion to any change in numbers that breed on the windfarm. This represents 0.08% of the most recently published regional population estimate (1120 pairs) and 0.15% of the provisional revised population (approximately 600 pairs) based on the most recent survey work (RSPB unpublished report to SNH). On average approximately 20% of adult Arctic skua in the regional breeding population die annually due to existing causes of mortality; this would amount to approximately 450 background deaths per year for a regional population of 1120 pairs, based on an adult survival rate of 80% (alternative 87.2% (Appendix A11.4)).

The predicted annual collision deaths of Arctic skua for the 127-turbine layout are 18.4% of those that were predicted for the 150-turbine layout in the 2009 ES. The primary reasons for this reduction are the deletion of 23 proposed turbines and allowing for displacement by assuming a reduction in flight activity in the vicinity of turbines by 50%. Small reductions also result from using a more accurate method for accounting for distance detection effects and from accounting for differences in the breeding bird density in the areas overlooked by VPs and the vicinity of turbines (Appendix A11.1).

The predicted collision mortality rates presented above use data that were corrected for distance-detection effects (Appendix A11.2). If this correction had not been made the predicted average annual collisions mortalities would be reduced to 0.45 birds (i.e. 24% of the prediction based on the corrected data). This value provided a basis for comparison with other windfarm assessments where data were not corrected for detection effects.

The predictions of collision mortality are based on an avoidance rate of 98%. For the same reasons discussed under golden plover, this rate is likely to be overly cautious for Arctic skua.

Table A11.53. Characterising the likely magnitude of collision on Arctic skuas.

Parameter	Assessment
Extent	1.9 collisions p.a. (for 98% avoidance rate and with distance-detection correction applied)
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Probable

In view of the above, it is considered that collisions with the turbine rotors would have long-term adverse effects of <u>negligible</u> magnitude on Arctic skua. Although Arctic skua is a species of high nature conservation importance it is judged that these effects would be

not significant under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

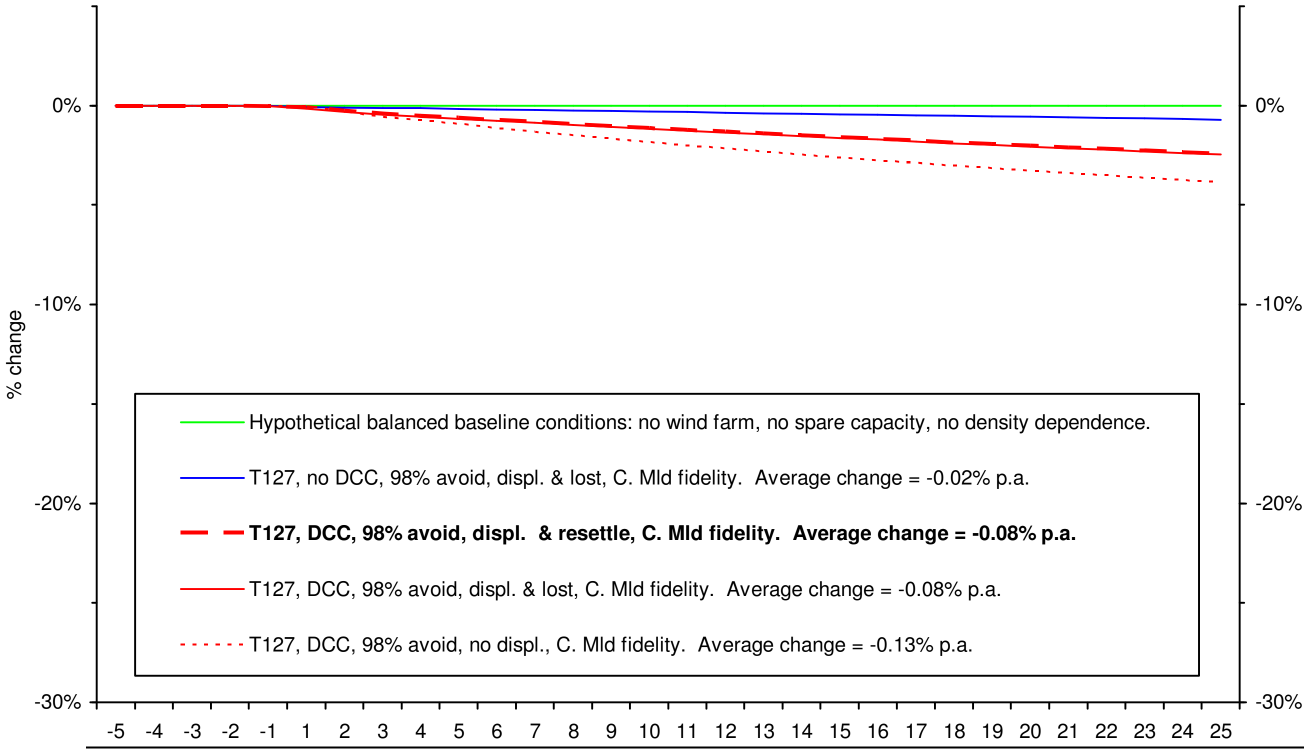
A11.19.8 Significance evaluation – combined effects on Arctic skua

