Hill of Forss Wind Farm:
Baseline Ornithology 2012 - 2014

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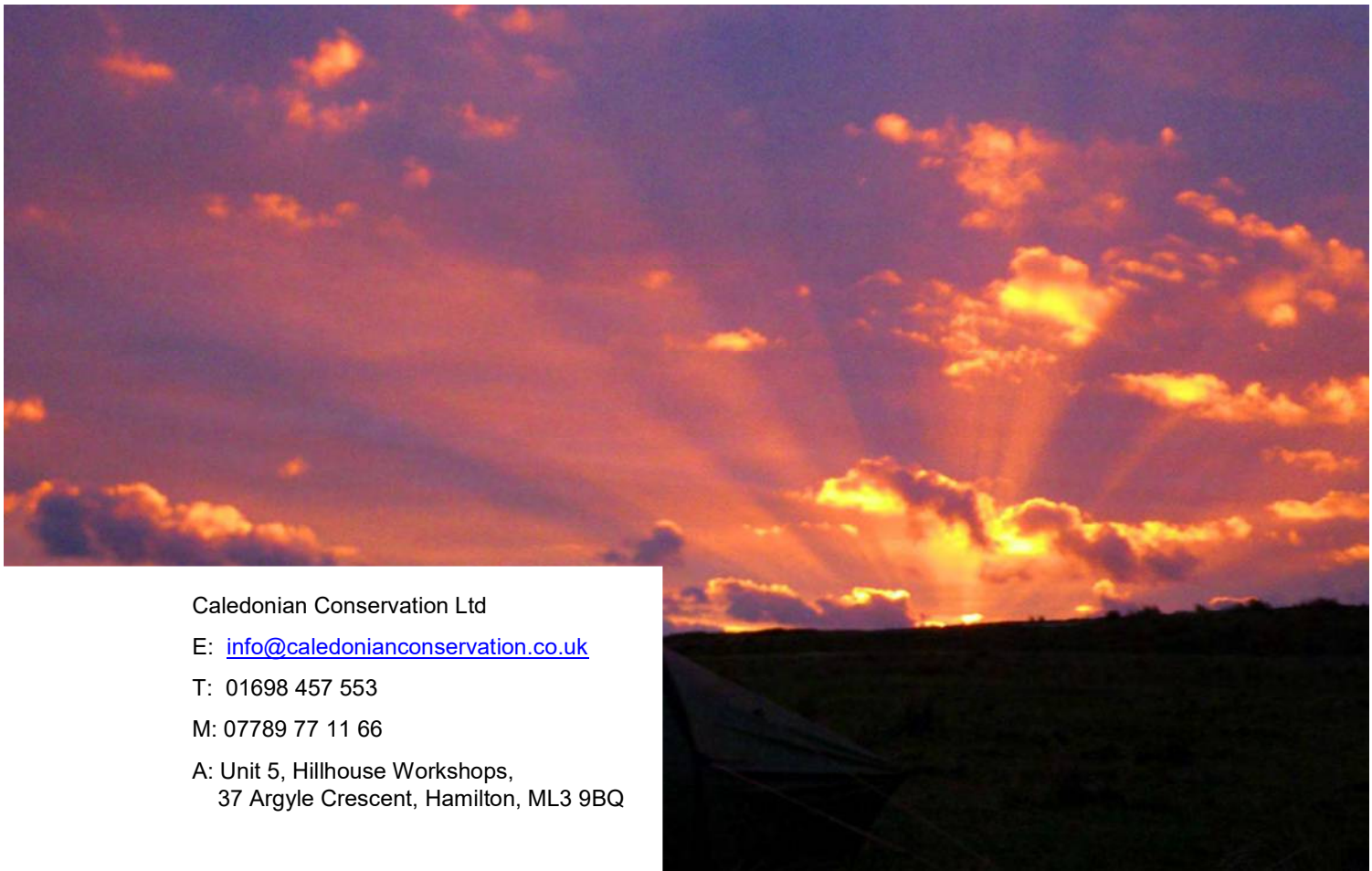

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Summary

Caledonian Conservation Ltd was commissioned by RES UK & Ireland Ltd (RES) to complete baseline ornithology surveys at Hill of Forss Wind Farm in Caithness.

The proposed Hill of Forss Wind Farm site is located approximately 6km west of Thurso and is currently used for rough grazing.

A consultation document was issued to Scottish Natural Heritage (SNH) and novel baseline ornithology surveys were agreed and undertaken, these included flight activity surveys, winter bird surveys, foraging goose surveys, breeding raptor and owl surveys and breeding bird surveys.

No 'showstopper' Valued Ecological Receptors (VERs) were identified during baseline surveys that would present a major obstacle to development at this site. However, it is advised that consultation is undertaken with SNH and RSPB in order to agree appropriate mitigation and / or compensation for potential impacts.

Wildfowl represent the major sensitivity of Hill of Forss, Greenland white-fronted and greylag geese as well as whooper swan are associated with the nearby Caithness Lochs SPA and forage in farmland around the site. Greenland white-fronted geese are listed on Annex I of the EU Birds Directive and are Red Listed on the Birds of Conservation Concern List (BoCC), whooper swan are listed on Annex I and are Amber Listed. Both greylag and pink-footed goose forage in the area in large numbers, although they are not associated with Caithness Lochs SPA, both species are listed on Annex II of the EU Birds Directive and are Amber Listed.

Based on the observations to date it is considered unlikely that the project would be found to have a significant effect on wildfowl species or the integrity of any SPAs with which they may be considered to be associated.

All species of wildfowl foraged in lowland fields and none were recorded onsite during foraging goose surveys. Small numbers of greylag and pink-footed geese were recorded foraging in fields within 500m of the Proposed Development Site, north of the A836, however the vast majority foraged outside of this.

Greylag and pink-footed geese commute along the valleys surrounding the site and comparatively few flights passed over the site. Collision risk modelling predicted mortality through collision with turbines for each species. Greylag collisions were estimated as one collision every 4.68 years during the autumn migration, one collision every 12.4 years during winter and one collision every 10.74 years during the spring migration. Pink-footed goose mortality through collision with turbines was estimated at one collision every 3.16 years during the spring migration.

No Greenland white-fronted goose flights were recorded during flight activity surveys and few whooper swan flights were recorded. Predicted mortality through collision with turbines for both these species is considered to be negligible.

No peregrine flights were recorded, the Proposed Development Site and immediate area offer only limited breeding habitat for this species. Peregrine associated with the nearby North Caithness Cliffs SPA are likely to predate the seabirds around the cliffs and it is unlikely that peregrine will move away inland to forage. It is considered extremely unlikely that the project would be found to have a significant effect on peregrine or the integrity of the Caithness Cliffs SPA. Peregrine are listed on Schedule 1.

Hen harrier were recorded during flight activity surveys although only one flight was at Potential Collision Height (PCH). Collision risk modelling estimated a negligible

risk of collision with turbines. Furthermore the site itself and surrounding area offers only limited breeding habitat for this species. Hen harrier are listed on Schedule 1.

No barn owl flights were recorded during flight activity surveys although barn owl were noted on the lower, northern part of the site by an observer camping onsite. Potential nesting sites were identified during preliminary surveys on and within 1km of the Proposed Development Site. However no evidence of occupancy by barn owl was noted during surveys, the high numbers of jackdaw in the area make potential nesting sites unsuitable. The risk of collision with turbines is considered to be negligible. Barn owl are listed on Schedule 1.

Kestrel, sparrowhawk and buzzard have all been recorded during surveys, these species are not protected under Schedule 1, although kestrel have suffered a decline in Scotland and are Amber Listed.

Several wader species were recorded within the Proposed Development Site and buffer area during surveys. Curlew, lapwing, oystercatcher, redshank and snipe were found to occupy breeding territories onsite and within the buffer area during breeding bird surveys. These species were also recorded during flight activity surveys as were golden plover, ringed plover and dunlin. Golden plover, redshank and snipe were also recorded within the buffer area during winter bird surveys. Lapwing and dunlin are Red Listed and the other wader species Amber Listed.

Curlew flights were recorded during flight activity surveys in and outwith the breeding season, Collision risk modelling estimated a risk of collision during the breeding season of one collision every 5.9 years. Breeding territories were located onsite and within the 500m survey buffer during breeding bird surveys. However the construction of the proposed wind farm may displace curlew from territories onsite and reduce the potential risk to breeding birds of collision with turbines.

Lapwing flights were recorded during flight activity surveys, both during and outside of the breeding seasons. Collision Risk Modelling estimated a risk of collision during the breeding season of one every 3.73 years, outside of the breeding season the estimated risk falls to one collision every 4.92 years. Breeding bird surveys located breeding territories onsite and offsite within the 500m survey buffer. However the construction of the proposed wind farm will displace lapwing from territories onsite and reduce the potential risk to breeding birds of collision with turbines.

Only six flights of oystercatcher were recorded during flight activity surveys. The risk of collision with turbines is considered to be negligible.

Only ten flights of redshank were recorded during flight activity surveys, seven at PCH. Collision risk modelling estimated a negligible risk of collision with turbines.

Snipe were recorded during flight activity surveys in and outwith the breeding season. Collision risk modelling estimated a risk during the breeding season of one collision every 17.69 years. Outside of the breeding season the estimated risk is estimated to be negligible.

Only seven flights of dunlin were recorded during flight activity surveys, all of which fell outside of the breeding season. Collision risk modelling estimated a negligible risk of collision with turbines.

Golden plover were recorded throughout flight activity surveys, the greater numbers of flights were observed during the winter months when large flocks gather in lowland, coastal fields and during the spring as golden plover move inland to establish breeding territories. Collision risk modelling estimated a negligible risk of collision with turbines during the breeding season, this rises to one collision every 17.05 years during the non-breeding season and to one collision every 12.85 years during the spring migration.

Ringed plover were recorded during flight activity surveys, ringed plover breed at the coast and all flights but one were recorded outside of the breeding season. Collision risk modelling estimated a negligible risk of collision with turbines during the breeding season, the risk rises to one collision every 24.32 years outside of this.

Five flights of Arctic skua (Red Listed) and five flights of great skua (Amber Listed) were recorded during flight activity although the estimated risk of collision with turbines is estimated to be negligible.

North Caithness Cliffs SPA supports nationally important populations of northern fulmar, black-legged kittiwake, razorbill, common guillemot and Atlantic puffin (all Amber Listed). These species have all been recorded nesting on sea cliffs between Scrabster Loch and Forss Wind Farm, no flights of these species were recorded during flight activity surveys and based on knowledge of their ecology it is unlikely that they would regularly fly inland.

Two cormorant (Amber Listed) flights were recorded during flight activity surveys, both flights were of individual birds commuting east to west over the low lying fields north of the Proposed Development Site. It is unlikely that cormorants would overfly the site and the risk of collision with turbines is considered to be negligible.

Four species of gull (all Amber Listed) were recorded within the Proposed Development Site during flight activity surveys, including common gull, great black-backed gull, lesser black-backed gull and herring gull. However, only small numbers of gulls used the site, typically numbers of less than ten, the vast majority of gulls in the area forage and commute over the low-lying fields north of the Proposed Development Site.

41 passerine species were recorded during the winter bird and breeding bird surveys. Schedule 1 and Red Listed fieldfare and redwing were recorded within the Proposed Development Site and buffer area during the winter bird surveys.

Large numbers of meadow pipit (Amber Listed) and skylark (Red Listed) territories were recorded during breeding bird surveys, many territories will remain after development and meadow pipits will continue to provide hosts to cuckoo (Red Listed), also recorded during breeding bird surveys.

Based on the results of the baseline surveys undertaken the following recommendations have been made.

Data requests for information should be made with Royal Society for the Protection of Birds (RSPB), Highland Raptor Study Group (HRSG), British Trust for Ornithology (BTO), Highland Biological Recording Group (HBRG) and Caithness Biodiversity Group.

Moving the easternmost turbine 100m to the west would significantly reduce the potential collision risk to wildfowl.

Installing barn owl nestboxes on suitable structures onsite would benefit barn owl and enhance local biodiversity.

Finally we recommend that an Ecological Impact Assessment (EcIA) is undertaken. This will allow a robust assessment following an updated approach consistent with current guidance. This will include the results of collision risk modelling for sensitive species as required.

1 Introduction

Caledonian Conservation Ltd was commissioned by RES UK & Ireland Ltd (RES) to complete baseline ornithology surveys at Hill of Forss Wind Farm in Caithness.

Novel baseline ornithology surveys were undertaken, which included flight activity surveys, winter bird surveys, foraging goose surveys, breeding raptor and owl surveys and breeding bird surveys.

This report presents the results of this work.

Ornithology survey work was completed by Chris Cathrine (Director), Eamonn Flood (Senior Ecologist), Glenn Norris (Ecologist), Steven Johnston (Ecologist), Tom Edwards (Associate Ornithologist), Gus Keys (Associate Ornithologist) and Rebecca Johnson (Associate Ornithologist).

This report was prepared by Chris Cathrine, Eamonn Flood, Glenn Norris and Steven Johnston. Mapping was undertaken using ArcGIS 10, and completed by Chris Cathrine, Glenn Norris and Steven Johnston.

2 The Proposed Development

The proposed Hill of Forss Wind Farm site is located approximately 6km west of Thurso. The site is currently used for rough grazing. The site location and boundary are shown in Figures 1 and 2.

The proposed wind farm infrastructure will include:

- Wind turbines and turbine foundations;
- Access tracks;
- Control Building;
- Meteorological Mast; and
- Grid Connection (transformers, cables and substation).

3 Methodology

Ecology and ornithology surveys were undertaken between September 2012 and August 2014. These surveys can be used to inform a full Ecological Impact Assessment (EcIA) which will support a full Planning Application.

Survey methods are fully detailed below.

3.1 Consultation

A detailed consultation document was issued to SNH, who were invited to comment on methodology and the proposed approach should the site be progressed.

3.2 Baseline Ornithology Surveys

Our approach to ornithology surveys is designed with reference to current SNH guidance. It should be noted that as surveys commenced in September 2012, the first year of surveys followed the 2010 SNH guidance, whereas ongoing surveys from September 2013 onwards follow 2013 SNH guidance.

All methodology was agreed by with SNH.

Baseline ornithology surveys included the following:

- Flight Activity Survey (36 hours observations during each of the autumn migration, winter, spring migration and breeding seasons) (2012/2013 and 2013/2014);
- Winter Bird Survey (to include 500m buffer) (2012/2013 season only);
- Foraging Goose Survey (within 3km of proposed Development Area) (2013/2014 season only);
- Breeding Raptor, Seabird and Owl Survey (Schedule 1 species within 2km of proposed Development Area, with the exception of barn owl) (2013 and 2014);
- Breeding Barn Owl Survey (within 1km of proposed Development Area) (2013 and 2014); and
- Breeding Bird Survey (modified Brown and Shepherd methodology, to include Development Area and 500m buffer) (three visit survey was completed in 2013 and four visit survey was completed in 2014).

These are described in greater detail in the following sections.

3.2.1 Flight activity survey

The survey methodology has been designed with reference to SNH guidance (SNH 2010a; SNH 2013a). Flight activity surveys were conducted from September 2012 until August 2014.

Based upon the site locations and local knowledge, it was considered that migratory wildfowl; raptors and breeding lowland waders constituted the primary target species. Therefore, surveys were designed to cover the Vantage Point (VP) in each of the following seasons annually over two years of survey effort (Table 1).

Table 1. Vantage Point Survey Effort 2012 - 2014

	Year	
Season	**2012/13**	**2013/14**
Autumn migration season (September to November)	36	36
Winter migration season (December to February)	12*	36
Spring migration season (March to mid-May)	4*	42
Wader breeding season (March to July);	36	72
Raptor breeding season (mid-March to August)	40	72
Raptor non-breeding season (September to mid-March)	48	78
Wader non-breeding season (September to February)	48	72

**Not used for collision risk modelling.*

Target species include diver species, all grebe species, all swan species, all wild geese (excluding feral Canada and greylag geese), all ducks (except mallard), all herons, all raptors and owls listed on Annex I of the Birds Directive or Schedule 1 of the Wildlife and Countryside Act, all terns and all waders. The flight lines of target species were recorded on large scale maps. Following the recommended methodology, the altitude of the birds were recorded at 15 second intervals. So as to cover indicative turbine models under consideration (within nearest 5m), birds have been recorded in three height bands to accommodate potential turbine models: <20m (below rotor height), 20-125m (rotor height – potential collision height [PCH]) and >125m (above rotor height). These data can be used to inform an impact assessment, including collision risk modelling (CRM) (Band *et al*. 2007; SNH 2000).

Secondary species included all other raptors, gulls, mallard and raven. All secondary species were recorded using 5-minute summaries. Each watch is sub-divided into 5 minute periods. At the end of each 5-minute period, the number and activity of all secondary species observed is recorded. Observation of target species takes priority over the recording of secondary species. The number of birds recorded in a 5-minute period represents the minimum number of individuals that could account for the activity observed. Any discrete and regularly used flight paths or movements of gulls across the site was also recorded. This information was recorded with the five minute summary records, with significant flight paths noted on large scale maps.

A single VP location was selected to provide good coverage of the Proposed Development Site and surrounding area. A theoretical viewshed of the visible area is shown in Figure 3. Viewsheds were calculated assuming the surveyor is sitting at the location (placing head height at approximately 1m above ground), and show the area visible at 20m above ground level – which is the lowest approximate elevation of the blade swept area for the turbine model – and at 0m (ground level). The VPs were selected by identifying the pixel of the Digital Terrain Model (DTM) that had the greatest visibility of the site. This was carried out by creating a grid of 20m tall 'turbines' to populate the site and carrying out a viewshed analysis from their locations. The best location for a VP would be where all 'turbines' could be seen within a 2km 180º viewarc.

Full details of survey visits are provided in Appendix 1, including weather conditions and observers on each date. Recorded flights are provided in Appendix 2.

3.2.2 Foraging goose survey

As geese were observed to use the wider area during flight activity surveys undertaken in 2012/2013, but were not found to be present on or within 500m of the Proposed Development Site during the winter bird survey of 2012/13, a survey of foraging geese was undertaken over a wider area during the winter of 2013/14 to establish the number of geese foraging in the surrounding areas. The survey methodology has been designed with reference to SNH guidance, and involved driving the wider area and selecting vantage points to observe fields within at least 3km of the Proposed Development Site (SNH 2013a). The survey area exceeded guidelines, covering all potential foraging areas within at least 3km of the Proposed Development Site (although a wider area of up to 5km was covered during fieldwork). Foraging goose surveys were undertaken every two weeks between September 2013 and mid-May 2014. As goose flight patterns remained similar between 2012/13 and 2013/14 despite different weather, it is considered that a single year of foraging goose surveys provides a representative baseline dataset and a repeat survey was therefore not required.

3.2.3 Breeding raptor, seabird and owl survey

Walkovers and short VP watches of all suitable areas within 2km for breeding raptor and owl species were carried out between April and June of 2013 and 2014 to establish whether any protected raptors and owls breed within or close to the site, following methodologies detailed in Hardey *et al*. (2009). The survey also recorded any breeding seabirds in this area in accordance with SNH guidance (SNH 2013a). Target species are Annex I (EU Birds Directive) and Schedule 1 (Wildlife and Countryside Act) listed species, although observations of buzzards, kestrels and sparrowhawks were also noted. Potential barn owl nest sites were identified within 1km of the Proposed Development Site during visits undertaken in winter 2013/14. Potential nest sites were then visited in the breeding seasons. These visits were undertaken in June and July to search for evidence of occupancy. This survey is based upon the methodology recommended in Hardey *et al*. (2009) and by the Barn Owl Trust (2001 and 2012).

All signs and observations were recorded on large scale maps, using standard BTO notation.

3.2.4 Breeding bird survey

Two years of breeding bird survey data were collected within the site and 500m buffer area, following the modified Brown and Shepherd methodology recommended by SNH guidance and based upon the methods detailed in Gilbert *et al.* (1998). This methodology is used to census upland breeding birds, which may use more open habitats surrounding the sites. Three survey visits were made between April and July 2013, following then current guidance (SNH 2010a). However, the survey was repeated in 2014 following new guidance (SNH 2013a). This involved four survey visits between April and July 2014, in line with SNH guidance (2013a) and Calladine *et al.* (2009). In both cases, each 500mx500m quadrat of open land is surveyed for

20-25 minutes. Details of bird behaviour are noted using standard BTO Common Bird Census (CBC) notation (see Gilbert *et al.* 1998), with the exception of meadow pipit which will be tallied per quadrat.

The 2014 survey focussed on breeding waders, in accordance with SNH guidance (SNH 2013a). However, all species seen or heard were recorded accurately onto 1:10,000 scale maps, using BTO CBC codes. This allows distinction between different species and between behaviours – particularly between behaviours indicative of breeding and those not related to breeding.

The purpose of the breeding bird survey is to map the territories of breeding birds and breeding bird density in order to allow an assessment of potential displacement impacts, particularly for waders.

3.2.5 Winter bird survey

The site and a 500m buffer has been surveyed following the same methods as the breeding bird survey described below, to assess the use of these areas by wintering birds. All areas were approached within 200m. Three visits were made between September 2012 and February 2013, as recommended in SNH guidance (SNH 2010a). The site was not found to be important for wintering birds, and wildfowl were not found to use the site or 500m buffer. Therefore, the single year of winter bird survey data is considered adequate to inform a robust impact assessment, and it was not considered necessary to repeat this survey for a second year. However, foraging goose surveys were completed in the wider area during winter 2013/14.

All species seen or heard were recorded accurately onto 1:10,000 scale maps, using BTO CBC codes. This allows distinction between different species and between behaviours.

Three visits were completed in the winter of 2012/2013, as recommended in the then current SNH guidance (SNH 2010a).

Full details for each survey visit (including weather conditions and observers) are included in Appendix 1.

