Environmental Impact Assessment Report

Swarclett Wind Farm

Technical Appendix 7-1: Ornithology Technical Appendix

Swarclett Wind Energy Limited

June 2024

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Please note that figures with ** are confidential

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1 Introduction

1.1 Terms of Reference

In September 2019, Atmos Consulting Limited was commissioned by Swarclett Wind Energy Limited to undertake ornithological surveys in relation to a proposed wind farm development, on land approximately 10km southeast of Thurso, Highland.

The Proposed Development has been subject to avian surveys from October 2019 through to May 2021 inclusive with a further set of breeding season surveys carried out between March and August 2023.

This Technical Appendix provides details of the ornithology surveys carried out; it describes the methodology used, reports on their findings and describes the results of the desk study carried out in support of the Ornithological Impact Assessment described in Chapter 7: Ornithology.

1.2 Site Location and Description

The Proposed Development is located approximately 1km southeast of Mains of Durran, Castletown, Thurso, Highlands (the 'Proposed Development Site'). The Proposed Development Site is centred on Grid Reference (ND 21032 62606) and is illustrated in Figure 1-1.

The Proposed Development Site itself is a mix of semi-improved agricultural fields, felled/windblown forestry plantation, and an area of mire or fen in the valley bottom. Loch Scarmclate is situated 2.3km to the southwest.

The Proposed Development Site lies 2.3km northeast of Caithness Lochs Special Protection Area (SPA), which regularly supports wintering populations of Whooper swan *Cygnus cygnus*, Greenland White-fronted goose *Anser albifrons flavirostris* and Greylag goose *Anser anser*. It also lies approximately 7.8km west southwest of Caithness and Sutherland Peatlands SPA (Figure 7-1-1), which is internationally important for supporting a diverse assemblage of moorland breeding birds. Additionally, the Proposed Development Site lies 6km south of North Caithness Cliffs SPA which is designated for a number of cliff nesting birds. Full details of designated sites are provided in Section 4.1.

1.3 Objectives

The objectives of this Technical Appendix are to:

- summarise the avian desk study information obtained to date for the Proposed Development Site;
- document the ornithological survey methodologies and avian species recorded during the period of survey:
  - Vantage Point (VP) surveys undertaken between October 2019 and August 2020, September 2020 to May 2021 and March 2023 to August 2023, including flight data recorded for target species;
  - Goose and Whooper swan activity surveys undertaken between September and April in all years between October 2019 and April 2021, and recent supplementary surveys in April and May 2023.

- Goose and Whooper swan flock density surveys between October and December 2019.
- Moorland Breeding Bird surveys undertaken between April and July in both 2020 and 2023; and
- Breeding Raptor surveys undertaken between April and July in both 2020 and 2023.

2 Ornithological Legislation & Conservation Status

Legislation, non-statutory conservation designations, and NatureScot (NS) guidance pertaining to the ornithological interests discussed within this report are presented below.

2.1 Wildlife and Countryside Act 1981 (as amended) & Conservation (Natural Habitats & c.) Regulations 1994 (as amended in Scotland)

The Wildlife and Countryside Act 1981 (as amended) (WCA) is the principal mechanism for the legislative protection of wildlife in Great Britain. All wild birds and their active nests, eggs and young are protected from damage, destruction or capture under the WCA. Bird species listed on Schedule 1 gain additional protection particularly around their nests, with disturbance listed as an offence, with special penalties for breaches of the law related to those Schedule 1 species. The WCA also provides the mechanism by which the Directive on the Conservation of Wild Birds (Directive 2009/147/EC, the 'Birds Directive') is transposed into UK law, allowing for the designation of Special Protection Areas (SPAs).

The Birds Directive lays out special measures to conserve wild birds, their eggs, nests and habitats, and applies special protection to those species as listed under Annex I of the Directive. This is to apply special protection, in particular, to those species which are migratory and are considered to be of a shared heritage and conservation responsibility across all European Union member states.

The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland), or 'Habitat Regulations', are the method by which the relevant European Directives are translated into Scottish law. Specifically, the Habitat Regulations transpose the Convention on the Conservation of European Wildlife and Natural Habitats (the 'Bern Convention') and Natural Habitats and Wild Fauna and Flora (92/43/EEC, the 'Habitats Directive') into a Scottish context.

2.2 Nature Conservation (Scotland) Act 2004

The Scottish Biodiversity List (SBL) was developed to meet the requirements of Section 2(4) of the Nature Conservation (Scotland) 2004 Act (NCSA) for the conservation of biodiversity. This legislation required Scottish Ministers to publish lists of species of flora, fauna and habitats considered to be of principal importance for the purposes of biodiversity.

Taken together, the WCA (1981) and NCSA (2004) ensure that all wild birds, their nests and eggs are protected by making it an offence to:

- Intentionally or recklessly kill, injure or take any wild bird;
- Intentionally or recklessly take, damage or destroy the nest of any wild bird while it is in use or being built;
- Intentionally or recklessly take or destroy the egg of any wild bird; and

- Intentionally or recklessly disturb any wild bird listed on Schedule 1 while it is nest building or is at (or near) a nest with eggs or young, or disturb the dependent young of such a bird without a Schedule 1 licence provided by NatureScot.

2.3 Ramsar

Ramsar sites are designated under the Ramsar Convention on Wetlands (Ramsar 1971), which requires signatories to maintain the ecological character of their internationally important wetlands.

Within the Scottish context, most Ramsars are also SPAs or Natura sites, with the exception of specific sites where they are designated as wetland habitats only. Generally, they have been treated as being the equivalent to Natura sites within the planning framework, although the situation has been complicated by recent statements on the Scottish Government website which state that Ramsar qualifying interests which coincide with the interests of Natura sites are given the same level of legal protection; where interests are not the same as Natura interests but instead match SSSI interests, they will receive protection under the SSSI regime. As such, although sites designated as Ramsar sites will be identified as such in the text, any consideration will address them as SPAs only.

2.4 Biodiversity Action Plans

The UK Biodiversity Action Plan (UK BAP) was the UK's response to the commitments of the Rio Convention on Biological Diversity. The plan outlines action for 26 species of birds of conservation importance/concern.

The Nature Conservation (Scotland) Act 2004 places a duty of care on public bodies to further the conservation of biodiversity in Scotland, the execution of which is implemented through Local Biodiversity Action Plans (LBAPs).

The 'UK Post-2010 Biodiversity Framework' succeeded the UK BAP and 'Conserving Biodiversity – the UK Approach'. The framework takes into account the 'Aichi targets' following a conference in Japan in 2010 and publication of the new EU Biodiversity Strategy (EUBS) in 2011, and complements existing UK biodiversity strategies and targets by identifying activities required to achieve them. This framework places more weight on national responses such as the Scottish Biodiversity Strategy, than on a UK wide response.

2.5 Birds of Conservation Concern 5 (BoCC)

The leading government (Joint Nature Conservation Committee (JNCC)) and nongovernment conservation organisations in the UK jointly reviewed the population status of the 247 bird species that are regularly found within the United Kingdom using data from national monitoring schemes. This was most recently reviewed in 2015 (Eaton et al., 2015) and was an update to the earlier 2009 BoCC report. On the basis of seven quantitative criteria, each species has been placed on one of three lists, these being:

• Red - red list species are those that are globally threatened, have had an historical population decline in the UK from 1800 -1995, a rapid (> or = 50%) decline in UK breeding population over the past 25 years, or a rapid (> or = 50%) contraction of UK breeding range over the past 25 years;

• Amber - amber listed species are those that have had a historical population decline from 1800-1995 but are recovering (population size has more than doubled over the past 25 years), a moderate (25-49%) decline in UK breeding population over the past 25 years, a moderate (25-49%) contraction of UK breeding range over the past 25 years, a moderate (25-49%) decline in UK non-breeding population over the past 25 years, or species with unfavourable conservation status in Europe also known as Species of European Conservation Concern (SPEC); and

• Green - green listed species are those that have no identified threat to their population status.

2.6 Ornithological Guidance

NatureScot, formerly Scottish Natural Heritage[1] has produced several guidance documents in relation to the assessment of impacts of wind farm developments on bird populations. The following guidance informed the survey work and any subsequent assessments:

- Wind farms and birds: calculating a theoretical collision risk assuming no avoidance action (2000);
- Monitoring the Impact of Onshore Wind Farms on Birds (2009a);
- Assessing the Cumulative Impacts of Onshore Wind Energy Developments (2012);
- Natural Heritage Zones Bird Population Estimates (2015) (published by the Scottish Wind farm Bird Steering Group (SWBSG)) (Wilson, 2015);
- Assessing Connectivity with Special Protection Areas (SPAs) (2016a);
- Environmental Statements and Annexes of Environmentally Sensitive Bird information (2016b);
- Avoidance Rates for the Onshore SNH Bird Wind Farm Collision Risk Model (2017a);
- Recommended bird survey methods to inform impact assessment of onshore wind farms (2017b); and
- Assessing the Significance of Impacts from Onshore Wind Farms on Birds at Sites Outwith Designated Areas (2018a).

[1] References will therefore still refer to 'SNH' as this was the publisher of guidance etc at the time of publication.

3 Methodology

3.1 Desktop Study

3.1.1 Designated Sites

The desktop study consisted of a search for statutory and non-statutory designated sites with avian qualifying features within 10km of the Proposed Development, increased to 20km for Natura 2000 sites with qualifying interests for geese as a result of NatureScot guidance on connectivity (SNH, 2016a), as well as a data review for sources of information relating to bird populations on and within the vicinity of the Proposed Development.

3.1.2 Species Records

A search of publicly available records on the NBN Atlas (https://nbnatlas.org) for the last 10 years was completed to review historical records with respect to target species of birds that have been reported in the vicinity of the Proposed Development. Only records which are licensed for commercial use have been consulted.

Additionally, data for Schedule 1, Annex 1 and BoCC (Red & Amber) listed birds provided by the RSPB was reviewed in September 2023. This pertained to birds within a 2 km radius of the Proposed Development. These will be summarised in Confidential Technical Appendix 7-2.

3.1.3 Target Species

Target avian species were identified as those that are either afforded specific legislative protection (i.e. of high conservation interest) or represent qualifying interests in designated sites in the wider area. Reference was then made to guidance for the identification of potentially vulnerable species (SNH, 2017a; SNH, 2018a). The final list of target species was determined using these guidance documents along with the likelihood of each species being present at the Proposed Development Site and in the environs (based upon available habitat, experience of working in this region and geographical location).

Target species are considered to be those:

- identified as potentially at risk from impacts of onshore wind farms (SNH, 2018a);
- species listed in Annex I of the Birds Directive (2009/147/EC); or
- non-passerines listed in Schedule 1 of the WCA

Following the above guidance and knowledge of the general area, Vantage Point surveys (from two locations consisting of two diurnal, dawn and dusk watches of 3 hour duration per month) were carried out.

3.2 Survey Methodologies

Survey methodologies were in accordance with SNH (2017b) guidance as well as survey methodologies described in Gilbert *et al*. (1998) and Hardey *et al*. (2013).

All surveys were carried out by experienced ornithological surveyors who hold NatureScot Schedule 1 bird licences.

3.2.1 Vantage Point Surveys

Vantage point (VP) surveys were initiated in October 2019. Surveys which took place between 2019-2021 were at a single VP location. A second VP location was introduced for the 2023 VP surveys which were carried out between March and August 2023.

Each VP survey was undertaken by a suitably experienced single observer in conditions of good visibility. Acceptable weather conditions included winds no stronger than Beaufort force six, and no persistent heavy rain. The surveyor positioned themselves as inconspicuously as possible to minimise their effect on the birds' natural behaviour. The surveyor surveyed a 180° arc centred on a predetermined view bearing. The VPs were selected to ensure that the viewshed covered the required study area out to 2km, as per NatureScot guidance, observations from the VPs have not been constrained to a 2km radius. The viewshed is based on visibility over bare ground at an imaginary layer 20m above the ground. Figure 7-1-2 shows the VP locations and their viewsheds. Table 7-1-1 presents the details of all VP locations.

Table 7-1-1: Details of Vantage Point Locations

VP Number	Grid Reference		View Bearing	Notes
	Easting	Northing		
VP1	320100	962157	150°	Surveyed between October 2019 - May 2021
VP2	320192	962846	100°	Surveyed between March -August 2023.

VP surveys were undertaken between October 2019 – May 2021 inclusive and then between March – August 2023 inclusive.

Surveys at each VP location lasted no longer than three hours in duration. No simultaneous observations were undertaken. Other survey work and estate activity on the Proposed Development Site was considered in order to minimise the potential for disturbance of baseline conditions and issues compromising data integrity. Diurnal VPs were completed to cover all daylight hours (between dawn and dusk) in any given survey day.

During each survey, the landscape was scanned continuously until a target species was detected. Once detected, the bird was observed until it landed or flew out of sight, with monitoring occurring so long as it remained within the viewshed field of view. The time of first detection was noted, and the exact time spent flying in a specified height band was recorded.

Flight lines from October 2019 onwards were recorded within the following three height bands:

- A - < 20m;
- B - 20m – 130m; and,
- C - > 130m.

Band B is the band where collision risk can occur, being the height which the turbine blades will sweep once the Proposed Development is active. Birds at this height are therefore considered to be at collision risk height. Since the surveys were carried out, a larger turbine mode, with a swept area between 20 – 150m was identified for use for

the Proposed Development. Data was therefore adjusted, and any flights which had been recorded with an estimated mean height of between 130 – 150m, was also included for assessment purposes in Band B.

3.2.2 Wintering Goose Surveys

Goose walkover surveys commenced in October 2019 and were carried out during winter and migratory periods until May 2023. All fields and land areas in the vicinity of the Proposed Development Site, covering a 10.9km^2 area (Figures 7-1-17 to 7-1-19 inclusive) were numbered and transects were carried out approximately two weeks apart, ensuring that each field/numbered area was scanned to check for the presence of feeding waterbirds, specifically geese and swans. Surveys were undertaken outside the dawn/dusk period to ensure that what was captured were records of feeling locations of birds.

3.2.3 Brown and Shepherd Breeding Bird Survey

A moorland breeding bird survey was carried out using an amended Brown & Shepherd upland breeding bird survey method for moorland habitats (Brown & Shepherd, 1993), but using four visits as per NatureScot guidance (SNH, 2017b). This technique is used to census upland breeding waders such as Golden plover *Pluvialis apricaria*, Dunlin *Calidris alpina*, Greenshank *Tringa nebularia* and other species of open upland moor but can be used to record all moorland species and provides a reliable estimate for most other species so long as four visits are used.

These were completed between April and July in both 2020 and 2023, avoiding high winds and other unfavourable weather conditions. The method is based on a constant search effort, allowing 20 to 25 minutes per 500 x 500m quadrat of open land. A predetermined route through each quadrat was followed so that all areas of each quadrat were approached to within at least 100m, with the surveys taking place between 08:30 and 18:00, in accordance with the guidelines.

The behaviour and location of each individual bird was recorded on a 1:25,000 scale map, using standard BTO codes. Records from each survey were combined into a final visit map, to allow analysis for the identification of territories.

Birds were assumed to be breeding or holding a territory (confirmed breeding) at a location if one or more of the following was recorded:

- Presence of a nest, eggs or young (including newly fledged); and/or
- A bird was observed carrying food or breeding material.

In the absence of either of these indicative behaviours, birds were classified as probable breeding if one or more of the following was recorded:

- Courtship, displaying or singing in the same location on more than one visit;
- Agitated behaviour including alarm calls or distraction display; and/or
- Territorial disputes.

In the absence of any of the above indicative behaviours, birds were classified as possible breeding if one or more of the following was recorded:

- Singing or displaying on one visit;
- A pair in suitable habitat; and/or
- Birds reacting antagonistically on one visit.

Other records were considered to be of non-breeding birds.

3.2.4 Breeding Raptor Survey

Surveys for breeding moorland raptors require visits between March and July. The first visit in March to early April is carried out to detect occupancy by the various species. A second visit is used to identify active nests in April and early May. The third visit is carried out in June to check for the presence of young birds, and the final visit in July to August is used to recorded fledged young (Hardey *et al.*, 2013). Surveys were carried out during daylight hours.

Target species during the breeding raptor surveys included Hen harrier *Circus cyaneus*, Merlin *Falco columbarius*, Peregrine *Falco peregrinnus* and Short-eared owl *Asio flammeus*. These were identified based on the suitable habitats present on the Proposed Development Site.

Additional surveys were carried out in summer 2020 for breeding Barn owl *Tyto* but survey were discontinued thereafter due lack of access permission.

The identity and activity of all raptors were recorded on 1:25,000 scale maps, using standard BTO codes for all species and behaviour.

3.2.5 Diver surveys

NatureScot guidance (SNH 2017b) requires any water bodies within 1.5km of the Proposed Development to be surveyed for breeding divers. There are no waterbodies within 1.5km of the Proposed Development but Loch Scarmclete was surveyed for any divers during raptor surveys in 2020 due to its inclusion with the 2km raptor buffer at the time.

3.3 Survey Limitations

The Proposed Development boundary changed prior to commencement of Year 3 ornithology surveys requiring analysis of earlier data within the context of the revised Proposed Development boundary to allow for comparison across years. The new boundary is smaller and largely sits within the previous boundary with slight differences, however as breeding bird and raptor surveys included buffer zones, it is assessed that all areas within the new red line boundary were sufficiently surveyed in 2020 to detect presence of breeding species.

The position and bearing of the Vantage Point for the Proposed Development was also altered prior to year 3 following the changes to the Proposed Development Site boundary. The position has moved approximately 0.5 km south and the bearing changed from 150° to 118° to provide sufficient coverage of the new area. The changes are considered minor and data from year 1 and 2 is still relevant to the amended Proposed Development boundary, as much of the data overlaps and captures localised activity over the Proposed Development Site.

Barn owl surveys were only possible in 2020 because in subsequent years there no access was granted.

4 Results

4.1 Desktop Study

4.1.1 Designated Sites

Statutory Designations

There are several designated sites with avian qualifying features in the vicinity (< 10km) of the Proposed Development (Figure 7-1-1).

Special Protection Areas (SPA)

Caithness Lochs SPA, which consists of six lochs and a mire (Broubster Leans), is situated approximately 2.3 km to the southwest of the Proposed Development Site boundary. The lochs cover a range of types from oligotrophic to eutrophic and support a wide diversity of aquatic and wetland vegetation. The SPA is designated for non-breeding populations of three waterfowl species (Table 7-1-2).

Table 7-1-2: Caithness Lochs SPA qualifying features (SNH 1999)

Species	Scientific Name	Criteria for inclusion	Population Estimate	Current conservation status
Greenland white-fronted goose	*Anser albifrons flavirostris*	Article 4.1	Winter peak mean of 440 (3% of GB population, 1% of Greenlandic population) (1993 / 1994 – 1997 / 1998)	Favourable declining
Greylag goose	*Anser anser*	Article 4.2	Winter peak mean of 7,190 (7% of GB and Icelandic populations) (1993 / 1994 – 1997 / 1998)	Favourable maintained
Whooper swan	*Cygnus cygnus*	Article 4.1	Winter peak mean of 240 (4% of GB population, 1% of Icelandic population) (1993 / 1994 – 1997 / 1998)	Favourable maintained

The Caithness and Sutherland Peatlands SPA is situated approximately 8km to the east northeast of the Proposed Development Site boundary at its closest point and forms the largest and most intact area of blanket bog in the UK. These peatlands, the surrounding moorland and open water, are of international importance for the conservation of a diverse range of breeding birds. Species for which the SPA is designated for are shown in Table 7-1-3.