In summary:

- Construction disturbance is predicted to reduce the regional (Shetland) young production by approximately 0.3% for a period of five years, assuming a baseline regional population of 1120 pairs.
- Operational disturbance, predicted to result in the long term displacement of up to 0.5 pairs, approximately <0.05% in the regional (Shetland) breeding population of 1120 pairs. Displaced birds are likely to be able to successfully resettle elsewhere, as evidenced by island studies.
- CRM for a 98% avoidance rate and allowing for a 50% reduction in flight activity in the vicinity of turbines due to displacement predicts that 1.85 Arctic skua per year would be killed initially, representing approximately 0.08% of the regional breeding population of 1120 pairs.

A deterministic model based on a baseline regional population size of 1120 pairs and that assumes displaced birds do not resettle elsewhere indicates that the combined effects of operational disturbance and predicted collision mortality could cause a regional population decline rate averaging 0.04% per annum over the lifetime of the windfarm if the baseline population was perfectly balanced i.e. it has no spare capacity. A second model based on a regional population size of 600 pairs predicts an average decline rate of 0.08% per annum (Appendix A11.4).

Illustration A11.13. Deterministic population model for Arctic skua



The decline rate of Arctic skua in Shetland has been approximately 5% per annum over the past two decades. In view of the continuing decline, it is expected that the Shetland population currently has no spare capacity. Indeed, on average there is likely to be a shortfall in the number of potential recruits of young birds required to offset adult mortality. The magnitude of the predicted adverse effect of the windfarm is negligible when compared with the magnitude of the existing rate of decline, being approximately 50-100 times smaller, at least. The magnitudes of the adverse effects have been predicted using cautious assumptions and therefore the actual magnitude of effects is likely to be smaller. In particular, the true avoidance rate is likely to be substantially greater than 98%, a value that is essentially a conservative guess, and it is known that established breeding adults Arctic skuas can move elsewhere to breed in response to changed circumstances. The predicted magnitude of the adverse effect of the windfarm is too small to make a material difference to a future population recovery, should changes in the marine environment occur that enable this to happen.

In view of the above, the overall the effects of windfarm construction and operation are predicted to have long-term adverse effects of negligible magnitude on Arctic skua and it is judged that these effects would most likely be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.19.9 Mitigation/Enhancement

As a result of no significant impacts on Arctic skua being predicted, specific mitigation and enhancement was considered unnecessary. Nevertheless, the habitat restoration and management and in particular whimbrel measures set out in the HMP are expected to fully offset the adverse but not significant effects caused by the windfarm (Appendix A10.9). The HMP focus on management of whimbrel hot spot areas is likely to benefit Arctic skuas breeding in the same areas.

A11.19.10 Residual effects on Arctic skua

It is considered that the magnitude of the residual effects on Arctic skua due to windfarm land-take, construction and operational activities is most likely to be negligible. Although Arctic skua is a species of high Nature Conservation Importance, the likely residual effects after mitigation are judged to be **not significant** under the terms of the EIA Regulations, i.e. there will be no detectable regional population level effects. Therefore, if the Viking Wind Farm is built, the available information indicates that FCS will not be adversely affected because:

- Arctic skua will maintain itself on a long-term basis as a viable component of its habitat in Shetland;

- The natural range of Arctic skua in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain Arctic skua populations on a long-term basis.

Given there is recent evidence that the Shetland Arctic skua population is not in Favourable Conservation Status, it is important that the Viking Wind Farm not only avoids adverse population level effects, but also avoids hindering potential population recovery. The extensive management areas where HMP measures primarily aimed at whimbrel are planned also contain many pairs of Arctic skua and these are also expected to benefit. However, it is recognised that Arctic skua population issues may be prominently marine-based, in which case HMP efforts may make less overall difference to population recovery.

A11.20 GREAT SKUA

A11.20.1 Background

Great skuas are large predatory seabirds that are very common breeding summer visitors to Shetland (Pennington *et al.* 2004). Great skua is a localised breeding species in Scotland and a coastal passage migrant. The current Scottish population is estimated at 9,650 apparently occupied territories ('pairs'), which is the entire British population (Forrester *et al.* (eds) 2007). There have been five attempts to census the entire population between 1969 and 2002. Over this period numbers have approximately tripled. Its European conservation status has recently been evaluated as *Secure* (its population has been increasing since 1900), with population estimates suggesting 16,000 pairs, which equates to 100% of the global population estimate (Birdlife International 2004; Mitchell *et al.* 2004). However, the taxonomy of the 'large skua complex' is controversial and some authors recognise other southern hemisphere subspecies, in which case the Scottish population represents 61% of the northern hemisphere population (Forrester *et al.* (eds) 2007).

Great skua is the most intensively studied bird species on Shetland. The most recent comprehensive survey, Seabird 2000 (1998-2002), estimated 6,874 pairs, approximately 50% of the world population (Mitchell *et al.* 2004). The species has provoked considerable controversy amongst conservationists and islanders over its impacts on seabirds and other animals, and how these should be dealt with. As a consequence of the unpopularity of great skua with some people, (illegal) human persecution has undoubtedly occurred, but it has had little effect on the increasing population (Pennington *et al.* 2004).