3.2.6 Collision Risk Modelling

Data collected during flight activity surveys has been used undertake collision risk modelling using current guidelines for an indicative turbine layout, and candidate turbine model (Band *et al*. 2007; SNH 2000). The results of this are indicative only, and the results of collision risk modelling will vary depending on the final turbine layout and model used for the planning application. Furthermore, the model inputs require a degree of interpretation based on the ecology of species recorded. It is therefore strongly recommended that agreement on the methodology is sought from SNH. If SNH disagree with any of the assumptions made, it may be necessary to re-run elements of the models. A number of greylag goose flights were discounted from the model, as they followed a commuting route to the east of the site and did not enter the proposed turbine area. As these flights were in close proximity to the VP location, we are confident that the location of the commuting route is accurate. However, it is possible that SNH may insist upon including these within the modelling process, in which case modelling will need to be repeated for greylag geese, and risk of collision will increase. In order to increase confidence that greylag geese using

this commuting route at the east of the site are not at risk of collision, it is recommended that the easternmost turbine is relocated at least 100m to the west of the current location, ensuring a buffer around this flight corridor.

Full details of collision risk modelling, including the indicative layout, can be found in Appendix 3.

3.3 Survey Limitations

All methodology was agreed with SNH and no significant survey limitations were encountered.

However, it was not possible to conduct flight activity surveys during the spring migration season of 2013 although surveys were carried out during the spring migration season of 2014. Comparative observations of goose flights during the autumn and winter of the two survey years 2012/13 and 2013/14 show that the flight patterns of geese remained consistent despite the weather conditions of the two survey years being markedly different i.e. cold in 2012/13 and mild and very windy 2013/14. Therefore it is considered that the proposed flight activity surveys, carried out over the spring of 2014, were adequate.

4 Baseline Results

The preliminary baseline results are discussed in detail below. Each potential Valued Ecological Receptor (VER) is discussed in turn using the recommended survey buffer distances to allow these results to more easily inform a full Ecological Impact Assessment (EcIA) for inclusion in an Environmental Statement (ES) to accompany a full Planning Application. A structured and robust assessment of potential effects has not been undertaken as part of this report.

Survey results of flight activity surveys, breeding and winter bird surveys are located in Appendices 2, 4 and 5 respectively.

The results of consultation and designated sites desk study are provided below. Potential ornithological VERs are then discussed in turn. Their Conservation Status is indicated if the species is listed on Annex I of the Birds Directive, Schedule 1 of the Wildlife and Countryside Act (as amended) or if they are Amber or Red Listed in Birds of Conservation Concern 2009 (BoCC) (Eaton *et al.* 2009).

4.1 Consultation

Full details of SNH's response to the consultation document and further correspondence are contained in Appendix 6.

Particular comments of note are summarised below:

- Given that the guidance on ornithology survey methodology was updated in 2013, midway through baseline surveys SNH were in agreement with the approach to baseline surveys;
- As goose flight patterns remained similar between 2012/13 and 2013/14 despite different weather, SNH agreed that a single year of foraging goose surveys would provide a representative baseline dataset and a repeat survey was not required; and
- As the North Caithness Cliffs Special Protection Area (SPA) is located 1.5km north of the Proposed Development Site the potential effects on the integrity of the SPA should be included in surveys with particular emphasis on peregrine as the site could be within the core foraging range of this species.

4.2 Designated Sites

Consultation and a search of available digital datasets indicates that there are no statutory designations of European importance (e.g. SPA), national importance (e.g. Sites of Special Scientific Interest [SSSI]) or non-statutory local importance (e.g. Local Nature Reserves) within the application site boundary. Table 2 provides details of statutory designations of European importance within 20km and national importance within 5km. Full citations for statutory designated sites can be requested from Caledonian Conservation Ltd or can be obtained at http://www.snh.org.uk/snhi/.

Table 2. Designated Sites

Designation	Site name	Distance (km)	Comments
Special Protection Area (SPA)	North Caithness Cliffs	1.5km N	Supports peregrine falcon populations of European importance. Supports nationally important populations of Northern fulmar, black-legged kittiwake, razorbill, common guillemot and Atlantic puffin. Although peregrine were not observed to overfly the site, it is possible they may do so occasionally. However, risk of collision would be negligible based on the results of the flight activity survey. Although it is not impossible that the other species will overfly the site, based on knowledge of their ecology it is unlikely that they would regularly fly inland.
SPA	Caithness Lochs	5.7km S	Supports an internationally important proportion of the population of wintering Greenland white-fronted geese, greylag geese and whooper swans. Of these species, only greylag geese were found to overfly the Proposed Development Site at potential collision risk height. Whooper swans did not overfly the proposed turbine area at potential collision height, they did fly within 1km of the site at this elevation. There is therefore a risk of collision with turbines (see sections below).

Designation	Site name	Distance (km)	Comments
SPA	Caithness and Sutherland Peatlands	9.3km S	Supports an internationally important population of dunlin. Supports a wide range of nationally important populations including: - Red-throated diver - Black-throated diver - Hen harrier - Golden eagle - Merlin - Golden plover - Wood sandpiper - Short-eared owl It is possible that birds of these species with large ranges or individuals associated with the SPA that nest outside it may overfly the Proposed Development Site boundary. If birds overfly the site, they would be at risk of collision with turbines.

4.3 Wildfowl

Large numbers of geese migrate through Caithness and Sutherland to overwinter in the UK and breed further north. It is possible that whooper swans, Greenland white-fronted geese and greylag geese associated with the nearby Caithness Lochs SPA may overfly the site and use farmland for foraging. Whooper swans, Greenland white-fronted and greylag geese are notified features of the Caithness Lochs SPA designation. Pink-footed geese also commonly pass through Caithness and Sutherland during the spring migration. Each of these species is considered separately in the following sections.

In addition, two single bean geese were noted during a foraging goose survey on one occasion although the observation was not repeated and is not considered further.

Based on the results of baseline ornithology surveys it is considered unlikely that the project would be found to have a significant effect on these species or the integrity of any SPAs which they may be considered to be associated with. However, a detailed cumulative impact assessment will be necessary to inform the planning application. The results of this will depend on the other developments that will need to be considered alongside Hill of Forss at the time of submission.

Flight details are presented in Tables A2.1 to A2.15 in Appendix 2.

4.3.1 Greenland white-fronted goose

No Greenland white-fronted geese were recorded within 500m of the Proposed Development Site during foraging goose surveys. The closest fields to the site being used by this species were those along the coast, approximately 1km north of the site. Most Greenland white-fronted geese used fields around the farm at Oust, more than 2km south of the site. Further groups foraged to the west around Bridge of Forss and the operational Forss 2 Wind Farm (Figure 4). This is largely consistent with the results of other studies, where goose activity was found to be concentrated in low lying fields, with peaks in certain areas whilst remaining widely distributed (Patterson *et al.* 2013; Francis *et al.* 2011). However, it should be noted that there is an observation of indeterminate abundance and frequency of use in the fields 250m to the west of the site (over 400m from the nearest indicative turbine location) (Francis *et al.* 2011). However, the habitat at this location is similar to Hill of Forss, being heath, and so unsuitable to support foraging geese. The area proposed for turbine development at time of writing is unsuitable for supporting foraging or roosting geese

There were no flights of Greenland white-fronted geese recorded during flight activity surveys, therefore any risk of collision with turbines is considered to be negligible.

4.3.2 Greylag goose

The majority of greylag geese recorded foraging were noted in low lying fields surrounding the Proposed Development Site. Flocks of foraging greylag geese were concentrated in fields around the farm at Oust and the minor road running west, fields around the Thurso Business Estate and fields along the coast north of the site. Fields to the west around Kennachy were also frequently used (Figure 4). The vast majority of foraging greylag geese recorded were outside the 500m buffer area. From a total of 214 flocks (30,140 birds) recorded during surveys only 10 flocks (989 birds) were recorded within the 500m buffer area. The area proposed for turbine development at time of writing is unsuitable for supporting foraging or roosting geese. These observations are largely consistent with the results of other studies, where goose activity was found to be concentrated in low lying fields, with peaks in certain areas whilst remaining widely distributed (Patterson *et al.* 2013). Hill of Forss was not found to be used as a foraging location.

The low lying fields along the north coast and the shallow valleys that surround the rest of the Hill of Forss provide commuting routes for greylag geese and other wildfowl species. The majority of greylag goose flights observed during flight activity surveys were along these natural corridors (Figures 5 and 6). Collision risk modelling estimated a risk of one collision every 4.68 years during the autumn migration, one collision every 10.74 years in spring migration and one collision every 12.4 years during winter (see Appendix 3). This is equivalent to a total estimated mortality of 0.38 birds per year.

However, a number of greylag goose flights were discounted from the collision risk model, as they followed a commuting route to the east of the site and did not enter the proposed turbine area. As these flights were in close proximity to the VP location, we are confident that the location of the commuting route is accurate. However, it is possible that SNH may insist upon including these within the modelling process, in which case modelling will need to be repeated for greylag geese, and risk of collision will increase. In order to increase confidence that greylag geese using this commuting route at the east of the site are not at risk of collision, it is

recommended that the easternmost turbine is relocated at least 100m to the west of the current location, ensuring a buffer around this flight corridor.

4.3.3 Whooper swan

Foraging flocks of whooper swans were mostly recorded in wet fields around Loch Lieurary, some 3km south of the site, and in fields south of Scrabster Loch. None were observed with the 500m buffer area, the closest observation being approximately 900m north of the Proposed Development Site, around Brims (Figure 4). The area proposed for turbine development at time of writing is unsuitable for supporting foraging or roosting swans. These observations are largely consistent with the results of other studies, where goose activity was found to be concentrated in low lying fields, with peaks in certain areas whilst remaining widely distributed (Patterson *et al.* 2013). Hill of Forss was not found to be used as a foraging location.

The low lying fields along the north coast and the shallow valleys that surround the rest of the Hill of Forss provide commuting routes for whooper swan and other wildfowl species. Only one flight of whooper swans passed over the site. This flight consisted of three swans, flying below collision risk height (so low that they had to raise flight height to pass over a fence), and alighting on the pond onsite (Figure 7). This pond is not suitable to support roosting swans, and birds were only observed to use this feature on this single occasion. The risk of collision with turbines is considered to be negligible.

4.3.4 Pink-footed goose

The distribution of foraging pink-footed geese recorded was similar to those of the other wildfowl species. Foraging was concentrated around the farm at Oust and the minor road running west toward Shebster, the Thurso Business Estate, fields along the north coast and fields west of Bridge of Forss. The vast majority of pink-footed geese foraged outside the buffer area, from a total of 62 flocks (10,952 birds) recorded foraging only 4 flocks (805 birds) were seen within the buffer area (Figure 4). Pink-footed geese were found to be mainly present in the area during the late winter months and spring. The area proposed for turbine development at time of writing is unsuitable for supporting foraging or roosting geese. These observations are largely consistent with the results of other studies, where goose activity was found to be concentrated in low lying fields, with peaks in certain areas whilst remaining widely distributed (Patterson *et al.* 2013). Hill of Forss was not found to be used as a foraging location.

The low lying fields along the north coast and the shallow valleys that surround the rest of Hill of Forss provide commuting routes for pink-footed geese and other wildfowl species, the majority of flights observed during flight activity surveys were along these natural corridors (Figure 8). Collision risk modelling predicted a risk of one collision every 3.16 years during the spring migration season (see Appendix 3). Pink-footed geese were not recorded to overfly the site during other seasons.

4.4 Raptors

4.4.1 Peregrine

No peregrine flights were recorded during flight activity surveys, while the site itself does not offer suitable breeding habitat for this species. The wider area also offers limited breeding habitat with the exception of the sea cliffs, including North Caithness Cliffs SPA. Peregrine have been recorded around the sea cliffs around St. Mary's Chapel, approximately 3km north-west of the Proposed Development Site, during breeding raptor surveys for the proposed Forss 3 Wind Farm, although they were not found to nest here. It is unlikely that peregrine active around these sea cliffs would forage far inland with a large source of prey in the form of seabird colonies close by. Any risk of collision with turbines is considered to be negligible. Based on the results of baseline ornithology surveys it is considered extremely unlikely that the project would be found to have a significant effect on peregrine or the integrity of the North Caithness Cliffs SPA with which they are associated.

Peregrine are listed on Schedule 1.

4.4.2 Hen harrier

19 hen harrier flights were observed during flight activity surveys, only one of which was recorded at PCH (Tables A2.16 to A2.18; Figure 9). With the exception of the flight at PCH, these represented individual foraging flights very close to the ground. The site and surrounding area offers only limited breeding habitat for this species and the predicted risk of collision with turbines is considered to be negligible (see Appendix 3).

Hen harrier are listed on Schedule 1 and are Red Listed.

4.4.3 Barn owl

No barn owl flights were recorded during flight activity surveys although barn owl were noted foraging low to the ground on the lower, northern part of the site by an observer camping onsite, and these flights were very infrequent. Potential nesting sites were identified during preliminary surveys within 1km of the Proposed Development Site and onsite in the derelict building named as Taldale (Figure 2). However no evidence of occupancy by barn owl was noted during surveys, and the high densities of jackdaws occupying potential nest sites make these unsuitable (Barn Owl trust 2012). Any risk of collision with turbines is considered to be negligible.

Barn owl are listed on Schedule 1 and are Amber Listed.

4.4.4 Short-eared owl

A short eared owl was observed west of the proposed Forss 3 Wind Farm during surveys for that project although none have been recorded within 2km of Hill of Forss. The site and surrounding area offers only limited breeding habitat for this species and any risk of collision with turbines is considered to be negligible.

Short-eared owl are listed on Annex I and are Amber Listed.

4.4.5 Kestrel, sparrowhawk and buzzard

Kestrel, sparrowhawk and buzzard have all been recorded during surveys. A buzzard nest was found 1.3km north-west of the site (over 2.5km from the nearest indicative turbine location). Buzzards were seen mostly foraging along the A836 or over agricultural fields around the site. An individual kestrel was observed over the lower fields at the north of the site. An individual sparrowhawk was observed west of site around Forss House. These species are not protected under Schedule 1, although kestrel has suffered a decline in Scotland and is Amber Listed.

4.5 Waders

Curlew, lapwing, oystercatcher, redshank and snipe were found to occupy breeding territories within the Proposed Development Site and within the buffer area during the breeding bird surveys (Figures 10 and 11). These species were also recorded during flight activity surveys as were golden plover, ringed plover and dunlin. Golden plover, redshank and snipe were also recorded within the buffer area during winter bird surveys. These species are discussed separately below.

Based on the results of baseline ornithology surveys it is considered unlikely that the project would be found to have a significant effect on these species or the integrity of any SPAs which they may be considered to be associated with. However, a detailed cumulative impact assessment will be necessary to inform the planning application. The results of this will depend on the other developments that will need to be considered alongside Hill of Forss at the time of submission.

Flight details are presented in Tables A2.19 to A2.44 in Appendix 2.

4.5.1 Curlew

One curlew territory was recorded onsite both in 2013 and 2014, located in the low wet grassland towards the north of the site. Two further territories were recorded within the buffer area in both years of survey, south-east and west of site (Figures 10 and 11).

Curlew flights were recorded during flight activity surveys some of which were recorded both during and outside of the breeding seasons (Figures 12 to 14). Collision risk modelling estimated a risk of collision during the breeding season of curlew every 5.9 years, and outside of the breeding season the estimated risk is negligible (see Appendix 3). However it is likely that the proposed wind farm will be predicted to displace curlew from territories onsite and reduce the potential risk to breeding birds of collision with turbines.

Curlew are Amber Listed.

4.5.2 Lapwing

Three breeding territories of lapwing were recorded in 2013 and two in 2014. In 2013, one territory was recorded within the Proposed Development Site, east of the

pond (Figure 10). Two further territories were recorded in the buffer area. In 2014, the two territories were found onsite, both close to the pond (Figure 11).

Lapwing flights were recorded during flight activity surveys, both during and outside of the breeding seasons (Figures 15 to 17). Collision risk modelling estimated a risk of collision during the breeding season of one lapwing every 3.73 years, and outside of the breeding season the estimated risk is one collision every 4.92 years (see Appendix 3). However it is likely the proposed wind farm will be predicted to displace lapwing from territories onsite and reduce the potential risk to breeding birds of collision with turbines.

Although there was a large amount of flight activity over the quarries at Hopefield, to the south of the site, Hill of Forss does not offer equivalent habitat and so these birds are not considered to be at risk of collision.

Lapwing are Red Listed.

4.5.3 Oystercatcher

A single breeding oystercatcher territory was recorded on 2013 east of the pond (Figure 10) and only six flights were recorded during flight activity surveys (Figures 18 to 20). The risk of collision with turbines is considered to be negligible, while it is likely that the territory will be predicted to be displaced by the wind farm.

Oystercatcher are Amber Listed.

4.5.4 Redshank

A single breeding redshank territory was recorded onsite in 2013 north of the pond (Figure 10). It is likely that the wind farm will be predicted to displace this territory. Redshank were also recorded within the buffer area during winter bird surveys, with a peak count of three (Table A5.1). Only ten flights were recorded during flight activity surveys, seven at PCH (Figures 21 to 23). Collision risk modelling estimated a negligible risk of collision with turbines (see Appendix 3).

Redshank are Amber Listed.

4.5.5 Snipe

A single snipe breeding territory was recorded onsite in 2013 (Figure 10). Two further territories were recorded in the buffer area and individual snipe were recorded within the buffer area during winter bird surveys (Table A5.1). It is likely that the wind farm will be predicted to displace the territories. Snipe were recorded during flight activity surveys in and out of the breeding season (Figures 24 to 26). Collision risk modelling estimated a risk during the breeding season of one snipe collision every 17.69 years. Outside of the breeding season the estimated risk is estimated to be negligible (see Appendix 3).

Snipe are Amber Listed.

4.5.6 Dunlin

No dunlin territories were recorded onsite and only seven flights recoded during flight activity surveys all of which fell outside of the breeding season (Figure 27). Collision risk modelling estimated a negligible risk of collision with turbines.

Dunlin are Red Listed.

4.5.7 Golden plover

No golden plover territories were recorded onsite during breeding wader surveys although golden plover were recorded within the buffer area during the winter bird surveys, with a peak count of eight (Table A5.1). Golden plover were recorded throughout flight activity surveys (Figures 28 to 30), with the greater number of flights being observed during the winter months when large flocks gather in lowland fields and during the spring as golden plover move inland to establish breeding territories. Birds recorded during the breeding and spring migration seasons may be associated with Caithness and Sutherland Peatlands SPA. Collision risk modelling estimated a negligible risk of collision with turbines during the breeding season, one collision every 17.05 years during the non-breeding season and one collision every 12.85 years during the spring migration (see Appendix 3).

Golden plover are Amber Listed.

4.5.8 Ringed plover

Ringed plover were recorded during flight activity surveys, ringed plover breed at the coast and all flights but one were recorded outside of the breeding season (Figures 31 and 32). Collision risk modelling estimated a negligible risk of collision with turbines during the breeding season, and the risk is estimated to be one collision every 24.32 years outside of this (see Appendix 3).

Ringed plover are Amber Listed.

4.6 Seabirds

4.6.1 Skuas

Arctic skua (Red Listed) were not found to breed onsite. Five flights of Arctic skua were observed during the flight activity surveys, four of which were at PCH. Three flights were recorded in summer of 2013 and 2014 at PCH, two of which were over the Proposed Development Site. Two flights were recorded over site on 15th November 2012, one of which was at PCH, and are almost certainly attributable to the same individual (Table A2.45; Figure 33). The breeding population of Arctic skuas migrates to the southern hemisphere in autumn, where they spend winter. Fewer than 10 individuals are thought to remain in Scotland through winter (Forrester *et al.* 2007). It is likely that those that do overwinter in Scotland were unable to migrate due to injury or illness.

The risk of collision with turbines is estimated to be negligible.

Great skua (Amber Listed) were not found to breed onsite. The flight activity surveys recorded five flights of great skua, three of which were at PCH. In 2013 two flights

were observed in May and July, both of which at PCH. In 2014 all three flights were recorded on the same day and are almost certainly attributable to the same individual (Table 2.46; Figure 34). All flights were over the site, although only one was at PCH and the estimated risk of collision with turbines is estimated to be negligible.

4.6.2 Seabirds associated with North Caithness Cliffs SPA

North Caithness cliffs SPA supports nationally important populations of northern fulmar, black-legged kittiwake, razorbill, common guillemot and Atlantic puffin (all Amber Listed). Although colonies including all of these specie were recorded on sea cliffs between Scrabster Loch and Forss Wind Farm, no flights of these species were recorded during flight activity surveys and based on knowledge of their ecology it is unlikely that they would regularly fly inland. Based on the results of baseline ornithology surveys it is considered extremely unlikely that the project would be found to have a significant effect on these species or the integrity of the North Caithness Cliffs SPA with which they may be considered to be associated.

4.6.3 Cormorant

Two cormorant flights were recorded during flight activity surveys (Table A2.47; Figure 35), both flights were of individual birds commuting east to west over the low lying fields north of the Proposed Development Site. It is unlikely that cormorants would overfly the site and the risk of collision with turbines is considered to be negligible.

4.6.4 Gulls

Four species of gull were recorded within the Proposed Development Site during flight activity surveys, including common gull, great black-backed gull, lesser black-backed gull and herring gull. However, only small numbers of gulls used the site, and typically numbers of less than ten would move over the low-level fields at the north of the site. More infrequently individual birds would move southward across the more elevated north of the site where turbines would be located. Far larger numbers of gulls used the agricultural fields north of the A836 and gulls commuting southward flew along the shallow valley of the Forss Water, west of the site.

Herring gull is Red Listed, while common gull, great black-backed gull and lesser black-backed gull are Amber Listed. Fulmar (Amber Listed) nest in sea cliffs to the north of the site and are discussed in Section 4.6.2.

4.7 Passerine Assemblage

Species of particular note are discussed below, while breeding bird survey results are provided in greater detail in Appendix 4 and winter bird surveys in Appendix 5.

The breeding bird survey of 2013 recorded 28 species of passerine, nine of which are Red Listed and six are Amber Listed.