Table 7-1-3: Caithness and Sutherland Peatlands SPA qualifying features (SNH 2017c)

Species	Scientific Name	Criteria for inclusion	Population Estimate (2001)	Most Recent Population Estimate (2007/09)	Current conservation status
Black-throated Diver	*Gavia arctica*	Article 4.1	26 pairs (16.3% of GB population)	17 pairs	Unfavourable declining
Golden Eagle	*Aquila chrysaetos*	Article 4.1	5 pairs (1.3% of GB population)	5 pairs	Favourable maintained
Golden Plover	*Pluvialis apricaria*	Article 4.1	1064 pairs (4.7% of GB population)	1922 pairs	Favourable maintained
Hen Harrier	*Circus cyaneus*	Article 4.1	14 pairs (2.8% of GB population)	18 pairs	Favourable maintained
Merlin	*Falco columbarius*	Article 4.1	54 pairs (4.2% of GB population)	54 pairs	Favourable maintained
Red-throated Diver	*Gavia stellata*	Article 4.1	89 pairs (9.5% of GB population)	46 pairs	Favourable maintained
Short-eared Owl	*Asio flammeus*	Article 4.1	30 pairs (3% of GB population)	30 pairs	-
Wood Sandpiper	*Tringa glareola*	Article 4.1	5 pairs (50% of GB population)	6 pairs	Favourable maintained
Common Scoter	*Melanitta nigra*	Article 4.2	27 pairs (<0.1% of Western Siberian/ Western & Northern Europe/ Northwestern Africa population)	26 pairs	Unfavourable declining
Dunlin	*Calidris alpina schinzii*	Article 4.2	1860 pairs (16.9% of the Baltic/UK/Ireland population)	1366 pairs	Favourable maintained
Greenshank	*Tringa nebularia*	Article 4.2	54 pairs (0.4% of the Europe/Western Africa population)	653 pairs	Favourable maintained
Wigeon	*Anas penelope*	Article 4.2	43 pairs (<0.1% of Western Siberian/Northwestern/Northeastern Europe population)	43 pairs	-

The North Caithness Cliffs SPA lies approximately 6km north of the Proposed Development at its closest point. The SPA covers a stretch of northern coastline extending 2km out to sea and supports in excess of 20,000 individual seabirds. Species for which the SPA is designated for are shown in Table 7-1-4.

Table 7-1-4: North Caithness Cliffs SPA qualifying features (SNH 2018b)

Species	Scientific Name	Criteria for inclusion	Population Estimate	Current conservation status
Peregrine	*Falco peregrinus*	Article 4.1	6 pairs (0.5% of GB population) (figure from SPA citation 2018)	Unfavourable declining
Common Guillemot	*Uria aalge*	Article 4.2	38,300 individuals (1% of the North Atlantic biogeographic population and 4% of GB population) (1985 – 1987)	Favourable maintained
Fulmar	*Fulmarus glacialis*	Article 4.2	14,700 pairs (3% of GB population) (1985 – 1987)	Favourable maintained
Black-legged Kittiwake	*Rissa tridactyla*	Article 4.2	13,100 pairs (3% of GB population) (1985 – 1987)	Unfavourable declining
Razorbill	*Alca torda*	Article 4.2	4,000 individuals (3% of GB population) (1985 – 1987)	Favourable recovered
Puffin	*Fratercula arctica*	Article 4.2	2,080 pairs (0.4% of GB population and greater than 2,000 individuals) (1985 – 1987)	Favourable maintained
Seabird assemblage	No additional species beyond those listed above	Article 4.2	110,000 individuals (1985 – 1987)	Favourable maintained

Ramsar

Caithness Lochs RAMSAR consists of the same six lochs as listed above, covering the Caithness region. In winter, these lochs support internationally important populations of Whooper swan, Greenland White-fronted goose and Greylag goose (JNCC, 1998).

Caithness and Sutherland Peatlands RAMSAR forms one of the largest and most intact areas of blanket bog in the world, including an exceptionally wide range of vegetation and surface pattern types. It supports a diverse range of breeding waterfowl, including internationally important populations of Dunlin and Greylag goose and nationally important populations of Red-throated diver, Black-throated diver, Wigeon, teal *Anas crecca*, Common scoter, Curlew *Numenius arquata*, Greenshank, Wood sandpiper, and Golden plover. Golden eagle, Hen harrier, Arctic skua *Stercorarius parasiticus* and Short-eared owl are also supported within the Proposed Development Site. The RAMSAR covers a similar footprint as the Caithness and Sutherland Peatlands SPA, located approximately 8km to the east-northeast of the Proposed Development Site boundary at its closest point (JNCC, 1999).

Sites of Special Scientific Interest (SSSI)

Loch of Durran SSSI is located approximately 1km to the north of the Proposed Development (at its closest point). The site is primarily designated for its botanical value, however the loch supports 4% of the UK wintering population of Whooper swan.

Loch Scarmclate SSSI is situated approximately 2.3km southwest of the Proposed Development Site boundary. The area is designated for its base-rich freshwater lochs and roosting site for wintering Greylag goose between late September and April (SNH, 2011).

Loch Watten SSSI lies 4.1km south of the Proposed Development Site boundary and supports an overwintering population of Greylag goose. The loch is one of the largest roost sites in the area supporting up to 3,000 geese equating to 3% of the overall British population (SNH, 2010a).

Loch Heilen SSSI lies approximately 6km northeast of the Proposed Development Site and is designated for its loch habitat and overwintering bird populations. The loch acts as a roosting site for nationally important flocks of Whooper swan, Greenland White-fronted goose and Greylag goose which are present on the loch between September and April. The rough grassland near the loch is an important feeding site for Greenland White-fronted goose so this species can often use the Proposed Development Site during the day, as well as for roosting (SNH, 2010b).

Dunnet Head SSSI lies approximately 10km to the north of the Proposed Development Site at its closest point. It is located on the north coast of Caithness about 10km east of Thurso. The site is designated for the nationally important coastal vegetation and breeding seabirds. More than 10,000 pairs of seabirds nest in the crevices and ledges of the cliffs, making this site of national importance for breeding seabirds. The seabird colony includes large numbers of Guillemot and Kittiwake, as well as Fulmar, Razorbill, Puffin, Shag *Phalacrocorax aristotelis*, Cormorant, Herring gull *Larus argentatus* and Great black-backed gull *Larus marinus* (SNH, 2010c).

Shielton Peatlands SSSI lies approximately 10 km to the southeast of the Proposed Development Site at its closest point. The site is located approximately 6km north of Lybster and forms the largest continuous area of peatland in the eastern half of Caithness. The site is designated for the nationally important blanket bog habitat and upland breeding birds. The extent and diversity of the blanket bog and dubh lochans on the site provide suitable habitat for a wide range of breeding birds of prey, waders, and waterfowl. Notable birds of prey recorded include hen harrier, merlin, peregrine, and short-eared owl. A range of wader and waterfowl species breed on the site including greylag goose, dunlin, golden plover, greenshank and wigeon. The dubh lochans also provide ideal breeding habitat for red-throated diver. Several pairs of arctic skua also breed on the blanket bog (SNH, 2010d).

4.1.2 Species Records

A search of the NBN Atlas for the last 10 years within a 5km radius of the Proposed Development showed records for nineteen species that are listed either on Annex I of the EC Birds Directive (2009/147/EC), Schedule 1 of the Wildlife and Countryside Act 1981 (as amended), or are species determined by NatureScot to be particularly at risk from onshore wind farms (SNH, 2018a) (undertaken under licence CC0, OGL, CC-BY) (Table 7-1-3). RSPB count data within a 2km radius did not identify any additional species.

Table 7-1-5: Recorded Bird Species (data from NBN Atlas)

Species	Annex I	Schedule 1	At risk from wind farms
Curlew [1] *Numenius arquata*			X
Dunlin [1, 2] *Calidris alpina*	X		X
European White-fronted Goose *Anser albifrons albifrons*			X
Golden Plover *Pluvialis apricaria*	X		X
Greenland White-fronteed Goose *Anser albifrons flavirostris*	X		X
Greylag goose *Anser anser*			X
Herring gull [1] *Larus argentatus*			X
Lapwing [1] *Vanellus vanellus*			X
Pink-footed Goose *Anser brachyrhynchus*			X
Redwing [1] *Turdus iliacus*		X	
Skylark *Alauda arvensis*			
Whooper swan [1] *Cygnus cygnus*	X	X	X
Great skua *Stercorarius skua*			X
Taiga bean goose *Anser Fabalia*			X
Tundra Bean Goose Anser serratirostris			X
Merlin *Falco columbarius*	X	X	
Brent Goose *Branta bernicla*			X
Kestrel *Falco tinnunculus*			X

[1] Data sourced from Birds (BTO/JNCC/RSPB Partnership).

[2] Only *schinzii* race listed as an Annex I species.

Vantage Point Surveys

Table 7-1-6 summarises the VP survey effort across all VP locations between October 2019 and August 2023, inclusive.

Table 7-1-6: Vantage Point Survey Effort across all survey periods.

Year	VP Number	January	February	March	April	May	June	July	August	September	October	November	December	Total Hours
2019	**1**										12	12	12	36
2020	**1**	6	12	6	12	12	6	6	6	6	10	12	12	106
2021	**1**	12	12	12		6								42
2023	**2**			12	12	12	12	12	12					60

- **Visit details**: The specific details of each VP survey visit (date, time, duration, and surveyor) can be found in Annex A, Tables 7-1-27 – 7-1-29. A summary of the weather conditions during each VP survey is presented in Annex B, Tables 7-1-30 – 7-1-32.
- **Flight data:** Individual flight data for all target species including incidental sightings outside of the survey period or outside the viewshed are detailed in Annex C, Tables 7-1-33 - 7-1-35.
- **Point records:** Birds that were only heard, or observed on the ground are summarised separately in a summary of all point registrations in Annex E, Table 7-1-37. The locations of these registrations are presented in Figures 7-1-15 – 7-1-16.

For each year of survey, a summary of numbers of target species flights and flight times are presented in turn below in 'Summary flight data' tables, along with 'Seasonal Activity Pattern' tables displaying monthly activity of each species present during the breeding period (March- August inclusive).

4.1.3 Year 1

A total of 14 target species were recorded during the VP watches that took place between October 2019 – August 2020.

Table 7-1-7: Summary Flight Data for Target Species (October 2019 – August 2020)

Species	Min No. of Birds	Max No. of Birds	No. of Flights	Total Bird Seconds	At Risk Bird Seconds
Common scoter	1	1	1	35	35
Cormorant	1	1	1	5	5
Curlew	1	1	21	524	174
Golden plover	17	17	1	170	0
Greylag goose	1	500	36	398250	357525
Hen harrier	1	1	2	400	0
Lapwing	1	4	36	1335	523
Mute swan	1	50	20	9915	8830
Oystercatcher	1	2	16	237	59
Peregrine	1	1	1	20	15
Pink-footed goose	1	700	35	288076	272976
Pochard	7	7	1	315	315
Snipe	1	3	4	273	273
Whooper swan	1	150	15	18865	18240

In the first year, Greylag goose had the highest number of recorded flights and at- risk bird flight seconds, totalling 357,525 seconds over 36 flights, with flocks of up to 500 birds recorded in the non-breeding season accounting for most of the activity observed. This was followed by Pink-footed goose with 27,2976 at risk seconds over 35 registrations over the year. In the non-breeding period, flocks of up to 700 Pink-footed geese were recorded across 15 registrations, accounting for 17,2640 of all at risk seconds. Mute swan was another regularly observed species in the non-breeding period, with 20 flights from up to 50 birds recorded, totalling 8,830 at risk bird seconds. Whooper swan was recorded on 15 flights totalling 18,240 at risk bird seconds. Both Whooper swan and Greylag goose are qualifying species for the nearby Caithness Lochs SPA; the third qualifying species, Greenland white-fronted goose, has not been recorded.

During the breeding season between March and August 2020, eight target species were recorded during vantage point surveys. Table 7-1-8 presents a monthly summary of all flight line data recorded during the VP surveys, with total flight time per species. The most recorded species across the breeding season was lapwing, with 36 flights,1,335 bird seconds and 523 bird seconds at risk height recorded. This species was not present outside of the breeding period. Additionally, Curlew was frequently encountered with 21 flights recorded across all months between April and July, totalling 524 bird seconds and 144 bird seconds at risk height. Other waders observed were oystercatcher (16 flights) and snipe (4 flights).

Table 7-1-8: Seasonal Activity Patterns for Target Species from March to August 2020 total bird seconds at all heights

Species	March	April	May	June	July	August
Curlew		240	140	79	65	
Golden plover		170				
Greylag goose	400					
Hen harrier					80	
Lapwing	401	589	345			
Oystercatcher		67	104		66	
Pink-footed goose	10,0336					
Snipe			245		28	

Pink-footed goose had the highest number of at risk bird seconds (98,086) during the breeding period, with a total of 10,0336 bird seconds over 20 flights in March. Given the timing, this activity is likely flocks in passage to their breeding grounds. Similarly, Greylag goose was only observed in March as opposed to the breeding season and only on one occasion.

Hen harrier was observed once in July flying below risk height and a flock of 17 golden plover were observed once in April. These species are qualifying features of the Caithness and Sutherland Peatlands SPA.

4.1.4 Year 2

A total of thirteen target species were recorded during the VP watches that took place between September 2020 and May 2021.

Table 7-1-9: Summary Flight Data for Target Species (September 2020 – May 2021)

Species	Minimum No. of Birds	Maximum No. of Birds	No. of Flights	Total Bird Seconds	At Risk Bird Seconds
Barn owl	1	1	2	17	0
Brent goose	2	2	1	70	0
Greylag goose	1	150	44	101451	91907
Hen harrier	1	1	2	58	36
Lapwing	1	70	19	21829	20999
Peregrine	1	1	1	130	130
Pink-footed goose	1	18	7	1877	1877
Snipe	1	5	7	129	45
Curlew	1	1	1	20	20
Mute swan	1	1	1	34	34
Oystercatcher	1	2	2	24	0
Whimbrel	1	1	1	20	20
Whooper swan	1	14	9	3006	881

In the second year, Greylag goose was again the most frequently recorded species with also the greatest number of total and at-risk height bird seconds, with 40 out of all 44 flights recorded in the non- breeding periods. These were from flocks of up to 150 birds accounting for 81,242 out of all 91,907 at risk seconds for this species. Pink-footed goose had seven flights recorded with all 1887 bird seconds recorded at risk height; 1,709 seconds were in the non-breeding period. Whooper swan was observed on nine occasions during the non-breeding period with 881 out of 3006 observed flight seconds, at risk height. Both these species are likely to form part of the SPA population at Caithness Lochs SPA and Ramsar.

Lapwing was recorded year round with twelve flights in the non-breeding season and seven in the breeding season. Due to the large number of birds within flocks in the non-breeding season (≤70), they had a high recorded flight activity, with 20,404 and 19,997 seconds of flight activity in total and at risk height respectively. Snipe showed less recorded flight activity with 129 total bird second and 45 seconds of at risk height flight activity, of which was only in to the non-breeding season.

The remaining species had two flights or less and spent little time at risk height. Brent goose, with a single flight of two birds, was the only record of this species during survey. Hen harrier, Peregrine, and Barn owl are Schedule 1 species listed in the WCA and Hen harrier is a qualifying feature of the Caithness and Sutherland Peatlands SPA and peregrine a qualifying feature of the North Caithness Cliffs SPA and mentioned in the breeding bird assemblage citation for the Shielton Peatlands SSSI.

Seven target species were recorded during the breeding season VP surveys in March and May 2021.

Table 7-1-10: Seasonal Activity Patterns for Target Species from March and May 2021 (total bird seconds at all heights)

Species	March	May
Curlew		20
Greylag goose	10665	
Lapwing	1012	413

Species	March	May
Mute swan		34
Oystercatcher		24
Pink-footed goose	168	
Whimbrel		20

Greylag goose, a feature of the Caithness Lochs SPA and Ramsar, spent the most time within the risk window, recorded at this height for 10,665 seconds over 4 flights and with a peak count of 100 birds.

The next most frequently observed species, with 12 flights, of up to 12 birds, amounting to 1,425 bird seconds was lapwing.

There were two flights each of pink-footed goose and oystercatcher and single flights of curlew, mute swan and whimbrel. Whimbrel is a Schedule 1 breeding species on the WCA.

4.1.5 Year 3

Only the breeding period was covered during the third year of VP surveys. A total of seven target species were recorded during VP surveys between March and August 2023.

Table 7-1-11: Summary Flight Data for Target Species (March – August 2023)

Species	Minimum No. of Birds	Maximum No. of Birds	No. of Flights	Total Bird Seconds	At Risk Bird Seconds
Arctic skua	1	1	1	120	120
Curlew	1	2	61	1768	1046
Greylag goose	2	250	8	53795	33445
Lapwing	1	150	18	117293	104755
Mute swan	1	40	7	6554	2054
Oystercatcher	1	6	4	310	310
Pink-footed goose	1	120	36	111533	111533

Table 7-1-12: Seasonal Activity Patterns for Target Species from March to August 2023 (total flight (not bird) seconds at all heights)

Species	March	April	May	June	July	August
Arctic skua	120					
Curlew	274	510	627	255	102	
Greylag goose	52650	80	1065			
Lapwing		85	343		45	116820
Mute swan	6424		100	30		
Oystercatcher		240		40	30	
Pink-footed goose	111533					

These species will be discussed in order of decreasing flight activity at risk height.

Lapwing had the highest total of flight seconds with 18 records and flocks of up 150 birds active on Site in late August, which accounted for 104,755 seconds at risk height seconds.

The species with the next highest flight activity levels were predominantly migratory winter species that passed through the Proposed Development Site, Pink-footed goose and Greylag goose, with 111,533 and 33445 bird seconds at risk height. These large totals are partly accounted for by flock sizes of 250 and 120 birds respectively. Greylag goose is a feature of the Caithness Lochs SPA.

Seven flights of mute swan were seen through most of the season and accounted for 6554 seconds at risk height.

The most recorded species across the breeding season was curlew with 61 flights recorded throughout the Proposed Development Site, totalling 1,046 seconds at risk height.

4.2 Wintering Goose Surveys

Twenty-nine visits during suitable periods between October 2019 and May 2023 were carried out as detailed in Table 7-1-13. As previously mentioned, the survey area increased from October 2020 onwards.