A11.20.2 Assumed conservation status

On balance, the weight of recent evidence suggests that the Shetland great skua population is currently stable or increasing and so has a Favourable Conservation Status.

A11.20.3 Great skua influences on design change

The 2009 ES layout avoided some potential great skua issues through design planning. However, great skua are widespread over large parts the Viking study area, especially so on hill summits. As a consequence, it is not possible to build a large-scale wind farm in Shetland without some great skuas potentially being affected by the layout. Therefore, great skua were a secondary design consideration in terms of layout changes rather than a primary one. The predicted effects of construction and operation of the windfarm arising from the 127-turbine layout are less than those previously predicted in the 2009 ES. For example, the predicted annual collision deaths of great skua for the 127-turbine layout are 40.5% of those that were predicted for the 150-turbine layout in the 2009 ES, i.e. a reduction of just under 60%. The primary reasons for this reduction are the deletion of 23 turbines from areas used by great skua (e.g. including the entire Collafirth quadrant) and accounting for displacement effects.

A11.20.4 Baseline great skua data

(a) **Surveys**

Breeding great skua were surveyed by generic moorland bird surveys. Flight activity was quantified by the programme of generic VP watches. Full details on all baseline survey work for great skua are provided in Appendix A11.1.

(b) **Results**

Great skuas are breeding visitors to Shetland, present within the Viking development site during the period March-September.

Breeding sites

Approximately 49 pairs of great skua breed within 500m of the proposed turbines, tracks and other features of site infrastructure (Fig. 11.14) (there were 53 under the 2009 ES layout). This represents 0.5% of the UK breeding population and 0.7% of the Shetland breeding population. Shetland supports 43% of the world's breeding great skua population (depending upon which taxonomy is used), meaning that the development site holds perhaps 0.3 % of the global population.

Quadrant	**Territories**
Delting	11
Kergord	13
Nesting (N)	8
Nesting (S)	17
Total	**49**

Twenty-one territory centres were located within 250m of the proposed turbines, with the nearest as close as approximately 80m.

Flight activity

Flying great skuas were recorded for 12.8% of generic VP observation time (8.6% after correction for monthly variation in observation effort)[1]. Approximately 54% of flight activity was at the RSH of the proposed turbines (Appendix A11.1: Table 26). Detection trials indicated that less than half of flights beyond 1000m were detected by observers (Appendix A11.1: Table 25). Allowing for this bias and considering data only from VPs overlooking the 127-turbine layout, the mean annual flight activity at RSH was estimated to be 2841 bird secs/ha/yr.

Great skua numbers have increased markedly in Shetland in recent decades, at approximately 1.6% per annum. It should be noted there is circumstantial evidence that the decline in breeding whimbrel is linked to increases in great skua, at least at some sites.

(c) **Do nothing scenario**

The population of great skua in Shetland has been increasing for a considerable period of time. During the last two decades of the 20th century annual population growth was around 1.5% per annum. However, it is unlikely that great skuas can maintain the population growth rates seen over the last century (Mitchell *et al.* 2004), indeed the rate of increase has probably already slowed. As the species is not affected by the degradation of blanket bog, habitat condition across does not appear to be particularly important. Therefore, it is assumed that the '*do nothing*' scenario would be for great skua populations to continue increasing Shetland, but at a slower rate than previously recorded.

A11.20.5 Great skua habitat loss/modification

(a) **Habitat requirements**

In Shetland, breeding great skuas are associated with flat ground with vegetation cover less than 20cm tall. On the Viking survey area territories are mostly on the higher ground, particular on flat summit areas, Elsewhere on Shetland they often breed close to seabird colonies, where they kleptoparasitise food as well as directly predate on seabirds.

(b) **Land take effects**

Based on the mean density of breeding within 800m of the proposed site infrastructure, it is estimated that direct habitat loss would result in the potential loss of approximately 2 pairs of great skua. Great skuas are evenly distributed across the higher parts of the development site, apparently irrespective of peatland condition. This species is not expected to be sensitive to the effects of localised hydrological changes. Therefore, it is considered that the likely magnitude of adverse effects on great skua due to habitat loss/modification would be negligible. It is therefore judged these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population effects on the Shetland NHZ.

Table A11.54. Characterising the likely magnitude of land take on great skuas.

Parameter	Assessment
Extent	Up to 2 pairs
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Irreversible
Frequency	One-off event
Probability	Likely

A11.20.6 Great skua disturbance impacts

(a) **Construction disturbance**

Breeding great skuas are judged to have moderate sensitivity to disturbance (and are fiercely territorial towards humans) and therefore construction works would potentially displace some birds from suitable nesting areas, possibly resulting in reduced site productivity.