68 skylark territories were recorded in this year as well as an estimated 219 meadow pipit territories. In the 2014 breeding bird survey 30 species were recorded, eight of

which are Red Listed and five are Amber Listed In this year 53 skylark and as estimated 158 meadow pipit territories were recorded. These are very high densities, and likely to be a precautionary overestimate.

Linnet, song thrush and yellowhammer (all Red Listed) are likely to be restricted to the gorse along the fringes of the site and house sparrow (Red Listed) are restricted to the areas around the farm buildings at the north of the site and along the A836. Corn bunting (Red Listed) are associated with low lying mixed and arable fields and are unlikely to move over the site. Starlings (Red Listed) recorded onsite have been mainly restricted to the lower northern part of the site around the farm buildings. Small flocks of redpoll (Red Listed) and twite have been recorded moving over the site during breeding bird surveys and are likely to use the areas of gorse at the fringes of the site (Forrester et al. 2007).

Cuckoo (Red Listed) were recorded onsite and are a brood parasite known to use meadow pipits and skylarks as favourite host species, both of which occupy the site in large numbers. As maximum estimate of 219 breeding meadow pipit territories were recorded onsite and within the buffer area (see Tables A4.1 and A4.2), meadow pipit host numbers will remain abundant even with some territories being lost to development. Therefore host birds will still be available to cuckoo after development.

21 species of passerines were recorded during the three visit winter bird survey in 2012/13. Two species recorded are listed on Schedule 1, seven are Red Listed and two are Amber Listed. A total of 97 fieldfare and eight redwing were seen onsite during the winter bird surveys. The birds were flying over the site but may stop to forage. Fieldfare and redwing are both listed on Schedule 1 and the Red List. Meadow pipits were only recorded on visits one and two, with a maximum of 23 seen in a single visit. Meadow pipits are Amber Listed. Twite (Red Listed) were also recorded flying over the site on two occasions in flocks of eight and nine.

5 Recommendations

The following recommendations are based on the findings of the ornithology surveys contained in this report.

5.1 Desk-based Study

Historic data is an essential component of any assessment as it informs and provides context for the novel baseline surveys undertaken at the site. Data requests for information should be made with Royal Society for the Protection of Birds (RSPB), Highland Raptor Study Group (HRSG), British Trust for Ornithology (BTO), Wildfowl and Wetlands Trust (WWT), Highland Biological Recording Group (HBRG) and Caithness Biodiversity Group.

5.2 Turbine Location

A number of greylag goose flights were discounted from the model, as they followed a commuting route to the east of the site and did not enter the proposed turbine area. As these flights were in close proximity to the VP location, we are confident that the location of the commuting route is accurate. However, it is possible that SNH may insist upon including these within the modelling process, in which case modelling will need to be repeated for greylag geese, and risk of collision will increase. In order to increase confidence that greylag geese using this commuting route at the east of the site are not at risk of collision, it is recommended that the easternmost turbine (turbine 3) is relocated at least 100m to the west of the current location, ensuring a buffer around this flight corridor (Figure 38).

5.3 Barn Owl Boxes

Although barn owls are present in the area, nest opportunities appear to be limited by competition with jackdaw colonies. Installing barn owl nestboxes may benefit barn owls and enhance local biodiversity. Two nestboxes should be installed. Install boxes within a building if possible. If this is not possible an external box may suffice, which may be positioned on the control building or sub-station. Install with the hole clearly visible to birds, if inside a building with the hole facing the most likely entrance, on a dry and reasonably warm day, as this will minimise the chances of flushing a barn owl. The winter months are preferable for installation (Barn Owl Trust 2012). Particular care should be taken to minimise problems associated with corvids such as jackdaw colonies by ensuring they are not sited where there are colonial nesting opportunities and, if within buildings, small entrance holes are wired shut to allow only one main access point. Pole mounted nest boxes may be used as a last resort.

5.4 Ecological Impact Assessment (EcIA)

We recommend that an Ecological Impact Assessment (EcIA) is undertaken. This will allow a robust assessment following an updated approach consistent with current

guidance and formats now preferred by SNH and other stakeholders. This would include collision risk modelling for sensitive species as required, using the Band model (Band *et al*. 2007; SNH 2000). The EcIA should be completed in accordance with best practice guidelines (Institute of Ecology and Environmental Management [IEEM] 2006; Regini 2000; Scottish Natural Heritage [SNH] 2006; SNH 2009). It will also involve the development of an HMMP, which should aim to enhance biodiversity.

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APPENDIX 1: Survey Details

This Appendix provides full details of bird survey visits, including dates, times, surveyors and weather conditions. Visit details are provided in the following tables:

- Flight activity survey visit details – Table A1.1;
- Foraging goose survey visit details – A1.2
- Winter bird survey visit details – Table A1.3;
- Breeding raptor and owl survey visit details 2013 – Table A1.4;
- Breeding raptor and owl visit details 2014 – Table A1.5;
- Breeding bird survey visit details 2013 – Table A1.6; and
- Breeding bird survey visit details 2014 – Table A1.7.

Table A1.1. Hill of Forss Flight Activity Survey visit details.

VP	Date	Start Time	End Time	Hour	Visibility	Wind speed	Wind direction	Precipitation	Cloud cover	Cloud height	Frost	Snow	Observer
1	28/09/12	16:55	19:55	1	2	6	SW	3	5	1	0	0	SJ
1	28/09/12	16:55	19:55	2	2	6	W	0	4	1	0	0	SJ
1	28/09/12	16:55	19:55	3	2	6	W	0	3	1	0	0	SJ
1	29/09/12	10:27	13:27	1	2	7	W	0	3	0	0	0	SJ
1	29/09/12	10:27	13:27	2	2	8	NW	2	1	0	0	0	SJ
1	29/09/12	10:27	13:27	3	2	7	W	2	7	0	0	0	SJ
1	29/09/12	15:10	18:10	1	2	7	W	2	7	0	0	0	SJ
1	29/09/12	15:10	18:10	2	2	6	W	0	6	0	0	0	SJ
1	29/09/12	15:10	18:10	3	2	6	W	3	6	0	0	0	SJ
1	30/09/12	06:20	09:20	1	2	3	SW	0	1	2	0	0	SJ
1	30/09/12	06:20	09:20	2	2	2	W	0	0		0	0	SJ
1	30/09/12	06:20	09:20	3	2	2	W	0	0		0	0	SJ
1	15/10/12	16:09	19:09	1	2	3	NE	3	7	2	0	0	CC
1	15/10/12	16:09	19:09	2	2	1	ENE	0	3	2	0	0	CC
1	15/10/12	16:09	19:09	3	2	1	ENE	0	4	2	0	0	CC
1	16/10/12	06:53	09:53	1	2	0		0	8	2	0	0	CC

VP	Date	Start Time	End Time	Hour	Visibility	Wind speed	Wind direction	Precipitation	Cloud cover	Cloud height	Frost	Snow	Observer
1	16/10/12	06:53	09:53	2	2	2	SW	2	6	2	0	0	CC
1	16/10/12	06:53	09:53	3	2	1	SW	0	3	2	0	0	CC
1	16/10/12	10:53	13:53	1	2	0		0	7	2	0	0	CC
1	16/10/12	10:53	13:53	2	2	1	WSW	3	8	2	0	0	CC
1	16/10/12	10:53	13:53	3	2	1	WSW	0	6	2	0	0	CC
1	16/10/12	16:06	19:06	1	2	0		0	5	2	0	0	CC
1	16/10/12	16:06	19:06	2	2	0		0	5	2	0	0	CC
1	16/10/12	16:06	19:06	3	2	0		0	6	2	0	0	CC
1	14/11/12	13:58	16:58	1	2	3	WNW	3	6	2	0	0	CC
1	14/11/12	13:58	16:58	2	2	4	NW	0	5	2	0	0	CC
1	14/11/12	13:58	16:58	3	2	4	NW	0	3	2	0	0	CC
1	15/11/12	07:02	10:02	1	2	4	WSW	0	0		0	0	CC
1	15/11/12	07:02	10:02	2	2	5	WSW	0	0		0	0	CC
1	15/11/12	07:02	10:02	3	2	4	WSW	0	0		0	0	CC
1	15/11/12	11:02	14:02	1	2	6	SW	0	1	2	0	0	CC
1	15/11/12	11:02	14:02	2	2	5	SW	0	1	2	0	0	CC
1	15/11/12	11:02	14:02	3	2	4	WSW	0	2	2	0	0	CC
1	16/11/12	07:04	10:04	1	2	4	SW	0	5	2	0	0	CC
1	16/11/12	07:04	10:04	2	2	4	SW	0	6	2	0	0	CC
1	16/11/12	07:04	10:04	3	2	3	SW	0	5	2	0	0	CC
1	10/12/12	13:23	15:23	1	2	4	NNE	0	6	2	0	0	EF
1	10/12/12	13:23	15:23	2	2	3	NNE	0	8	2	0	0	EF
1	10/12/12	16:55	19:55	1	2	6	SW	3	5	1	0	0	EF
1	10/12/12	16:55	19:55	2	2	6	W	0	4	1	0	0	EF
1	10/12/12	16:55	19:55	3	2	6	W	0	3	1	0	0	EF
1	12/12/12	07:52	09:52	1	1	3	NE	0	6	2	1	1	EF
1	12/12/12	07:52	09:52	2	2	2	NE	0	4	2	0	0	EF
1	24/01/13	08:55	10:55	1	2	3	S	0	8	2	0	1	SJ
1	24/01/13	08:55	10:55	2	2	2	S	0	7	2	0	1	SJ

VP	Date	Start Time	End Time	Hour	Visibility	Wind speed	Wind direction	Precipitation	Cloud cover	Cloud height	Frost	Snow	Observer
1	24/01/13	11:25	13:25	1	2	3	S	0	8	2	0	1	SJ
1	24/01/13	11:25	13:25	2	2	4	S	0	8	2	0	1	SJ
1	12/02/13	11:45	13:45	1	2	3	SE	0	8	2	0	0	SJ
1	12/02/13	11:45	13:45	2	2	4	SE	0	8	2	0	0	SJ
1	12/02/13	14:15	16:15	1	2	4	SSE	0	7	2	0	0	SJ
1	12/02/13	14:15	16:15	2	2	5	SSE	0	6	2	0	0	SJ
1	04/05/13	17:50	19:50	1	2	4	SW	2	7	2	0	2	TE
1	04/05/13	17:50	19:50	2	2	3	SW	2	6	2	0	2	TE
1	05/05/13	14:30	16:30	1	2	3	SW	0	3	2	0	0	TE
1	05/05/13	14:30	16:30	2	2	4	SW	0	3	2	0	0	TE
1	28/05/13	17:15	19:15	1	2	5	SE	0	2	2	0	0	TE
1	28/05/13	17:15	19:15	2	2	5	SE	0	1	2	0	0	TE
1	29/05/13	09:00	11:00	1	2	2	NW	0	3	2	0	0	TE
1	29/05/13	09:00	11:00	2	2	3	NW	1	5	1	0	0	TE
1	31/05/13	08:15	10:15	1	2	1	NW	0	8	1	0	0	TE
1	31/05/13	08:15	10:15	2	2	1	NW	0	8	2	0	0	TE
1	31/05/13	10:45	12:45	1	2	2	NW	0	8	2	0	0	TE
1	31/05/13	10:45	12:45	2	1	3	NW	0	8	1	0	0	TE
1	15/06/13	21:00	23:00	1	2	1	NE	0	8	2	0	0	GK
1	15/06/13	21:00	23:00	2	1	1	NE	0	8	1	0	0	GK
1	16/06/13	12:35	14:25	1	1	2	NE	0	7	1	0	0	RJ
1	16/06/13	12:35	14:25	2	0	2	NE	0	8	0	0	0	RJ
1	16/06/13	18:10	20:10	1	2	2	NE	0	3	2	0	0	RJ
1	16/06/13	18:10	20:10	2	2	2	NE	0	2	2	0	0	RJ
1	17/06/13	07:45	09:45	1	1	1	NE	1	8	1	0	0	GK
1	17/06/13	07:45	09:45	2	1	1	N	0	8	1	0	0	GK
1	17/06/13	09:50	11:50	1	2	1	N	0	8	2	0	0	RJ
1	17/06/13	09:50	11:50	2	2	1	N	0	8	2	0	0	RJ
1	30/07/13	17:45	19:45	1	2	4	E	0	3	2	0	0	RJ

VP	Date	Start Time	End Time	Hour	Visibility	Wind speed	Wind direction	Precipitation	Cloud cover	Cloud height	Frost	Snow	Observer
1	30/07/13	17:45	19:45	2	2	2	E	0	2	2	0	0	RJ
1	30/07/13	20:15	22:15	1	2	2	SW	0	5	2	0	0	RJ
1	30/07/13	20:15	22:15	2	2	1	SW	0	7	2	0	0	RJ
1	31/07/13	04:25	06:25	1	2	2	WSW	0	5	2	0	0	GK
1	31/07/13	04:25	06:25	2	2	2	WSW	0	4	2	0	0	GK
1	31/07/13	10:30	12:30	1	2	2	NW	0	8	1	0	0	RJ
1	31/07/13	10:30	12:30	2	2	2	NW	0	7	2	0	0	RJ
1	31/07/13	13:00	15:00	1	2	2	NW	0	5	2	0	0	RJ
1	31/07/13	13:00	15:00	2	2	2	N	0	3	2	0	0	RJ
1	31/07/13	15:05	17:05	1	2	1	N	0	2	2	0	0	GK
1	31/07/13	15:05	17:05	2	2	2	NE	0	1	2	0	0	GK
1	29/08/13	16:40	18:40	1	2	1	WNW	0	8	2	0	0	GK
1	29/08/13	16:40	18:40	2	2	1	WNW	0	8	2	0	0	GK
1	29/08/13	19:10	21:10	1	2	0	-	0	8	2	0	0	GK
1	29/08/13	19:10	21:10	2	2	0	-	0	8	2	0	0	GK
1	27/09/13	06:08	09:08	1	1	2	SSW	0	8	2	0	0	GN
1	27/09/13	06:08	09:08	2	2	3	S	0	8	2	0	0	GN
1	27/09/13	06:08	09:08	3	2	2	SE	0	8	2	0	0	GN
1	30/09/13	16:52	19:52	1	2	8	SE	0	2	2	0	0	CC
1	30/09/13	16:52	19:52	2	2	8	SE	0	1	2	0	0	CC
1	30/09/13	16:52	19:52	3	2	8	SE	0	1	2	0	0	CC
1	01/10/13	06:18	09:18	1	2	7	SE	0	0		0	0	CC
1	01/10/13	06:18	09:18	2	2	7	SE	0	1	2	0	0	CC
1	01/10/13	06:18	09:18	3	2	6	SE	0	2	2	0	0	CC
1	15/10/13	16:09	19:09	1	2	0	-	0	6	2	0	0	CC
1	15/10/13	16:09	19:09	2	2	0	-	0	7	2	0	0	CC
1	15/10/13	16:09	19:09	3	2	1	ESE	0	6	2	0	0	CC
1	16/10/13	06:52	09:52	1	2	2	SE	1	8	1	0	0	CC
1	16/10/13	06:52	09:52	2	2	2	SE	1	8	1	0	0	CC

VP	Date	Start Time	End Time	Hour	Visibility	Wind speed	Wind direction	Precipitation	Cloud cover	Cloud height	Frost	Snow	Observer
1	16/10/13	06:52	09:52	3	2	2	SE	0	5	0	0	0	CC
1	26/10/13	17:02	20:02	1	2	4	SSE	0	3	2	0	0	EF
1	26/10/13	17:02	20:02	2	2	3	SSE	0	2	2	0	0	EF
1	26/10/13	17:02	20:02	3	2	2	SSE	0	4	2	0	0	EF
1	28/10/13	14:45	17:45	1	2	2	NW	0	6	2	0	0	CC
1	28/10/13	14:45	17:45	2	2	2	WNW	2	6	2	0	0	CC
1	28/10/13	14:45	17:45	3	2	4	WNW	3	7	1	0	0	CC
1	29/10/13	06:15	09:15	1	2	5	NW	3	6	1	0	0	CC
1	29/10/13	06:15	09:15	2	2	6	NW	3	5	1	0	0	CC
1	29/10/13	06:15	09:15	3	2	6	NNW	3	7	1	0	0	CC
1	14/11/13	13:55	16:55	1	2	10	NW	3	6	2	0	0	CC
1	14/11/13	13:55	16:55	2	2	9	NW	2	5	2	0	0	CC
1	14/11/13	13:55	16:55	3	2	10	NW	3	5	2	0	0	CC
1	15/11/13	07:03	10:03	1	2	8	WNW	0	6	2	0	0	CC
1	15/11/13	07:03	10:03	2	2	6	WNW	0	6	2	0	0	CC
1	15/11/13	07:03	10:03	3	2	6	WNW	0	6	2	0	0	CC
1	28/11/13	13:32	16:32	1	2	1	NW	1	8	2	0	0	CC
1	28/11/13	13:32	16:32	2	2	2	NW	1	8	2	0	0	CC
1	28/11/13	13:32	16:32	3	0	1	NW	0	8	2	0	0	CC
1	29/11/13	07:34	10:34	1	2	9	NW	3	6	1	0	0	CC
1	29/11/13	07:34	10:34	2	2	10	NW	3	7	1	0	0	CC
1	29/11/13	07:34	10:34	3	2	10	NW	3	5	1	0	0	CC
1	12/12/13	13:20	16:20	1	2	3	SE	0	8	2	0	0	GN
1	12/12/13	13:20	16:20	2	2	3	SE	2	8	2	0	0	GN
1	12/12/13	13:20	16:20	3	1	3	SE	2	8	2	0	0	GN
1	13/12/13	07:56	10:56	1	2	3	SSW	0	8	2	0	0	GN
1	13/12/13	07:56	10:56	2	2	3	SW	0	8	2	0	0	GN
1	13/12/13	07:56	10:56	3	2	5	SW	0	7	2	0	0	GN
1	23/12/13	13:22	16:22	1	2	7	SE	4	8	1	1	0	EF

VP	Date	Start Time	End Time	Hour	Visibility	Wind speed	Wind direction	Precipitation	Cloud cover	Cloud height	Frost	Snow	Observer
1	23/12/13	13:22	16:22	2	1	8	ESE	4	8	1	1	0	EF
1	23/12/13	13:22	16:22	3	1	8	ESE	4	8	0	1	0	EF
1	24/12/13	08:05	11:05	1	2	8	SSW	0	1	2	0	0	EF
1	24/12/13	08:05	11:05	2	2	9	SSW	0	3	2	0	0	EF
1	24/12/13	08:05	11:05	3	2	10	S	0	6	2	0	0	EF
1	06/01/14	13:39	16:39	1	2	4	SSE	2	7	2	0	0	EF
1	06/01/14	13:39	16:39	2	2	4	SSE	0	6	2	0	0	EF
1	06/01/14	13:39	16:39	3	2	4	SSE	0	5	2	0	0	EF
1	07/01/14	08:01	11:01	1	2	5	SSW	0	3	2	0	0	CC
1	07/01/14	08:01	11:01	2	2	4	SW	0	3	2	0	0	CC
1	07/01/14	08:01	11:01	3	2	4	SW	0	2	2	0	0	CC
1	20/01/14	13:36	16:36	1	2	6	SSW	0	1	2	0	0	EF
1	20/01/14	13:36	16:36	2	2	4	SSW	0	1	2	0	0	EF
1	20/01/14	13:36	16:36	3	2	3	SSW	0	3	2	0	0	EF
1	21/01/14	07:44	10:44	1	2	7	SE	0	7	2	0	0	EF
1	21/01/14	07:44	10:44	2	2	7	SE	0	8	2	0	0	EF
1	21/01/14	07:44	10:44	3	2	8	SE	0	8	2	0	0	EF
1	06/02/14	14:20	17:20	1	2	3	SW	0	2	2	0	0	SJ
1	06/02/14	14:20	17:20	2	2	3	WSW	0	3	2	0	0	SJ
1	06/02/14	14:20	17:20	3	2	3	WSW	0	3	2	0	0	SJ
1	07/02/14	07:40	10:40	1	2	2	W	0	7	1	0	0	SJ
1	07/02/14	07:40	10:40	2	2	2	W	1	7	1	0	0	SJ
1	07/02/14	07:40	10:40	3	2	2	WNW	2	6	2	0	0	SJ
1	20/02/14	15:15	18:15	1	2	6	W	0	2	2	0	0	SJ
1	20/02/14	15:15	18:15	2	2	5	WSW	0	3	1	0	0	SJ
1	20/02/14	15:15	18:15	3	2	4	W	0	1	2	0	0	SJ
1	21/02/14	07:46	10:46	1	2	6	S	0	8	2	0	0	EF
1	21/02/14	07:46	10:46	2	2	7	S	0	7	2	0	0	EF
1	21/02/14	07:46	10:46	3	2	7	S	0	6	2	0	0	EF