Table 7-1-13: Dates and times of wintering geese survey

Survey Date	Survey Period Number	Visit Number	Start Time	Finish Time	Duration	Surveyor
30/10/2019	1	1	08:20	14:20	6:00	GC
13/11/2019	1	2	09:00	14:00	5:00	GC
28/11/2019	1	3	09:00	14:00	5:00	GC
12/12/2019	1	4	08:30	14:00	5:30	GC
20/12/2019	1	5	08:40	14:20	5:40	GC
05/02/2020	1	7	09:00	14:30	5:30	CM
19/02/2020	1	8	09:30	15:30	06:00	CM
05/03/2020	1	9	09:30	14:30	5:00	SL
20/04/2020	1	10	09:00	15:00	6:00	PH
29/04/2020	1	11	08:00	14:00	6:00	PH
08/05/2020	1	12	08:00	14:00	6:00	PH
15/10/2020	1	13	10:00	16:00	4:00	CM
27/10/2020	1	14	10:00	16:00	4:00	MD
13/11/2020	1	15	08:00	14:10	6:10	PH
23/11/2020	1	16	10:00	15:00	5:00	PH
07/12/2020	1	17	09:25	15:25	6:00	PH
18/12/2020	1	18	09:30	15:30	6:00	PH
06/01/2021	2	19	12:00	16:00	4:00	SL
20/01/2021	2	20	10:00	16:00	6:00	MD
04/02/2021	2	21	10:00	16:00	6:00	MD
18/02/2021	2	22	08:00	14:00	6:00	MD
03/03/2021	2	23	10;00	16:00	4:00	MD
19/03/2021	2	24	08:00	13:00	5:00	MD
11/05/2021	2	25	07:45	11:30	3:45	KT
07/04/2023	3	26	08:15	14:30	6:15	JE
21/04/2023	3	27	08:00	12:00	4:00	TJC

Survey Date	Survey Period Number	Visit Number	Start Time	Finish Time	Duration	Surveyor
15/05/2023	3	28	12:00	16:00	4:00	FT
30/05/2023	3	29	12:00	15:30	3:15	DM

Whooper swans, pink-footed and greylag geese were observed feeding in 39 fields across the survey area (detailed in Table 7-1-14 below and highlighted in Figures 7-1-17 to 7-1-19). Numbers at the tops of columns refer to the survey periods with dates as outlined in Table 7-1-13. Fields with 17 visits were part of the extended survey area and were not surveyed in period 1. Total figures are mean counts for the full period for which the specified fields were surveyed.

Table 7-1-14: Goose survey results, mean number of birds per survey area from October 2019 to May 2023

Field	Number of surveys	Greylag Goose				Pink-footed goose				Whooper Swan		
		1	2	3	Total	1	2	3	Total	1	2	Total
5	28		3.0		1.4		5.2		2.4		0.5	0.3
12	28	9.1			3.6	81.8			32.1			
17	28							500.0	71.4			
26	28						1.2		0.5			
49	28		0.1		0.0						0.7	0.3
59	28									0.8		0.3
72	28									2.9		1.1
73	28					0.8			0.3			
81	28	18.2			7.1	22.7			8.9			
82	28										0.6	0.3
87	28	9.1			3.6					5.9	3.1	3.8
91	28	3.4			1.3	2.2			0.9			
94	28		42.5		19.8							
106	28		12.6		5.9							
108	28		2.8		1.3							
110	28		31.5		14.6		2.5		1.1		5.3	2.5
112	28									4.5		1.8
115	28	9.1			3.6							
119	28	4.5			1.8							
126	28						1.7		0.8			
133	28											
137	28		12.0		5.6						2.2	1.0
138	28					12.9			5.1			
140	28									0.1		0.0
142	28									1.5		0.6
146	28	0.5	18.6		8.8		3.2		1.5	1.0	4.7	2.6
211	17		6.5		4.9		4.8		3.6		0.1	0.1
249	17			1.8	0.4							
344	17											

Field	Number of surveys	Greylag Goose				Pink-footed goose				Whooper Swan		
		1	2	3	Total	1	2	3	Total	1	2	Total
350	17						1.5		1.1			
351	17		15.4		11.8		2.9		2.2			
352	17		1.8		1.4			137.5	32.4			
353	17		7.0		5.4						0.8	0.6
355	17						1.4		1.1			
358	28	0.1			0.0	27.3			10.7			
361	17		15.4		11.8							
362	17		6.4		4.9							
395	17		10.5		8.0							
398	17										0.6	0.5

Pink-footed goose were widely distributed across the survey area with field 17, approximately 0.4km from the closest turbine having the greatest mean use by this species (Figure 7-1-17).

Greylag goose were widely distributed across the survey area with field 351, about 2 km from the closest turbine having the greatest average use (Figure 7-1-18).

Whooper swan were predominantly situated to the south of the Proposed Development and in the vicinity of Tisker cottage about 1.5 km from the Proposed Development or further south and closer to Loch Scarmclate (Figure 7-1-19).

4.3 Moorland Breeding Bird Survey Results

4.3.1 2020

Four Brown and Shepherd visits were carried out as detailed in Table 7-1-15, which meets NatureScot guidance (2017b) requirements of four survey visits at least seven days apart between early April and the end of July. The study area for this survey included the Proposed Development Site boundary plus a 500m buffer.

Table 7-1-15: Moorland Breeding Bird Survey Effort 2020

Visit Number	Date	Observer	Start time	Stop time	Duration
1	25/04/2020	PH	08:00	14:00	6 hours
2	19/05/2020	PH	10:30	16:30	6 hours
3	10/06/2020	PH	10:00	16:00	6 hours
4	17/07/2020	PH	08:00	14:00	6 hours

During the breeding bird survey, a total of 25 species were recorded (Figure 7-1-3). Table 7-1-16 presents each of the species in terms of their breeding status, conservation value, and whether they are considered to be at risk from wind farms (SNH, 2018a). It also presents the species' breeding status at the Proposed Development Site.

Table 7-1-16: Breeding Bird Survey Recorded Species

BTO Code	Common Name	Scientific Name	EU Birds Directive : Annex I	Schedule 1 Wildlife & Countryside Act 1981	Scottish Priority Species	Birds of Conservation Concern (BoCC)	At risk from wind farms (SNH 2006)	Breeding Status and number of territories (possible, probable, confirmed or non-breeding)
B.	Blackbird	Turdus merula				Green	No	Probable (1) Possible (3) Non-breeding (1)
CH	Chaffinch	Fringilla coelebs				Green	No	Probable (3) Possible (3) Non-breeding (3)
CU	Curlew	Numenius arquata			X	Red	Yes	Probable (1) Possible (1)
D.	Dunnock	Prunella modularis				Amber	No	Non-breeding (2)
GO	Goldfinch	Carduelis carduelis				Green	No	Probable (1) Possible (3) Non-breeding (1)
HC	Hooded crow	Corvus cornix			X	Green	No	Possible (1) Non-breeding (1)
JD	Jackdaw	Corvus monedula				Green	No	Possible (1) Non-breeding (1)
L.	Lapwing	Vanellus vanellus			X	Red	Yes	Confirmed (3) Possible (1) Non-breeding (2)
LR	Lesser redpoll	Acanthis cabaret			X	Red	No	Non-breeding (1)
LI	Linnet	Linaria cannabina			X	Red	No	Non-breeding (3)
MP	Meadow pipit	Anthus pratensis				Amber	No	Probable (4) Possible (4) Non-breeding (8)
OC	Oystercatcher	Haematopus ostralegus				Amber	No	Probable (2)
PH	Pheasant	Phasianus colchicus				Green	No	Probable (1)

BTO Code	Common Name	Scientific Name	EU Birds Directive : Annex I	Schedule 1 Wildlife & Countryside Act 1981	Scottish Priority Species	Birds of Conservation Concern (BoCC)	At risk from wind farms (SNH 2006)	Breeding Status and number of territories (possible, probable, confirmed or non-breeding)
PW	Pied wagtail	Motacilla alba				Green	No	Possible (4) Non-breeding (3)
RK	Redshank	Tringa Totanus				Amber	No	Non-breeding (1)
RB	Reed bunting	Emberiza schoeniclus			X	Amber	No	Possible (1)
R.	Robin	Erithacus rubecula				Green	No	Probable (2) Non-breeding (1)
S.	Skylark	Alauda arvensis			X	Red	No	Probable (5) Possible (9)
ST	Song thrush	Turdus philomelos			X	Amber	No	Possible (2) Non-breeding (3)
W.	Wheatear	Oenanthe oenanthe				Amber	No	Non-breeding (2)
WW	Willow warbler	Phylloscopus trochilus				Amber	No	Probable (1)
WP	Woodpigeon	Columba palumbus				Amber	No	Probable (1) Possible (1)
WR	Wren	Troglodytes troglodytes				Amber	No	Probable (4) Possible (5) Non-breeding (2)
Y.	Yellowhammer	Emberiza citrinella			X	Red	No	Possible (1)

Lapwing were the only confirmed breeding species on Site, with three nest locations found within the boundary along with a further two possible breeding territories and two non-breeding territories. This species is a SBL and UK BoCC red listed species, which has been identified by NS as sensitive to wind farms. There were twelve probable breeding species including amber and red BoCC listed species such as Curlew, Oystercatcher, Meadow pipit, Skylark, Wren, Woodpigeon and Willow warbler. A further nine possible breedeing species were also identified, including SBL species, Yellowhammer, Reed bunting, Hooded crow and Song thrush.

4.3.2 2023

Four Brown and Shepherd visits were carried out as detailed in Table 7-1-17, which meets NatureScot guidance (2017b) requirements of four survey visits at least seven days apart between early April and the end of July. The study area for this survey included the Proposed Development Site boundary plus a 500m buffer.

Table 7-1-17: Moorland Breeding Bird Survey Effort 2023

Visit Number	Date	Observer	Start time	Stop time	Duration
1	20/04/2023	TJC	10:00	17:00	7hrs
2	24/05/2023	FT	11:30	16:30	5hrs
3	22/06/2023	DB	9:00	15:00	6hrs
4	17/07/2023	YM	8:30	14:30	6hrs

During the breeding bird survey, a total of 34 species were recorded (Figure 7-1-4). Table 7-1-18 presents, alphabetically, each of the species in terms of their breeding status, conservation value, and whether they are considered to be at risk from wind farms (SNH, 2018a). It also presents the species' breeding status at the Proposed Development Site.

The suite of breeding bird surveys identified one species as a confirmed breeder onsite, carrion crow *Corvus corone* along with two probable breeders, meadow pipit and skylark and a further two possible breeders, curlew and wren. Of note is curlew, a SBL and BoCC Red list species, which has been identified by NS as sensitive to wind farms. Lapwing were the only confirmed breeding species on Site, with three nest locations found within the boundary along with a further two possible breeding territories and two non-breeding territories. This species is a SBL and UK BoCC red listed species, which has been identified by NS as sensitive to wind farms. There were twelve probable breeding species including amber and red BoCC listed species such as Curlew, Oystercatcher, Meadow pipit, Skylark, Wren, Woodpigeon and Willow warbler. A further nine possible breeding species were also identified, including SBL species, yellowhammer, reed bunting, hooded crow and song thrush. farm developments. This species was observed on Site three out of four months, with a peak count of nine birds in April. Similarly, Lapwing has also these conservation protections and has shown sensitivity to wind farms, however in the 2023 breeding season, whilst present for three out of four months, with a peak count of 20 birds in June, no breeding activity was observed on Site.

Table 7-1-18: Breeding Bird Survey Recorded Species

BTO Code	Common Name	Latin Name	EU Birds Directive: Annex 1	Schedule 1 Wildlife & Countryside Act 1981	Scottish Priority Species	Birds of Conservation Concern (BoCC)	At risk from wind farms (SNH 2006)	Breeding Status and number of territories (possible, probable, confirmed or non-breeding)
B.	Blackbird	Turdus merula				Green	No	Non-breeding (1)
C.	Carrion Crow	Corvus corone				Green	No	Confirmed (1) Non-breeding (1)
CH	Chaffinch	Fringilla coelebs				Green	No	Non-breeding (8)
CM	Common Gull	Larus canus				Amber	No	Non-breeding (1)
CU	Curlew	Numenius arquata			X	Red	Yes	Possible (1) Non-breeding (4)
D.	Dunnock	Prunella modularis				Amber	No	Non-breeding (1)
GC	Goldcrest	Regulus regulus				Green	No	Non-breeding (1)
GJ	Greylag goose	Anser anser				Amber	Yes	Non-breeding (1)
GT	Great tit	Parus major				Green	No	Non-breeding (1)
H.	Grey heron	Ardea cinerea				Green	No	Non-breeding (1)
HG	Herring Gull	Larus argentatus			X	Red	No	Non-breeding (2)
JD	Jackdaw	Corvus monedula				Green	No	Non-breeding (3)
L.	Lapwing	Vanellus vanellus			X	Red	Yes	Non-breeding (5)
LN	Linnet	Linaria cannabina			X	Red	No	Non-breeding (6)
LR	Lesser redpoll	Acanthis cabaret			X	Red	No	Non-breeding (1)
MP	Meadow pipit	Anthus pratensis				Amber	No	Probable (4) Possible (12) Non-breeding(14)
OC	Oystercatcher	Haematopus ostralegus				Amber	No	Non-breeding (1)
PH	Pheasant	Phasianus colchicus				Green	No	Possible (1)
PW	Pied wagtail	Motacilla alba				Green	No	Non-breeding (3)
R.	Robin	Erithacus rubecula				Green	No	Non-breeding (2)
RB	Reed bunting	Emberiza Schoeniclus			X	Amber	No	Non-breeding (3)

BTO Code	Common Name	Latin Name	EU Birds Directive: Annex 1	Schedule 1 Wildlife & Countryside Act 1981	Scottish Priority Species	Birds of Conservation Concern (BoCC)	At risk from wind farms (SNH 2006)	Breeding Status and number of territories (possible, probable, confirmed or non-breeding)
RN	Raven	Corvus corax				Green	No	Non-breeding (1)
RO	Rook	Corvus frugilegus				N/A	No	Non-breeding (6)
S.	Skylark	Alauda arvensis			X	Red	No	Non-breeding (3) Possible (8) Probable (5)
SC	Stonechat	Saxicola rubicola				Green	No	Non-breeding (3)
SK	Siskin	Spinus spinus				Green	No	Non-breeding (4)
SL	Swallow	Hirundo rustica				Green	No	Non-breeding (1)
SN	Snipe	Gallinago gallinago				Amber	No	Non-breeding (1)
ST	Song thrush	Turdus philomelos			X	Amber	No	Non-breeding (1)
SW	Sedge warbler	Acrocephalus schoenobaenus				Amber	No	Non-breeding (2)
WP	Woodpigeon	Columba palumbus				Amber	No	Non-breeding (2)
WR	Wren	Troglodytes troglodytes				Amber	No	Possible (1) Non-breeding (9)
WW	Willow warbler	Phylloscopus Trochilus				Amber	No	Non-breeding (2)
Y.	Yellowhammer	Emberiza citrinella			X	Red	No	Non-breeding (2)

4.4 Breeding Raptor and Owl Survey Results

4.4.1 2020

Four surveys were carried out between April – July 2020 as detailed in Table 7-1-19. The survey included a 2km buffer from the Proposed Development Site. Additionally, two surveys were conducted for Barn owls in June and July 2020 when access was permitted.

Table 7-1-19: Breeding Raptor Survey Effort 2020

Visit	Date	Observer	Start time	Stop time	Duration
Raptors 1	27/04/2020	PH	07:00	13:00	6 Hours
	28/04/2020	PH	13:00	19:00	6 Hours
	03/05/2020	PH	09:00	15:00	6 Hours
	04/05/2020	PH	10:30	16:30	6 Hours
	05/05/2020	PH	10:00	13:00	3 Hours
Raptors 2	13/05/2020	PH	12:00	18:00	6 Hours
	19/05/2020	PH	10:30	16:30	6 Hours
	22/05/2020	PH	08:00	14:00	6 Hours
	31/05/2020	PH	09:00	15:00	6 Hours
Raptors 3	13/06/2020	PH	08:00	14:00	6 Hours
	15/06/2020	PH	07:00	13:00	6 Hours
	20/06/2020	PH	12:00	18:00	6 Hours
	21/06/2020	PH	12:00	18:00	6 Hours
Barn Owl 1	22/06/2020	CM	17:05	11:30	4.5 Hours
Raptors 4	13/07/2020	PH	08:00	14:00	6 Hours
	14/07/2020	PH	08:00	14:00	6 Hours
	15/07/2020	PH	08:00	14:00	6 Hours
	16/07/2020	PH	08:00	14:00	6 Hours
Barn Owl 2	30/07/2020	SL	04:00	07:00	3 Hours

One Annex I/Schedule 1 species were recorded during surveys as shown in 7-1-20. However, it should be noted that nest location is more than 2km from the Proposed Development Site. The locations of these breeding event is discussed in the Confidential Technical Appendix 7-2

Table 7-1-20: Breeding Status of Annex I/Schedule 1 Raptors Observed During Raptor Surveys 2020

Schedule 1 species	Breeding status	No. of Territories
Barn Owl	Breeding	1
Osprey	Breeding	1

Barn Owl was confirmed breeding in June 2020 when chicks were heard calling and adult birds were observed in flight during both surveys.

Osprey were confirmed breeding within the original 2km survey buffer, whereby an active nest was observed on every visit, although overall flight activity was low during walkover surveys, with only one flight recorded flying towards the nest in July.

Within the updated Site boundary and buffer, two juvenile kestrel were observed in July also confirming their breeding activity on or in the vicinity of the Proposed Development Site. Buzzard and sparrowhawk were frequently recorded across all survey visits, with single possible breeding territories for both these species identified through sightings of buzzard pairs and male and female sparrowhawk active on Site. A number of sightings for other raptor species were made where there was no evidence of breeding; buzzard (3), sparrowhawk (1) and red kite (1).

4.4.2 2023

Four surveys were carried out between April – July 2023 as detailed in Table 7-1-21. The survey included a 2km buffer encompassing the Proposed Development Site. Due to the reduction of the Proposed Development Site boundary prior to the 2023 breeding season, significantly less survey time was required to cover the Proposed Development Site and new 2km buffer compared to the 2020 breeding season.

Table 7-1-21: Breeding Raptor Survey Effort 2023

Visit Number	Date	Observer	Start time	Stop time	Duration
1	20/04/2023	TJC	10:00	17:00	7 Hours
2	23/05/2023	FT	09:30	17:00	7.5 Hours
	24/05/2023	FT	09:30	17:30	8 Hours
3	23/06/2023	DB	08:15	13:30	5.25 Hours
4	20/07/2023	PH	08:00	14:00	6 Hours

Two raptor species were observed on Site during the 2023 breeding season, kestrel and buzzard. Neither of these species were confirmed breeding on Site or showed signs of breeding activity. Osprey were incidentally recorded hunting on Loch Scarmclate. Observations of all raptors recorded during these surveys are presented in Figure 7-1-20.

5 Collision Risk Modelling

Collision Risk Modelling (CRM) was carried out for five species for which levels of flight activity recorded over the Proposed Development Site during 21 months of VP surveys through years 1-3 which were considered to have sufficient flight activity to require modelling to be undertaken.

In this instance, CRM has been undertaken for the following species:

- Curlew;
- Lapwing;
- Snipe;
- Pink-footed goose;
- Whooper swan; and
- Greylag goose

Flights included in the calculations were all those recorded within the viewsheds of the VP locations during surveys (i.e. not including incidental records) and recorded at collision risk height. Examples of CRM Calculation are presented in Annex F.

For the three wader species, the standard random collision risk model was used. The three species of geese and swan showed evidence for daily flights across the survey area, and so the predictable model was used to estimate collision risk for these species.

A model (Forsythe *et al.* 1995) was used to calculate the daytime length as a function of latitude (58°30'39"N for the centre of the Proposed Development Site) and date (2020). The VP data was analysed for seasonal presence of a species on Site. Table 7-1-22 presents the turbine parameters used for this model.