For the purposes of this assessment it is assumed that great skua would be displaced from areas within 250m of construction work sites. This is likely to be highly cautious. Baseline surveys indicate that 31 pairs of great skua typically breed within this assumed displacement zone (refer to Fig. 11.14). Following the example of golden plover it is unlikely that great skua territories within the disturbance zone would be affected in more than one year. For the purposes of this assessment it is assumed that up to 8 pairs would be affected in any one year and experience a 50% reduction in breeding performance.

This analysis suggests that at most, construction works would result in the productivity of regional (Shetland) great skua population being reduced by up to 0.1% for a period of four years. No longer-term consequences are anticipated.

Table A11.55. Characterising the likely magnitude of construction disturbance on great skuas.

Parameter	Assessment
Extent	Some disturbance of up to 8 pairs per year leading to reduced breeding success
Effect	Direct
Duration	Over a 4 year period
Reversibility	Reversible once construction stops
Frequency	One off effect
Probability	Likely

In view of the above, it is considered that construction works would have short-term adverse effects of <u>negligible</u> magnitude on great skua. Great skua is a species of high nature conservation importance and it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the internationally important Shetland NHZ population.

(b) **Operational disturbance**

Breeding great skuas are judged to have moderate sensitivity to disturbance and therefore operation of the development would potentially displace some birds from suitable nesting areas, possibly resulting in reduced site productivity (see Impact prediction techniques approach A11.4.2). In the absence of any specific information on the response of great skuas to operational windfarms it is assumed that their response is similar to the most sensitive wader species studied such as golden plover and curlew. There is anecdotal evidence from Burradale Wind Farm in Shetland that great skua are relatively unaffected by the presence of turbines, regularly choosing to fly within 200m of operational rotors (D Jackson *pers. obs.*). Great skua appear to habituate well to benign human disturbance. For example on Handa Island Nature Reserve, Sutherland, and Hermaness National Nature Reserve, Unst some pairs allow visitors to approach within 50m before showing any detectable response (D Jackson *pers. obs.*).

For the purposes of this assessment it is assumed that nesting and foraging great skuas would be displaced from areas within 200m of operating turbines and from areas within 100m of tracks. Baseline surveys indicate that this would equate to the displacement of 5.5 pairs of great skua (refer to Fig A11.14). Following the example of golden plover this suggests that operational disturbance would result in a reduction of $< 0.1\%$ in the regional (Shetland) breeding population, which is increasing.

Table A11.56. Characterising the likely magnitude of operational disturbance on great skuas.

Parameter	Assessment
Extent	Displacement of 5.5 pairs
Effect	Direct
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning (if assume pairs do not move elsewhere)
Frequency	On-going effect during breeding season
Probability	Possible

In view of the above, it is considered that disturbance due to operation of the development would have long-term adverse effects of negligible magnitude on great skua. Great skua is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the internationally important Shetland NHZ population.

A11.20.7 Great skua collision impacts

Employing data collected during timed VP observations (corrected for detection bias) and assuming 98% avoidance, CRM estimated that 24.9 great skua per year would be killed initially (Appendix A11.3). The numbers potentially killed each year would be expected to change in direct proportion to any change in numbers that breed on the windfarm. This represents 0.18% of the regional breeding population. On average approximately 1529 adult great skuas in the regional breeding population die annually due to existing causes of mortality, based on an adult survival rate of 89% (Appendix A11.4).

The predicted annual collision deaths of great skua for the 127-turbine layout are 41.4% of those that were predicted for the 2009 ES. The primary reasons for this 59.5% reduction are the deletion of 23 proposed turbines and allowing for displacement by assuming a reduction in flight activity in the vicinity of turbines by 50%. Small reductions also result from using a more accurate method for accounting for distance detection effects and from accounting for differences in the breeding bird density between the areas overlooked by VPs and the vicinity of turbines (Appendix A11.1).

The predicted collision rates for great skua presented above use data that were corrected for distance-detection effects (Appendix A11.2). If this correction had not been made the predicted average annual collisions would be reduced to 9.4 birds (i.e. 38.5% of the prediction based on the corrected data). This value provides a basis for comparison with other windfarm assessments where data were not corrected for detection effects.

The predictions of collision mortality are based on an avoidance rate of 98%. For the same reasons discussed under golden plover, this rate is likely to be overly precautious for great skua.

Table A11.57. Characterising the likely magnitude of collision on great skuas.

Parameter	Assessment
Extent	24.9 collisions p.a. (for 98% avoidance rate and with distance-detection correction applied)
Effect	Direct
Duration	Life of windfarm, 25 years

Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Probable

In view of the above, it is considered that collisions with the turbine rotors would have long-term adverse effects of negligible-low magnitude on great skua. Even in the case of the species of highest nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the internationally important Shetland NHZ population.