VP	Date	Start Time	End Time	Hour	Visibility	Wind speed	Wind direction	Precipitation	Cloud cover	Cloud height	Frost	Snow	Observer
1	04/03/14	15:28	18:28	1	2	5	WNW	0	5	2	0	0	EF
1	04/03/14	15:28	18:28	2	2	4	W	0	2	2	0	0	EF
1	04/03/14	15:28	18:28	3	2	4	WNW	0	3	2	0	0	EF
1	05/03/14	07:35	10:35	1	2	4	SSW	0	8	2	0	0	SJ
1	05/03/14	07:35	10:35	2	2	3	SW	0	8	1	0	0	SJ
1	05/03/14	07:35	10:35	3	2	4	SW	0	8	1	0	0	SJ
1	20/03/14	15:44	18:44	1	2	7	WNW	3	4	2	0	0	EF
1	20/03/14	15:44	18:44	2	2	7	WNW	3	3	2	0	0	EF
1	20/03/14	15:44	18:44	3	2	6	WSW	0	4	2	0	0	EF
1	21/03/14	06:35	09:35	1	2	7	WSW	0	1	2	1	1	EF
1	21/03/14	06:35	09:35	2	2	8	WSW	0	1	2	1	1	EF
1	21/03/14	06:35	09:35	3	2	8	SW	0	1	2	0	0	EF
1	31/03/14	16:31	19:31	1	2	7	ESE	0	7	2	0	0	GN
1	31/03/14	16:31	19:31	2	2	7	ESE	0	7	2	0	0	GN
1	31/03/14	16:31	19:31	3	2	6	ESE	0	7	2	0	0	GN
1	01/04/14	07:04	10:04	1	2	6	SE	0	8	2	0	0	GN
1	01/04/14	07:04	10:04	2	2	5	SE	0	8	2	0	0	GN
1	01/04/14	07:04	10:04	3	2	5	SE	0	8	2	0	0	GN
1	14/04/14	18:21	21:21	1	2	4	NNW	0	1	2	0	0	GN
1	14/04/14	18:21	21:21	2	2	2	NW	0	1	2	0	0	GN
1	14/04/14	18:21	21:21	3	2	2	NW	0	3	2	0	0	GN
1	15/04/14	06:38	09:38	1	2	3	SE	0	3	2	0	0	GN
1	15/04/14	06:38	09:38	2	2	3	SE	0	3	2	0	0	GN
1	15/04/14	06:38	09:38	3	2	3	SSE	0	3	2	0	0	GN
1	15/04/14	10:08	13:08	1	2	2	SSE	0	8	2	0	0	GN
1	15/04/14	10:08	13:08	2	2	2	SSE	0	6	2	0	0	GN
1	15/04/14	10:08	13:08	3	2	3	ESE	0	4	2	0	0	GN
1	17/04/14	07:41	10:41	1	2	6	WNW	3	4	2	0	0	GN
1	17/04/14	07:41	10:41	2	2	7	NW	3	5	2	0	0	GN

VP	Date	Start Time	End Time	Hour	Visibility	Wind speed	Wind direction	Precipitation	Cloud cover	Cloud height	Frost	Snow	Observer
1	17/04/14	07:41	10:41	3	2	9	NW	3	5	2	0	0	GN
1	01/05/14	16:10	19:10	1	2	4	ENE	0	5	2	0	0	SJ
1	01/05/14	16:10	19:10	2	2	5	E	2	6	2	0	0	SJ
1	01/05/14	16:10	19:10	3	2	4	ENE	0	2	2	0	0	SJ
1	02/05/14	07:10	10:10	1	2	2	E	0	1	2	0	0	SJ
1	02/05/14	07:10	10:10	2	2	1	ENE	0	2	1	0	0	SJ
1	02/05/14	07:10	10:10	3	2	1	E	0	3	1	0	0	SJ
1	12/05/14	19:25	22:25	1	2	2	NE	0	1	2	0	0	EF
1	12/05/14	19:25	22:25	2	2	2	NE	0	1	2	0	0	EF
1	12/05/14	19:25	22:25	3	1	3	NE	0	1	2	0	0	EF
1	15/05/14	09:55	12:55	1	2	5	WSW	0	8	1	0	0	SJ
1	15/05/14	09:55	12:55	2	2	6	WSW	0	8	1	0	0	SJ
1	15/05/14	09:55	12:55	3	2	7	WSW	0	8	1	0	0	SJ
1	27/05/14	17:30	19:30	1	2	2	ESE	0	2	2	0	0	CC
1	27/05/14	17:30	19:30	2	2	2	ESE	0	1	2	0	0	CC
1	27/05/14	20:00	22:00	1	2	2	SE	0	6	2	0	0	CC
1	27/05/14	20:00	22:00	2	2	1	SE	0	8	1	0	0	CC
1	28/05/14	07:35	09:35	1	2	2	SE	2	7	1	0	0	CC
1	28/05/14	07:35	09:35	2	2	1	SE	1	6	2	0	0	CC
1	10/06/14	17:20	20:20	1	2	0	-	3	7	1	0	0	SJ
1	10/06/14	17:20	20:20	2	2	1	SE	4	8	1	0	0	SJ
1	10/06/14	17:20	20:20	3	2	1	SE	2	8	1	0	0	SJ
1	11/06/14	13:30	16:30	1	2	4	WNW	0	7	1	0	0	SJ
1	11/06/14	13:30	16:30	2	2	3	WNW	0	4	2	0	0	SJ
1	11/06/14	13:30	16:30	3	2	4	WNW	0	7	1	0	0	SJ
1	12/06/14	09:43	12:43	1	2	3	NW	0	5	2	0	0	GN
1	12/06/14	09:43	12:43	2	2	2	NW	0	7	2	0	0	GN
1	12/06/14	09:43	12:43	3	2	3	NW	0	8	2	0	0	GN
1	12/06/14	13:13	16:13	1	2	3	NW	0	8	2	0	0	GN

VP	Date	Start Time	End Time	Hour	Visibility	Wind speed	Wind direction	Precipitation	Cloud cover	Cloud height	Frost	Snow	Observer
1	12/06/14	13:13	16:13	2	2	2	NW	0	7	2	0	0	GN
1	12/06/14	13:13	16:13	3	2	4	NW	0	7	2	0	0	GN
1	01/07/14	15:56	18:56	1	2	2	E	0	2	2	0	0	EF
1	01/07/14	15:56	18:56	2	2	2	ESE	0	3	2	0	0	EF
1	01/07/14	15:56	18:56	3	2	1	ESE	0	3	2	0	0	EF
1	02/07/14	10:58	13:58	1	2	4	S	2	8	2	0	0	EF
1	02/07/14	10:58	13:58	2	2	5	S	2	8	2	0	0	EF
1	02/07/14	10:58	13:58	3	2	5	S	2	8	2	0	0	EF
1	21/07/14	18:41	21:41	1	2	2	NE	0	5	2	0	0	EF
1	21/07/14	18:41	21:41	2	2	1	NE	0	7	2	0	0	EF
1	21/07/14	18:41	21:41	3	2	0	-	0	7	0	0	0	EF
1	24/07/14	08:50	11:50	1	1	2	SE	0	4	1	0	0	SJ
1	24/07/14	08:50	11:50	2	2	3	SSE	0	0	2	0	0	SJ
1	24/07/14	08:50	11:50	3	2	2	SE	0	0	2	0	0	SJ
1	06/08/14	15:34	18:34	1	1	3	S	3	8	0	0	0	EF
1	06/08/14	15:34	18:34	2	1	2	S	5	8	0	0	0	EF
1	06/08/14	15:34	18:34	3	1	0	S	4	8	0	0	0	EF
1	07/08/14	08:36	11:36	1	2	4	WNW	0	1	2	0	0	EF
1	07/08/14	08:36	11:36	2	2	4	WNW	0	3	2	0	0	EF
1	07/08/14	08:36	11:36	3	2	3	WNW	0	4	2	0	0	EF

Visibility; 0 = <1km; 1 = 1-2km; 2 = ≥2km

Wind direction: according to 16-point compass

Wind strength: according to the Beaufort scale

Cloud cover: in eighths of sky

Cloud height: 0 = <150m; 1 = 150-500m; 2 = >500m

Rain: 0 = None; 1 = Drizzle/Mist; 2 = Light showers; 3 = Heavy showers; 4 = Heavy rain

Frost: 0 = None; 1 = Ground; 2 = All day

Snow: 0 = None; 1 = Onsite; 2 = On high ground only

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GN = Glenn Norris; GK = Gus Keys; RJ = Rachael Johnson; SJ = Steven Johnston; TE = Tom Edwards.

Table A1.2. Hill Of Forss Foraging Geese visit details

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
1	26/09/2013	GN	16:15	1	2	3	S	0	1	2	0	0
				2	2	3	SE	0	1	2	0	0
				3	2	3	ESE	0	3	2	0	0
				4	1	1	SE	0	5	2	0	0
	27/09/2013	EF	06:07	1	1	2	SE	0	7	2	0	0
				2	2	1	SE	0	8	2	0	0
				3	2	1	SE	0	8	2	0	0
2	30/09/2013	SJ	16:30	1	2	5	SSE	0	3	2	0	0
				2	2	6	SE	0	2	2	0	0
				3	1	5	SE	0	2	2	0	0
	01/10/2013	SJ	06:30	1	1	5	SE	0	0	-	0	0
				2	2	6	SE	0	2	2	0	0
				3	2	7	SE	0	2	2	0	0
3	15/10/2013	EF	15:40	1	2	1	WSW	0	3	2	0	0
				2	2	1	WSW	0	6	2	0	0
				3	1	1	WSW	0	7	2	0	0
	16/10/2013	EF	06:50	1	1	0	-	1	8	2	0	0
				2	2	1	SE	0	8	2	0	0
				3	2	2	SE	0	2	2	0	0
4	28/10/2013	EF	15:00	1	2	3	W	2	8	2	0	0
				2	2	3	W	3	8	2	0	0
				3	1	3	W	3	8	1	0	0
	29/10/2013	EF	06:15	1	1	5	WSW	3	8	2	0	0

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
				2	2	4	WSW	3	7	2	0	0
				3	2	4	WSW	3	7	2	0	0
5	14/11/2013	EF	14:40	1	2	7	NW	3	7	2	0	0
				2	2	6	NW	3	7	2	0	0
	15/11/2013	EF	07.15	1	1	5	WNW	0	6	2	0	0
				2	2	6	WNW	0	6	2	0	0
				3	2	7	WNW	0	7	2	0	0
6	28/11/2013	SJ	13.32	1	2	2	WNW	1	8	2	0	0
				2	2	2	NW	0	8	2	0	0
				3	2	2	NW	0	8	2	0	0
	29/11/2013	SJ	07.34	1	2	7	NW	3	7	1	0	0
				2	2	8	NW	3	7	1	0	0
				3	2	8	NW	3	6	1	0	0
7	12/12/2013	SJ	13:20	1	2	3	SSE	2	8	1	0	0
				2	2	3	SE	2	8	1	0	0
				3	1	2	SE	2	8	1	0	0
	13/12/2013	SJ	07:56	1	1	2	SSW	0	6	2	0	0
				2	2	3	SW	0	7	2	0	0
				3	2	3	SSW	0	8	2	0	0
8	23/12/2013	CC	12.50	1	2	5	SE	0	8	2	2	2
				2	2	5	SE	3	8	1	2	2
				3	2	6	SE	2	8	1	2	2
				4	2	6	SE	0	8	1	2	2

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
	24/12/2013	CC	08.00	1	2	7	SW	0	3	2	0	2
				2	2	8	SW	0	2	2	0	2
				3	2	8	SW	0	6	2	0	2
9	06/01/2014	EF	13.10	1	1	6	SE	2	8	1	0	0
				2	2	5	SE	2	6	2	0	0
				3	2	4	SE	2	7	2	0	0
	07/01/2014	EF	08.20	1	2	5	SW	0	3	2	0	0
				2	2	4	SW	0	2	2	0	0
				3	2	4	SW	0	5	2	0	0
10	20/01/2014	SJ	13:25	1	2	3	SW	0	3	2	0	0
				2	2	3	SW	0	4	2	0	0
				3	2	3	SW	0	4	2	0	0
	21/01/2014	SJ	07:45	1	1	5	SE	0	8	2	0	0
				2	2	5	SE	0	8	2	0	0
				3	2	6	SE	0	8	2	0	0
11	06/02/2014	EF	14:10	1	2	3	SW	0	4	2	0	0
				2	2	3	SW	0	3	2	0	0
				3	2	3	SW	0	3	2	0	0
	07/02/2014	EF	07:30	1	2	3	SW	2	8	2	1	0
				2	2	2	SW	0	7	2	1	0
				3	2	2	SW	0	5	2	0	0
12	20/02/2014	EF	15.00	1	2	6	SW	0	4	2	0	0
				2	2	5	SW	0	2	2	0	0

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
				3	2	4	SW	0	1	2	0	0
	21/02/2014	SJ	07.40	1	2	3	S	0	7	2	0	0
				2	2	4	S	0	7	2	0	0
				3	2	3	S	0	6	2	0	0
13	04/03/2014	SJ	15.30	1	2	4	W	0	6	1	0	0
				2	2	3	W	0	2	2	0	0
				3	2	4	W	0	4	1	0	0
	05/03/2014	EF	07.15	1	2	4	SSW	0	8	2	0	0
				2	2	3	SW	0	8	1	0	0
				3	2	4	SW	0	8	1	0	0
14	20/03/2014	SJ	15:45	1	2	6	NW	3	5	1	0	0
				2	2	5	NW	3	5	1	0	0
				3	2	5	W	2	4	1	0	0
	21/03/2014	SJ	06:40	1	2	5	WSW	0	1	2	1	1
				2	2	5	SW	0	2	2	0	0
				3	2	5	SW	0	1	2	0	0
15	01/04/2014	GN	10:15	1	2	6	SE	0	7	2	0	0
				2	2	5	SE	0	7	2	0	0
				3	2	5	SE	0	7	2	0	0
	02/04/2014	GN	06:38	1	2	4	SE	0	8	2	0	0
				2	2	2	SE	0	8	2	0	0
				3	2	2	SE	0	8	2	0	0
16	14/04/2014	EF	18.20	1	2	3	SW	0	2	2	0	0

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
				2	2	3	SW	0	4	2	0	0
				3	2	3	SW	0	4	2	0	0
	15/04/2014	EF	06.10	1	2	3	SW	0	0	2	0	0
				2	2	3	SW	0	6	2	0	0
				3	2	3	SW	0	8	2	0	0
17	01/05/2014	EF	16:00	1	2	5	ENE	0	4	2	0	0
				2	2	5	ENE	0	4	2	0	0
				3	2	4	ENE	0	2	2	0	0
17	02/05/2014	EF	06:55	1	2	3	E	0	1	2	0	0
				2	2	2	E	0	1	1	0	0
				3	2	2	E	0	3	2	0	0
18	12/05/2014	SJ	19:10	1	2	2	NNE	0	0	-	0	0
				2	2	1	N	0	1	2	0	0
				3	2	2	NNE	0	0	-	0	0
	15/05/2014	EF	09:40	1	2	5	WSW	0	2	2	0	0
				2	2	5	WSW	0	2	2	0	0
				3	2	6	WSW	0	2	2	0	0

Visibility; 0 = <1km; 1 = 1-2km; 2 = ≥2km

Wind direction: according to 16-point compass

Wind strength: according to the Beaufort scale

Cloud cover: in eighths of sky

Cloud height: 0 = <150m; 1 = 150-500m; 2 = >500m

Rain: 0 = None; 1 = Drizzle/Mist; 2 = Light showers; 3 = Heavy showers; 4 = Heavy rain

Frost: 0 = None; 1 = Ground; 2 = All day

Snow: 0 = None; 1 = Onsite; 2 = On high ground only

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GN = Glenn Norris; SJ = Steven Johnston.

Table A1.3. Winter bird survey visit details

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
1	10/12/2012	EF	12:50	1	2	4	NNE	0	6	2	0	0
1	11/12/2012	EF	08:50	1	2	3	NW	3	8	2	0	0
				2	2	2	NW	2	7	2	0	0
				3	2	2	NW	0	6	2	0	0
				4	2	2	NW	0	6	2	0	0
				5	2	2	NW	3	6	2	0	0
				6	2	2	NW	3	6	2	0	0
				7	2	2	NW	3	7	2	0	0
2	23/01/2013	SJ	14:45	1	2	3	SE	0	5	2	0	1
				2	2	3	SE	0	6	2	0	1
2	24/01/2013	SJ	13:30	1	3	2	S	0	8	2	0	1
				2	1	2	S	0	8	2	0	1
				3	2	2	S	0	8	2	0	1
3	11/02/2013	SJ	14:45	1	2	3	SE	0	7	2	0	0
				2	2	4	SE	0	7	2	0	0
3	12/02/2013	SJ	08:30	1	2	3	SSE	0	8	2	1	0
				2	2	3	SSE	0	8	2	1	0
				3	2	3	SSE	0	8	2	1	0

Visibility; 0 = <1km; 1 = 1-2km; 2 = ≥2km

Wind direction: according to 16-point compass

Wind strength: according to the Beaufort scale

Cloud cover: in eighths of sky

Cloud height: 0 = <150m; 1 = 150-500m; 2 = >500m

Rain: 0 = None; 1 = Drizzle/Mist; 2 = Light showers; 3 = Heavy showers; 4 = Heavy rain

Frost: 0 = None; 1 = Ground; 2 = All day

Snow: 0 = None; 1 = Onsite; 2 = On high ground only

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GN = Glenn Norris; SJ = Steven Johnston.

Table A1.4. Raptor and owl survey 2013 visit details

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
1	04/05/2013	TE	07:25	1	2	1	SSW	0	6	2	0	2
				2	2	2	SSW	0	6	2	0	2
				3	2	4	SW	2	7	1	0	1
1	04/05/2013	TE	14:00	1	2	6	SW	1	5	2	0	2
				2	2	6	SW	0	5	2	0	2
				3	2	5	SW	0	5	2	0	2
2	30/05/2013	TE	05:50	1	2	3	NW	0	8	1	0	0
				2	1	3	NW	0	8	1	0	0
				3	1	3	NW	0	8	1	0	0
				4	2	3	NW	0	8	1	0	0
			14:45	1	2	3	NNW	0	8	1	0	0
				2	2	3	NNW	0	8	1	0	0
3	16/06/2013	GK	12:30	1	2	2	NE	0	6	2	0	0
				2	2	2	NE	0	4	2	0	0
				3	2	2	ENE	0	4	2	0	0
				4	2	2	ENE	0	5	2	0	0
				5	2	2	NE	0	4	2	0	0
				6	2	1	NE	0	2	2	0	0
				7	2	1	NE	0	1	2	0	0
				8	2	1	NE	0	1	2	0	0

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
4	30/07/2013	GK	17:50	1	2	3	E	0	2	2	0	0
				2	2	2	E	0	2	2	0	0
4	31/07/2013	GK	06:30	1	2	2	NW	0	6	2	0	0
				2	2	2	NW	0	6	2	0	0
			10:05	1	2	2	NW	0	5	2	0	0
				2	2	2	NW	0	3	2	0	0

Visibility; 0 = <1km; 1 = 1-2km; 2 = ≥2km

Wind direction: according to 16-point compass

Wind strength: according to the Beaufort scale

Cloud cover: in eighths of sky

Cloud height: 0 = <150m; 1 = 150-500m; 2 = >500m

Rain: 0 = None; 1 = Drizzle/Mist; 2 = Light showers; 3 = Heavy showers; 4 = Heavy rain

Frost: 0 = None; 1 = Ground; 2 = All day

Snow: 0 = None; 1 = Onsite; 2 = On high ground only

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GN = Glenn Norris; GK = Gus Keys; SJ = Steven Johnston; TE = Tom Edwards

Table A1.5. Raptor and owl survey 2014 visit details

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
1	13/04/2014	EF	13:00	1	2	2	NNW	2	8	2	0	0
				2	2	3	NNW	0	6	2	0	0
				3	2	4	NNW	0	3	2	0	0
				4	2	4	NNW	0	3	2	0	0
				5	2	3	NNW	0	2	2	0	0
				6	2	3	NNW	0	0	-	0	0
				7	2	4	NW	0	0	-	0	0
				8	2	3	NW	0	0	-	0	0
	15/04/2014	EF	09:38	1	2	2	S	0	8	2	0	0
				2	2	1	S	0	6	2	0	0
				3	2	3	S	0	6	2	0	0
	16/04/2014	EF	12:00	1	2	3	WSW	0	8	2	0	0
				2	2	4	WSW	0	8	2	0	0
				3	2	3	W	0	8	2	0	0
	16/04/2014	GN	12:00	1	2	4	SW	0	8	2	0	0
				2	2	3	SW	0	8	2	0	0
				3	2	3	SW	0	8	2	0	0
	17/04/2014	EF	07:28	1	2	7	WNW	4	6	2	0	0
				2	2	8	WNW	4	6	2	0	0
				3	2	8	WNW	4	6	2	0	0
2	29/04/2014	GN	18:25	1	1	7	E	1	8	1	0	0
				2	1	6	E	1	8	1	0	0
				3	1	6	E	0	8	1	0	0

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
	30/04/2014	CC	06:20	1	2	3	E	0	8	1	0	0
				2	2	5	E	1	8	0	0	0
				3	2	4	E	1	8	0	0	0
				4	2	4	E	1	8	0	0	0
	01/05/2014	GN	06:20	1	2	3	E	0	7	2	0	0
				2	2	1	E	0	7	2	0	0
				3	2	2	E	0	7	2	0	0
	14/05/2014	EF	13:20	1	2	4	SW	0	8	2	0	0
				2	2	4	SW	0	8	2	0	0
				3	2	5	SW	0	8	2	0	0
				4	2	4	SW	0	8	2	0	0
	14/05/2014	SJ	13:15	1	2	3	SE	0	6	2	0	0
				2	2	4	SSE	0	7	2	0	0
				3	2	5	SSE	0	8	2	0	0
				4	2	5	SSE	0	8	2	0	0
	15/05/2014	SJ	13:30	1	2	7	W	0	8	1	0	0
				2	2	6	WNW	0	8	1	0	0
				3	2	4	WNW	0	7	1	0	0
3	12/06/2014	SJ	09:25	1	2	2	NW	0	7	2	0	0
				2	2	3	NW	0	8	2	0	0
				3	2	3	WNW	0	8	2	0	0
				4	2	4	W	2	8	1	0	0
				5	2	3	WNW	2	8	1	0	0

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
				6	2	3	WNW	0	8	2	0	0
				7	2	3	WNW	2	8	2	0	0
4	11/09/2014	SJ	17:45	1	2	2	WSW	0	7	2	0	0
				2	2	2	WSW	0	7	2	0	0
				3	2	2	WSW	0	8	2	0	0

Visibility; 0 = <1km; 1 = 1-2km; 2 = ≥2km

Wind direction: according to 16-point compass

Wind strength: according to the Beaufort scale

Cloud cover: in eighths of sky

Cloud height: 0 = <150m; 1 = 150-500m; 2 = >500m

Rain: 0 = None; 1 = Drizzle/Mist; 2 = Light showers; 3 = Heavy showers; 4 = Heavy rain

Frost: 0 = None; 1 = Ground; 2 = All day

Snow: 0 = None; 1 = Onsite; 2 = On high ground only

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GN = Glenn Norris; SJ = Steven Johnston.