Table 7-1-22: Turbine Parameters

Parameter	Dimensions	Unit
Number of turbines	2	-
Blades per turbine	3	-
Hub height	83.5	metres
Rotor radius	66.5	metres
Maximum chord	4	metres
Pitch	0	degrees
Rotation period	4.55	seconds
Proportion operational	85%	-

5.1 Random Collision Risk Model

The general methodology used to predict collision risk for birds using the wind farm airspace is provided by NatureScot (SNH, 2009a).

In summary, the following steps were followed for random bird movements (as assumed for all species) in this assessment:

- Digitise all flight lines and record relevant characteristics (including species, number of birds, start time of flight and time within each height band) in database;

- Review the flight line data, which in this instance indicated that a random collision analysis should be conducted for each species;
- Identify all flights for each species that are at any point within the 'at risk' height band and sum the total 'at risk' flight duration for each VP, multiplying any flight at risk time by the number of birds observed, where more than one bird is recorded per flight line;
- Calculate an 'occupancy rate' for each vantage point, defined as the observed 'at risk' activity levels divided by total observation time and area observed, giving the occupancy per unit time and unit area for each VP;
- Average the occupancy rate across the VPs using an un-weighted mean approach;
- Apply the average occupancy rate to the wind development Site, based on the Proposed Development Site area, risk volume and total turbine rotor volume, applying a factor to estimate the total time that the birds could theoretically be active during the year, based on an algorithm for calculating day length (Forsythe *et al.* 1995); thus determining the total predicted time spent by the individual species within air space that could be swept by turbine blades;
- Run the collision model with relevant turbine and ornithological parameters to calculate the theoretical probability of transits resulting in a collision assuming no avoiding action;
- Multiply the number of transits by the collision rate, avoidance factor and operating parameters of the proposed wind farm to estimate the theoretical number of collisions per year; and
- Avoidance rates used were in accordance with NS guidance (SNH, 2017a).

The predicted mortality through collision is dependent on a number of variables, including flight activity within the turbine envelope, the species' physiology, nocturnal flight behaviour and flight velocity, weather conditions, the predicted avoidance rate, the number, rotational speed and dimensions of the turbines, and the proportion of the time that the turbines are operational throughout the year.

The following assumptions were made for the various species:

- A daylight calculator was used to produce figures for the total daylight period at the Proposed Development Site;
- Biometric data (bird length and wingspan) for the various species were obtained from the BTO webpage; and
- An assessment was made on the months active at the Proposed Development Site for each species, with some species resident and others seasonal visitors. All species were considered active during the day only.

Table 7-1-23 presents a summary of the model used for each species, biometric parameters, avoidance rates and the seasons during which the species was present on Site.

Table 7-1-23: Random CRM Biometric Parameters

Species	Bird length (m)	Wingspan (m)	Bird speed (m/s)	Avoidance rate	Months active	Daylight hours	Nocturnal hours	Total hours	Assumed activity period	Flapping / gliding
Curlew	0.55	0.90	16.3	0.980	March - July	2413.52	0.00	2413.52	Daylight hours only	Flapping
Lapwing	0.30	0.84	12.8	0.980	The year	4517.75	0.00	4517.75	Daylight hours only	Flapping
Snipe	0.26	0.46	17.1	0.980	The year	4517.75	0.00	4517.75	Daylight hours only	Flapping

Table 7-1-24 presents the results of the random model for Year 1 (October 2019 - May 2020), Year 2 (September 2020 - April 2021) and Year 3 (March- August 2023), predicting collision over 25 years, along with the mean collision risk for all three years over 30 years. A worked example for the model is included in Annex F.

Table 7-1-24: Random CRM Results

Species	Year	Annual collision risk	Years per collision	Collision over 25 years
Curlew	Year 1	0.005	185.995	0.134
	Year 2	-	-	-
	Year 3	0.023	43.335	0.577
	Mean (30 years)	0.014	70.292	0.427
Lapwing	Year 1	0.09	117.577	0.213
	Year 2	0.198	5.054	4.946
	Year 3	2.557	0.319	63.927
	Mean (30 years)	0.921	1.086	27.634
Snipe	Year 1	0.005	192.063	0.130
	Year 2	0	0	0
	Year 3	0	0	0
	Mean (30 years)	0.002	576.188	0.052

5.2 Predicable Collision Risk Model

The collision risk estimates for pink-footed goose, whooper swan and greylag goose were modelled using the predictable collision risk model. This model is employed when bird flight activity is typically aligned in a given direction and occurs regularly, suggesting movements from a regular point, most typically a roost or a nest site. In these circumstances collision rates are modelled with reference to a collision corridor based around the axis of the flights and the number of turbines contained within that corridor as well as the number of flights observed in the time pe perpendicular to the prevailing direction of flight and the number of flights which cross the collision risk window in the time observed. Most of the flights made were in a north- south easterly direction as can be seen in Figures 7-1-5 – 7-1-9. A collision risk window length of 395m was used for modelling.

The turbine parameters used for modelling are reported above in Table 7-1-22 and a summary of the model used to estimate mortality for the three species of geese and swan is presented in Table 7-1-25 below. These consist of biometric parameters, avoidance rates and the seasons during which species were present on Site.

Table 7-1-25: Predictable CRM Biometric Parameters

Species	Bird length (m)	Wingspan (m)	Bird speed (m/s)	Avoidance rate	Months active	Daylight hours	Nocturnal hours	Total hours	Assumed activity period	Flapping / gliding
Pink-footed goose	0.68	1.52	17.1	0.998	September - March	1990.08	619.58	2609.66	Daylight hours plus 20% night time hours	Flapping
Whooper swan	1.52	2.30	17.3	0.995	October - March	1602.98	0.00	1602.98	Daylight hours only	Flapping
Greylag goose	0.82	1.64	17.1	0.998	October - April	2034.19	610.76	2644.95	Daylight hours + 20% night time hours	Flapping

Table 7-1-26 presents the results of the random model for Year 1 (October 2019 - May 2020) and Year 2 (October 2020 - April 2021) predicting collision over 25 years, along with the mean collision risk for both years over 30 years. A worked example for the model is included in Annex F.

Table 7-1-26: Predictable CRM Results

Species	Year	Annual collision risk	Years per collision	Collision over 30 years
Pink-footed Goose	Year 1	2.652	0.377	79.547
	Year 2	0.016	61.231	0.490
	Mean	1.334	0.750	40.018
Whooper Swan	Year 1	0.909	1.100	27.280
	Year 2	0.022	45.638	0.657
	Mean	0.466	2.148	13.968
Greylag Goose	Year 1	2.041	0.490	61.217
	Year 2	0.701	1.427	21.018
	Mean	1.371	0.730	41.118

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Annexes

Annex A: Vantage Point Survey Visit Details

Table 7-1-27: VP Survey Information – Timing and Duration of Surveys (October 2019 - August 2020)

Survey Date	Start Time	Finish Time	Duration	Surveyor	VP Type	VP Number
28/10/2019	14:30	17:30	03:00:00	GC	Dusk	1
29/10/2019	06:20	09:20	03:00:00	GC	Dawn	1
29/10/2019	09:20	12:20	03:00:00	GC	Diurnal	1
12/11/2019	06:55	09:55	03:00:00	GC	Dawn	1
12/11/2019	12:00	15:00	03:00:00	GC	Diurnal	1
27/11/2019	08:45	11:45	03:00:00	GC	Diurnal	1
27/11/2019	13:30	16:30	03:00:00	GC	Dusk	1
11/12/2019	07:50	10:50	03:00:00	GC	Dawn	1
11/12/2019	13:20	16:20	03:00:00	GC	Dusk	1
19/12/2019	09:00	12:00	03:00:00	GC	Diurnal	1
19/12/2019	12:00	15:00	03:00:00	GC	Diurnal	1
08/01/2020	07:45	10:45	03:00:00	GC	Dawn	1
08/01/2020	12:00	15:00	03:00:00	GC	Diurnal	1
04/02/2020	10:50	13:50	03:00:00	CM	Diurnal	1
04/02/2020	14:20	17:20	03:00:00	CM	Dusk	1
20/02/2020	06:35	09:35	03:00:00	CM	Dawn	1
20/02/2020	10:05	13:05	03:00:00	CM	Diurnal	1
06/03/2020	06:00	09:00	03:00:00	SL	Dawn	1
06/03/2020	09:00	12:00	03:00:00	SL	Diurnal	1
21/04/2020	14:15	17:15	03:00:00	PH	Diurnal	1
21/04/2020	17:45	20:45	03:00:00	PH	Dusk	1
25/04/2020	14:30	17:30	03:00:00	PH	Diurnal	1
29/04/2020	04:30	07:30	03:00:00	PH	Dawn	1
04/05/2020	07:00	10:00	03:00:00	PH	Diurnal	1
05/05/2020	19:00	22:00	03:00:00	PH	Dusk	1
19/05/2020	07:00	10:00	03:00:00	PH	Diurnal	1
22/05/2020	14:30	17:30	03:00:00	PH	Diurnal	1
22/06/2020	17:05	20:05	03:00:00	CM	Diurnal	1
26/06/2020	09:50	12:50	03:00:00	CM	Diurnal	1
01/07/2020	09:05	12:05	03:00:00	CM	Diurnal	1
01/07/2020	13:40	16:40	03:00:00	CM	Diurnal	1
27/08/2020	09:10	12:10	03:00:00	CM	Diurnal	1
27/08/2020	12:40	15:40	03:00:00	CM	Diurnal	1

Table 7-1-28: VP Survey Information – Timing and Duration of Surveys (September 2020 – May 2021)

Survey Date	Start Time	Finish Time	Duration	Surveyor	VP Type	VP Number
29/09/2020	08:40	11:40	03:00:00	CM	Diurnal	1
29/09/2020	12:10	15:10	03:00:00	CM	Diurnal	1
14/10/2020	13:00	16:00	03:00:00	CM	Diurnal	1
14/10/2020	16:10	17:10	01:00:00	CM	Dusk	1
16/10/2020	06:55	09:55	03:00:00	CM	Dawn	1
16/10/2020	10:30	13:30	03:00:00	CM	Diurnal	1
11/11/2020	10:15	13:15	03:00:00	PH	Diurnal	1
11/11/2020	13:45	16:45	03:00:00	PH	Dusk	1
27/11/2020	07:31	10:31	03:00:00	MD	Dawn	1
27/11/2020	11:01	14:01	03:00:00	MD	Diurnal	1
11/12/2020	09:30	12:30	03:00:00	PH	Diurnal	1
11/12/2020	13:00	16:00	03:00:00	PH	Dusk	1
12/12/2020	08:00	11:00	03:00:00	PH	Dawn	1
12/12/2020	11:30	14:30	03:00:00	PH	Diurnal	1
07/01/2021	08:15	11:15	03:00:00	SL	Dawn	1
07/01/2021	11:45	14:45	03:00:00	SL	Diurnal	1
21/01/2021	07:41	10:41	03:00:00	MD	Dawn	1
21/01/2021	11:11	14:11	03:00:00	MD	Diurnal	1
03/02/2021	11:10	14:10	03:00:00	MD	Diurnal	1
03/02/2021	14:40	17:40	03:00:00	MD	Dusk	1
17/02/2021	11:45	14:45	03:00:00	MD	Diurnal	1
17/02/2021	15:15	18:15	03:00:00	MD	Dusk	1
04/03/2021	06:01	09:01	03:00:00	MD	Dawn	1
04/03/2021	09:31	12:31	03:00:00	MD	Diurnal	1
18/03/2021	12:53	15:53	03:00:00	MD	Diurnal	1
18/03/2021	16:23	19:23	03:00:00	MD	Dusk	1
10/05/2021	15:30	18:30	03:00:00	KT	Diurnal	1
11/05/2021	19:28	22:28	03:00:00	KT	Dusk	1

Table 7-1-29: VP Survey Information – Timing and Duration of Surveys (March 2023 – August 2023)

Survey Date	Start Time	Finish Time	Duration	Surveyor	VP Type	VP Number
01/03/2023	11:30	14:30	03:00:00	GC	Diurnal	2
20/03/2023	12:45	15:45	03:00:00	FT	Diurnal	2
20/03/2023	16:28	19:28	03:00:00	FT	Dusk	2
21/03/2023	08:50	11:50	03:00:00	FT	Diurnal	2
22/03/2023	05:11	08:11	03:00:00	FT	Dawn	2
13/04/2023	13:00	16:00	03:00:00	FT	Diurnal	2
13/04/2023	17:23	20:23	03:00:00	FT	Dusk	2
14/04/2023	06:05	09:05	03:00:00	FT	Dawn	2
14/04/2023	09:40	12:40	03:00:00	FT	Diurnal	2
11/05/2023	12:53	15:53	03:00:00	DB	Diurnal	2
11/05/2023	18:26	21:26	03:00:00	DB	Dusk	2
12/05/2023	04:53	07:53	03:00:00	DB	Dawn	2
12/05/2023	09:40	12:40	03:00:00	DB	Diurnal	2
20/06/2023	04:04	07:04	03:00:00	DB	Dawn	2
20/06/2023	10:05	13:05	03:00:00	DB	Diurnal	2
21/06/2023	08:00	11:00	03:00:00	DB	Diurnal	2
21/06/2023	19:26	22:26	03:00:00	DB	Dusk	2
18/07/2023	04:00	07:00	03:00:00	PH	Dawn	2
18/07/2023	08:15	11:15	03:00:00	PH	Diurnal	2
19/07/2023	13:00	16:00	03:00:00	PH	Diurnal	2
19/07/2023	19:30	22:30	03:00:00	PH	Dusk	2
25/08/2023	08:20	11:20	03:00:00	DB	Diurnal	2
25/08/2023	11:50	14:50	03:00:00	DB	Diurnal	2
30/08/2023	08:05	11:05	03:00:00	DB	Diurnal	2
30/08/2023	11:35	14:35	03:00:00	DB	Diurnal	2

Annex B: Vantage Point Survey Summary of Weather Conditions

Table 7-1-30: Vantage Point Weather Summary (October 2019 – February 2020)

Survey Date	VP Number	VP Type	Mean Cloud Cover (eights)	Modal Visibility	Modal Precipitation	Mean Temperature (˚C)	Mean Wind Speed (Beaufort Scale)	Modal Wind Direction
28/10/2019	1	Dusk	5	> 2km	Light Intermittent	7	1	NNW
29/10/2019	1	Dawn	3	> 2km	None	1	0	-
		Diurnal	5	> 2km	None	1	0	-
12/11/2019	1	Dawn	7	> 2km	Light Persistent	5	1	NNE
		Diurnal	8	> 2km	Heavy Intermittent	6	1	NNE
27/11/2019	1	Diurnal	8	> 2km	Light Persistent	7	2	NE
		Dusk	8	> 2km	Heavy Intermittent	6	2	NE
11/12/2019	1	Dawn	5	> 2km	None	2	3	SW
		Dusk	7	1km - 2km	Heavy Intermittent	2	2	SW
19/12/2019	1	Diurnal	6	> 2km	None	5	0	SW
			5	> 2km	None	5	0	SSW
08/01/2020	1	Dawn	3	> 2km	None	2	2	WSW
		Diurnal	3	> 2km	None	3	2	WSW
04/02/2020	1	Diurnal	5	> 2km	None	9	0	SE
		Dusk	1	> 2km	None	7	0	
20/02/2020	1	Dawn	7	> 2km	Light Intermittent	3	1	SE
		Diurnal	1	> 2km	None	4	3	NE
06/03/2020	1	Dawn	1	> 2km	None	1	0	-
		Diurnal	3	> 2km	None	4	0	-
21/04/2020	1	Diurnal	3	> 2km	None	10	3	E
		Dusk	4	> 2km	None	9	3	SE
25/04/2020	1	Diurnal	3	> 2km	None	9	3	SE

Survey Date	VP Number	VP Type	Mean Cloud Cover (eights)	Modal Visibility	Modal Precipitation	Mean Temperature (˚C)	Mean Wind Speed (Beaufort Scale)	Modal Wind Direction
29/04/2020	1	Dawn	1	> 2km	None	4	1	SW
04/05/2020	1	Diurnal	2	> 2km	None	5	2	NE
05/05/2020	1	Dusk	3	> 2km	None	8	2	NW
19/05/2020	1	Diurnal	2	> 2km	None	9	2	SE
22/05/2020	1	Diurnal	4	> 2km	None	13	3	S
22/06/2020	1	Diurnal	7	> 2km	None	17	3	N
26/06/2020	1	Diurnal	7	> 2km	None	14	2	NNW
01/07/2020	1	Diurnal	7	> 2km	None	11	2	SSW
			3	> 2km	None	13	2	SSE
27/08/2020	1	Diurnal	7	> 2km	None	12	1	NNE
			7	> 2km	None	12	1	ENE

Table 7-1-31: Vantage Point Weather Summary (September 2020 – May 2021)

Survey Date	VP Number	VP Type	Mean Cloud Cover (eights)	Modal Visibility	Modal Precipitation	Mean Temperature (˚C)	Mean Wind Speed (Beaufort Scale)	Modal Wind Direction
29/09/2020	1	Diurnal	4	> 2km	None	9	0	
			3	> 2km	None	13	1	NNW
14/10/2020	1	Diurnal	7	> 2km	None	11	1	WSW
		Dusk	8	> 2km	None	9	0	SW
16/10/2020	1	Dawn	7	> 2km	None	7	0	SSE
		Diurnal	8	> 2km	None	9	0	SSW
11/11/2020	1	Diurnal	7	> 2km	Light Intermittent	10	3	SSE
		Dusk	5	> 2km	None	10	3	SE
27/11/2020	1	Dawn	8	1km - 2km	Light Intermittent	6	1	SW
		Diurnal	6	> 2km	None	6	1	SW
11/12/2020	1	Diurnal	5	> 2km	None	7	4	SE
		Dusk	5	> 2km	Light Intermittent	7	4	SE

Survey Date	VP Number	VP Type	Mean Cloud Cover (eights)	Modal Visibility	Modal Precipitation	Mean Temperature (˚C)	Mean Wind Speed (Beaufort Scale)	Modal Wind Direction
12/12/2020	1	Dawn	6	> 2km	Light Intermittent	7	3	SE
		Diurnal	6	> 2km	None	8	3	SE
07/01/2021	1	Dawn	6	> 2km	None	2	1	N
		Diurnal	8	> 2km	Light Intermittent	4	1	N
21/01/2021	1	Dawn	8	> 2km	Heavy Persistent	4	5	N
		Diurnal	8	> 2km	Heavy Intermittent	4	5	NNW
03/02/2021	1	Diurnal	5	> 2km	None	2	3	E
		Dusk	6	> 2km	None	1	3	E
17/02/2021	1	Diurnal	0	> 2km	None	5	4	SSW
		Dusk	2	> 2km	None	4	4	S
04/03/2021	1	Dawn	7	> 2km	None	2	1	NE
		Diurnal	7	> 2km	None	2	1	NNE
18/03/2021	1	Diurnal	8	> 2km	None	2	2	NE
		Dusk	7	1km - 2km	Light Intermittent	7	5	NW
10/05/2021	1	Diurnal	8	1km - 2km	Light Intermittent	6	4	NW
			8	> 2km	None	8	3	SE
11/05/2021	1	Dusk	1	> 2km	Light Intermittent	8	1	NW