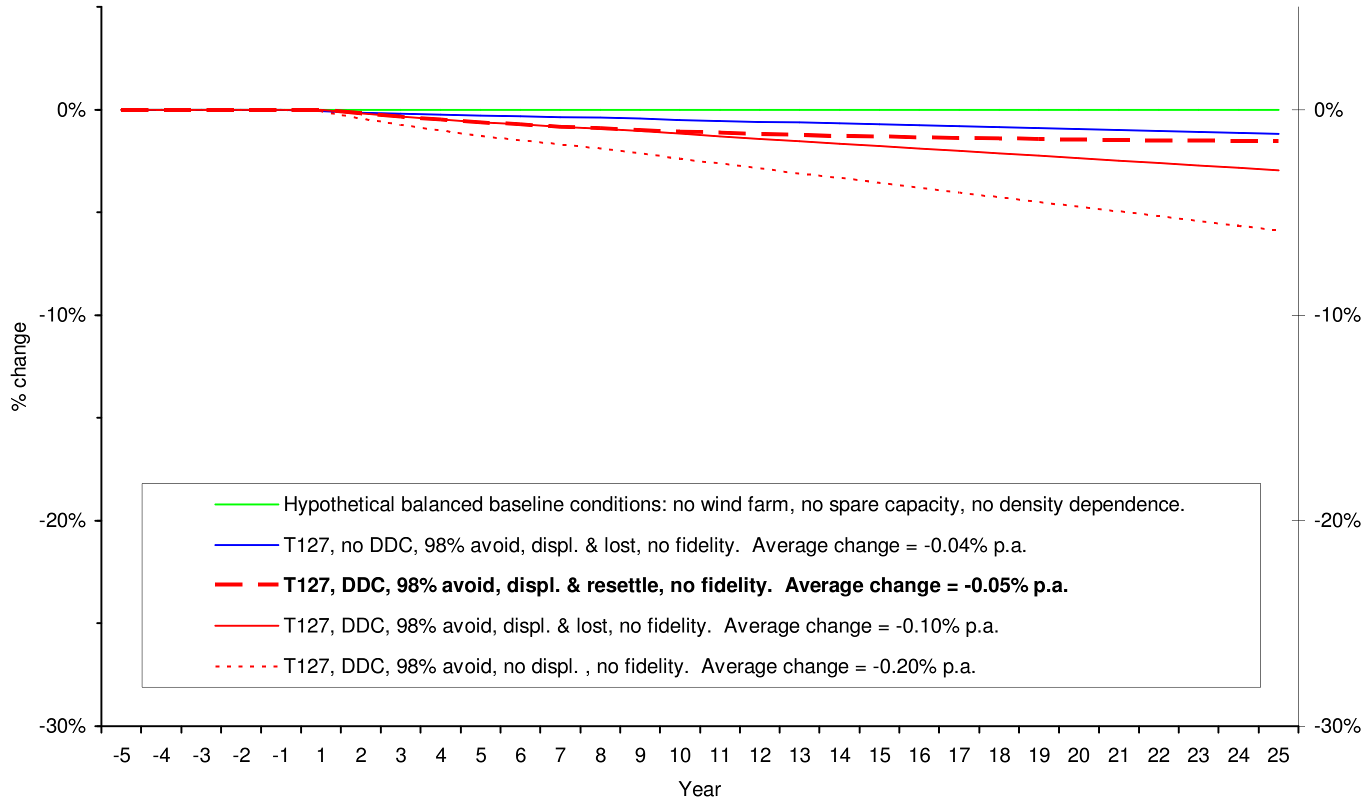
A11.20.8 Significance evaluation – combined effects on great skua

In summary:

- Construction disturbance is predicted to reduce the regional (Shetland) young production by approximately 0.10% for a period of four years.
- Operational disturbance is predicted to result in the long term displacement of up to 5.5 pairs, approximately <0.1% in the regional breeding population. Although displaced birds may be able to successfully resettle elsewhere this is assumed not to occur.
- CRM for a 98% avoidance rate and allowing for a 50% reduction in flight activity in the vicinity of turbines due to displacement predicts that 24.9 great skua per year would be killed, representing approximately 0.18% of the regional breeding population.

A deterministic model that assumes displaced birds do not resettle elsewhere indicates that the combined effects of operational disturbance and predicted collision mortality would cause the regional population to decline at a rate averaging 0.1% per annum over the lifetime of the windfarm if the baseline population was perfectly balanced, i.e. it has no spare capacity (Appendix A11.4). If displaced birds were to successfully resettle elsewhere, which is likely, then the magnitude of the overall effect is approximately halved. The magnitudes of the adverse effects have been predicted using cautious assumptions and therefore the actual magnitude of effects is most likely to be smaller. In particular, the true avoidance rate is most likely to be substantially greater than 98%, a value that is essentially a conservative guess.

Illustration A11.14. Deterministic population model for great skua



The size of the regional great skua population increased markedly through the 20th century, with an average annual rate of increase of approximately 1.5% during the last two decades of the 20th Century. The magnitude of the predicted adverse effect is less than one thirtieth of the magnitude of the baseline rate of increase. Therefore, the development is likely to have no detectable affect on the regional population.

In view of the above, the overall combined the effects of windfarm construction and operation are predicted to have long-term adverse effects of negligible magnitude on great skua and it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects, on the nationally important Shetland NHZ population.

A11.20.9 Mitigation/Enhancement

As a result of no significant impacts on great skua being predicted, specific mitigation and enhancement was considered unnecessary.