Table A1.6. Breeding bird survey 2013 visit details

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
1	05/05/2013	TE	05:50	1	2	3	SSW	0	6	2	0	2
				2	2	3	SSW	0	6	2	0	2
				3	2	4	SSW	0	6	2	0	2
				4	2	3	SW	0	6	2	0	2
				5	2	4	SSW	0	6	2	0	2
				6	2	3	SW	0	5	2	0	2
				7	2	3	SW	0	5	2	0	2
1	06/05/2013	TE	05:50	1	1	1	-	1	8	1	0	0
				2	1	1	-	1	8	1	0	0
				3	1	1	-	1	8	1	0	0
				4	0	2	SW	1	8	1	0	0
				5	1	2	SW	0	8	1	0	0
				6	1	2	SW	0	8	1	0	0
				7	2	2	SW	0	8	1	0	0
2	28/05/2013	TE	04:50	1	2	3	SW	0	6	2	0	0
				2	2	4	S	0	5	2	0	0
				3	2	4	S	0	4	2	0	0
				4	2	6	S	0	3	2	0	0
				5	2	6	S	0	3	2	0	0
				6	2	6	SE	0	4	2	0	0
				7	2	6	SE	0	5	2	0	0
2	29/05/2013	TE	04:45	1	2	0	-	0	2	2	0	0

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
				2	2	0	-	0	7	2	0	0
				3	2	1	W	0	6	2	0	0
				4	2	1	NW	0	5	2	0	0
3	16/06/2013	GK/RJ	06:00	1	2	1	ENE	0	8	1	0	0
				2	2	1	ENE	0	8	1	0	0
				3	2	2	NE	0	8	1	0	0
				4	2	2	NE	0	8	2	0	0
				5	2	2	NE	0	8	2	0	0
				6	2	2	NE	0	8	1	0	0

Visibility; 0 = <1km; 1 = 1-2km; 2 = ≥2km

Wind direction: according to 16-point compass

Wind strength: according to the Beaufort scale

Cloud cover: in eighths of sky

Cloud height: 0 = <150m; 1 = 150-500m; 2 = >500m

Rain: 0 = None; 1 = Drizzle/Mist; 2 = Light showers; 3 = Heavy showers; 4 = Heavy rain

Frost: 0 = None; 1 = Ground; 2 = All day

Snow: 0 = None; 1 = Onsite; 2 = On high ground only

Observer: GK = Gus Keys; RJ = Rebecca Johnson; TE = Tome Edwards.

Table A1.7. Hill of Forss Breeding bird survey 2014 visit details

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
1	16/04/2014	EF	08:30	1	2	3	W	0	8	2	0	0
				2	2	2	WSW	0	8	2	0	0
				3	2	3	W	0	8	2	0	0
	16/04/2014	GN	08:30	1	2	2	W	0	8	2	0	0
				2	2	1	W	0	8	2	0	0
				3	2	3	W	0	8	2	0	0
2	14/05/2014	EF	09:30	1	2	2	S	0	0	-	0	0
				2	2	3	S	0	4	2	0	0
				3	2	3	SW	0	7	2	0	0
				4	2	3	SW	0	8	2	0	0
	14/05/2014	SJ	09:35	1	2	3	SSE	0	2	2	0	0
				2	2	3	SSE	0	5	2	0	0
				3	2	3	SSE	0	8	2	0	0
3	11/06/2014	SJ	09:40	1	2	3	NW	0	6	2	0	0
				2	2	3	NW	0	7	2	0	0
				3	2	2	WNW	0	4	2	0	0
	11/06/2014	GN	09:30	1	2	3	NW	0	6	2	0	0
				2	2	3	WNW	0	5	2	0	0
				3	2	3	WNW	0	5	2	0	0
				4	2	3	WNW	0	4	2	0	0
4	02/07/2014	GN	06:55	1	2	3	SE	0	8	2	0	0
				2	2	3	SSE	0	8	2	0	0
				3	2	3	SSE	0	8	2	0	0

Visit	Date	Surveyor	Start Time	Hour	Visibility	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Frost	Snow
				4	2	3	SSE	0	8	2	0	0
	02/07/2014	EF	07:02	1	2	3	S	0	8	2	0	0
				2	2	3	S	0	8	2	0	0
				3	2	3	SSW	0	8	2	0	0
				4	2	3	SSW	0	8	2	0	0

Visibility; 0 = <1km; 1 = 1-2km; 2 = ≥2km

Wind direction: according to 16-point compass

Wind strength: according to the Beaufort scale

Cloud cover: in eighths of sky

Cloud height: 0 = <150m; 1 = 150-500m; 2 = >500m

Rain: 0 = None; 1 = Drizzle/Mist; 2 = Light showers; 3 = Heavy showers; 4 = Heavy rain

Frost: 0 = None; 1 = Ground; 2 = All day

Snow: 0 = None; 1 = Onsite; 2 = On high ground only

Observer: EF = Eamonn Flood; GN = Glenn Norris; SJ = Steven Johnston.

APPENDIX 2: Flight Activity Survey Results

This Appendix provides full details of bird survey results by season and species, including dates, times, surveyors and flight details. Visit details are provided in the following tables:

- Wildfowl flights, autumn migration 2012 – Tables A2.1;
- Wildfowl flights, winter 2012/2013 – Tables A2.2 and A2.3;
- Wildfowl flights, summer 2013 – Table A2.4;
- Wildfowl flights, autumn migration 2013 – Tables A2.5 to A2.7;
- Wildfowl flights, winter 2013/2014 – Tables A2.8 to A2.11;
- Wildfowl flights, spring migration 2014 – Table A2.12 to A2.14;
- Wildfowl flights, summer 2014 – Table A2.15;
- Hen harrier flights – Tables A2.16 to A2.18;
- Wader flights, non-breeding season 2012/2013 – Tables A2.19 to A2.25;
- Wader flights, breeding season 2013 – Tables A2.26 to A2.31;
- Wader flights, non-breeding season 2013/2014 – Tables A2.32 to A2.38;
- Wader flights, breeding season 2014 – Tables A2.39 to A2.44; and
- Seabird flights – Tables A2.45 to A2.47.

Wildfowl Flights, Autumn Migration 2012

Table A2.1. Greylag goose flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
29/09/12	1	17:20	15	90	1575	1575	N	SJ	1145
29/09/12	1	17:44	42	135	6300	6300	Y	SJ	1147
30/09/12	1	07:32	27	45	1620	1620	Y	SJ	1148
16/10/12	1	08:39	36	200	7560	4320	N	CC	1159
16/10/12	1	16:36	30	117	4050	1800	N	CC	1150
16/10/12	1	17:31	30	297	9000	8100	N	CC	1153
16/10/12	1	17:52	30	196	6300	5400	N	CC	1155
14/11/12	1	14:20	23	280	6210	0	N	CC	1187
14/11/12	1	16:43	32	200	6720	1440	Y	CC	1188
15/11/12	1	07:30	13	137	1950	1560	N	CC	1161
15/11/12	1	07:53	50	200	10500	0	N	CC	1163
15/11/12	1	07:54	50	200	10500	1500	N	CC	1164
15/11/12	1	07:58	130	220	29250	5850	N	CC	1165
15/11/12	1	08:10	25	45	1500	0	N	CC	1166
15/11/12	1	08:23	40	20	1200	1200	N	CC	1167
15/11/12	1	08:42	160	200	33600	9600	N	CC	1168

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
15/11/12	1	08:43	20	200	4200	300	N	CC	1169
15/11/12	1	09:10	110	20	3300	3300	N	CC	1172
15/11/12	1	09:29	14	250	3570	840	Y	CC	1176
15/11/12	1	11:02	16	180	3120	0	Y	CC	1189
15/11/12	1	12:40	1	118	120	75	N	CC	1190
15/11/12	1	13:43	17	200	3570	3570	N	CC	1192
15/11/12	1	13:48	17	229	4080	4080	N	CC	1193
16/11/12	1	08:04	30	215	6750	2700	Y	CC	1178
16/11/12	1	08:09	55	145	6600	2475	N	CC	1179
16/11/12	1	08:15	37	180	7215	0	N	CC	1180
16/11/12	1	08:22	5	45	300	300	N	CC	1182
16/11/12	1	08:30	76	437	34200	29640	Y	CC	1183
16/11/12	1	08:44	61	420	20130	20130	N	CC	1185
16/11/12	1	09:25	31	212	6975	6045	Y	CC	1186

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; SJ = Steven Johnston

Wildfowl Flights, Winter 2012-13

Table A2.2. Greylag goose flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
10/12/12	1	14:19	80	200	16800	0	Y	EF	1197

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: EF = Eamonn Flood

Table A2.3. Whooper swan flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
24/01/13	1	11:58	2	45	120	120	N	SJ	1199

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: SJ = Steven Johnston

Wildfowl Flights Summer Season 2013

Table A2.4. Greylag goose flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
31/07/13	1	10:58	2	70	150	150	N	RJ	1323

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: RJ = Rebecca Johnson

Wildfowl Flights Autumn Migration Season 2013

Table A2.5. Greylag goose flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
27/09/13	1	08:13	4	34	180	180	Y	GN	1329
15/10/13	1	16:20	6	297	1800	630	Y	CC	1344
15/10/13	1	17:45	8	220	1680	0	N	CC	1346
16/10/13	1	08:30	65	220	15600	1950	N	CC	1357
16/10/13	1	08:33	120	200	25200	0	N	CC	1358
16/10/13	1	08:38	70	190	13650	1050	N	CC	1359
16/10/13	1	08:41	60	30	2700	2700	N	CC	1360
16/10/13	1	08:41	100	187	19500	0	N	CC	1361
16/10/13	1	08:43	47	390	20445	8460	Y	CC	1362
16/10/13	1	08:57	70	120	9450	0	N	CC	1364
16/10/13	1	09:15	80	280	22800	0	N	CC	1366
16/10/13	1	09:34	39	195	8190	2925	N	CC	1368
16/10/13	1	09:45	45	270	12150	6750	N	CC	1369
26/10/13	1	18:01	23	240	5865	0	N	EF	1373
26/10/13	1	19:10	11	135	1650	0	N	EF	1374
28/10/13	1	15:50	22	289	6600	330	N	CC	1377
28/10/13	1	16:07	60	200	12600	0	Y	CC	1379

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
28/10/13	1	16:13	20	62	1500	1500	N	CC	1380
29/10/13	1	07:00	26	49	1560	0	Y	CC	1385
29/10/13	1	07:07	5	27	150	0	Y	CC	1386
29/10/13	1	07:12	2	45	120	120	N	CC	1387
29/10/13	1	08:38	29	69	2175	2175	Y	CC	1394
29/10/13	1	08:51	7	90	735	0	Y	CC	1395
29/10/13	1	09:03	24	100	2520	1800	Y	CC	1396
14/11/13	1	13:59	16	610	9840	7920	N	CC	1397
14/11/13	1	14:26	31	120	4185	4185	Y	CC	1398
14/11/13	1	14:55	1	37	45	45	N	CC	1399
15/11/13	1	07:39	20	22	600	0	N	CC	1401
15/11/13	1	07:40	9	180	1755	405	Y	CC	1402
15/11/13	1	08:03	6	150	990	180	N	CC	1404
15/11/13	1	08:08	25	200	4875	3000	N	CC	1405
15/11/13	1	08:28	67	39	3015	1005	N	CC	1407
15/11/13	1	08:37	15	300	4725	1350	Y	CC	1408
15/11/13	1	08:49	25	180	4875	1875	N	CC	1409
15/11/13	1	08:58	3	45	180	0	N	CC	1410
15/11/13	1	09:10	6	240	1530	450	Y	CC	1411
15/11/13	1	09:13	7	500	3570	210	Y	CC	1412
15/11/13	1	09:22	1	145	150	0	Y	CC	1413
28/11/13	1	15:03	1	420	405	0	N	CC	1417

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; GN = Glenn Norris

Table A2.6. Whooper swan flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
30/09/13	1	17:59	2	46	120	120	N	CC	1332
16/10/13	1	09:15	7	280	1995	0	N	CC	1367
29/10/13	1	07:55	7	76	630	630	N	CC	1390
29/10/13	1	08:16	13	80	1170	0	N	CC	1391
29/10/13	1	08:27	20	132	2700	1800	N	CC	1393
15/11/13	1	08:25	3	60	225	0	Y	CC	1406

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine

Table A2.7. Pink-footed goose flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
01/10/13	1	08:48	49	45	2940	0	N	CC	1341

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine

Wildfowl Flights Spring Winter 2013-14

Table A2.8. Greylag goose flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
12/12/13	1	14:17	2	247	510	0	N	GN	1424
12/12/13	1	15:16	400	180	78000	0	N	GN	1425
12/12/13	1	15:18	50	110	6750	1500	Y	GN	1427
12/12/13	1	15:18	30	150	4950	900	Y	GN	1428
12/12/13	1	15:19	11	180	2145	330	Y	GN	1429
13/12/13	1	08:07	25	40	1125	1125	N	GN	1430
13/12/13	1	08:17	20	35	900	900	N	GN	1431
13/12/13	1	08:28	2	55	120	0	N	GN	1432
13/12/13	1	08:47	3	17	90	0	N	GN	1433
13/12/13	1	08:54	14	87	1470	420	Y	GN	1435
13/12/13	1	09:09	1	120	135	0	Y	GN	1436
13/12/13	1	09:10	6	65	450	0	N	GN	1437
13/12/13	1	09:15	10	10	300	0	N	GN	1438
13/12/13	1	09:37	18	10	540	540	Y	GN	1440
13/12/13	1	09:46	46	187	8970	0	N	GN	1441
13/12/13	1	10:00	23	108	2760	0	Y	GN	1442
07/01/14	1	08:25	27	140	4050	4050	N	CC	1452
20/01/14	1	13:38	46	45	2760	2070	N	EF	1458
06/02/14	1	14:21	120	240	30600	30600	Y	SJ	1476
06/02/14	1	14:32	20	20	600	0	N	SJ	1477
06/02/14	1	15:16	50	120	7500	6000	N	SJ	1479
06/02/14	1	15:58	125	150	20625	20625	N	SJ	1481
06/02/14	1	15:59	60	60	4500	4500	N	SJ	1482

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
07/02/14	1	07:44	1	135	150	150	Y	SJ	1484
07/02/14	1	07:44	2	30	90	90	N	SJ	1485
07/02/14	1	07:48	10	15	300	0	N	SJ	1486
07/02/14	1	07:53	8	170	1440	1440	Y	SJ	1487
07/02/14	1	08:23	5	60	375	375	Y	SJ	1488
07/02/14	1	09:45	24	70	2160	1440	N	SJ	1492

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: GN = Glenn Norris; SJ = Steven Johnston

Table A2.9. Whooper swan flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
21/01/14	1	10:30	3	60	225	0	N	EF	1474

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: EF = Eamonn Flood

Table A2.10. Pink-footed goose flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
13/12/13	1	10:28	5	80	450	75	N	GN	1443
20/02/14	1	16:40	25	15	750	0	N	SJ	1501
20/02/14	1	18:03	650	65	48750	29250	N	SJ	1502

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: GN = Glenn Norris; SJ = Steven Johnston

Table A2.11. Unidentified goose flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
12/12/13	1	15:16	200	100	24000	0	N	GN	1426

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
13/12/13	1	10:36	7	7	105	0	N	GN	1444
13/12/13	1	10:46	3	60	225	0	N	GN	1445
20/01/14	1	16:01	20	60	1500	0	N	EF	1467
21/02/14	1	08:40	70	130	10500	1050	N	EF	1532

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: EF = Eamonn Flood; GN = Glenn Norris

Wildfowl Flights Spring Migration Season 2014

Table A2.12. Greylag goose flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
05/03/14	1	08:30	6	15	180	0	N	SJ	1515
05/03/14	1	08:31	5	60	375	375	N	SJ	1516
01/04/14	1	07:34	50	45	3000	1500	N	GN	1587
01/04/14	1	09:19	200	250	51000	6000	N	GN	1603
01/04/14	1	09:34	4	150	660	180	Y	GN	1604
14/04/14	1	19:54	80	238	21600	0	N	GN	1709
14/04/14	1	20:27	12	73	1080	540	Y	GN	1713
14/04/14	1	20:38	5	48	300	0	Y	GN	1715
14/04/14	1	21:00	20	130	3000	1200	Y	GN	1876
15/04/14	1	07:03	13	37	780	0	Y	GN	1631
15/04/14	1	11:51	11	41	495	495	Y	GN	1680
15/04/14	1	11:54	6	21	180	180	N	GN	1681
15/04/14	1	12:42	2	71	240	0	Y	GN	1688
15/04/14	1	12:56	8	21	240	0	N	GN	1689

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: GN = Glenn Norris; SJ = Steven Johnston

Table A2.13. Whooper swan flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
05/03/14	1	10:07	5	75	450	450	N	SJ	1526

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: SJ = Steven Johnston

Table A2.14. Pink-footed goose flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
04/03/14	1	18:15	2	40	120	0	N	EF	1512
05/03/14	1	09:17	29	480	14355	14355	N	SJ	1522
05/03/14	1	09:30	32	100	3840	3840	N	SJ	1523
05/03/14	1	10:32	25	185	4875	4875	Y	SJ	1530
14/04/14	1	20:25	50	90	5250	750	N	GN	1711
14/04/14	1	20:26	70	65	5250	1050	Y	GN	1712
14/04/14	1	21:11	150	65	11250	0	N	GN	1877
14/04/14	1	21:21	1500	120	202500	0	N	GN	1878
14/04/14	1	21:21	50	90	5250	0	N	GN	1879
14/04/14	1	21:22	25	90	2625	0	N	GN	1880
14/04/14	1	21:22	30	90	3150	0	N	GN	1881
15/04/14	1	07:01	31	57	2325	2325	Y	GN	1630
15/04/14	1	07:20	1	38	45	45	Y	GN	1639
15/04/14	1	08:54	1	34	45	45	Y	GN	1661
15/04/14	1	09:11	11	59	825	0	N	GN	1664
15/04/14	1	09:12	1	15	30	0	Y	GN	1665
15/04/14	1	09:13	100	90	10500	9000	Y	GN	1666
15/04/14	1	10:37	35	75	3150	3150	N	GN	1668
15/04/14	1	10:49	3	90	315	315	Y	GN	1671
15/04/14	1	11:06	1	50	60	0	Y	GN	1675
15/04/14	1	11:14	1	15	30	30	N	GN	1677
15/04/14	1	12:00	40	50	2400	2400	N	GN	1682
15/04/14	1	12:25	1	60	75	0	Y	GN	1684
15/04/14	1	12:29	1	35	45	0	N	GN	1686
15/04/14	1	13:00	34	63	2550	0	Y	GN	1690
15/04/14	1	13:01	40	65	3000	0	Y	GN	1691
17/04/14	1	08:33	1	5	15	0	Y	GN	1723
02/05/14	1	07:11	7	195	1470	1470	N	SJ	1760

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: EF = Eamonn Flood; GN = Glenn Norris; SJ = Steven Johnston

Wildfowl Flights Summer 2014

Table A2.15. Greylag goose flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
10/06/14	1	18:42	4	90	420	0	N	SJ	1975
12/06/14	1	14:13	7	90	735	735	N	GN	2056

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: GN = Glenn Norris; SJ = Steven Johnston

Hen Harrier Flights

Table A2.16. Hen harrier flights (non-breeding season 2012-13)

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
16/10/12	1	12:14	1	240	255	0	Y	CC	1132
15/11/12	1	09:12	1	156	165	0	Y	CC	1173
15/11/12	1	09:14	1	90	105	0	Y	CC	1174
15/11/12	1	09:23	1	17	30	0	N	CC	1175

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine

[no flights in Breeding Season 2013]

Table A2.17. Hen harrier flights (non-breeding season 2013-14)

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
27/09/13	1	07:48	1	71	90	0	Y	GN	1327
15/10/13	1	17:50	1	172	180	0	Y	CC	1347
15/10/13	1	17:53	1	17	30	0	Y	CC	1348
15/10/13	1	17:54	1	46	60	15	Y	CC	1349
15/10/13	1	18:58	1	29	30	0	Y	CC	1352
15/11/13	1	09:54	1	180	195	0	Y	CC	1414
28/11/13	1	14:32	1	35	45	0	Y	CC	1416
06/01/14	1	15:35	1	42	45	0	Y	EF	1457
07/01/14	1	09:45	36	36	1620	0	Y	CC	1455
06/02/14	1	15:23	1	25	45	0	Y	SJ	1480
20/02/14	1	15:44	1	10	30	0	Y	SJ	1498
21/02/14	1	09:02	1	7	15	0	Y	EF	1533
05/03/14	1	08:44	1	45	60	0	Y	SJ	1519

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GN = Glenn Norris; SJ = Steven Johnston

Table A2.18. Hen harrier flights (breeding season 2014)

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
20/03/14	1	18:14	1	40	60	0	Y	EF	1554
06/08/14	1	16:08	1	10	30	0	Y	EF	2121

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: EF = Eamonn Flood

Wader Winter Non-Breeding Season Flights 2012-13

Table A2.19. Curlew flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
30/09/12	1	07:49	1	30	45	45	Y	SJ	1149
15/10/12	1	17:40	1	57	60	45	Y	CC	1135

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine, SJ = Steven Johnston

Table A2.20. Lapwing flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
15/10/12	1	18:27	2	22	60	30	N	CC	1136
16/10/12	1	11:03	12	127	1620	1620	Y	CC	1130
16/10/12	1	11:34	16	190	3120	3120	N	CC	1131
15/11/12	1	12:55	39	87	3510	3510	N	CC	1191
12/02/13	1	14:26	8	5	240	0	N	SJ	1201
12/02/13	1	14:46	8	45	480	480	N	SJ	1202

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine, SJ = Steven Johnston

Table A2.21. Oystercatcher flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
15/11/12	1	09:04	10	78	900	900	N	CC	1171

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine

Table A2.22. Redshank flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
16/11/12	1	08:19	5	127	675	600	Y	CC	1181

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine

Table A2.23. Snipe flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
16/10/12	1	18:50	2	32	90	0	Y	CC	1156
16/10/12	1	18:59	1	20	30	30	Y	CC	1157
15/11/12	1	07:52	1	16	30	0	N	CC	1162
16/11/12	1	08:40	2	189	390	240	Y	CC	1184

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine

Table A2.24. Golden Plover flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
16/10/12	1	17:14	2	100	240	150	Y	CC	1151
16/10/12	1	17:20	2	42	90	0	Y	CC	1152
16/10/12	1	17:37	4	42	180	0	Y	CC	1154

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine

Table A2.25. Ringed plover flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
29/09/12	1	17:42	12	30	540	0	Y	SJ	1146
10/12/12	1	13:27	18	100	2160	1080	Y	EF	1194

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
10/12/12	1	13:37	24	19	720	360	Y	EF	1195
10/12/12	1	13:42	10	17	150	150	Y	EF	1196

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: EF = Eamonn Flood, SJ = Steven Johnston.