Table 7-1-32: Vantage Point Weather Summary (March – August 2021)

Survey Date	VP Number	VP Type	Mean Cloud Cover (eights)	Modal Visibility	Modal Precipitation	Mean Temperature (˚C)	Mean Wind Speed (Beaufort Scale)	Modal Wind Direction
01/03/2023	2	Diurnal	7	> 2km	Light Intermittent	7	1	NW
20/03/2023	2	Diurnal	7	> 2km	Light Persistent	9	4	W
		Dusk	8	1km - 2km	Light Persistent	6	4	N
21/03/2023	2	Diurnal	7	> 2km	None	5	4	N
22/03/2023	2	Dawn	7	> 2km	Light Persistent	7	3	W

13/04/2023	2	Diurnal	6	> 2km	None	12	4	S
		Dusk	6	> 2km	None	12	3	S
14/04/2023	2	Dawn	8	> 2km	Light Intermittent	7	3	S
		Diurnal	7	> 2km	None	9	4	S
11/05/2023	2	Diurnal	8	> 2km	None	8	2	NNE
		Dusk	8	> 2km	None	7	2	NNE
12/05/2023	2	Dawn	8	> 2km	None	7	1	NE
		Diurnal	8	> 2km	None	10	2	S
20/06/2023	2	Dawn	1	> 2km	None	13	1	S
		Diurnal	3	> 2km	None	19	3	SE
21/06/2023	2	Diurnal	5	> 2km	None	17	2	NW
		Dusk	3	> 2km	None	14	1	W
18/07/2023	2	Dawn	4	> 2km	None	12	2	W
		Diurnal	5	> 2km	None	13	3	W
19/07/2023	2	Diurnal	6	> 2km	None	12	3	W
		Dusk	5	> 2km	None	11	3	WNW
25/08/2023	2	Diurnal	8	> 2km	Light Persistent	13	3	NNE
			8	> 2km	Light Intermittent	14	4	NNE
30/08/2023	2	Diurnal	4	> 2km	None	13	2	NNW
			3	> 2km	None	14	2	NNW

Annex C: Vantage Point Survey Target Species Flights

Table 7-1-33: VP Flight Line Details (October 2019 – August 2020)

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
28/10/2019	Greylag goose	1	15:01	40	B	40	1600	60	Standard
28/10/2019	Greylag goose	1	16:15	100	C	260	0	150	Incidental
28/10/2019	Greylag goose	1	17:12	200	B	45	9000	120	Standard
28/10/2019	Mute swan	1	15:39	35	C	120	0	150	Incidental
29/10/2019	Greylag goose	1	06:56	30	A	10	0	15	Standard
29/10/2019	Greylag goose	1	06:56	30	B	20	600	60	Standard
29/10/2019	Greylag goose	1	06:56	30	C	30	0	150	Standard
29/10/2019	Greylag goose	1	06:57	50	A	15	0	15	Standard
29/10/2019	Greylag goose	1	06:57	50	B	25	1250	50	Standard
29/10/2019	Greylag goose	1	06:57	50	C	35	0	160	Standard
29/10/2019	Greylag goose	1	07:34	400	C	45	0	200	Incidental
29/10/2019	Greylag goose	1	07:36	200	C	55	0	200	Incidental
29/10/2019	Greylag goose	1	07:41	120	B	180	21600	110	Standard
29/10/2019	Greylag goose	1	07:44	100	C	100	0	180	Incidental
29/10/2019	Greylag goose	1	07:44	100	C	100	0	180	Incidental
29/10/2019	Greylag goose	1	07:48	300	C	120	0	150	Standard
29/10/2019	Greylag goose	1	07:55	500	B	70	35000	40	Incidental
29/10/2019	Greylag goose	1	07:55	500	C	70	0	180	Incidental
29/10/2019	Greylag goose	1	08:06	250	C	50	0	150	Standard
29/10/2019	Greylag goose	1	09:46	200	C	35	0	250	Standard
29/10/2019	Greylag goose	1	10:22	100	A	5	0	15	Standard
29/10/2019	Greylag goose	1	10:22	100	B	10	1000	100	Standard
29/10/2019	Greylag goose	1	10:22	100	C	55	0	200	Standard
29/10/2019	Greylag goose	1	10:27	75	C	100	0	250	Standard
29/10/2019	Hen harrier	1	12:11	1	A	320	0	5	Standard
29/10/2019	Mute swan	1	07:01	5	A	10	0	5	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
29/10/2019	Mute swan	1	07:01	5	B	60	300	50	Standard
29/10/2019	Mute swan	1	07:05	5	B	90	450	80	Standard
29/10/2019	Mute swan	1	07:09	5	A	5	0	80	Standard
29/10/2019	Mute swan	1	07:09	5	B	35	175	80	Standard
29/10/2019	Mute swan	1	07:32	9	B	135	1215	40	Standard
29/10/2019	Mute swan	1	07:46	6	A	5	0	15	Standard
29/10/2019	Mute swan	1	07:46	6	B	140	840	50	Standard
29/10/2019	Mute swan	1	07:49	4	B	35	140	25	Standard
29/10/2019	Mute swan	1	07:51	6	A	5	0	15	Standard
29/10/2019	Mute swan	1	07:51	6	B	25	150	40	Standard
29/10/2019	Mute swan	1	08:02	2	B	40	80	80	Standard
29/10/2019	Mute swan	1	08:02	2	C	35	0	140	Standard
29/10/2019	Mute swan	1	08:16	9	B	25	225	25	Standard
29/10/2019	Mute swan	1	08:24	16	B	40	640	40	Standard
29/10/2019	Mute swan	1	09:01	4	B	130	520	60	Standard
29/10/2019	Mute swan	1	09:31	4	A	15	0	15	Standard
29/10/2019	Mute swan	1	09:31	4	B	40	160	40	Standard
29/10/2019	Mute swan	1	09:52	25	A	20	0	10	Standard
29/10/2019	Mute swan	1	09:52	25	B	15	375	50	Standard
29/10/2019	Mute swan	1	09:52	25	C	10	0	200	Standard
29/10/2019	Mute swan	1	09:58	4	A	30	0	15	Standard
29/10/2019	Mute swan	1	09:58	4	B	15	60	40	Standard
29/10/2019	Mute swan	1	11:16	14	B	50	700	40	Standard
29/10/2019	Mute swan	1	11:53	7	B	40	280	40	Standard
29/10/2019	Pink-footed goose	1	07:07	140	A	15	0	15	Standard
29/10/2019	Pink-footed goose	1	07:07	140	B	60	8400	45	Standard
29/10/2019	Pink-footed goose	1	07:07	140	C	150	0	110	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
29/10/2019	Pink-footed goose	1	08:08	160	A	5	0	15	Standard
29/10/2019	Pink-footed goose	1	08:08	160	B	105	16800	100	Standard
29/10/2019	Pochard	1	07:11	7	A	5	0	15	Standard
29/10/2019	Pochard	1	07:11	7	B	40	280	60	Standard
29/10/2019	Whooper swan	1	07:23	3	A	10	0	15	Standard
29/10/2019	Whooper swan	1	07:23	3	B	35	105	80	Standard
29/10/2019	Whooper swan	1	08:35	3	B	210	630	40	Standard
29/10/2019	Whooper swan	1	09:57	10	A	10	0	10	Standard
29/10/2019	Whooper swan	1	09:57	10	B	45	450	60	Standard
29/10/2019	Whooper swan	1	10:42	6	B	185	1110	30	Standard
12/11/2019	Greylag goose	1	07:34	40	B	50	2000	50	Standard
12/11/2019	Greylag goose	1	07:46	200	A	10	0	10	Standard
12/11/2019	Greylag goose	1	07:46	200	B	30	6000	60	Standard
12/11/2019	Greylag goose	1	07:46	200	C	50	0	150	Standard
12/11/2019	Greylag goose	1	08:11	45	A	15	0	15	Standard
12/11/2019	Greylag goose	1	08:11	45	B	30	1350	60	Standard
12/11/2019	Greylag goose	1	08:11	45	C	15	0	150	Standard
12/11/2019	Greylag goose	1	08:24	80	A	5	0	15	Standard
12/11/2019	Greylag goose	1	08:24	80	B	20	1600	80	Standard
12/11/2019	Greylag goose	1	09:18	160	A	10	0	15	Standard
12/11/2019	Greylag goose	1	09:18	160	B	20	3200	100	Standard
12/11/2019	Greylag goose	1	09:18	160	B	20	3200	100	Standard
12/11/2019	Greylag goose	1	09:18	160	C	30	0	150	Standard
12/11/2019	Greylag goose	1	09:25	450	A	10	0	50	Standard
12/11/2019	Greylag goose	1	09:25	450	B	50	22500	100	Standard
12/11/2019	Greylag goose	1	09:25	450	C	20	0	150	Standard
12/11/2019	Greylag goose	1	12:00	250	A	35	0	15	Standard
12/11/2019	Greylag goose	1	12:00	250	B	30	7500	60	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
12/11/2019	Greylag goose	1	12:04	150	A	30	0	15	Standard
12/11/2019	Greylag goose	1	12:04	150	B	40	6000	60	Standard
12/11/2019	Greylag goose	1	12:25	200	A	5	0	15	Standard
12/11/2019	Greylag goose	1	12:25	200	B	10	2000	80	Standard
12/11/2019	Greylag goose	1	12:25	200	C	40	0	150	Standard
12/11/2019	Greylag goose	1	13:15	100	B	30	3000	100	Standard
12/11/2019	Greylag goose	1	13:15	100	C	45	0	180	Standard
12/11/2019	Greylag goose	1	13:33	500	A	40	0	15	Standard
12/11/2019	Greylag goose	1	13:33	200	A	40	0	15	Standard
12/11/2019	Greylag goose	1	13:33	200	B	40	8000	80	Standard
12/11/2019	Greylag goose	1	13:33	500	B	40	20000	80	Standard
12/11/2019	Greylag goose	1	13:33	500	C	65	0	150	Standard
12/11/2019	Greylag goose	1	13:33	200	C	50	0	200	Standard
12/11/2019	Greylag goose	1	14:32	250	A	20	0	15	Standard
12/11/2019	Greylag goose	1	14:32	250	B	30	7500	80	Standard
12/11/2019	Greylag goose	1	14:32	250	C	60	0	150	Standard
12/11/2019	Mute swan	1	07:18	3	B	40	120	25	Standard
12/11/2019	Mute swan	1	07:27	7	A	10	0	10	Standard
12/11/2019	Mute swan	1	07:27	7	B	30	210	10	Standard
12/11/2019	Mute swan	1	13:33	50	A	20	0	15	Standard
12/11/2019	Mute swan	1	13:45	50	B	20	1000	60	Standard
12/11/2019	Pink-footed goose	1	09:25	150	A	10	0	30	Standard
12/11/2019	Pink-footed goose	1	09:25	150	B	20	3000	100	Standard
12/11/2019	Pink-footed goose	1	09:25	150	C	20	0	150	Standard
12/11/2019	Pink-footed goose	1	12:20	100	A	25	0	10	Standard
12/11/2019	Pink-footed goose	1	12:20	100	B	10	1000	30	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
12/11/2019	Pink-footed goose	1	12:20	100	C	15	0	140	Standard
12/11/2019	Pink-footed goose	1	12:31	200	A	5	0	15	Standard
12/11/2019	Pink-footed goose	1	12:31	200	B	10	2000	100	Standard
12/11/2019	Pink-footed goose	1	12:31	200	C	55	0	180	Standard
12/11/2019	Pink-footed goose	1	13:33	200	A	40	0	15	Standard
12/11/2019	Pink-footed goose	1	13:33	200	B	50	10000	80	Standard
12/11/2019	Pink-footed goose	1	13:33	200	C	40	0	150	Standard
12/11/2019	Whooper swan	1	07:32	24	A	10	0	10	Standard
12/11/2019	Whooper swan	1	07:32	24	B	30	720	30	Standard
12/11/2019	Whooper swan	1	07:42	28	A	5	0	10	Standard
12/11/2019	Whooper swan	1	07:42	28	B	25	700	40	Standard
12/11/2019	Whooper swan	1	13:45	150	A	20	0	15	Standard
12/11/2019	Whooper swan	1	13:45	150	B	20	3000	60	Standard
12/11/2019	Whooper swan	1	14:57	135	A	10	0	15	Standard
12/11/2019	Whooper swan	1	14:57	135	B	40	5400	80	Standard
27/11/2019	Pink-footed goose	1	10:13	40	B	30	1200	50	Standard
27/11/2019	Pink-footed goose	1	10:13	40	C	40	0	200	Standard
11/12/2019	Greylag goose	1	10:42	120	B	210	25200	50	Standard
11/12/2019	Mute swan	1	09:34	1	A	5	0	5	Standard
11/12/2019	Mute swan	1	09:34	1	B	65	65	25	Standard
11/12/2019	Pink-footed goose	1	10:50	40	B	200	8000	60	Standard
11/12/2019	Whooper swan	1	09:19	1	B	180	180	25	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
19/12/2019	Greylag goose	1	11:41	3	A	5	0	5	Standard
19/12/2019	Greylag goose	1	11:41	3	B	45	135	60	Standard
19/12/2019	Whooper swan	1	09:11	17	A	5	0	5	Standard
08/01/2020	Common scoter	1	08:55	1	A	15	0	15	Standard
08/01/2020	Common scoter	1	08:55	1	B	20	20	35	Standard
08/01/2020	Greylag goose	1	08:10	1	B	40	40	35	Standard
08/01/2020	Greylag goose	1	08:40	6	A	10	0	10	Standard
08/01/2020	Greylag goose	1	08:40	6	B	35	210	45	Standard
08/01/2020	Greylag goose	1	08:41	100	C	30	0	150	Standard
08/01/2020	Greylag goose	1	08:59	6	B	65	390	45	Standard
08/01/2020	Greylag goose	1	10:14	38	C	210	0	150	Standard
08/01/2020	Greylag goose	1	13:34	12	A	45	0	15	Standard
08/01/2020	Greylag goose	1	14:11	22	B	165	3630	110	Standard
08/01/2020	Pink-footed goose	1	09:21	5	A	25	0	15	Standard
08/01/2020	Pink-footed goose	1	09:21	5	B	55	275	60	Standard
08/01/2020	Pink-footed goose	1	10:39	13	B	30	390	30	Standard
08/01/2020	Whooper swan	1	08:37	5	B	30	150	35	Standard
08/01/2020	Whooper swan	1	09:12	6	A	10	0	10	Standard
08/01/2020	Whooper swan	1	09:30	7	B	145	1015	100	Standard
08/01/2020	Whooper swan	1	13:34	8	A	40	0	15	Standard
04/02/2020	Cormorant	1	12:44	1	B	5	5	30	Standard
20/02/2020	Greylag goose	1	08:38	26	C	90	0	180	Standard
20/02/2020	Greylag goose	1	08:50	7	C	30	0	180	Standard
20/02/2020	Greylag goose	1	10:36	40	C	40	0	180	Standard
20/02/2020	Peregrine	1	08:52	1	A	5	0	10	Standard
20/02/2020	Peregrine	1	08:52	1	B	15	15	60	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
20/02/2020	Pink-footed goose	1	08:29	80	C	150	0	150	Standard
20/02/2020	Pink-footed goose	1	09:12	60	B	10	600	100	Standard
20/02/2020	Pink-footed goose	1	09:12	60	C	30	0	160	Standard
20/02/2020	Pink-footed goose	1	09:12	60	C	120	0	160	Standard
20/02/2020	Pink-footed goose	1	09:29	200	C	60	0	140	Standard
20/02/2020	Pink-footed goose	1	09:31	300	B	15	4500	130	Standard
20/02/2020	Pink-footed goose	1	09:31	300	C	90	0	140	Standard
20/02/2020	Pink-footed goose	1	10:43	105	C	90	0	150	Standard
20/02/2020	Pink-footed goose	1	11:38	600	B	120	72000	50	Incidental
20/02/2020	Whooper swan	1	09:30	4	A	20	0	15	Standard
06/03/2020	Greylag goose	1	07:50	16	B	25	400	70	Standard
06/03/2020	Lapwing	1	08:04	1	A	5	0	10	Standard
06/03/2020	Lapwing	1	08:04	1	B	40	40	40	Standard
06/03/2020	Lapwing	1	08:40	4	A	20	0	10	Standard
06/03/2020	Lapwing	1	08:42	2	B	40	80	25	Standard
06/03/2020	Lapwing	1	09:17	2	B	18	36	30	Standard
06/03/2020	Lapwing	1	10:30	4	B	10	40	20	Standard
06/03/2020	Lapwing	1	11:11	1	B	120	120	40	Standard
06/03/2020	Pink-footed goose	1	06:19	1	B	20	20	100	Standard
06/03/2020	Pink-footed goose	1	06:35	1	B	6	6	100	Standard
06/03/2020	Pink-footed	1	06:51	30	B	60	1800	40	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
	goose								
06/03/2020	Pink-footed goose	1	07:40	100	B	85	8500	30	Standard
06/03/2020	Pink-footed goose	1	07:55	60	B	60	3600	60	Standard
06/03/2020	Pink-footed goose	1	08:50	35	B	15	525	100	Standard
06/03/2020	Pink-footed goose	1	08:50	13	B	25	325	70	Standard
06/03/2020	Pink-footed goose	1	09:25	29	B	30	870	100	Standard
06/03/2020	Pink-footed goose	1	09:28	700	B	60	42000	120	Standard
06/03/2020	Pink-footed goose	1	09:32	350	B	50	17500	120	Standard
06/03/2020	Pink-footed goose	1	09:39	200	B	30	6000	100	Standard
06/03/2020	Pink-footed goose	1	09:45	17	B	30	510	100	Standard
06/03/2020	Pink-footed goose	1	09:49	3	B	10	30	70	Standard
06/03/2020	Pink-footed goose	1	09:51	12	B	40	480	70	Standard
06/03/2020	Pink-footed goose	1	09:58	10	B	40	400	70	Standard
06/03/2020	Pink-footed goose	1	10:07	60	B	20	1200	100	Standard
06/03/2020	Pink-footed goose	1	10:15	120	B	30	3600	100	Standard
06/03/2020	Pink-footed goose	1	10:27	100	B	45	4500	60	Standard
06/03/2020	Pink-footed goose	1	11:00	120	B	50	6000	120	Standard
06/03/2020	Pink-footed	1	11:05	50	C	45	0	150	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
	goose								
06/03/2020	Pink-footed goose	1	11:50	11	B	20	220	70	Standard
21/04/2020	Curlew	1	14:51	1	A	20	0	15	Standard
21/04/2020	Curlew	1	16:20	1	A	30	0	15	Standard
21/04/2020	Curlew	1	18:08	1	A	30	0	10	Standard
21/04/2020	Curlew	1	18:46	1	A	30	0	10	Standard
21/04/2020	Curlew	1	20:02	1	A	10	0	10	Standard
21/04/2020	Golden plover	1	15:10	17	C	10	0	200	Standard
21/04/2020	Lapwing	1	16:41	1	A	17	0	10	Standard
21/04/2020	Lapwing	1	16:49	1	A	20	0	15	Standard
21/04/2020	Lapwing	1	16:53	2	A	15	0	7	Standard
21/04/2020	Lapwing	1	17:49	1	A	25	0	15	Standard
21/04/2020	Lapwing	1	18:29	2	A	35	0	5	Standard
21/04/2020	Lapwing	1	19:03	1	A	45	0	10	Standard
21/04/2020	Lapwing	1	19:44	2	A	35	0	7	Standard
21/04/2020	Oystercatcher	1	15:38	1	A	10	0	5	Standard
21/04/2020	Oystercatcher	1	18:26	2	A	10	0	5	Standard
21/04/2020	Oystercatcher	1	19:27	2	A	10	0	5	Standard
25/04/2020	Curlew	1	15:20	1	A	30	0	10	Standard
25/04/2020	Curlew	1	17:11	1	A	45	0	10	Standard
25/04/2020	Lapwing	1	15:08	1	A	30	0	10	Standard
25/04/2020	Lapwing	1	15:51	2	A	45	0	15	Standard
25/04/2020	Lapwing	1	16:02	1	A	7	0	15	Standard
25/04/2020	Lapwing	1	16:24	2	A	25	0	10	Standard
25/04/2020	Oystercatcher	1	14:45	1	A	7	0	5	Standard
29/04/2020	Curlew	1	04:51	1	A	10	0	15	Standard
29/04/2020	Curlew	1	06:31	1	A	35	0	10	Standard
29/04/2020	Lapwing	1	05:11	2	A	20	0	5	Standard
29/04/2020	Lapwing	1	05:15	1	A	15	0	10	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
29/04/2020	Lapwing	1	06:04	1	A	30	0	10	Standard
29/04/2020	Lapwing	1	06:52	2	A	20	0	15	Standard
29/04/2020	Lapwing	1	07:09	1	A	10	0	5	Standard
29/04/2020	Oystercatcher	1	05:28	1	A	10	0	5	Standard
04/05/2020	Curlew	1	07:39	1	A	15	0	15	Standard
04/05/2020	Curlew	1	09:10	1	A	20	0	10	Standard
04/05/2020	Lapwing	1	07:10	1	A	30	0	10	Standard
04/05/2020	Lapwing	1	08:26	1	A	35	0	10	Standard
04/05/2020	Lapwing	1	08:58	2	A	25	0	10	Standard
04/05/2020	Oystercatcher	1	07:52	1	A	10	0	5	Standard
04/05/2020	Oystercatcher	1	08:11	1	A	7	0	5	Standard
04/05/2020	Snipe	1	08:17	2	B	25	50	25	Standard
04/05/2020	Snipe	1	09:41	1	B	15	15	30	Standard
05/05/2020	Curlew	1	19:53	1	A	25	0	15	Standard
05/05/2020	Lapwing	1	19:38	2	A	20	0	10	Standard
05/05/2020	Lapwing	1	19:56	1	A	25	0	90	Standard
05/05/2020	Lapwing	1	20:34	1	A	15	0	7	Standard
05/05/2020	Lapwing	1	21:01	1	A	20	0	10	Standard
05/05/2020	Oystercatcher	1	19:22	2	A	15	0	5	Standard
05/05/2020	Oystercatcher	1	20:09	1	A	10	0	5	Standard
05/05/2020	Snipe	1	21:36	3	B	60	180	25	Standard
19/05/2020	Curlew	1	09:11	1	A	10	0	15	Standard
19/05/2020	Curlew	1	09:37	1	A	15	0	10	Standard
19/05/2020	Lapwing	1	07:44	2	A	20	0	7	Standard
19/05/2020	Lapwing	1	08:30	1	A	15	0	10	Standard
19/05/2020	Lapwing	1	09:41	1	A	15	0	10	Standard
19/05/2020	Oystercatcher	1	09:14	1	A	7	0	10	Standard
22/05/2020	Curlew	1	15:28	1	A	25	0	10	Standard
22/05/2020	Curlew	1	16:20	1	A	20	0	12	Standard
22/05/2020	Curlew	1	16:32	1	A	10	0	10	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type
22/05/2020	Lapwing	1	14:27	1	A	20	0	7	Standard
22/05/2020	Lapwing	1	15:04	1	A	15	0	7	Standard
22/05/2020	Lapwing	1	16:11	1	A	15	0	7	Standard
22/05/2020	Lapwing	1	16:50	1	A	10	0	10	Standard
22/05/2020	Oystercatcher	1	14:53	1	A	10	0	10	Standard
22/05/2020	Oystercatcher	1	15:09	1	A	20	0	10	Standard
22/05/2020	Oystercatcher	1	15:33	1	A	10	0	5	Standard
22/06/2020	Curlew	1	17:21	1	A	6	0	7	Standard
22/06/2020	Curlew	1	17:21	1	A	16	0	7	Standard
22/06/2020	Curlew	1	17:30	1	A	8	0	10	Standard
22/06/2020	Curlew	1	17:48	1	A	10	0	8	Standard
22/06/2020	Curlew	1	17:48	1	A	15	0	8	Standard
22/06/2020	Curlew	1	17:48	1	B	20	20	25	Standard
22/06/2020	Curlew	1	17:48	1	B	4	4	20	Standard
01/07/2020	Curlew	1	16:10	1	A	25	0	8	Standard
01/07/2020	Curlew	1	16:10	1	A	20	0	15	Standard
01/07/2020	Curlew	1	16:10	1	B	20	20	30	Standard
01/07/2020	Hen harrier	1	14:42	1	A	80	0	6	Standard
01/07/2020	Oystercatcher	1	10:52	1	A	9	0	15	
01/07/2020	Oystercatcher	1	11:28	1	A	7	0	2	Standard
01/07/2020	Oystercatcher	1	16:16	2	B	25	50	60	Standard
01/07/2020	Snipe	1	10:56	1	B	28	28	70	Standard