A11.20.10 Residual effects on great skua

It is considered that the magnitude of the residual effects on great skua due to windfarm construction and operational activities is likely to be negligible. Although great skua is a species of high Nature Conservation Importance, the residual effects after mitigation are judged to be **not significant** under the terms of the EIA Regulations, i.e. there will be no detectable regional or international population level effects and so the Favourable Conservation Status of the Shetland NHZ will not be adversely affected and so the FCS of the Shetland NHZ will not be adversely affected. Therefore, if the Viking Wind Farm is built, the available information indicate that FCS will not be affected because:

- Great skua will maintain itself on a long-term basis as a viable component of its habitat in Shetland;
- The natural range of great skua in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain great skua populations on a long-term basis.

A11.21 ARCTIC TERN

A11.21.1 Background

Arctic terns are relatively small seabirds, which are very common breeding summer visitors to Shetland (Pennington *et al.* 2004). The species receives special legal protection under Annex 1 of the European Birds Directive. The Scottish population of approximately 47,300 pairs constitutes 84% of the UK population. Historically the species was a more abundant in Scotland but reduced food supply (especially sandeels), predation by introduced mink and human disturbance have all contributed to a decline in recent decades (Forrester *et al.* (eds) 2007).

The most recent estimate of the Shetland population is 24,716 pairs (Seabird 2000 survey, 1998-2002) but numbers have fluctuated widely linked to long-term changes to sandeel populations (Pennington *et al.* 2004). Its European conservation status has been evaluated as *Secure*, with the population estimate of 500,000-900,000 being ca. 10% of the world population (Birdlife International 2004). The highly variable population figures make identification of trends and assessment of Favourable Conservation Status particularly difficult for this species. However, the most recent published figures (in 2000) indicate an increase in 10,000 pairs since the previous survey.

A11.21.2 Assumed conservation status

On balance, the weight of recent evidence suggests that the Shetland Arctic tern population is currently stable or increasing and so has a Favourable Conservation Status.

A11.21.3 Arctic tern influences on design change

The 2009 ES layout avoided potential Arctic tern breeding issues through design planning. No additional Arctic tern mitigation has influenced the 127-turbine layout.

A11.21.4 Baseline Arctic tern data

(a) Surveys

Breeding Arctic tern were surveyed by generic moorland bird surveys. Flight activity was quantified by the programme of generic VP watches. Full details on all baseline survey work for Arctic tern are provided in Appendix A11.1.

(b) Results

Arctic terns are present within the development site during the period May-August.

<u>Breeding sites</u>

During baseline surveys, 12 pairs of Arctic tern bred in three colonies within 500m of the proposed turbines, tracks and other features of site infrastructure (Fig. 11.15). This represents less than 0.1% of the UK and Shetland breeding populations. The breeding territories are located mostly in one coastal colony in the Delting quadrant:

Quadrant	Territories
Delting	11
Kergord	0
Nesting (N)	1
Nesting (S)	0
Total	**12**

One pair of Arctic terns nested as close as 490m to the nearest proposed turbine. The coastal colony in the Delting quadrant is more than 2km from the closest proposed turbine.

Flight activity

Arctic Terns recorded during generic VP watches on 79 occasions (recorded in 5.7% of 5-minute periods in May-July). Of these, 58 were seen in the close vicinity of lochs or the coast and 21 were away from water (1.5% of 5-minute periods in May-July).

(c) **Do nothing scenario**

Since the fortunes of Arctic tern population in Shetland will likely closely follow those of its main prey the sandeel, the '*do nothing scenario*' will be likely be dependent upon changes in the marine environment rather than any other particular influence.

A11.21.5 Arctic tern habitat loss/modification

(a) **Habitat requirements**

This largely coastal species usually nests in sizeable colonies on shingle or short vegetation on beaches, headlands and islets, and forages in coastal waters. Small numbers also nest and feed at freshwater lochs. They have a relatively short foraging range when breeding and so are particularly sensitive to changes in food availability.

(b) **Land take effects**

The 127-turbine layout poses no threat to Arctic tern breeding habitat and consequently it is predicted that there will be no change to Arctic tern habitats due to the proposed windfarm land-take or habitat modification. Consequently, it is considered that the likely magnitude of adverse effects on Arctic tern due to habitat loss/modification would be negligible and therefore would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.21.6 Arctic tern disturbance impacts

(a) **Construction disturbance**

Breeding Arctic terns are judged to have moderate sensitivity to disturbance and therefore construction works could potentially disturb some breeding birds, possibly resulting in reduced site productivity.

For the purposes of this assessment it is assumed that Arctic terns would be displaced from areas within 250m of construction work sites. Baseline surveys indicate that no pairs typically breed within this assumed displacement zone (refer to Fig. A11.15). The colony of 12 pairs (the largest located during baseline surveys) on the beach at the Houb of Scatsta (500m from Scatsta airport) is 330m from one windfarm access point, this is slightly beyond the assumed displacement distance. Furthermore, a busy trunk road passes approximately 300m from this colony and the traffic there appears to cause no disturbance. Similarly, the aviation traffic from Scatsta airport does not appear to cause disturbance.