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Table A2.26. Curlew flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
04/05/13	1	18:06	1	3	15	0	Y	TE	1204
04/05/13	1	19:49	1	10	15	0	Y	TE	1216
05/05/13	1	14:49	1	11	15	0	Y	TE	1219
05/05/13	1	15:15	1	11	15	0	Y	TE	1224
05/05/13	1	15:26	1	8	15	0	Y	TE	1225
05/05/13	1	15:46	1	58	60	45	Y	TE	1226
05/05/13	1	15:48	1	11	15	0	Y	TE	1227
05/05/13	1	16:09	1	36	45	30	Y	TE	1229
05/05/13	1	16:09	1	66	75	60	Y	TE	1230
28/05/13	1	18:36	1	18	30	15	Y	TE	1255
28/05/13	1	18:48	1	23	30	15	Y	TE	1258
29/05/13	1	09:33	1	24	30	15	Y	TE	1242
29/05/13	1	10:53	1	10	15	0	Y	TE	1248
31/05/13	1	08:38	1	37	45	15	Y	TE	1265
31/05/13	1	09:41	2	46	120	120	Y	TE	1271
31/05/13	1	12:08	1	21	30	0	Y	TE	1237
16/06/13	1	18:19	1	70	75	60	Y	RJ	1283
16/06/13	1	19:34	1	125	135	120	Y	RJ	1286
16/06/13	1	20:08	1	15	30	0	Y	RJ	1289
17/06/13	1	07:49	1	16	30	0	Y	GK	1292
17/06/13	1	07:50	1	21	30	0	Y	GK	1293
17/06/13	1	08:44	1	21	30	15	Y	GK	1299
17/06/13	1	09:58	5	50	300	75	Y	RJ	1304
17/06/13	1	10:02	1	50	60	45	Y	RJ	1305
17/06/13	1	10:04	1	15	30	0	Y	RJ	1306
17/06/13	1	10:04	1	45	60	30	Y	RJ	1307

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
17/06/13	1	10:05	2	31	90	30	Y	RJ	1308
17/06/13	1	10:52	1	103	105	60	Y	RJ	1315

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: GK = Gus Keys; RJ = Rebecca Johnson; TE = Tom Edwards

Table A2.27. Lapwing flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
04/05/13	1	17:56	1	6	15	0	Y	TE	1203
04/05/13	1	18:07	1	5	15	0	Y	TE	1205
04/05/13	1	18:33	1	14	15	0	Y	TE	1206
04/05/13	1	18:34	1	204	225	90	Y	TE	1207
04/05/13	1	18:34	3	14	45	0	Y	TE	1208
04/05/13	1	18:36	1	17	30	0	Y	TE	1209
04/05/13	1	19:08	1	10	15	0	Y	TE	1210
04/05/13	1	19:21	2	81	210	60	Y	TE	1211
04/05/13	1	19:36	1	21	30	0	Y	TE	1212
04/05/13	1	19:43	1	19	30	0	Y	TE	1213
04/05/13	1	19:45	1	26	30	0	Y	TE	1214
04/05/13	1	19:48	1	25	30	0	Y	TE	1215
05/05/13	1	14:45	1	20	30	0	Y	TE	1217
05/05/13	1	14:48	2	18	60	30	Y	TE	1218
05/05/13	1	14:52	1	10	15	0	Y	TE	1220
05/05/13	1	15:02	1	35	45	30	Y	TE	1221
05/05/13	1	15:04	2	23	60	0	Y	TE	1222
05/05/13	1	15:10	1	16	30	0	Y	TE	1223
05/05/13	1	16:29	1	7	15	0	Y	TE	1231
28/05/13	1	17:29	1	28	30	0	N	TE	1249
28/05/13	1	17:45	1	10	15	0	Y	TE	1250
28/05/13	1	18:01	1	17	15	0	Y	TE	1251
28/05/13	1	18:27	2	25	60	0	Y	TE	1253
28/05/13	1	18:30	1	10	15	0	Y	TE	1254
28/05/13	1	18:39	1	12	15	0	Y	TE	1256
28/05/13	1	18:41	1	20	30	0	Y	TE	1257
28/05/13	1	18:53	2	26	60	0	Y	TE	1259
28/05/13	1	19:10	2	18	60	0	Y	TE	1260
29/05/13	1	09:14	1	3	15	0	Y	TE	1240
29/05/13	1	09:26	1	20	30	0	Y	TE	1241

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
29/05/13	1	09:45	1	19	30	0	Y	TE	1243
29/05/13	1	10:16	1	7	15	0	Y	TE	1244
29/05/13	1	10:35	1	8	15	0	Y	TE	1245
29/05/13	1	10:44	2	16	60	30	Y	TE	1246
29/05/13	1	10:44	1	12	15	0	Y	TE	1247
31/05/13	1	08:17	4	41	180	0	Y	TE	1261
31/05/13	1	08:19	2	65	150	90	Y	TE	1262
31/05/13	1	08:29	1	8	15	0	Y	TE	1264
31/05/13	1	09:03	1	8	15	0	Y	TE	1266
31/05/13	1	09:23	2	108	240	0	Y	TE	1269
31/05/13	1	09:58	2	10	30	0	Y	TE	1274
31/05/13	1	10:02	2	60	150	0	Y	TE	1275
31/05/13	1	10:08	1	25	30	0	Y	TE	1276
31/05/13	1	10:10	1	8	15	0	Y	TE	1277
31/05/13	1	10:13	1	8	15	0	Y	TE	1278
31/05/13	1	10:14	1	6	15	0	Y	TE	1279
31/05/13	1	11:46	1	9	15	0	Y	TE	1235
31/05/13	1	12:18	1	17	30	0	Y	TE	1238
31/05/13	1	12:31	1	32	45	0	N	TE	1239
15/06/13	1	21:10	2	24	60	0	Y	GK	1281
15/06/13	1	21:18	1	13	15	0	Y	GK	1282
16/06/13	1	18:51	1	25	30	0	Y	RJ	1284
16/06/13	1	19:05	1	36	45	0	N	RJ	1285
16/06/13	1	19:54	1	20	30	0	Y	RJ	1287
16/06/13	1	20:05	1	32	45	15	Y	RJ	1288
17/06/13	1	07:45	1	15	30	0	Y	GK	1290
17/06/13	1	07:48	2	47	120	0	Y	GK	1291
17/06/13	1	07:52	1	27	30	0	Y	GK	1294
17/06/13	1	08:13	1	13	15	0	Y	GK	1295
17/06/13	1	08:15	2	23	60	0	Y	GK	1296
17/06/13	1	09:00	1	14	15	0	Y	GK	1300
17/06/13	1	09:08	2	37	90	0	Y	GK	1301
17/06/13	1	09:10	1	62	75	45	Y	GK	1302
17/06/13	1	09:13	49	97	5145	1470	N	GK	1303
17/06/13	1	10:10	1	19	30	0	Y	RJ	1309
17/06/13	1	10:13	1	36	45	0	Y	RJ	1310
17/06/13	1	11:03	1	30	30	0	N	RJ	1316
17/06/13	1	11:08	1	10	15	0	Y	RJ	1317
17/06/13	1	11:25	1	7	15	0	Y	RJ	1319
31/07/13	1	04:59	55	76	4950	1650	N	GK	1324

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: GK = Gus Keys; RJ = Rebecca Johnson; TE = Tom Edwards

Table A2.28. Oystercatcher flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
31/05/13	1	10:53	1	10	15	0	Y	TE	1232
17/06/13	1	08:38	1	7	15	0	Y	GK	1297
17/06/13	1	08:41	1	42	45	0	Y	GK	1298

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: GK = Gus Keys; TE = Tom Edwards

Table A2.28. Redshank flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
28/05/13	1	18:17	1	35	45	15	Y	TE	1252
31/05/13	1	09:14	1	15	15	0	Y	TE	1267
31/05/13	1	09:54	1	19	30	15	Y	TE	1273
31/05/13	1	10:58	1	27	30	15	Y	TE	1233

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: TE = Tom Edwards

Table A2.29. Snipe flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
31/05/13	1	09:17	1	220	240	225	Y	TE	1268
31/05/13	1	09:29	1	135	150	135	Y	TE	1270
31/05/13	1	09:47	3	285	945	945	Y	TE	1272
31/05/13	1	11:59	1	35	45	45	Y	TE	1236
17/06/13	1	10:26	2	120	270	270	Y	RJ	1312
17/06/13	1	10:28	3	45	180	180	Y	RJ	1313

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: RJ = Rebecca Johnson; TE = Tom Edwards

Table A2.30. Golden Plover flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
17/06/13	1	10:18	4	55	240	240	Y	RJ	1311
31/07/13	1	05:10	2	26	60	60	Y	GK	1325
31/07/13	1	06:10	3	46	180	0	N	GK	1326

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: GK = Gus Keys; RJ = Rebecca Johnson

Table A2.31. Ringed plover flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
17/06/13	1	11:32	1	50	60	30	Y	RJ	1320

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: RJ = Rebecca Johnson

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Table A2.32. Curlew flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
24/12/13	1	09:34	1	55	60	30	Y	EF	1446
21/01/14	1	09:31	1	15	30	0	Y	EF	1469

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: EF = Eamonn Flood

Table A2.33. Lapwing flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
01/10/13	1	08:39	42	197	8820	7560	N	CC	1339
26/10/13	1	17:25	1	90	105	60	N	EF	1371
26/10/13	1	17:26	1	15	30	15	N	EF	1372
28/10/13	1	15:46	16	198	3360	240	N	CC	1376
29/10/13	1	07:42	40	30	1800	1800	N	CC	1389
29/11/13	1	08:50	18	37	810	270	N	CC	1418
13/12/13	1	08:50	13	20	390	195	Y	GN	1434
13/12/13	1	09:29	50	60	3750	0	N	GN	1439
24/12/13	1	09:36	16	40	960	240	Y	EF	1447
24/12/13	1	09:36	20	40	1200	600	Y	EF	1448
06/01/14	1	15:29	70	367	26250	14700	N	EF	1456
07/01/14	1	09:10	300	210	67500	0	Y	CC	1454
20/01/14	1	14:19	250	240	63750	56250	N	EF	1459
20/01/14	1	14:38	250	360	97500	67500	N	EF	1460
20/01/14	1	14:56	250	200	56250	30000	N	EF	1461
20/01/14	1	15:04	300	1155	351000	135000	N	EF	1462
20/01/14	1	15:25	70	660	48300	17850	N	EF	1463
20/01/14	1	15:37	70	120	9450	7350	N	EF	1464
20/01/14	1	15:37	30	180	5850	4950	N	EF	1465
20/01/14	1	15:39	100	60	7500	4500	N	EF	1466
21/01/14	1	09:29	30	60	2250	1350	N	EF	1468
21/01/14	1	09:33	12	45	540	180	N	EF	1470
21/01/14	1	09:35	100	60	7500	4500	N	EF	1471
21/01/14	1	09:35	20	45	1200	300	N	EF	1472
21/01/14	1	09:43	60	213	13500	3600	N	EF	1473
21/01/14	1	10:35	60	45	3600	1800	N	EF	1475
06/02/14	1	14:41	150	135	22500	15750	N	SJ	1478
06/02/14	1	16:32	65	185	12675	12675	N	SJ	1483
07/02/14	1	08:40	24	30	1080	1080	Y	SJ	1489
07/02/14	1	08:41	80	60	6000	4800	Y	SJ	1490
07/02/14	1	08:42	20	60	1500	1200	Y	SJ	1491
07/02/14	1	10:20	1	30	45	45	Y	SJ	1494
07/02/14	1	10:35	300	120	40500	22500	N	SJ	1495
20/02/14	1	15:41	35	65	2625	1575	N	SJ	1497
20/02/14	1	15:57	50	160	9000	6750	N	SJ	1499
21/02/14	1	09:03	50	140	7500	1500	N	EF	1534

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; EF =Eamonn Flood; GN = Glenn Norris; SJ = Steven Johnston

Table A2.34. Redshank flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
15/10/13	1	16:24	1	280	285	30	Y	CC	1345
15/10/13	1	18:10	1	90	105	30	Y	CC	1351
16/10/13	1	06:58	1	35	45	0	Y	CC	1355
16/10/13	1	08:54	15	142	2250	450	Y	CC	1363

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine

Table A2.35. Dunlin flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
27/09/13	1	08:01	4	55	300	240	Y	GN	1328
27/09/13	1	08:16	10	42	600	150	N	GN	1330
27/09/13	1	09:03	19	61	1425	285	Y	GN	1331
30/09/13	1	19:35	2	42	90	0	Y	CC	1333
01/10/13	1	07:58	2	62	150	30	Y	CC	1335
16/10/13	1	07:15	1	33	45	0	Y	CC	1356
28/10/13	1	17:02	1	30	45	0	Y	CC	1381

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; GN = Glenn Norris

Table A2.36. Golden Plover flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
01/10/13	1	08:29	2	17	60	0	N	CC	1336
01/10/13	1	08:30	2	9	30	0	N	CC	1337
01/10/13	1	08:31	2	6	30	0	Y	CC	1338
01/10/13	1	08:45	7	67	525	105	Y	CC	1340
01/10/13	1	08:49	26	121	3510	1560	Y	CC	1342

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
01/10/13	1	09:03	6	96	630	180	Y	CC	1343
28/10/13	1	17:20	5	37	225	0	Y	CC	1383
29/10/13	1	06:16	11	32	495	0	Y	CC	1384
29/10/13	1	07:35	26	220	5850	780	Y	CC	1388
29/10/13	1	08:20	200	90	21000	9000	N	CC	1392
14/11/13	1	15:35	150	300	47250	2250	N	CC	1400
29/11/13	1	09:14	46	100	4830	0	Y	CC	1419
29/11/13	1	09:17	46	40	2070	0	Y	CC	1420
29/11/13	1	09:25	12	30	540	0	Y	CC	1421
29/11/13	1	09:39	6	56	360	0	Y	CC	1422
29/11/13	1	09:45	6	20	180	0	Y	CC	1423
07/01/14	1	08:46	20	20	1200	0	N	CC	1453

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine

Table A2.37. Ringed plover flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
15/11/13	1	07:54	2	40	90	0	Y	CC	1403
21/02/14	1	09:40	5	5	75	0	Y	EF	1535

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; EF = Eamonn Flood

Table A2.38. Snipe flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
30/09/13	1	19:41	1	21	30	0	Y	CC	1334
15/10/13	1	18:02	1	58	60	15	Y	CC	1350
16/10/13	1	06:56	1	10	15	0	Y	CC	1353
16/10/13	1	06:57	1	30	45	0	Y	CC	1354
16/10/13	1	08:59	2	37	90	60	Y	CC	1365
16/10/13	1	09:50	1	25	30	15	Y	CC	1370
26/10/13	1	19:45	1	5	15	0	Y	EF	1375

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
28/10/13	1	16:02	2	42	90	30	Y	CC	1378
28/10/13	1	17:10	1	16	30	0	N	CC	1382
28/11/13	1	14:32	1	10	15	0	Y	CC	1415
24/12/13	1	10:27	1	5	15	0	Y	EF	1449
24/12/13	1	10:38	1	2	15	0	Y	EF	1450
24/12/13	1	10:44	1	10	30	15	Y	EF	1451

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; EF = Eamonn Flood

Wader Breeding Season Flights 2014

Table A2.39. Curlew flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
04/03/14	1	17:16	1	55	75	0	Y	EF	1511
05/03/14	1	09:12	1	9	30	0	Y	SJ	1521
21/03/14	1	07:35	1	5	15	0	Y	EF	1559
21/03/14	1	08:01	1	4	15	0	Y	EF	1564
21/03/14	1	08:01	1	3	15	0	Y	EF	1565
31/03/14	1	17:59	2	46	90	60	Y	GN	1616
31/03/14	1	18:24	1	31	45	15	Y	GN	1619
31/03/14	1	18:25	1	6	15	0	Y	GN	1620
31/03/14	1	18:29	1	49	60	30	Y	GN	1621
01/04/14	1	08:49	1	221	240	0	Y	GN	1599
15/04/14	1	07:18	1	15	15	0	Y	GN	1638
15/04/14	1	07:39	1	100	105	105	Y	GN	1645
15/04/14	1	08:06	1	59	60	30	Y	GN	1651
15/04/14	1	08:40	2	42	120	120	Y	GN	1656
15/04/14	1	08:41	2	12	30	0	Y	GN	1657
15/04/14	1	09:05	1	20	30	0	Y	GN	1662
15/04/14	1	10:40	1	32	45	15	Y	GN	1669
17/04/14	1	09:50	1	41	45	0	Y	GN	1733
17/04/14	1	09:55	1	65	75	0	Y	GN	1734
17/04/14	1	10:01	1	15	30	0	Y	GN	1735
01/05/14	1	16:52	2	35	90	0	Y	SJ	1744
01/05/14	1	17:06	1	28	45	0	Y	SJ	1745

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
01/05/14	1	17:38	16	110	1920	1920	N	SJ	1749
01/05/14	1	18:33	2	60	150	90	N	SJ	1752
02/05/14	1	07:18	1	64	75	45	Y	SJ	1762
02/05/14	1	08:27	1	75	90	75	Y	SJ	1777
02/05/14	1	08:35	2	25	90	0	Y	SJ	1780
02/05/14	1	09:17	1	90	105	75	Y	SJ	1790
02/05/14	1	09:18	1	45	60	30	Y	SJ	1791
02/05/14	1	09:26	1	45	60	30	Y	SJ	1792
02/05/14	1	09:52	1	85	105	75	Y	SJ	1800
12/05/14	1	19:38	1	15	30	15	Y	EF	1835
12/05/14	1	19:45	1	29	45	30	Y	EF	1838
12/05/14	1	19:57	1	42	60	45	Y	EF	1842
12/05/14	1	20:02	1	15	30	15	Y	EF	1844
12/05/14	1	20:24	1	20	30	0	Y	EF	1849
12/05/14	1	20:29	1	60	60	15	Y	EF	1852
12/05/14	1	20:30	1	30	45	30	Y	EF	1853
12/05/14	1	20:30	2	4	30	0	Y	EF	1854
12/05/14	1	21:04	1	15	30	0	Y	EF	1870
12/05/14	1	21:05	1	35	45	15	Y	EF	1871
27/05/14	1	20:21	1	35	45	0	N	CC	1910
28/05/14	1	08:19	1	5	15	15	N	CC	1936
10/06/14	1	17:28	1	31	45	15	N	SJ	1960
10/06/14	1	19:46	1	25	45	0	Y	SJ	1986
10/06/14	1	19:47	1	35	45	0	Y	SJ	1987
10/06/14	1	20:07	1	75	90	90	Y	SJ	1991
10/06/14	1	20:09	1	120	135	135	Y	SJ	1992
10/06/14	1	20:09	2	64	150	150	Y	SJ	1993
11/06/14	1	13:56	1	4	15	0	Y	SJ	2001
11/06/14	1	13:56	1	15	30	0	Y	SJ	2002
11/06/14	1	14:12	2	10	60	0	N	SJ	2008
12/06/14	1	11:03	1	34	45	0	N	GN	2038
12/06/14	1	11:11	1	28	30	0	Y	GN	2039
12/06/14	1	11:13	1	132	135	45	Y	GN	2040
12/06/14	1	14:10	1	25	30	0	Y	GN	2054
01/07/14	1	18:14	1	30	45	45	Y	EF	2085
02/07/14	1	11:15	1	230	240	240	Y	EF	2068
21/07/14	1	19:54	1	80	90	90	Y	EF	2115

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GN = Glenn Norris; SJ = Steven Johnston