* Standard record type means that the bird was observed during the duration of the vantage point watch and was within the viewshed of the VP (formed from a 180° arc centred on a predetermined view bearing out to a distance of 2km.

Incidental record type means that the bird was observed outwith the duration of the vantage point watch and / or was beyond the 2km limit.

Table 7-1-34: VP Flight Line Details (September 2020 – May 2021)

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type*
29/09/2020	Lapwing	1	09:01	37	A	11	0	5	Standard
29/09/2020	Lapwing	1	09:01	37	B	37	1369	25	Standard
29/09/2020	Lapwing	1	12:04	70	A	120	0	16	Incidental
29/09/2020	Lapwing	1	12:04	70	B	54	3780	30	Incidental
29/09/2020	Lapwing	1	13:12	6	B	102	612	30	Standard
14/10/2020	Greylag goose	1	13:51	6	C	65	0	170	Standard
14/10/2020	Greylag goose	1	16:29	31	C	72	0	180	Standard
14/10/2020	Greylag goose	1	17:05	70	C	132	0	160	Standard
14/10/2020	Greylag goose	1	17:21	13	C	55	0	140	Standard
14/10/2020	Greylag goose	1	17:47	16	C	127	0	170	Standard
14/10/2020	Greylag goose	1	17:47	6	C	90	0	170	Standard
14/10/2020	Greylag goose	1	18:40	150	B	130	19500	90	Standard
14/10/2020	Greylag goose	1	18:40	70	B	95	6650	100	Standard
14/10/2020	Greylag goose	1	18:53	38	C	106	0	150	Standard
14/10/2020	Lapwing	1	16:58	27	B	155	4185	30	Standard
14/10/2020	Snipe	1	17:08	2	A	20	0	18	Standard
14/10/2020	Whooper swan	1	18:14	14	A	42	0	10	Standard
14/10/2020	Whooper swan	1	18:20	9	A	50	0	10	Standard
16/10/2020	Barn owl	1	07:07	1	A	5	0	3	Standard
16/10/2020	Greylag goose	1	07:15	1	C	38	0	150	Standard
16/10/2020	Greylag goose	1	07:33	4	B	8	32	120	Standard
16/10/2020	Greylag goose	1	07:33	4	B	50	200	130	Standard
16/10/2020	Greylag goose	1	07:33	4	B	24	96	130	Standard
16/10/2020	Greylag goose	1	07:35	3	B	33	99	100	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type*
16/10/2020	Greylag goose	1	07:42	8	B	30	240	60	Standard
16/10/2020	Greylag goose	1	07:47	28	B	82	2296	110	Standard
16/10/2020	Greylag goose	1	07:54	70	B	41	2870	110	Standard
16/10/2020	Greylag goose	1	08:40	38	B	22	836	110	Standard
16/10/2020	Greylag goose	1	08:40	38	C	40	0	150	Standard
16/10/2020	Greylag goose	1	08:53	8	B	195	1560	80	Standard
16/10/2020	Greylag goose	1	08:58	18	B	45	810	80	Standard
16/10/2020	Greylag goose	1	09:13	28	C	35	0	160	Standard
16/10/2020	Greylag goose	1	10:40	1	C	133	0	150	Standard
16/10/2020	Greylag goose	1	11:13	1	B	153	153	120	Standard
16/10/2020	Greylag goose	1	11:36	33	B	120	3960	80	Standard
16/10/2020	Greylag goose	1	11:36	33	B	24	792	130	Standard
16/10/2020	Greylag goose	1	12:16	5	B	37	185	80	Standard
16/10/2020	Greylag goose	1	13:22	50	C	87	0	200	Standard
16/10/2020	Whooper swan	1	08:09	4	A	168	0	10	Standard
16/10/2020	Whooper swan	1	11:45	2	A	50	0	10	Standard
16/10/2020	Whooper swan	1	11:45	2	B	22	44	25	Standard
11/11/2020	Greylag goose	1	10:21	23	B	189	4347	35	Standard
11/11/2020	Greylag goose	1	11:02	11	B	216	2376	35	Standard
11/11/2020	Greylag goose	1	11:11	19	B	227	4313	40	Standard
11/11/2020	Greylag goose	1	11:29	8	B	119	952	45	Standard
11/11/2020	Greylag goose	1	14:57	12	B	58	696	30	Standard
11/11/2020	Greylag goose	1	15:38	9	B	89	801	30	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type*
11/11/2020	Greylag goose	1	15:50	16	B	104	1664	30	Standard
11/11/2020	Greylag goose	1	16:02	27	B	121	3267	30	Standard
27/11/2020	Barn owl	1	07:31	1	A	12	0	4	Standard
27/11/2020	Peregrine	1	11:47	1	C	130	0	150	Standard
27/11/2020	Pink-footed goose	1	09:00	3	B	103	309	60	Standard
27/11/2020	Pink-footed goose	1	12:05	1	B	56	56	80	Standard
11/12/2020	Greylag goose	1	09:32	27	B	24	648	50	Standard
11/12/2020	Greylag goose	1	12:09	14	B	32	448	80	Standard
11/12/2020	Greylag goose	1	15:04	34	B	25	850	60	Standard
11/12/2020	Snipe	1	10:19	5	A	10	0	5	Standard
11/12/2020	Snipe	1	14:22	1	A	5	0	5	Standard
11/12/2020	Snipe	1	15:28	2	A	8	0	5	Standard
11/12/2020	Snipe	1	15:32	1	A	5	0	15	Standard
12/12/2020	Greylag goose	1	08:46	16	B	28	448	40	Standard
12/12/2020	Greylag goose	1	10:11	28	B	20	560	40	Standard
12/12/2020	Greylag goose	1	12:18	9	B	38	342	40	Standard
12/12/2020	Greylag goose	1	12:52	46	B	53	2438	50	Standard
12/12/2020	Snipe	1	08:17	2	A	5	0	3	Standard
12/12/2020	Snipe	1	14:11	1	A	3	0	2	Standard
12/12/2020	Whooper swan	1	13:14	6	B	64	384	40	Standard
07/01/2021	Brent Goose	1	14:10	2	A	35	0	5	Standard
07/01/2021	Greylag goose	1	09:47	3	B	53	159	60	Standard
07/01/2021	Lapwing	1	12:04	30	B	32	960	100	Standard
07/01/2021	Lapwing	1	13:39	9	B	39	351	50	Standard
07/01/2021	Pink-footed goose	1	09:45	18	B	37	666	35	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type*
07/01/2021	Pink-footed goose	1	11:13	1	B	62	62	120	Standard
07/01/2021	Whooper swan	1	11:52	6	A	47	0	10	Standard
07/01/2021	Whooper swan	1	11:52	6	B	13	78	20	Standard
07/01/2021	Whooper swan	1	11:57	1	B	60	60	25	Standard
07/01/2021	Whooper swan	1	12:53	1	A	33	0	5	Standard
21/01/2021	Lapwing	1	10:24	17	B	20	340	40	Standard
03/02/2021	Hen harrier	1	14:47	1	A	36	0	15	Standard
17/02/2021	Hen harrier	1	16:25	1	A	22	0	5	Standard
17/02/2021	Pink-footed goose	1	11:42	7	B	88	616	100	Incidental
17/02/2021	Whooper swan	1	11:49	5	B	63	315	30	Standard
04/03/2021	Greylag goose	1	06:33	13	B	68	884	60	Standard
04/03/2021	Greylag goose	1	06:59	1	B	59	59	75	Standard
04/03/2021	Greylag goose	1	07:06	18	C	79	0	150	Standard
04/03/2021	Greylag goose	1	07:17	100	B	83	8300	100	Standard
04/03/2021	Pink-footed goose	1	06:21	1	B	18	18	50	Standard
04/03/2021	Pink-footed goose	1	11:00	2	B	75	150	50	Standard
18/03/2021	Lapwing	1	14:45	12	A	25	0	10	Standard
18/03/2021	Lapwing	1	14:45	12	B	48	576	30	Standard
18/03/2021	Lapwing	1	14:50	4	A	17	0	10	Standard
18/03/2021	Lapwing	1	14:50	4	A	5	0	10	Standard
18/03/2021	Lapwing	1	14:50	4	B	12	48	40	Standard
10/05/2021	Curlew	1	15:50	1	A	20	0	15	Standard
10/05/2021	Lapwing	1	15:47	1	B	40	40	80	Standard
10/05/2021	Lapwing	1	16:44	1	A	108	0	17	Standard
10/05/2021	Lapwing	1	17:08	2	A	25	0	18	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type*
10/05/2021	Lapwing	1	17:10	1	A	10	0	15	Standard
10/05/2021	Lapwing	1	17:22	1	A	20	0	15	Standard
10/05/2021	Lapwing	1	18:27	2	A	50	0	15	Standard
10/05/2021	Lapwing	1	18:27	2	B	10	20	40	Standard
10/05/2021	Lapwing	1	18:28	1	A	30	0	15	Standard
10/05/2021	Lapwing	1	18:28	1	A	30	0	10	Standard
11/05/2021	Lapwing	1	19:49	1	A	5	0	5	Standard
11/05/2021	Mute swan	1	20:50	1	B	34	34	120	Standard
11/05/2021	Oystercatcher	1	19:55	1	A	6	0	5	Standard
11/05/2021	Oystercatcher	1	20:31	2	A	9	0	1	Standard
11/05/2021	Whimbrel	1	19:51	1	A	20	0	18	Standard

* Standard record type means that the bird was observed during the duration of the vantage point watch and was within the viewshed of the VP (formed from a 180° arc centred on a predetermined view bearing out to a distance of 2km.

Incidental record type means that the bird was observed outwith the duration of the vantage point watch and / or was beyond the 2km limit.

Table 7-1-35: VP Flight Line Details (March 2023 – August 2023)

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type*
01/03/2023	Arctic skua	2	12:57	1	A	30	0	15	Standard
01/03/2023	Arctic skua	2	12:57	1	B	45	45	60	Standard
01/03/2023	Arctic skua	2	12:57	1	B	45	45	60	Standard
01/03/2023	Greylag goose	2	13:06	130	A	45	0	15	Standard
01/03/2023	Greylag goose	2	13:06	130	B	50	6500	40	Standard
01/03/2023	Greylag goose	2	13:06	130	B	25	3250	120	Standard
01/03/2023	Greylag goose	2	13:06	130	C	20	0	150	Standard
01/03/2023	Greylag goose	2	13:21	80	B	25	2000	100	Standard
01/03/2023	Greylag goose	2	13:21	80	B	20	1600	130	Standard
01/03/2023	Greylag goose	2	13:21	80	C	20	0	180	Standard
01/03/2023	Greylag goose	2	13:57	100	C	180	0	180	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type*
01/03/2023	Greylag goose	2	14:01	250	C	45	0	150	Incidental
01/03/2023	Mute swan	2	13:56	25	C	180	0	180	Standard
01/03/2023	Mute swan	2	14:01	40	C	45	0	150	Standard
20/03/2023	Curlew	2	12:59	1	B	34	34	60	Standard
20/03/2023	Curlew	2	13:14	1	B	40	40	60	Standard
20/03/2023	Mute swan	2	18:24	2	B	24	48	60	Standard
20/03/2023	Pink-footed goose	2	12:49	6	B	84	504	50	Incidental
20/03/2023	Pink-footed goose	2	13:13	4	B	24	96	60	Incidental
20/03/2023	Pink-footed goose	2	13:29	3	B	30	90	60	Standard
20/03/2023	Pink-footed goose	2	13:41	60	B	114	6840	50	Standard
20/03/2023	Pink-footed goose	2	14:27	9	B	26	234	60	Incidental
20/03/2023	Pink-footed goose	2	14:50	100	B	234	23400	100	Standard
20/03/2023	Pink-footed goose	2	14:58	2	B	30	60	40	Standard
20/03/2023	Pink-footed goose	2	15:40	24	B	42	1008	80	Standard
20/03/2023	Pink-footed goose	2	16:34	6	B	43	258	75	Standard
20/03/2023	Pink-footed goose	2	16:38	35	B	88	3080	40	Standard
20/03/2023	Pink-footed goose	2	17:00	4	B	93	372	50	Standard
20/03/2023	Pink-footed goose	2	17:44	120	C	62	0	150	Standard
20/03/2023	Pink-footed goose	2	18:10	45	B	110	4950	50	Standard
20/03/2023	Pink-footed goose	2	18:33	8	B	29	232	80	Standard
20/03/2023	Pink-footed goose	2	18:38	5	B	120	600	50	Standard
20/03/2023	Pink-footed goose	2	19:07	80	B	146	11680	60	Standard
21/03/2023	Mute swan	2	09:24	2	B	38	76	55	Standard
21/03/2023	Pink-footed goose	2	09:25	1	B	25	25	60	Standard
21/03/2023	Pink-footed goose	2	09:40	2	B	19	38	50	Standard
21/03/2023	Pink-footed goose	2	09:42	1	B	14	14	50	Standard
21/03/2023	Pink-footed goose	2	09:49	2	B	30	60	100	Standard
21/03/2023	Pink-footed goose	2	10:02	70	B	125	8750	50	Standard
21/03/2023	Pink-footed goose	2	10:09	6	B	70	420	100	Standard
21/03/2023	Pink-footed goose	2	10:12	40	B	75	3000	60	Incidental