Table A11.58. Characterising the likely magnitude of construction disturbance on Arctic terns.

Parameter	Assessment
Extent	Disturbance of no pairs per year
Effect	Uncertain
Duration	Over a 4 year period
Reversibility	Reversible once construction stops
Frequency	One off effect
Probability	Unlikely

In view of the above, it is considered that construction works would have short-term adverse effects of negligible magnitude on Arctic tern. Although Arctic tern is a species of high nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

(b) **Operational disturbance**

Breeding Arctic terns are judged to have moderate sensitivity to disturbance and therefore operation of the development could potentially displace some birds from suitable nesting sites, possibly resulting in reduced site productivity.

For the purposes of this assessment it is assumed that nesting and foraging terns would be displaced from areas within 250m of operating turbines and from areas within 100m of tracks. Baseline surveys indicate that no pairs of Arctic tern typically nest within the assumed displacement zone (refer to Fig. A11.15).

Table A11.59. Characterising the likely magnitude of operational disturbance on Arctic terns.

Parameter	Assessment
Extent	No displacement of pairs
Effect	Uncertain
Duration	Life of windfarm, 25 years
Reversibility	Only after decommissioning
Frequency	On-going effect during breeding season
Probability	Unlikely

In view of the above, it is considered that disturbance due to operation of the development would have long-term adverse effects of negligible magnitude on Arctic tern. Although Arctic tern is a species of low/moderate nature conservation importance it is judged that these effects would be **not significant** under the terms of the EIA Regulations, i.e. no detectable population level effects on the Shetland NHZ.

A11.21.7 Arctic tern collision impacts

Very little flight activity was recorded during the timed generic VP watches and nearly all that was seen was in the close vicinity of freshwater lochs or the coast (Appendix A11.1), i.e. away from the location of proposed turbines. Consequently, the likelihood of collision is considered to be negligible and therefore effects would to be **not significant**. No CRM was carried out as it was considered unnecessary given the extremely low flight activity within the areas where turbines are proposed.

A11.21.8 Significance evaluation – combined effects on Arctic tern

The combined effects of land-take, construction and operational activities are negligible and judged to be **not significant**, i.e. no detectable population level effects on the Shetland NHZ. Consequently, no population modelling was conducted for this species.

A11.21.9 Mitigation/Enhancement

As a result of no significant effects on Arctic tern, specific mitigation and enhancement was considered unnecessary.

A11.21.10 Residual effects on Arctic tern

It is considered that the magnitude of the residual effects on Arctic tern due to windfarm construction and operational activities is likely to be negligible. Although Arctic tern is a species of high Nature Conservation Importance, the residual effects are judged to be **not significant** under the terms of the EIA Regulations, i.e. there will be no detectable regional population level effects and so the FCS of the Shetland NHZ will not be adversely affected. Therefore, if the Viking Wind Farm is built, the available information indicate that FCS will not be affected because:

- Arctic tern will maintain itself on a long-term basis as a viable component of its habitat in Shetland;

- The natural range of Arctic tern in Shetland will not be reduced by the wind farm, nor will it become likely to be reduced in the foreseeable future; and
- There will be (and will continue to be) a sufficiently large habitat area in Shetland to maintain Arctic tern populations on a long-term basis.

A11.22 MONITORING

The proposed Viking Wind Farm development provides a unique opportunity to investigate potential effects and interactions of a windfarm on a suite of bird species for which little or no published information exists. The effects of the proposals on birds would be monitored through a carefully planned and agreed programme of ornithological studies.

It is proposed that the following aspects would be covered:

- The location and success of red-throated diver and merlin breeding attempts across the VDSA and VMSA (i.e. most of Central Mainland). Annually from 2011subject to consent;
- The distribution and abundance of whimbrel territories within the development site. All construction years, operational years 1-3 (following final commissioning) and at 4-year intervals thereafter;
- The distribution and abundance of moorland bird species (including all wader, wildfowl and skua species) at eight selected plots each of at least 4 km^2. Four plots within the development area and four reference plots elsewhere in Central Mainland. Every four years commencing 2011;
- Focal vantage point watches to quantify flight activity by red-throated divers, merlin and whimbrel at selected turbines. Operational years 1-3;
- Searches around selected turbines to quantify collisions by red-throated divers, merlin, waders and skua species. Operational years 1-3 and thereafter at 5 year intervals; and
- A 'one-off' study to measure bias in collision mortality searches due to detection error and carcass removal by scavengers. Year following final commissioning of the windfarm.

The above monitoring programme is additional to the ornithological research and monitoring work required to inform and monitor the HMP (Appendix A10.9). Nevertheless there will be some overlap (e.g. with regard to monitoring whimbrel) between the two work programmes and a need to integrate the work. The bird monitoring programme would be agreed with SNH and RSPB prior to construction commencing.

Implementation of the HMP (Appendix A10.9) will be the responsibility of the Viking Energy Partnership, overseen and advised by the proposed independent Shetland Windfarm Environmental Advisory Group (SWEAG) and Monitoring Committee modelled on but distinct from the Shetland Oil Terminal Environmental Advisory Group (SOTEAG). It is likely that there will be monitoring overlap in terms of these work areas and this will be considered with the relevant partners when finalising forward monitoring work programmes.