Table A2.40. Lapwing flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
04/03/14	1	15:32	1	210	225	105	Y	EF	1505
04/03/14	1	15:53	1	15	30	0	Y	EF	1506
04/03/14	1	15:57	1	10	30	15	Y	EF	1507
04/03/14	1	16:28	24	38	1440	360	N	EF	1508
04/03/14	1	16:45	4	20	180	0	Y	EF	1509
04/03/14	1	16:50	1	2	15	0	Y	EF	1510
05/03/14	1	08:12	7	75	630	210	Y	SJ	1514
05/03/14	1	08:43	1	10	30	0	Y	SJ	1517
05/03/14	1	08:44	2	15	60	0	Y	SJ	1518
05/03/14	1	08:45	9	60	675	135	Y	SJ	1520
05/03/14	1	09:31	1	10	30	0	Y	SJ	1524
05/03/14	1	10:02	2	20	60	0	Y	SJ	1525
05/03/14	1	10:21	1	8	30	0	N	SJ	1527
05/03/14	1	10:25	1	10	30	0	Y	SJ	1528
20/03/14	1	15:59	1	26	45	0	Y	EF	1537
20/03/14	1	15:59	1	5	15	0	Y	EF	1538
20/03/14	1	15:59	1	5	15	0	Y	EF	1539
20/03/14	1	16:09	1	140	150	90	Y	EF	1541
20/03/14	1	16:11	1	10	30	0	Y	EF	1542
20/03/14	1	16:38	1	8	15	0	Y	EF	1545
20/03/14	1	16:39	1	4	15	0	Y	EF	1546
20/03/14	1	16:42	1	40	60	15	Y	EF	1548
20/03/14	1	16:42	2	4	30	0	Y	EF	1549
20/03/14	1	16:47	2	10	60	0	Y	EF	1550
20/03/14	1	16:47	1	50	60	45	Y	EF	1551
20/03/14	1	17:14	1	10	30	0	Y	EF	1552
21/03/14	1	07:33	1	92	105	60	Y	EF	1557
21/03/14	1	07:33	1	84	105	15	Y	EF	1558
21/03/14	1	07:36	1	5	15	0	Y	EF	1560
21/03/14	1	07:44	1	26	30	15	Y	EF	1562
21/03/14	1	07:44	1	26	30	0	Y	EF	1563
21/03/14	1	08:03	1	10	15	0	Y	EF	1566
21/03/14	1	08:23	1	58	75	0	Y	EF	1567
21/03/14	1	08:32	1	57	75	15	Y	EF	1568
21/03/14	1	08:32	1	57	75	45	Y	EF	1569
21/03/14	1	08:37	1	19	30	0	Y	EF	1570
21/03/14	1	08:40	1	10	30	0	Y	EF	1571
21/03/14	1	08:42	2	12	60	0	Y	EF	1572

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
21/03/14	1	08:50	1	16	30	0	Y	EF	1575
21/03/14	1	08:50	1	16	30	0	Y	EF	1576
21/03/14	1	08:52	1	40	60	0	Y	EF	1577
21/03/14	1	08:52	3	28	135	0	Y	EF	1578
21/03/14	1	08:58	1	14	45	0	Y	EF	1579
21/03/14	1	08:58	1	28	45	0	Y	EF	1580
21/03/14	1	09:00	1	16	30	0	Y	EF	1581
21/03/14	1	09:07	2	30	90	30	Y	EF	1582
21/03/14	1	09:08	1	48	60	15	Y	EF	1583
21/03/14	1	09:18	1	31	60	15	Y	EF	1584
21/03/14	1	09:28	1	30	45	0	Y	EF	1585
31/03/14	1	17:00	1	5	15	0	Y	GN	1607
31/03/14	1	17:04	1	6	15	0	Y	GN	1608
31/03/14	1	17:23	1	5	15	0	Y	GN	1611
31/03/14	1	17:34	1	10	15	15	Y	GN	1612
31/03/14	1	17:39	1	9	15	15	Y	GN	1613
31/03/14	1	18:19	2	9	30	0	Y	GN	1618
31/03/14	1	18:43	3	11	45	0	Y	GN	1623
31/03/14	1	18:53	2	33	90	0	Y	GN	1625
01/04/14	1	07:25	2	25	60	0	Y	GN	1586
01/04/14	1	07:51	2	7	30	0	Y	GN	1588
01/04/14	1	07:54	2	49	120	0	Y	GN	1590
01/04/14	1	08:02	4	131	540	300	Y	GN	1592
01/04/14	1	08:34	1	12	15	0	Y	GN	1596
01/04/14	1	08:39	1	20	30	0	Y	GN	1597
01/04/14	1	08:41	1	29	30	0	Y	GN	1598
01/04/14	1	09:14	3	31	135	90	Y	GN	1602
14/04/14	1	18:41	1	5	15	0	Y	GN	1693
14/04/14	1	18:43	3	38	135	0	Y	GN	1694
14/04/14	1	18:50	1	4	15	0	Y	GN	1695
14/04/14	1	18:51	1	3	15	0	Y	GN	1696
14/04/14	1	19:02	1	11	15	0	Y	GN	1697
14/04/14	1	19:32	2	23	60	0	Y	GN	1702
14/04/14	1	19:35	1	7	15	0	Y	GN	1704
14/04/14	1	20:33	2	13	30	0	Y	GN	1714
15/04/14	1	06:43	1	7	15	0	Y	GN	1628
15/04/14	1	07:08	1	34	45	0	Y	GN	1632
15/04/14	1	07:09	1	58	75	0	Y	GN	1633
15/04/14	1	07:09	1	24	45	0	Y	GN	1634
15/04/14	1	07:09	1	47	60	0	Y	GN	1635
15/04/14	1	07:15	2	11	30	0	Y	GN	1637
15/04/14	1	07:21	2	10	30	0	Y	GN	1640

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
15/04/14	1	07:26	2	34	90	0	Y	GN	1642
15/04/14	1	07:38	3	15	45	0	Y	GN	1644
15/04/14	1	07:45	1	30	30	0	Y	GN	1646
15/04/14	1	07:51	1	5	15	0	Y	GN	1647
15/04/14	1	08:00	2	10	30	0	Y	GN	1650
15/04/14	1	08:19	2	10	30	0	Y	GN	1652
15/04/14	1	08:20	1	5	15	0	Y	GN	1653
15/04/14	1	08:28	5	25	150	0	Y	GN	1655
15/04/14	1	08:45	1	31	45	0	Y	GN	1658
15/04/14	1	09:25	1	3	15	0	Y	GN	1667
15/04/14	1	10:53	1	25	30	0	Y	GN	1672
15/04/14	1	11:32	2	41	90	0	Y	GN	1678
15/04/14	1	12:20	1	300	270	0	Y	GN	1683
17/04/14	1	07:55	1	5	15	0	Y	GN	1717
17/04/14	1	08:05	2	15	60	0	Y	GN	1718
17/04/14	1	08:07	1	3	15	0	Y	GN	1719
17/04/14	1	08:22	1	5	15	0	Y	GN	1721
17/04/14	1	08:49	2	35	90	0	Y	GN	1725
17/04/14	1	09:06	1	8	15	0	Y	GN	1727
17/04/14	1	09:11	1	9	15	0	Y	GN	1729
17/04/14	1	09:14	1	9	15	0	Y	GN	1730
17/04/14	1	09:46	1	4	15	0	Y	GN	1731
01/05/14	1	16:37	1	125	135	0	Y	SJ	1739
01/05/14	1	16:37	3	30	135	0	Y	SJ	1740
01/05/14	1	16:42	1	15	30	0	Y	SJ	1741
01/05/14	1	16:42	2	60	150	0	Y	SJ	1742
01/05/14	1	16:46	3	75	270	45	Y	SJ	1743
01/05/14	1	17:06	5	45	300	0	Y	SJ	1746
01/05/14	1	17:55	2	15	60	0	Y	SJ	1750
01/05/14	1	18:08	1	29	45	0	Y	SJ	1751
01/05/14	1	18:43	1	53	75	0	Y	SJ	1753
01/05/14	1	18:52	1	140	150	75	Y	SJ	1754
01/05/14	1	18:54	1	60	75	30	Y	SJ	1755
01/05/14	1	18:54	4	60	300	0	Y	SJ	1756
02/05/14	1	07:16	1	30	45	45	Y	SJ	1761
02/05/14	1	07:36	1	115	135	90	N	SJ	1764
02/05/14	1	07:51	2	20	60	0	Y	SJ	1767
02/05/14	1	07:51	1	75	90	0	Y	SJ	1768
02/05/14	1	07:56	2	30	90	0	Y	SJ	1769
02/05/14	1	07:56	2	220	480	270	Y	SJ	1770
02/05/14	1	08:01	1	135	150	15	Y	SJ	1771
02/05/14	1	08:07	2	180	390	0	Y	SJ	1773

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
02/05/14	1	08:21	1	15	30	0	Y	SJ	1774
02/05/14	1	08:21	5	45	300	0	Y	SJ	1775
02/05/14	1	08:36	2	45	120	0	Y	SJ	1782
02/05/14	1	09:07	1	10	30	0	Y	SJ	1786
02/05/14	1	09:13	2	60	150	0	Y	SJ	1788
02/05/14	1	09:13	1	85	105	105	Y	SJ	1789
02/05/14	1	09:34	1	30	45	0	Y	SJ	1794
02/05/14	1	09:35	2	50	120	0	Y	SJ	1795
02/05/14	1	09:36	2	25	90	0	Y	SJ	1796
02/05/14	1	09:41	2	10	60	0	Y	SJ	1797
02/05/14	1	09:46	1	65	75	0	Y	SJ	1798
02/05/14	1	09:47	1	105	120	15	Y	SJ	1799
02/05/14	1	10:00	1	50	60	0	Y	SJ	1801
02/05/14	1	10:06	1	10	30	0	Y	SJ	1802
02/05/14	1	10:07	2	90	210	0	Y	SJ	1803
12/05/14	1	19:29	1	36	60	0	Y	EF	1831
12/05/14	1	19:34	2	48	120	60	Y	EF	1834
12/05/14	1	19:42	1	14	30	0	Y	EF	1836
12/05/14	1	19:55	1	14	30	15	Y	EF	1839
12/05/14	1	19:55	1	20	30	15	Y	EF	1840
12/05/14	1	19:56	1	10	15	0	N	EF	1841
12/05/14	1	19:58	1	14	30	0	Y	EF	1843
12/05/14	1	20:04	1	36	60	15	Y	EF	1845
12/05/14	1	20:05	1	34	60	0	Y	EF	1846
12/05/14	1	20:11	1	17	30	0	Y	EF	1847
12/05/14	1	20:23	1	180	195	0	N	EF	1848
12/05/14	1	20:28	1	76	75	60	Y	EF	1850
12/05/14	1	20:28	1	70	75	60	Y	EF	1851
12/05/14	1	20:30	2	100	240	240	Y	EF	1855
12/05/14	1	20:32	1	10	15	0	Y	EF	1856
12/05/14	1	20:45	1	36	45	30	Y	EF	1858
12/05/14	1	20:45	1	78	90	30	Y	EF	1859
12/05/14	1	20:48	1	30	45	0	Y	EF	1860
12/05/14	1	20:50	1	40	60	0	Y	EF	1861
12/05/14	1	20:51	1	32	45	0	Y	EF	1862
12/05/14	1	20:52	2	20	60	60	Y	EF	1864
12/05/14	1	20:54	1	26	45	15	Y	EF	1865
12/05/14	1	20:54	1	18	30	0	Y	EF	1866
12/05/14	1	20:56	1	15	30	0	Y	EF	1867
12/05/14	1	21:00	1	12	30	0	Y	EF	1868
12/05/14	1	21:00	1	8	15	0	Y	EF	1869
15/05/14	1	09:55	1	30	45	15	Y	SJ	1804

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
15/05/14	1	10:08	1	50	60	0	Y	SJ	1805
15/05/14	1	10:12	3	60	225	0	Y	SJ	1806
15/05/14	1	10:18	2	65	150	30	Y	SJ	1808
15/05/14	1	10:43	2	60	150	0	Y	SJ	1814
15/05/14	1	11:11	2	60	150	30	Y	SJ	1818
15/05/14	1	12:33	1	10	30	0	N	SJ	1827
27/05/14	1	17:33	1	83	90	15	Y	CC	1882
27/05/14	1	17:33	1	54	60	0	Y	CC	1883
27/05/14	1	17:50	1	27	30	0	Y	CC	1884
27/05/14	1	17:58	1	15	30	0	Y	CC	1887
27/05/14	1	18:12	1	17	30	0	Y	CC	1891
27/05/14	1	18:13	1	20	30	0	Y	CC	1892
27/05/14	1	18:19	1	21	30	0	Y	CC	1893
27/05/14	1	18:22	1	16	30	0	Y	CC	1895
27/05/14	1	18:22	1	16	30	0	Y	CC	1896
27/05/14	1	18:32	1	37	45	15	Y	CC	1900
27/05/14	1	18:33	1	25	30	0	Y	CC	1901
27/05/14	1	18:33	1	35	45	15	Y	CC	1902
27/05/14	1	19:06	1	31	45	30	Y	CC	1905
27/05/14	1	19:27	1	20	30	0	Y	CC	1908
27/05/14	1	20:27	2	70	150	30	Y	CC	1912
27/05/14	1	20:28	1	65	75	15	Y	CC	1913
27/05/14	1	20:36	1	17	30	0	N	CC	1914
27/05/14	1	20:37	1	19	30	15	N	CC	1915
27/05/14	1	20:43	1	5	15	15	Y	CC	1917
27/05/14	1	21:06	1	9	15	15	Y	CC	1921
27/05/14	1	21:06	1	16	15	0	Y	CC	1922
28/05/14	1	08:07	2	80	180	150	Y	CC	1932
28/05/14	1	08:07	2	60	150	60	Y	CC	1933
28/05/14	1	08:24	1	22	30	15	Y	CC	1937
28/05/14	1	08:26	1	17	30	0	N	CC	1938
28/05/14	1	08:27	1	5	15	0	Y	CC	1939
28/05/14	1	08:27	1	33	45	30	N	CC	1940
28/05/14	1	08:39	1	7	15	15	Y	CC	1943
28/05/14	1	08:45	1	50	60	15	Y	CC	1944
28/05/14	1	08:45	1	66	75	30	Y	CC	1945
28/05/14	1	08:53	2	110	240	60	N	CC	1947
28/05/14	1	08:57	2	72	150	30	Y	CC	1948
28/05/14	1	08:58	2	34	90	60	Y	CC	1949
28/05/14	1	09:11	2	189	390	60	Y	CC	1950
28/05/14	1	09:18	1	80	105	30	Y	CC	1951
28/05/14	1	09:20	1	38	45	15	Y	CC	1952

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
28/05/14	1	09:20	2	56	120	60	Y	CC	1953
28/05/14	1	09:28	2	111	240	150	Y	CC	1954
28/05/14	1	09:33	2	60	150	30	Y	CC	1955
28/05/14	1	09:34	1	25	30	30	Y	CC	1956
10/06/14	1	17:23	1	60	75	0	Y	SJ	1957
10/06/14	1	17:24	1	4	15	0	Y	SJ	1958
10/06/14	1	17:26	1	5	15	0	Y	SJ	1959
10/06/14	1	17:47	1	8	30	0	Y	SJ	1962
10/06/14	1	18:01	1	10	30	0	Y	SJ	1965
10/06/14	1	18:01	1	70	90	45	Y	SJ	1966
10/06/14	1	18:02	1	45	60	15	Y	SJ	1967
10/06/14	1	18:18	2	60	150	30	Y	SJ	1969
10/06/14	1	19:55	1	55	75	60	Y	SJ	1988
10/06/14	1	20:01	1	135	150	120	Y	SJ	1990
10/06/14	1	20:11	2	85	210	150	Y	SJ	1995
10/06/14	1	20:16	1	10	30	0	Y	SJ	1996
11/06/14	1	13:33	1	44	60	30	N	SJ	1999
11/06/14	1	14:00	1	30	45	30	Y	SJ	2003
11/06/14	1	14:06	1	35	45	0	Y	SJ	2004
11/06/14	1	14:09	1	30	45	0	Y	SJ	2007
11/06/14	1	14:33	1	60	75	0	Y	SJ	2009
11/06/14	1	14:50	1	60	75	45	Y	SJ	2011
11/06/14	1	14:55	1	40	45	30	Y	SJ	2012
11/06/14	1	14:59	1	30	45	15	Y	SJ	2014
11/06/14	1	15:02	2	225	480	0	Y	SJ	2015
11/06/14	1	15:08	1	60	75	0	Y	SJ	2016
11/06/14	1	16:04	1	30	45	0	Y	SJ	2025
11/06/14	1	16:27	1	45	60	45	Y	SJ	2031
12/06/14	1	09:49	1	144	150	30	Y	GN	2033
12/06/14	1	09:55	1	160	165	15	Y	GN	2034
12/06/14	1	10:07	1	24	30	0	Y	GN	2035
12/06/14	1	10:52	1	22	30	0	Y	GN	2037
12/06/14	1	11:18	1	7	15	0	Y	GN	2041
12/06/14	1	11:19	2	22	60	0	Y	GN	2042
12/06/14	1	11:26	1	18	30	0	Y	GN	2043
12/06/14	1	11:31	1	14	15	0	Y	GN	2044
12/06/14	1	12:07	2	53	120	0	Y	GN	2046
12/06/14	1	14:00	1	54	60	0	Y	GN	2053
12/06/14	1	14:42	1	56	60	30	Y	GN	2057
12/06/14	1	14:47	1	51	60	45	Y	GN	2058
12/06/14	1	14:51	1	12	15	0	Y	GN	2059
12/06/14	1	15:30	1	7	15	0	Y	GN	2061

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
12/06/14	1	15:30	1	73	75	45	Y	GN	2062
12/06/14	1	16:12	1	22	30	0	Y	GN	2064
02/07/14	1	11:43	1	29	45	15	Y	EF	2070
02/07/14	1	13:46	1	400	405	315	Y	EF	2079
02/07/14	1	13:48	1	40	45	30	Y	EF	2082
21/07/14	1	18:42	1	640	660	660	Y	EF	2096
21/07/14	1	18:49	1	180	195	165	Y	EF	2099
21/07/14	1	19:04	1	61	75	45	Y	EF	2100
21/07/14	1	19:05	1	32	45	15	Y	EF	2101
21/07/14	1	19:07	1	30	45	15	Y	EF	2102
21/07/14	1	19:20	1	160	135	90	Y	EF	2104
21/07/14	1	19:23	1	144	150	45	Y	EF	2105
21/07/14	1	19:26	1	30	45	15	Y	EF	2106
21/07/14	1	19:43	1	51	75	45	Y	EF	2108
21/07/14	1	19:44	1	19	30	15	Y	EF	2109
21/07/14	1	19:44	1	39	45	15	Y	EF	2110
21/07/14	1	19:45	1	105	120	105	Y	EF	2111
21/07/14	1	19:50	1	42	60	30	Y	EF	2113
21/07/14	1	19:53	1	60	75	30	Y	EF	2114
21/07/14	1	19:56	1	102	120	105	Y	EF	2116
21/07/14	1	20:29	1	33	45	30	Y	EF	2118
24/07/14	1	10:51	2	25	90	30	Y	SJ	2095

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GN = Glenn Norris; SJ = Steven Johnston

Table A2.41. Oystercatcher flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
02/05/14	1	09:06	1	10	30	0	Y	SJ	1785
27/05/14	1	19:02	1	89	90	0	Y	CC	1904

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; SJ = Steven Johnston

Table A2.42. Redshank flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
21/07/14	1	20:26	16	88	1440	0	N	EF	2117

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: EF = Eamonn Flood

Table A2.43. Snipe flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
28/05/14	1	07:56	1	54	60	15	Y	CC	1925
28/05/14	1	07:57	2	30	90	0	N	CC	1926
28/05/14	1	08:00	1	15	30	0	Y	CC	1928
28/05/14	1	08:01	1	15	30	30	Y	CC	1929
28/05/14	1	08:04	1	10	15	0	Y	CC	1930
28/05/14	1	08:18	1	7	15	0	Y	CC	1935
10/06/14	1	20:17	1	50	60	45	N	SJ	1997
10/06/14	1	20:19	1	40	60	60	N	SJ	1998

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; SJ = Steven Johnston

Table A2.44. Golden Plover flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
21/03/14	1	07:39	4	12	120	0	N	EF	1561
21/03/14	1	08:42	3	4	45	0	Y	EF	1573
21/03/14	1	08:48	1	3	15	0	Y	EF	1574
14/04/14	1	19:13	70	31	3150	1050	Y	GN	1699
14/04/14	1	19:14	20	41	900	300	Y	GN	1700
14/04/14	1	19:14	50	63	3750	750	Y	GN	1701
15/04/14	1	07:12	30	50	1800	0	Y	GN	1636
15/04/14	1	07:53	15	30	675	225	Y	GN	1648
15/04/14	1	10:54	55	72	4125	0	Y	GN	1673
15/04/14	1	12:26	11	20	825	0	Y	GN	1685
28/05/14	1	08:31	1	35	45	15	Y	CC	1941

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
01/07/14	1	18:52	4	18	120	0	Y	EF	2089
01/07/14	1	18:55	4	15	120	0	Y	EF	2090
24/07/14	1	10:21	3	3	45	0	Y	SJ	2094

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GN = Glenn Norris; SJ = Steven Johnston

Seabirds Flights 2012-2014

Table A2.45. Arctic skua flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
15/11/12	1	08:49	1	126	135	135	Y	CC	1170
15/11/12	1	09:47	1	40	45	0	Y	CC	1177
31/05/13	1	08:29	1	83	90	30	Y	TE	1263
17/06/13	1	11:48	1	41	45	45	N	RJ	1321
15/05/14	1	10:45	1	45	60	45	Y	SJ	1816

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; RJ = Rebecca Johnson; SJ = Steven Johnston; TE = Tom Edwards

Table A2.46. Great skua flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
05/05/13	1	15:57	1	58	60	30	Y	TE	1228
17/06/13	1	11:21	1	217	225	150	Y	RJ	1318
27/05/14	1	18:25	1	10	15	0	Y	CC	1897
27/05/14	1	18:30	1	13	15	0	N	CC	1898
27/05/14	1	20:05	1	62	75	30	N	CC	1909

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; RJ = Rebecca Johnson; TE = Tom Edwards

Table A2.47. Cormorant flights

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
07/02/14	1	10:05	1	125	135	135	N	SJ	1493
20/02/14	1	16:39	1	40	60	60	N	SJ	1500

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: SJ = Steven Johnston

APPENDIX 3: Collision Risk Modelling

This appendix provides full details of collision risk modelling. This collision risk modelling is preliminary and indicative only. It is based on the indicative turbine layout provided in August 2014, as shown in Figure 38. If the layout changes modelling will need to be repeated. The model inputs require a degree of interpretation based on the ecology of species recorded. It is therefore strongly recommended that agreement on the methodology is sought from SNH. If SNH disagree with any of the assumptions made, it may be necessary to re-run elements of the models. A number of greylag goose flights were discounted from the model, as they followed a commuting route to the east of the site and did not enter the proposed turbine area. As these flights were in close proximity to the VP location, we are confident that the location of the commuting route is accurate. However, it is possible that SNH may insist upon including these within the modelling process, in which case modelling will need to be repeated for greylag geese, and risk of collision will increase. In order to increase confidence that greylag geese using this commuting route at the east of the site are not at risk of collision, it is recommended that the easternmost turbine is relocated at least 100m to the west of the current location, ensuring a buffer around this flight corridor.