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type*
21/03/2023	Pink-footed goose	2	11:05	80	B	80	6400	100	Incidental
22/03/2023	Curlew	2	06:26	1	B	126	126	80	Standard
22/03/2023	Curlew	2	07:25	1	B	74	74	50	Standard
22/03/2023	Pink-footed goose	2	05:20	20	B	28	560	50	Standard
22/03/2023	Pink-footed goose	2	05:48	80	B	168	13440	40	Standard
22/03/2023	Pink-footed goose	2	05:51	34	B	144	4896	60	Standard
22/03/2023	Pink-footed goose	2	05:55	2	B	60	120	50	Standard
22/03/2023	Pink-footed goose	2	05:56	2	B	73	146	50	Standard
22/03/2023	Pink-footed goose	2	06:01	14	B	37	518	50	Incidental
22/03/2023	Pink-footed goose	2	06:21	20	A	20	0	15	Standard
22/03/2023	Pink-footed goose	2	07:07	1	B	50	50	40	Standard
22/03/2023	Pink-footed goose	2	07:20	60	B	170	10200	110	Standard
22/03/2023	Pink-footed goose	2	07:24	12	A	65	0	15	Incidental
22/03/2023	Pink-footed goose	2	07:33	4	B	18	72	30	Standard
22/03/2023	Pink-footed goose	2	07:44	40	B	20	800	30	Incidental
13/04/2023	Curlew	2	13:20	1	B	40	40	40	Standard
13/04/2023	Curlew	2	13:40	1	B	40	40	40	Standard
13/04/2023	Curlew	2	18:05	1	B	20	20	50	Standard
13/04/2023	Lapwing	2	13:25	1	B	30	30	40	Standard
14/04/2023	Curlew	2	06:47	1	B	30	30	30	Standard
14/04/2023	Curlew	2	06:52	1	B	20	20	50	Standard
14/04/2023	Curlew	2	07:11	2	B	50	100	50	Standard
14/04/2023	Curlew	2	07:14	1	B	30	30	50	Standard
14/04/2023	Curlew	2	07:35	1	B	30	30	50	Standard
14/04/2023	Curlew	2	07:45	1	B	35	35	50	Standard
14/04/2023	Curlew	2	08:20	1	B	30	30	50	Standard
14/04/2023	Curlew	2	08:29	1	B	15	15	50	Standard
14/04/2023	Curlew	2	10:25	1	B	30	30	50	Standard
14/04/2023	Curlew	2	10:45	1	B	30	30	50	Standard
14/04/2023	Curlew	2	10:50	1	B	30	30	50	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type*
14/04/2023	Curlew	2	11:50	1	B	30	30	40	Standard
14/04/2023	Greylag goose	2	09:58	2	B	40	80	75	Standard
14/04/2023	Lapwing	2	07:22	1	B	25	25	40	Standard
14/04/2023	Lapwing	2	09:50	1	B	30	30	40	Standard
14/04/2023	Oystercatcher	2	08:35	6	A	20	0	20	Incidental
14/04/2023	Oystercatcher	2	08:40	2	B	60	120	60	Standard
11/05/2023	Curlew	2	13:02	1	A	50	0	10	Standard
11/05/2023	Curlew	2	13:06	1	A	12	0	10	Standard
11/05/2023	Curlew	2	13:06	1	B	35	35	25	Standard
11/05/2023	Curlew	2	13:50	1	A	45	0	10	Standard
11/05/2023	Curlew	2	13:50	1	A	25	0	19	Standard
11/05/2023	Curlew	2	13:51	1	A	10	0	10	Standard
11/05/2023	Curlew	2	14:32	1	A	15	0	5	Standard
11/05/2023	Curlew	2	18:45	1	A	5	0	5	Standard
11/05/2023	Curlew	2	19:27	1	A	45	0	10	Standard
11/05/2023	Curlew	2	19:33	1	A	15	0	10	Standard
11/05/2023	Curlew	2	19:51	1	A	25	0	15	Standard
11/05/2023	Curlew	2	20:14	1	A	5	0	1	Standard
11/05/2023	Curlew	2	20:19	1	A	10	0	2	Standard
11/05/2023	Curlew	2	20:30	1	A	30	0	5	Standard
11/05/2023	Curlew	2	20:30	1	A	15	0	5	Standard
11/05/2023	Curlew	2	20:30	1	A	5	0	2	Standard
11/05/2023	Greylag goose	2	15:20	3	B	105	315	40	Standard
11/05/2023	Lapwing	2	13:32	3	A	35	0	10	Standard
11/05/2023	Lapwing	2	19:25	1	A	3	0	10	Standard
11/05/2023	Lapwing	2	19:37	1	A	5	0	2	Standard
12/05/2023	Curlew	2	04:58	1	A	15	0	5	Standard
12/05/2023	Curlew	2	04:58	1	A	30	0	10	Standard
12/05/2023	Curlew	2	05:17	2	A	5	0	10	Standard
12/05/2023	Curlew	2	05:28	1	A	10	0	5	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type*
12/05/2023	Curlew	2	06:35	1	A	20	0	15	Standard
12/05/2023	Curlew	2	06:35	1	B	40	40	30	Standard
12/05/2023	Curlew	2	07:15	1	A	15	0	5	Standard
12/05/2023	Curlew	2	09:53	1	A	10	0	5	Standard
12/05/2023	Curlew	2	09:53	1	A	20	0	5	Standard
12/05/2023	Curlew	2	09:53	1	A	5	0	2	Standard
12/05/2023	Curlew	2	10:13	1	A	10	0	10	Standard
12/05/2023	Curlew	2	10:59	1	A	10	0	10	Standard
12/05/2023	Curlew	2	11:56	1	A	45	0	5	Standard
12/05/2023	Curlew	2	12:25	1	A	40	0	5	Standard
12/05/2023	Greylag goose	2	05:43	25	A	10	0	5	Standard
12/05/2023	Greylag goose	2	07:07	25	A	20	0	10	Standard
12/05/2023	Lapwing	2	07:52	1	A	5	0	2	Standard
12/05/2023	Lapwing	2	12:28	3	A	75	0	15	Standard
12/05/2023	Mute swan	2	10:24	1	B	60	60	30	Standard
12/05/2023	Mute swan	2	11:55	1	B	40	40	25	Standard
20/06/2023	Curlew	2	05:02	1	A	10	0	3	Standard
20/06/2023	Curlew	2	05:02	1	A	10	0	3	Standard
20/06/2023	Curlew	2	05:23	1	A	15	0	7	Standard
20/06/2023	Curlew	2	05:24	1	A	20	0	7	Standard
20/06/2023	Curlew	2	05:57	1	A	45	0	5	Standard
20/06/2023	Curlew	2	05:57	1	A	15	0	7	Standard
20/06/2023	Curlew	2	05:59	1	A	30	0	7	Standard
20/06/2023	Curlew	2	06:46	1	A	20	0	5	Standard
20/06/2023	Curlew	2	06:53	1	A	15	0	4	Standard
20/06/2023	Mute swan	2	05:11	1	A	30	0	15	Standard
20/06/2023	Oystercatcher	2	07:03	1	B	40	40	25	Standard
21/06/2023	Curlew	2	20:36	1	A	60	0	10	Standard
21/06/2023	Curlew	2	20:36	1	B	15	15	20	Standard
18/07/2023	Curlew	2	05:47	2	B	15	30	40	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	No. of Bird Seconds at Risk height	Average Height (m)	Record Type*
18/07/2023	Curlew	2	06:22	1	B	20	20	25	Standard
18/07/2023	Curlew	2	10:32	1	A	20	0	15	Standard
18/07/2023	Lapwing	2	09:16	1	A	15	0	15	Standard
18/07/2023	Oystercatcher	2	06:19	3	A	10	0	15	Standard
19/07/2023	Curlew	2	19:56	2	B	16	32	30	Standard
19/07/2023	Lapwing	2	20:24	1	B	30	30	35	Standard
25/08/2023	Lapwing	2	12:50	17	A	35	0	8	Standard
30/08/2023	Lapwing	2	09:37	130	A	180	0	15	Standard
30/08/2023	Lapwing	2	09:40	130	A	15	0	2	Standard
30/08/2023	Lapwing	2	10:21	25	A	15	0	3	Standard
30/08/2023	Lapwing	2	10:21	25	A	20	0	10	Standard
30/08/2023	Lapwing	2	11:50	150	B	240	36000	25	Standard
30/08/2023	Lapwing	2	11:54	150	A	60	0	3	Standard
30/08/2023	Lapwing	2	12:20	150	B	180	27000	20	Standard
30/08/2023	Lapwing	2	13:15	150	A	120	0	15	Standard

* Standard record type means that the bird was observed during the duration of the vantage point watch and was within the viewshed of the VP (formed from a 180° arc centred on a predetermined view bearing out to a distance of 2km.

Incidental record type means that the bird was observed outwith the duration of the vantage point watch and / or was beyond the 2km limit.

Annex D: Conservation Status of all Recorded Bird Species

Table 7-1-36: Full List of Species Recorded on Site

Species	Scientific Name	Annex 1	Schedule 1	Scottish Priority Species	Birds of Conservation Concern	Vantage Point
Arctic skua	Stercorarius parasiticus			Yes	Red	Yes
Barn owl	Tyto alba		Yes	Yes		Yes
Blackbird	Turdus merula					
Black-headed gull	Chroicocephalus ridibundus			Yes	Amber	Yes
Brent Goose	Branta bernicla				Amber	Yes
Buzzard	Buteo buteo					Yes
Carrion crow	Corvus corone					Yes
Chaffinch	Fringilla coelebs					
Chiffchaff	Phylloscopus collybita					Yes
Common gull	Larus canus				Amber	Yes
Common scoter	Melanitta nigra		Yes	Yes	Red	Yes
Cormorant	Phalacrocorax carbo					Yes
Curlew	Numenius arquata			Yes	Red	Yes
Dunnock	Prunella modularis			Yes	Amber	
Fieldfare	Turdus pilaris		Yes		Red	Yes
Goldcrest	Regulus regulus					
Golden plover	Pluvialis apricaria	Yes		Yes		Yes
Goldfinch	Carduelis carduelis					
Great tit	Parus major					
Grey heron	Ardea cinerea					Yes
Grey wagtail	Motacilla cinerea				Amber	
Greylag goose	Anser anser				Amber	Yes
Hen harrier	Circus cyaneus	Yes	Yes	Yes	Red	Yes
Herring gull	Larus argentatus			Yes	Red	Yes
Hooded crow	Corvus cornix			Yes		
Jackdaw	Corvus monedula					

Species	Scientific Name	Annex 1	Schedule 1	Scottish Priority Species	Birds of Conservation Concern	Vantage Point
Kestrel	Falco tinnunculus			Yes	Amber	Yes
Lapwing	Vanellus vanellus			Yes	Red	Yes
Lesser redpoll	Acanthis cabaret			Yes		
Linnet	Linaria cannabina			Yes	Red	
Long-tailed duck	Clangula hyemalis		Yes		Red	
Mallard	Anas platyrhynchos				Amber	Yes
Marsh harrier	Circus aeruginosus	Yes	Yes	Yes	Amber	
Meadow pipit	Anthus pratensis				Amber	
Mute swan	Cygnus olor					Yes
Osprey	Pandion haliaetus	Yes	Yes	Yes	Amber	
Oystercatcher	Haematopus ostralegus				Amber	Yes
Peregrine	Falco peregrinus	Yes	Yes	Yes		Yes
Pheasant	Phasianus colchicus					Yes
Pied wagtail	Motacilla alba					
Pink-footed goose	Anser brachyrhynchus				Amber	Yes
Pochard	Aythya ferina			Yes	Red	Yes
Raven	Corvus corax					Yes
Red kite	Milvus milvus	Yes	Yes	Yes		
Redshank	Tringa totanus				Amber	Yes
Red-throated diver	Gavia stellata	Yes	Yes	Yes		
Redwing	Turdus iliacus		Yes	Yes	Amber	Yes
Reed bunting	Emberiza schoeniclus			Yes	Amber	
Robin	Erithacus rubecula					
Rook	Corvus frugilegus				Amber	
Sedge warbler	Acrocephalus schoenobaenus				Amber	
Siskin	Spinus spinus			Yes		
Skylark	Alauda arvensis			Yes	Red	
Snipe	Gallinago gallinago				Amber	Yes
Song thrush	Turdus philomelos			Yes	Amber	
Sparrowhawk	Accipiter nisus				Amber	Yes

Species	Scientific Name	Annex 1	Schedule 1	Scottish Priority Species	Birds of Conservation Concern	Vantage Point
Starling	Sturnus vulgaris			Yes	Red	Yes
Stonechat	Saxicola rubicola					
Swallow	Hirundo rustica					
Wheatear	Oenanthe oenanthe				Amber	
Whimbrel	Numenius phaeopus		Yes		Red	Yes
Whooper swan	Cygnus Cygnus	Yes	Yes	Yes	Amber	Yes
Willow warbler	Phylloscopus trochilus				Amber	
Woodpigeon	Columba palumbus				Amber	
Wren	Troglodytes troglodytes				Amber	
Yellowhammer	Emberiza citrinella			Yes	Red	

Annex E: Vantage Point Survey Ground and Heard-Only Registrations of Target Species

Table 7-1-37: Point Registrations from VP Surveys (All Periods October 2019 – August 2023)

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	Average Height (m)	Record Type
October 2019- August 2020								
28/10/2019	Mute swan	1	14:30	21	Ground	Present	-1	Standard
28/10/2019	Whooper swan	1	14:30	6	Ground	Present	-1	Standard
29/10/2019	Greylag goose	1	06:56	30	Ground	Present	-1	Standard
29/10/2019	Greylag goose	1	06:57	50	Ground	Present	-1	Standard
29/10/2019	Mute swan	1	07:01	5	Ground	Present	-1	Standard
29/10/2019	Mute swan	1	07:57	6	Ground	Present	-1	Standard
29/10/2019	Mute swan	1	09:52	25	Ground	Present	-1	Standard
12/11/2019	Greylag goose	1	07:46	200	Ground	Present	-1	Standard
12/11/2019	Greylag goose	1	08:24	80	Ground	Present	-1	Standard
12/11/2019	Greylag goose	1	08:24	45	Ground	Present	-1	Standard
12/11/2019	Greylag goose	1	09:18	160	Ground	Present	-1	Standard
12/11/2019	Greylag goose	1	12:00	250	Ground	Present	-1	Standard
12/11/2019	Greylag goose	1	12:04	150	Ground	Present	-1	Standard
12/11/2019	Greylag goose	1	12:05	100	Ground	Present	-1	Standard
12/11/2019	Greylag goose	1	12:25	200	Ground	Present	-1	Standard
12/11/2019	Greylag goose	1	12:31	200	Ground	Present	-1	Standard
12/11/2019	Greylag goose	1	13:33	500	Ground	Present	-1	Standard
12/11/2019	Greylag goose	1	14:32	250	Ground	Present	-1	Standard
12/11/2019	Mute swan	1	07:27	7	Ground	Present	-1	Standard
12/11/2019	Mute swan	1	12:05	30	Ground	Present	-1	Standard
12/11/2019	Mute swan	1	13:35	50	Ground	Present	-1	Standard
12/11/2019	Pink-footed goose	1	09:25	150	Ground	Present	-1	Standard
12/11/2019	Pink-footed goose	1	12:20	100	Ground	Present	-1	Standard
12/11/2019	Pink-footed goose	1	13:33	200	Ground	Present	-1	Standard
12/11/2019	Whooper swan	1	07:32	24	Ground	Present	-1	Standard
12/11/2019	Whooper swan	1	07:42	28	Ground	Present	-1	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	Average Height (m)	Record Type
12/11/2019	Whooper swan	1	13:45	150	Ground	Present	-1	Standard
12/11/2019	Whooper swan	1	14:51	35	Ground	Present	-1	Standard
11/12/2019	Mute swan	1	09:34	1	Ground	Present	-1	Standard
19/12/2019	Greylag goose	1	11:41	3	Ground	Present	-1	Standard
19/12/2019	Whooper swan	1	09:11	17	Ground	Present	-1	Standard
08/01/2020	Greylag goose	1	12:00	12	Ground	Present	-1	Standard
08/01/2020	Pink-footed goose	1	09:21	5	Ground	Present	-1	Standard
08/01/2020	Whooper swan	1	09:12	6	Ground	Present	-1	Standard
08/01/2020	Whooper swan	1	12:00	8	Ground	Present	-1	Standard
06/03/2020	Lapwing	1	08:04	1	Ground	Present	-1	Standard
21/04/2020	Curlew	1	14:51	1	Ground	Present	15	Standard
21/04/2020	Curlew	1	18:46	1	Ground	Present	-1	Standard
21/04/2020	Lapwing	1	16:41	1	Ground	Present	-1	Standard
21/04/2020	Lapwing	1	16:53	1	Ground	Present	-1	Standard
21/04/2020	Lapwing	1	17:49	1	Ground	Present	-1	Standard
21/04/2020	Lapwing	1	18:29	2	Ground	Present	-1	Standard
21/04/2020	Lapwing	1	19:03	1	Ground	Present	-1	Standard
21/04/2020	Lapwing	1	19:44	2	Ground	Present	-1	Standard
21/04/2020	Oystercatcher	1	15:38	1	Ground	Present	-1	Standard
21/04/2020	Oystercatcher	1	18:26	2	Ground	Present	-1	Standard
21/04/2020	Redshank	1	19:08	1	Heard only	Present	-1	Standard
21/04/2020	Snipe	1	20:32	1	Heard only	Present	30	Standard
25/04/2020	Lapwing	1	15:51	2	Ground	Present	-1	Standard
25/04/2020	Lapwing	1	16:24	2	Ground	Present	-1	Standard
29/04/2020	Curlew	1	06:31	1	Ground	Present	-1	Standard
29/04/2020	Lapwing	1	06:52	2	Ground	Present	-1	Standard
29/04/2020	Lapwing	1	07:09	1	Ground	Present	-1	Standard
29/04/2020	Oystercatcher	1	05:28	1	Ground	Present	-1	Standard
04/05/2020	Lapwing	1	08:58	2	Ground	Present	-1	Standard
04/05/2020	Oystercatcher	1	08:11	1	Ground	Present	-1	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	Average Height (m)	Record Type
05/05/2020	Lapwing	1	21:01	1	Ground	Present	-1	Standard
05/05/2020	Oystercatcher	1	19:22	2	Ground	Present	-1	Standard
19/05/2020	Snipe	1	07:01	1	Heard only	Present	-1	Standard
22/06/2020	Curlew	1	17:21	1	Ground	Present	-1	Standard
01/07/2020	Curlew	1	10:10	1	Heard only	Present	-1	Standard
01/07/2020	Curlew	1	14:28	2	Heard only	Present	-1	Standard
01/07/2020	Oystercatcher	1	11:28	1	Ground	Present	-1	Standard
September 2020- May 2021								
11/11/2020	Greylag goose	1	10:15	400	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	10:15	250	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	10:15	100	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	10:21	23	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	11:02	11	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	11:11	19	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	11:29	8	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	13:45	260	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	13:45	140	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	13:45	420	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	14:57	12	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	15:38	9	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	15:50	16	Ground	Present	-1	Standard
11/11/2020	Greylag goose	1	16:02	27	Ground	Present	-1	Standard
27/11/2020	Whooper swan	1	09:28	2	Ground	180	-1	Standard
11/12/2020	Snipe	1	14:22	1	Ground	Present	-1	Standard
11/12/2020	Snipe	1	15:28	2	Ground	Present	-1	Standard
12/12/2020	Snipe	1	08:17	2	Ground	Present	-1	Standard
12/12/2020	Snipe	1	14:11	1	Ground	Present	-1	Standard
10/05/2021	Curlew	1	15:33	1	Heard only	Present	-1	Standard
10/05/2021	Lapwing	1	15:31	1	Heard only	Present	-1	Standard
10/05/2021	Lapwing	1	17:22	1	Ground	Present	-1	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	Average Height (m)	Record Type
10/05/2021	Oystercatcher	1	17:33	1	Ground	Present	-1	Standard
11/05/2021	Curlew	1	19:33	1	Ground	Present	-1	
11/05/2021	Curlew	1	19:37	1	Heard only	Present	-1	
11/05/2021	Lapwing	1	19:49	1	Ground	Present	-1	
11/05/2021	Oystercatcher	1	19:28	2	Ground	Present	-1	
11/05/2021	Oystercatcher	1	22:12	2	Ground	Present	-1	
March 2023 - August 2023								
01/03/2023	Mute swan	2	13:06	21	Ground	Present	-1	Standard
01/03/2023	Whooper swan	2	13:06	6	Ground	Present	-1	Standard
20/03/2023	Pink-footed goose	2	12:49	6	Ground	0	0	Standard
20/03/2023	Pink-footed goose	2	13:41	60	Ground	0	0	Standard
20/03/2023	Pink-footed goose	2	16:38	35	Ground	0	0	Standard
20/03/2023	Pink-footed goose	2	19:07	60	Ground	0	0	Standard
21/03/2023	Pink-footed goose	2	10:42	1	Ground	Present	-1	Standard
22/03/2023	Pink-footed goose	2	05:48	80	Ground	0	0	Incidental
22/03/2023	Pink-footed goose	2	05:55	2	Ground	0	0	Standard
22/03/2023	Pink-footed goose	2	05:56	2	Ground	0	0	Standard
22/03/2023	Pink-footed goose	2	06:01	14	Ground	0	0	Incidental
22/03/2023	Pink-footed goose	2	07:24	12	Ground	0	0	Incidental
22/03/2023	Pink-footed goose	2	07:33	4	Ground	0	0	Incidental
22/03/2023	Pink-footed goose	2	07:44	40	Ground	0	0	Incidental
11/05/2023	Curlew	2	13:02	1	Ground	0	0	Standard
11/05/2023	Curlew	2	18:45	1	Ground	0	0	Standard
11/05/2023	Curlew	2	19:26	1	Ground	0	0	Standard
11/05/2023	Curlew	2	19:27	1	Ground	0	0	Standard
11/05/2023	Curlew	2	19:33	1	Ground	0	0	Standard
11/05/2023	Curlew	2	19:51	1	Ground	0	0	Standard
11/05/2023	Curlew	2	20:14	1	Ground	0	0	Standard
11/05/2023	Curlew	2	20:19	1	Ground	0	0	Standard
11/05/2023	Curlew	2	20:30	1	Ground	0	0	Standard