A report would be sent to the Scottish Government, SNH and RSPB after each year of monitoring, together with details of any proposed changes to the monitoring programme as a result of survey findings. The aims and details of the ornithological monitoring programme would be subject to regular review in light of findings and other events.

A11.23 SUMMARY OF PREDICTED EFFECTS

Tables 11.59 and 11.60 summarise the predicted effects of the proposed Viking Wind Farm on the main ornithological receptors. This assessment has determined that the predicted residual effects of the proposed Viking Wind Farm on the main ornithological receptors after mitigation are all likely to be **not significant**. Furthermore, there is strong reason to believe that conservation management outlined in the HMP may have significant beneficial effects on a range of important species e.g. red-throated diver, merlin and whimbrel.

Table 11.59: Summary of effects on species:

Species	Assumed Conservation Status	Land take	Habitat modification	Construction Disturbance	Operation Disturbance	Collision	Effects combined before mitigation	Effects combined with HMP mitigation
Red-throated diver	Favourable	Negligible	Negligible	Negligible	Low	Negligible to Low	Negligible	Negligible
Whooper swan	Favourable	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Greylag goose	Favourable	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Merlin	Favourable	Negligible	Negligible	Low	Low to moderate	Negligible	Low to moderate	Negligible
Hen harrier	N/A	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Golden plover	Favourable	Negligible	Negligible	Low	Negligible	Negligible to low	Low	Negligible
Lapwing	Favourable	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Dunlin	Favourable	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Black-tailed godwit	Favourable	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Whimbrel	Not favourable	Negligible	Negligible	Negligible	Low	Low	Low	Negligible
Curlew	Favourable	Negligible	Negligible	Low	Low to moderate	Low	Low	Negligible
Arctic skua	Not favourable	Negligible	Negligible	Negligible	Negligible to low	Negligible	Negligible	Negligible
Great skua	Favourable	Negligible	Negligible	Negligible	Negligible	Negligible to low	Negligible	Negligible
Arctic tern	Favourable	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
All other species	N/A	Negligible	Negligible	Negligible to low	Negligible	Negligible	Negligible	Negligible

Table 11.60: Summary effects and mitigation and enhancement measures.

Potential Effect	Description	Initial magnitude and significance	Residual magnitude and significance
Land Take			
All species	Offset effect by HMP habitat restoration measures	Negligible/ Not significant	Negligible/ Not significant
Habitat Modification			
All species	Offset effect by HMP habitat restoration measures	Negligible/ Not significant	Negligible/ Not significant
Construction Disturbance			
Red-throated diver	At nesting sites, avoid effect by restrictions under the BPP on the timing and location of construction works	Negligible/ Not significant	Negligible/ Not significant
Merlin	At nesting sites, avoid effect by restrictions under the BPP. If Territory C is occupied, reduce breeding season overlap between construction work and critical foraging area to below 20%.	Low/ Not significant	Negligible/ Not significant
Whimbrel	At nesting sites, avoid effect by restrictions under the BBP	Negligible/ Not significant	Negligible/ Not significant
All other species	None required.	Negligible or Low/ Not significant	Negligible or Low/ Not significant
Operational disturbance			
Red-throated diver	Avoid effect by i) Micro-siting of windfarm access roads at five lochans, ii) Strategic screening along access roads at 3 lochans	Low/ Not Significant	Negligible/ Not significant
Merlin	Offset effect by management to enhance the value of nesting heather at five territories in Central Mainland	Low/ Moderate **Significant**	Negligible/ Not significant
Whimbrel	Offset effect by habitat enhancement and crow control over wide areas as described in HMP	Low/ **Significant**	Negligible/ Not significant
Golden plover, curlew, Arctic skua	Offset effect by habitat restoration and enhancement and crow control over wide areas as described in HMP	Negligible or Low/ Not Significant	Negligible/ Not significant

All other species	None required.	Negligible / Not significant	Negligible / Not significant
Collision			
Red-throated diver	Offset effect by: i) Measures to safeguard and enhance the quality of lochans aimed at increasing occupancy and productivity, as described in HMP. ii) Provision of nesting rafts at five large lochs to encourage breeding, as described in HMP.	Low/ Not Significant	Negligible/ Not significant
Whimbrel	Offset effect by habitat restoration and enhancement and crow control over wide areas as described in HMP	Low/ Not Significant	Negligible/ Not significant
Golden plover curlew, great skua	Offset effect by habitat restoration and enhancement and crow control over wide areas as described in HMP (mitigation not relevant to great skua)	Negligible or Low/Not Significant	Negligible/ Not significant
All other species	None required.	Negligible/ Not significant	Negligible/ Not significant
Decommissioning			
Red-throated diver, merlin, whimbrel (and any other WCA Schedule 1 species)	Restrictions under the Bird Protection Plan on the timing and location of decommissioning works	Low/ Not significant	Negligible/ Not significant
All other species	None required.	Not significant	Not significant

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