Date	Species	VP Number	Time First Observed	Number of Birds	Height Band	Time in Height Band (s)	Average Height (m)	Record Type
11/05/2023	Curlew	2	20:30	1	Ground	0	0	Standard
11/05/2023	Curlew	2	20:30	1	Ground	0	0	Standard
11/05/2023	Lapwing	2	14:45	1	Ground	120	0	Standard
11/05/2023	Peregrine	2	13:36	1	Ground	20	0	Standard
12/05/2023	Lapwing	2	09:46	2	Ground	2700	0	Standard
20/06/2023	Curlew	2	04:14	1	Heard only	15	0	Standard
20/06/2023	Curlew	2	05:02	1	Ground	0	0	Standard
21/06/2023	Curlew	2	21:55	1	Heard only	5	0	Standard
30/08/2023	Lapwing	2	09:40	130	Ground	60	0	Standard
30/08/2023	Lapwing	2	10:21	25	Ground	60	0	Standard
30/08/2023	Lapwing	2	11:35	150	Ground	60	0	Standard
30/08/2023	Lapwing	2	11:55	150	Ground	60	0	Standard
30/08/2023	Lapwing	2	12:23	150	Ground	60	0	Standard

* Standard record type means that the bird was observed during the duration of the vantage point watch and was within the viewshed of the VP (formed from a 180° arc centred on a predetermined view bearing out to a distance of 2km.

Incidental record type means that the bird was observed outwith the duration of the vantage point watch and / or was beyond the 2km limit.

Annex F: Examples of CRM Calculation

Example 1 – CRM calculation on Whooper Swan in Year 1 – Predictable model

Collision Risk Model Calculations for Whooper swan

Stage 1: Number of birds flying through the rotors per year

Calculate the "risk window" i.e. the cross-sectional area equal to the width of the windfarm across the general flight direction multiplied by the maximum height of the turbines.

A single usual flight path was identified using GIS.

Width = 395
Height = 145 m

Cross-sectional area (W) = 57275 m2

Calculate the area presented by the wind farm rotors, assuming no overlap.

Area = Number of turbines x π x rotor radius^2
A=N x πR^2

Area = 2 x Pi x 66.5^2
Area = 27785.8162 m2

Express the total rotor area as a proportion of the risk window (A/W)

Proportion of risk window taken up by rotors = A/W
Proportion = 0.4851

Calculate the time the site was observed for and how long birds, as a % activity, were seen within 200m of the turbines

The annual hours potentially active are taken as 1610.95 for October - March per year. The number of hours is calculated where the day length is a function of latitude and day of the year[1]

The survey period is taken as October - March from 28/10/2019 to 5/5/2020

Total survey hours		Observed number of birds	Transit Rate (birds per hour)	Number of hours potentially active	Total predicted transits through risk window	Predicted transits through the rotors
Dawn	13.77	37	2.688	364.00	978.43	474.67
Day	37.42	150	4.009	882.95	3539.75	1717.24
Dusk	8.78	0	0	364.00	0.00	0.00
				Total	**4518.18**	**2191.90**

The total daytime predicted transits through the rotor blades = 2191.9

An additional 0% for night time activity is also predicted = 0

Therefore, the total number of predicted transits through the rotor blades = 2191.9

Stage 2: Collision risk for bird passing through rotor area (assuming no avoidance)

Convert pitch of chord into radians

K: 1D or 3D (0 or 1)	1
No. of blades	3
Maximum chord	4 m
Pitch (degrees)	0
Rotor radius	66.5 m
Rotation Period	4.55 s

Pitch in radians = pitch (degrees) x Pi/180
Pitch in radians = 0 x Pi/180
Pitch in radians = 0

Calculate the bird aspect ratio

Bird length	1.52 m
Wingspan	2.3 m
Bird speed	17.3 m/s
F:Flapping	1

Bird aspect ratio (b) = bird length/wingspan
Bird aspect ratio (b) = 1.52/2.3
Bird aspect ratio (b) = 0.6609

Calculation of alpha and p(collision) as a function of radius

r/R radius	c/C chord	a alpha	Upwind:			Downwind:			check area total
			collide length	p(collision)	contribution from radius r	collide length	p(collision)	contribution from radius r	
0.025	0.575	7.535568	34.6636	1	0.00125	34.663612	1	0.00125	0.00125
0.075	0.575	2.511856	11.5545	0.440368564	0.003302764	11.554537	0.440368564	0.003302764	0.0075
0.125	0.7015	1.507114	7.69532	0.293285464	0.003666068	7.6953218	0.293285464	0.003666068	0.0125
0.175	0.8601	1.07651	6.1796	0.235517861	0.004121563	6.1795961	0.235517861	0.004121563	0.0175
0.225	0.99435	0.837285	5.25597	0.20031664	0.004507124	5.2559748	0.20031664	0.004507124	0.0225
0.275	0.94665	0.685052	4.16964	0.158913872	0.004370131	4.1696351	0.158913872	0.004370131	0.0275
0.325	0.89895	0.579659	3.60434	0.137369169	0.004464498	3.604338	0.137369169	0.004464498	0.0325
0.375	0.85125	0.502371	3.23057	0.123124203	0.004617158	3.2305739	0.123124203	0.004617158	0.0375
0.425	0.80355	0.443269	2.94475	0.112230994	0.004769817	2.9447542	0.112230994	0.004769817	0.0425
0.475	0.75585	0.396609	2.71911	0.103631092	0.004922477	2.7191071	0.103631092	0.004922477	0.0475
0.525	0.70815	0.358837	2.53644	0.096669266	0.005075136	2.5364404	0.096669266	0.005075136	0.0525
0.575	0.66045	0.327633	2.38554	0.090918193	0.005227796	2.3855419	0.090918193	0.005227796	0.0575
0.625	0.61275	0.301423	2.25879	0.086087292	0.005380456	2.2587871	0.086087292	0.005380456	0.0625
0.675	0.56505	0.279095	2.15081	0.08197208	0.005533115	2.1508107	0.08197208	0.005533115	0.0675
0.725	0.51735	0.259847	2.05773	0.078424483	0.005685775	2.0577277	0.078424483	0.005685775	0.0725
0.775	0.46965	0.243083	1.97666	0.07533464	0.005838435	1.9766554	0.07533464	0.005838435	0.0775
0.825	0.42195	0.228351	1.90541	0.072619324	0.005991094	1.90541	0.072619324	0.005991094	0.0825
0.875	0.37425	0.215302	1.84231	0.07021433	0.006143754	1.842307	0.07021433	0.006143754	0.0875
0.925	0.32655	0.203664	1.78603	0.068069335	0.006296414	1.7860259	0.068069335	0.006296414	0.0925
0.975	0.27885	0.19322	1.73552	0.06614434	0.006449073	1.7355172	0.06614434	0.006449073	0.0975
Overall p(collision)			**Upwind**		**0.09761265**	**Downwind**		**0.09761265**	**0.99875**

Average probability of collision = (upwind collision total + downwind collision total)/2
Average probability of collision = (0.097612648740929 + 0.097612648740929)/2
Average probability of collision = 0.097613

Annual collision risk for Whooper swan assuming no avoidance

Annual collision risk = no. of transits per year through the rotors x the average probability of collision
Annual collision risk = 2191.90360297806 x 0.097613
Annual collision risk = 213.957516 birds

Corrected annual collision risk assuming avoidance

Whooper swan avoidance rate = 0.995

Annual collision risk, with avoidance = annual collision risk x (1 - avoidance rate)
Annual collision risk, with avoidance = 213.957516471474 x (1 - 0.995)
Annual collision risk, with avoidance = 1.06978758235737 birds

Corrected for assumed operational downtime of the rotors

Proportion of time wind turbines operational = 0.85

Corrected annual risk = annual risk, with avoidance x proportion of time wind turbines operational
Corrected annual risk = 0.909319 birds

Calculate number of years per collision

Number of years per collision for Whooper swan = 1/corrected annual risk
Number of years per collision for Whooper swan = 1/0.909319445003764

Number of years per collision for Whooper swan = 1.0997

[1] Forsythe, W. C., Rykiel, E. J., Stahl, R. S., Wu, H. and Schoolfield, R. M.,1995. A model comparison for daylength as a function of latitude and day of year. *Ecological Modelling Vol 80, Issue 1, 87-95*

Example 2 – CRM calculation on Lapwing in Year 1 - Random model

Collision Risk Model Calculations for Lapwing

Stage 1: Number of birds flying through the rotors per year

Calculate the time the site was observed for and how long birds (as a % area-time activity) were seen in the observation area during this time and bird activity for each vantage point

The survey period for this species is taken as the whole year.

VP	Area (Ha)	Time (hours)	Ha hours	Ha seconds (hours x 3600)	Flight time observed in risk window (s)	Bird Activity (flight time/ha-s)
1	592.65	105	62228.25	224021700	523	2.3346E-06
Total	592.65	105	62228.25	224021700	523	2.3346E-06

Calculate the average bird observation activity in all areas and the percentage of time birds active within the overall observed area

Mean bird activity =Total bird activity/number of VPs
Mean bird activity = 2.33459526465516E-06/1 = **2.335E-06**

Overall area covered by VPs (excluding overlap) = 592.65 ha
Proportion of time birds active in the area = Overall area (excluding overlaps) in ha x mean bird activity
Proportion of time birds active in area = 592.65 x 2.33459526465516E-06 = **1.3836E-03**

Correct for differences between the recording height band and the actual height swept by the rotors

Corrected bird activity=Proportion of actual height band x Proportion of time birds active in the area

Hub height = 83.5 m Observed height band max = 160 m
Rotor radius = 66.5 m Observed height band min = 15 m

Rotor max height= hub height + rotor radius
Rotor min height= hub height - rotor radius
Rotor max height = 150 m
Rotor min height = 17 m

Proportion of actual height band = (Rotor max height – rotor min height)/(observed height band max – observed height band min)
Proportion of actual height band = (150 - 17)/(160 - 15)
Proportion of actual height band = 0.9172414

Corrected bird activity = **1.269E-03**

Calculate the number of hours per day the birds are potentially active over a year and the number of hours of bird occupancy in the airspace per year

Hours potentially active are taken as daylight hours only for the year and then calculated where the day length is a function of latitude and day of the year[1]

Hours potentially active = 4517.74877895095

No. of hours of bird occupancy in the airspace per year =hours potentially active x bird activity
No. of hours of bird occupancy in the airspace per year = 4517.74877895095 x 0.0012690932311622
No. of hours of bird occupancy = 5.73344

Calculate the flight risk volume

Flight risk volume (Vw) = Overall area (ha) x 10000 x rotor radius (m) x 2
Vw = 592.65 x 10000 x 66.5 x 2
Vw = 788224500 m3

Calculate the combined rotor swept volume

Number of turbines = 2
Maximum chord = 4 m
Bird length = 0.3 m

Combined rotor swept volume (Vr) = number of turbines (N) x Pi x r2 x (maximum chord + bird length)
Vr = 2 x Pi x 66.5 x 66.5 x (4 + 0.3)
Vr = 119479.01 m3

Calculate the bird occupancy in the rotor swept volume

No. of hours of bird occupancy (converted to seconds) x Combined rotor swept volume/Flight risk volume = n x (Vr/Vw)
Bird occupancy in rotor swept volume = 5.73344439545792 x 3600 x 119479.01/788224500
Bird occupancy in rotor swept volume = 3.128670242

Calculate the bird transit time through the rotors and the potential number of transits per year

Bird speed = 12.8 m/s

Bird transit time through the rotors = (maximum chord + bird length) /bird speed
Bird transit time through the rotors = (4 + 0.3)/12.8
Bird transit time through the rotors = 0.3359375 s

No. of transits = bird occupancy in the rotor swept volume/bird transit time
No. of transits = 3.12867/0.3359375
No. of transits = 9.313251

Stage 2: Collision risk for bird passing through rotor area (assuming no avoidance)

Convert pitch of chord into radians

K: 1D or 3D (0 or 1	1
No. of blades	3
Maximum chord	4 m
Pitch (degrees)	0
Rotor radius	66.5 m
Rotation Period	4.55 s

Pitch in radians = pitch (degrees) x Pi/180
Pitch in radians = 0 x Pi/180
Pitch in radians = 0

Calculate the bird aspect ratio

Bird length	0.3 m
Wingspan	0.84 m
Bird speed	12.8 m/s
F:Flapping	1

Bird aspect ratio (b) = bird length/wingspan
Bird aspect ratio (b) = 0.3/0.84
Bird aspect ratio (b) = 0.3571

Calculation of alpha and p(collision) as a function of radius

r/R radius	c/C chord	a alpha	Upwind:			Downwind:			check area total
			collide length	p(collision)	contribution from radius r	collide length	p(collision)	contribution from radius r	
0.025	0.575	5.575449	17.5069	0.9017982	0.001127248	17.5069	0.9017982	0.00112725	0.00125
0.075	0.575	1.858483	5.83564	0.3005994	0.002254496	5.83564	0.3005994	0.0022545	0.0075
0.125	0.7015	1.11509	4.06562	0.209424	0.0026178	4.06562	0.209424	0.0026178	0.0125
0.175	0.8601	0.796493	3.40931	0.1756168	0.003073294	3.40931	0.1756168	0.00307329	0.0175
0.225	0.99435	0.619494	2.98435	0.1537269	0.003458856	2.98435	0.1537269	0.00345886	0.0225
0.275	0.94665	0.506859	2.34503	0.120795	0.003321863	2.34503	0.120795	0.00332186	0.0275
0.325	0.89895	0.428881	1.90243	0.097996	0.00318487	1.90243	0.097996	0.00318487	0.0325
0.375	0.85125	0.371697	1.57785	0.0812767	0.003047877	1.57785	0.0812767	0.00304788	0.0375
0.425	0.80355	0.327968	1.35415	0.0697538	0.002964536	1.35415	0.0697538	0.00296454	0.0425
0.475	0.75585	0.293445	1.1872	0.0611539	0.002904809	1.1872	0.0611539	0.00290481	0.0475
0.525	0.70815	0.265498	1.05205	0.0541921	0.002845083	1.05205	0.0541921	0.00284508	0.0525
0.575	0.66045	0.242411	0.9404	0.048441	0.002785356	0.9404	0.048441	0.00278536	0.0575
0.625	0.61275	0.223018	0.84662	0.0436101	0.00272563	0.84662	0.0436101	0.00272563	0.0625
0.675	0.56505	0.206498	0.76673	0.0394949	0.002665904	0.76673	0.0394949	0.0026659	0.0675
0.725	0.51735	0.192257	0.69786	0.0359473	0.002606177	0.69786	0.0359473	0.00260618	0.0725
0.775	0.46965	0.179853	0.63787	0.0328574	0.002546451	0.63787	0.0328574	0.00254645	0.0775
0.825	0.42195	0.168953	0.58516	0.0301421	0.002486724	0.58516	0.0301421	0.00248672	0.0825
0.875	0.37425	0.159299	0.53847	0.0277371	0.002426998	0.53847	0.0277371	0.002427	0.0875
0.925	0.32655	0.150688	0.49683	0.0255921	0.002367271	0.49683	0.0255921	0.00236727	0.0925
0.975	0.27885	0.14296	0.45946	0.0236671	0.002307545	0.45946	0.0236671	0.00230754	0.0975
Overall p(collision)			**Upwind**		**0.053718786**	**Downwind**		**0.05371879**	**0.99875**

Average probability of collision = (upwind collision total + downwind collision total)/2
Average probability of collision = (0.0537187864567953 + 0.0537187864567953)/2
Average probability of collision = 0.053719

Annual collision risk for Lapwing assuming no avoidance

Annual collision risk = no. of transits per year through the rotors x the average probability of collision
Annual collision risk = 9.31325095205548 x 0.053719
Annual collision risk = 0.500297 birds

Corrected annual collision risk assuming avoidance

Lapwing avoidance rate = 0.98

Annual collision risk, with avoidance = annual collision risk x (1 - avoidance rate)
Annual collision risk, with avoidance = 0.500296539112014 x (1 - 0.98)
Annual collision risk, with avoidance = 0.0100059307822403 birds

Corrected for assumed operational downtime of the rotors

Proportion of time wind turbines operational = 0.85

Corrected annual risk = annual risk, with avoidance x proportion of time wind turbines operational
Corrected annual risk = 0.008505 birds

Calculate number of years per collision

Number of years per collision for Lapwing = 1/corrected annual risk
Number of years per collision for Lapwing = 1/0.00850504116490424

Number of years per collision for Lapwing = 117.5773

[1] Forsythe, W. C., Rykiel, E. J., Stahl, R. S., Wu, H. and Schoolfield, R. M.,1995. A model comparison for daylength as a function of latitude and day of year. *Ecological Modelling Vol 80, Issue 1, 87-95*