Methodology

Collision risk modelling has been undertaken for all of the target species flights at potential collision height (PCH) recorded. Therefore, collision risk modelling has been carried out for Arctic skua (breeding and non-breeding), curlew (breeding and non-breeding), dunlin (non-breeding), golden plover (breeding, non-breeding and spring migration), great skua (breeding), greylag goose (autumn migration, winter and spring migration), hen harrier (non-breeding), lapwing (breeding and non-breeding), pink-footed goose (spring migration), redshank (breeding and non-breeding), ringed plover (breeding and non-breeding) and snipe (breeding and non-breeding). However, a number of these species were recorded infrequently, and so collision risk predictions are highly precautionary.

The risk of birds colliding with the turbine rotors has been assessed using a model developed by Band, which estimates the number of bird collisions with the turbine rotors during a specified time period (Band *et al.* 2007; SNH 2000). Collision risk is calculated in two stages:

- Estimating the number of birds passing through the area or volume swept by the rotors; and
- Estimating the probability that a bird will be struck by a rotor blade when passing through the area swept by the rotors.

The first stage of calculation varies depending on whether flight activity follows a regular predictable pattern, or is random. The second stage is identical for both methods.

The modelling method for birds with regular (or predictable) flight activity, such as geese following a regular migration route or travelling from a winter roost to a regular feeding area, or divers travelling from breeding lochans to feed at sea or on larger water bodies requires the calculation of the number of bird passes through the

turbine rotor swept area each year. At Hill of Forss, only greylag geese and pink-footed geese were found to follow this flight pattern over the proposed turbine area.

The modelling method with irregular (or random) flight activity, such as raptors and waders, requires the calculation of the amount of time birds were observed flying per unit of area surveyed. This level of flight activity is then applied to the turbine area in subsequent calculations of the collision risk. This method has been applied to collision risk calculations for all other species.

Where multiple years of data have been collected for particular seasons, an average collision risk has been calculated. This average has been weighted against the proportion of available hours observed in the season during surveys, as this equates to a larger sample size and so is more likely to be an accurate representation of reality. Note that a weighted average for winter hen harrier has not been calculated. This is because the collision risk calculated from the single winter where flight activity was observed at PCH was so very low, it was not considered necessary to average this with a season of no collision risk as this would only reduce the estimate further.

The turbine model proposed for Hill of Forss Wind Farm is Nordex N90/2500 HS with a hub height of 65m and rotor diameter of 90m, with potential collision risk height (PCH) being 20-110m. However, the flight activity surveys were carried out prior to turbine model selection, and used three height bands that are not identical to the final turbine dimensions. Height band 2 covered 20-125m, which includes all of the PCH, as well as an additional 15m compared with the final candidate turbine model subsequently selected. As observer accuracy is likely to vary over such small height differences, all flights within height band 2 have been considered as PCH for the purposes of this assessment. This will provide precautionary results. Table A3.1 summarises flight activity survey height bands and the proportion of time from each band used to calculate PCH for each flight (represented as a percentage).

Table A3.1. Flight Activity Survey Height Bands and Proportion of Time used from Each to Calculate PCH.

Height band	Range (m)	Proportion of observed time at PCH (%)
1	<20	0
2	20-125	100
3	>125	0

Table A3.2 provides the turbine and wind farm specifications (obtained from client and manufacturer) used for all collision risk modelling.

Table A3.2. Nordex N90/2500 HS Turbine and Wind Farm Specifications.

Variable	Code	Quantity	Units
Hub height		65.00	m
Rotor radius	r	45.00	m
No. of turbines	x	5	
No. of rotor blades	X	3	
Risk Window Area	Arisk	11.36	ha
Risk volume	Vw	10,221,025.50	m^3
Maximum chord width	d	3.18	m
Rotation period		3.31	seconds
Average pitch*		6.00	degrees
Estimated maximum operation (BWEA 2007)		85	%

**Estimate.*

Collision risk modelling results are discussed below for predictable and random models. Species dimensions used are the average of the range published by SNH or in Birds of the Western PalaeArctic if the species is not included in the former (Provan and Whitfield 2006; Snow and Perrins 1998). References are provided for flight speeds as appropriate.

Predictable Model

The predictable model was only applicable for greylag goose and pink-footed goose collision risk modelling in this case. The calculations are described below.

Stage 1: Number of birds passing through rotors

Collision risk was calculated separately for each of the seasons monitored: autumn migration season (September to November), winter (December to February) and spring migration season (March to mid-May). Autumn migration was monitored during 2012 and 2013, and so modelling has been completed for each year separately. Winter was monitored during 2012/13 and 2013/14. However, the level of effort was significantly greater in 2013/14 following new SNH guidance that was published after winter 2012/13. As no greylag geese were observed to overfly the site at PCH during winter 2012/13 modelling has only been completed for 2013/14 following the precautionary principle (as calculating a weighted average with a year of no collision risk would only reduce the estimate). Spring migration was only monitored during 2014.

Furthermore, as goose activity varies at different times of day, and during different months, these behaviours have been taken into account during modelling.

The risk window (W) was identified as an area equal to the width of the wind farm (WW) perpendicular to the flight path of the birds, and maximum height of the rotor swept area (rotor diameter = 2R). As greylag geese and pink-footed geese were found to follow different flight paths, separate risk windows were identified for each. The risk window for greylag geese was 781.2m wide, while the risk window for pink-footed geese was 1,024.0m.

The area (A) presented by the turbine rotors is calculated, assuming the rotors are aligned in the line of the risk window. It is considered that any reduction in the area due to rotors being positioned at an oblique angle is offset by the increased risk due to the longer transit through the depth of the rotors correlated with this change in position, given the accuracy of the model. Similarly, where rotors overlap when viewed in cross-section, the full cross-sectional area of separate rotors is included so as to compensate for the increased risk to birds flying through multiple rotors. The area was therefore calculated by multiplying the number of rotors (X) by the area swept by the rotors ($A = X \times \pi R^2$).

The total rotor swept area is then expressed a proportion of the risk window (A/W).

The number of birds flying through the risk window per season per year (n) is calculated. All flights at collision risk height which intersect with the turbine positions are included in this calculation. Flights outside of this area or not at PCH have not been included in the calculation, as they are not at risk of collision. As observers were located within close proximity to the site, it is considered unlikely that there were would be significant observer error with regards to flight path location, particularly with flights at the east of the site near the VP location. Details of greylag goose and pink-footed goose flights used for collision risk modelling are provided in Tables A3.3 and A3.4 below.

Table A3.3. Greylag Goose Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
29/09/12	1	17:44	42	135	6300	6300	Y	SJ	1147
30/09/12	1	07:32	27	45	1620	1620	Y	SJ	1148
16/11/12	1	09:25	31	212	6975	6045	Y	CC	1186
27/09/13	1	08:13	4	34	180	180	Y	GN	1329
29/10/13	1	09:03	24	100	2520	1800	Y	CC	1396
12/12/13	1	15:18	50	110	6750	1500	Y	GN	1427
12/12/13	1	15:18	30	150	4950	900	Y	GN	1428
12/12/13	1	15:19	11	180	2145	330	Y	GN	1429
01/04/14	1	09:34	4	150	660	180	Y	GN	1604
14/04/14	1	20:27	12	73	1080	540	Y	GN	1713
14/04/14	1	21:00	20	130	3000	1200	Y	GN	1876
15/04/14	1	11:51	11	41	495	495	Y	GN	1680

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; GN = Glenn Norris; SJ = Steven Johnston

Table A3.4. Pink-footed Goose Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
05/03/14	1	10:32	25	185	4875	4875	Y	SJ	1530
15/04/14	1	07:20	1	38	45	45	Y	GN	1639
15/04/14	1	08:54	1	34	45	45	Y	GN	1661
15/04/14	1	09:13	100	90	10500	9000	Y	GN	1666
15/04/14	1	10:37	35	75	3150	3150	N	GN	1668
15/04/14	1	10:49	3	90	315	315	Y	GN	1671

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: GN = Glenn Norris; SJ = Steven Johnston

Calculations for the potential number of greylag goose transits through the risk window during the 2012 autumn migration season, 2013 autumn migration season, 2013/14 winter season and 2014 spring migration season are provided in Tables A3.5 to A3.8 below.

Table A3.5. Potential Number of Greylag Geese In Collision Risk Window During the 2012 Autumn Migration Season.

	September	October	November	
Dawn/dusk observations (hours)	4.00	6.00	6.00	
Daytime observations (hours)	8.00	6.00	6.00	
No. birds observed in risk window at dawn/dusk	27	0	0	
No. birds observed in risk window at day	42	0	31	
No. birds per hour of observation at dawn/dusk	6.75	0.00	0.00	
No. birds per hour of observation at day	5.25	0.00	5.17	
Available hours for flight activity at dawn/dusk (hours)	120	124	120	
Available hours for flight activity at daytime/25% night (hours)	452.31	407.43	340.46	**TOTAL**
Potential no. of birds in risk window	3184.64	0.00	1759.06	**4943.70**

Table A3.6. Potential Number of Greylag Geese In Collision Risk Window During the 2013 Autumn Migration Season.

	September	October	November	
Dawn/dusk observations (hours)	4.00	12.00	8.00	
Daytime observations (hours)	2.00	6.00	4.00	
No. birds observed in risk window at dawn/dusk	0	0	0	
No. birds observed in risk window at day	4	24	0	
No. birds per hour of observation at dawn/dusk	0.00	0.00	0.00	
No. birds per hour of observation at day	2.00	4.00	0.00	
Available hours for flight activity at dawn/dusk (hours)	120	124	120	
Available hours for flight activity at daytime/25% night (hours)	452.76	407.94	340.76	**TOTAL**
Potential no. of birds in risk window	905.53	1631.75	0.00	**2537.275**

Table A3.7. Potential Number of Greylag Geese In Collision Risk Window During the 2013/14 Winter Season.

	December	January	February	
Dawn/dusk observations (hours)	8.00	8.00	5.00	
Daytime observations (hours)	4.00	4.00	7.00	
No. birds observed in risk window at dawn/dusk	91	0	0	
No. birds observed in risk window at day	0	0	0	
No. birds per hour of observation at dawn/dusk	11.38	0.00	0.00	
No. birds per hour of observation at day	0.00	0.00	0.00	
Available hours for flight activity at dawn/dusk (hours)	124	124	112	
Available hours for flight activity at daytime/25% night (hours)	320.24	337.85	350.16	**TOTAL**
Potential no. of birds in risk window	1410.50	0.00	0.00	**1410.5**

Table A3.8. Potential Number of Greylag Geese In Collision Risk Window During the 2014 Spring Migration Season.

	March	April	Mid-May	
Dawn/dusk observations (hours)	8.00	4.00	2.00	
Daytime observations (hours)	7.00	11.00	10.00	
No. birds observed in risk window at dawn/dusk	0	32	0	
No. birds observed in risk window at day	0	15	0	
No. birds per hour of observation at dawn/dusk	0.00	8.00	0.00	
No. birds per hour of observation at day	0.00	1.36	0.00	
Available hours for flight activity at dawn/dusk (hours)	124	120	64	
Available hours for flight activity at daytime/25% night (hours)	445.99	490.34	284.01	**TOTAL**
Potential no. of birds in risk window	0.00	1628.64	0.00	**1628.642**

Calculations for the potential number of pink-footed goose transits through the risk window during the 2014 spring migration season are provided in Table A3.9 below.

Table A3.9. Potential Number of Pink-footed Geese In Collision Risk Window During the 2014 Spring Migration Season.

	March	April	Mid-May	
Dawn/dusk observations (hours)	8.00	4.00	2.00	
Daytime observations (hours)	7.00	11.00	10.00	
No. birds observed in risk window at dawn/dusk	0	0	0	
No. birds observed in risk window at day	25	140	0	
No. birds per hour of observation at dawn/dusk	0.00	0.00	0.00	
No. birds per hour of observation at day	3.57	12.73	0	
Available hours for flight activity at dawn/dusk (hours)	124	120	64	
Available hours for flight activity at daytime/25% night (hours)	445.99	490.34	284.01.00	**TOTAL**
Potential no. of birds in risk window	1592.81	6240.66	0.00	**7833.472**

The number of birds transits through the rotor swept area (N) is equal to the number of birds flying through the risk window per season per year multiplied by the proportion of the risk window occupied by rotors (N = n x (A/W)). Note that the assumption has been made that turbines are operational for a maximum of 85% of the time; therefore the number of bird transits through rotor swept area has been

adjusted, and reduced by 15%, as birds would not be at risk from collision mortality with stationary rotors (BWEA 2007). This is summarised in Table A3.10 below.

Table A3.10. Number of Transits Through the Rotor Swept Area.

Species	Season	Number of birds flying through risk window	Risk window area (m^2)	Rotor swept area (m^2)	Number of bird transits through rotor swept area during spring migration per year
		n	W	A	N = (n x (A/W)) x 0.85
Greylag goose	Autumn migration 2012	4943.70	70308.00	31808.63	1901.13
Greylag goose	Autumn migration 2013	2537.28	70308.00	31808.63	975.72
Greylag goose	Winter 2013/14	1410.50	70308.00	31808.63	542.42
Greylag goose	Spring migration 2014	1628.64	70308.00	31808.63	626.30
Pink-footed goose	Spring migration 2014	7833.47	92160.00	31808.63	2298.14

Stage 2: Estimating risk of collision

The probability of a bird that flies through the area swept by the rotors being hit by a rotor blade depends on a number of parameters: the dimensions of the bird and type of flight (speed, and flapping or gliding), and the size and rotation speed of the rotors. Biological parameters used for this assessment are provided in Table A3.11. For this assessment, birds were assumed to use flapping flight, which gives the higher worst-case probability of being struck by a blade.

Table A3.11. Predictable Model Biometrics and Flight Speed.

Species	Length of bird (m)	Wing span of bird (m)	Typical flight speed (m/s)
	l	w	v
Greylag goose	0.825	1.635	19.3[1]
Pink-footed goose	0.675	1.525	19.3[1]

[1] *Pendlebury 2006.*

These parameters were input into a bespoke Excel spreadsheet (available from SNH) that calculates the average collision risk for each species passing through the rotor volume, expressed as a percentage. Table A3.12 shows the mean percentage risk of being struck by a rotor if the bird flies through the volume of air swept by the rotors.

Table A3.12. Percentage Chance of a Greylag and Pink-footed Goose Being Struck by a Rotor when Passing Through the Rotor Volume

Species	% collision risk
Greylag goose	8.7
Pink-footed goose	7.2

Using the Stage 1 results, the number of birds colliding with the rotors during each season was calculated, assuming that birds take no action to avoid being struck by the operating rotor blades. In reality, a very high proportion of birds are likely to take avoiding action. An avoidance rate of 99.8% is considered realistic for geese (SNH 2013b). Table A3.13 presents the collision risk estimates for no avoiding action and for 99.8% avoidance for each season, including weighted averages where appropriate.

Table A3.13. Collision Risk for Greylag and Pink-Footed Goose (shaded cells indicate figures used for consideration in baseline description)

Species: Season	Avoidance Rate	Year / Weighted Average*	Collisions per Year		Years per Collision	
			No Avoiding Action	Avoiding Action	No avoiding Action	Avoiding Action
Greylag goose: autumn migration	99.8%	2012	141.28	0.28	0.01	3.54
		2013	72.51	0.15	0.01	13.79
		Average	106.9	**0.21**	0.01	**4.68**
Greylag goose: winter	99.8%	2013/14	40.31	**0.08**	0.02	**12.40**
Greylag goose: spring migration	99.8%	2014	46.54	**0.09**	0.02	**10.74**
Pink-footed goose: spring migration	99.8%	2014	158.20	**0.32**	0.01	**3.16**

** Average weighted against proportion of available hours in season observed during surveys.*

Random model

The random collision risk model is applicable for estimating collision risk for species with less predictable flight activity. The random model has been applied to Arctic skua (breeding and non-breeding), curlew (breeding and non-breeding), dunlin (non-

breeding), golden plover (breeding, non-breeding and spring migration), great skua (breeding), hen harrier (non-breeding), lapwing (breeding and non-breeding), redshank (breeding and non-breeding), ringed plover (breeding and non-breeding) and snipe (breeding and non-breeding). The random model calculation methods are described below.

Stage 1: Number of birds passing through rotors

Collision risk was calculated separately for each of the seasons monitored, as appropriate to each species.

The visible area surveyed from each vantage point used for estimating collision risk (Avp) was calculated by producing a predicted 'viewshed' from each VP using terrain data within a Geographical Information System (GIS) (the viewshed is shown in Figure 3). The viewshed was calculated as the area visible 20m above ground level from 1m height at the vantage point (considered to represent the height of a sitting human observer), and was restricted to a 180° arc of observation in front of the observer and to a distance of 2km from the vantage point. The viewshed area (Avp) was 528.52ha.

Only flights intersecting with the viewshed of the VP from which it was recorded were considered in collision risk calculations, as activity levels are calculated per unit area based upon the viewshed areas and activity observed. Flights that intersect with the viewshed may not be restricted to this area, and so the level of activity may be marginally overestimated. Inclusion of flights observed entirely outwith the viewshed would result in a greater overestimate of activity levels, and therefore would not be valid.

Although the random model is not spatially explicit, it assumes that habitat observed in the viewshed is equivalent to that where activity levels will be applied at the wind farm, and therefore that species usage will be the same. During flight activity surveys, waders were found to overwinter in large numbers at Hopefield in waterlogged quarries. Although activity was observed over this area within the viewshed, these birds did not overfly the site. The behaviour was not random, instead being associated with the habitat offered by the quarries. Equivalent habitat is not available at Hill of Forss, and so there is no risk of collision for these birds. As such, these flights were excluded from collision risk calculations.

Flights used in collision risk modelling are detailed in Tables A3.14 to A3.23 below.

Table A3.14. Arctic Skua Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
15/11/12	1	08:49	1	126	135	135	Y	CC	1170
31/05/13	1	08:29	1	83	90	30	Y	TE	1263
17/06/13	1	11:48	1	41	45	45	N	RJ	1321
15/05/14	1	10:45	1	45	60	45	Y	SJ	1816

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; RJ = Rebecca Johnson; SJ = Steven Johnston; TE = Tom Edwards

Table A3.15. Curlew Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
30/09/12	1	07:49	1	30	45	45	Y	SJ	1149
15/10/12	1	17:40	1	57	60	45	Y	CC	1135
05/05/13	1	15:46	1	58	60	45	Y	TE	1226
05/05/13	1	16:09	1	36	45	30	Y	TE	1229
05/05/13	1	16:09	1	66	75	60	Y	TE	1230
28/05/13	1	18:36	1	18	30	15	Y	TE	1255
28/05/13	1	18:48	1	23	30	15	Y	TE	1258
29/05/13	1	09:33	1	24	30	15	Y	TE	1242
31/05/13	1	08:38	1	37	45	15	Y	TE	1265
31/05/13	1	09:41	2	46	120	120	Y	TE	1271
16/06/13	1	18:19	1	70	75	60	Y	RJ	1283
16/06/13	1	19:34	1	125	135	120	Y	RJ	1286
17/06/13	1	08:44	1	21	30	15	Y	GK	1299
17/06/13	1	09:58	5	50	300	75	Y	RJ	1304
17/06/13	1	10:02	1	50	60	45	Y	RJ	1305
17/06/13	1	10:04	1	45	60	30	Y	RJ	1307
17/06/13	1	10:05	2	31	90	30	Y	RJ	1308
17/06/13	1	10:52	1	103	105	60	Y	RJ	1315
24/12/13	1	09:34	1	55	60	30	Y	EF	1446
31/03/14	1	17:59	2	46	90	60	Y	GN	1616
31/03/14	1	18:24	1	31	45	15	Y	GN	1619
31/03/14	1	18:29	1	49	60	30	Y	GN	1621
15/04/14	1	07:39	1	100	105	105	Y	GN	1645
15/04/14	1	08:06	1	59	60	30	Y	GN	1651
15/04/14	1	08:40	2	42	120	120	Y	GN	1656
15/04/14	1	10:40	1	32	45	15	Y	GN	1669
01/05/14	1	17:38	16	110	1920	1920	N	SJ	1749
01/05/14	1	18:33	2	60	150	90	N	SJ	1752
02/05/14	1	07:18	1	64	75	45	Y	SJ	1762
02/05/14	1	08:27	1	75	90	75	Y	SJ	1777
02/05/14	1	09:17	1	90	105	75	Y	SJ	1790
02/05/14	1	09:18	1	45	60	30	Y	SJ	1791
02/05/14	1	09:26	1	45	60	30	Y	SJ	1792
02/05/14	1	09:52	1	85	105	75	Y	SJ	1800
12/05/14	1	19:38	1	15	30	15	Y	EF	1835
12/05/14	1	19:45	1	29	45	30	Y	EF	1838
12/05/14	1	19:57	1	42	60	45	Y	EF	1842
12/05/14	1	20:02	1	15	30	15	Y	EF	1844
12/05/14	1	20:29	1	60	60	15	Y	EF	1852
12/05/14	1	20:30	1	30	45	30	Y	EF	1853
12/05/14	1	21:05	1	35	45	15	Y	EF	1871

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
28/05/14	1	08:19	1	5	15	15	N	CC	1936
10/06/14	1	20:07	1	75	90	90	Y	SJ	1991
10/06/14	1	20:09	1	120	135	135	Y	SJ	1992
10/06/14	1	20:09	2	64	150	150	Y	SJ	1993
12/06/14	1	11:13	1	132	135	45	Y	GN	2040
01/07/14	1	18:14	1	30	45	45	Y	EF	2085
02/07/14	1	11:15	1	230	240	240	Y	EF	2068
21/07/14	1	19:54	1	80	90	90	Y	EF	2115

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GK = Gus Keys; GN = Glenn Norris; RJ = Rebecca Johnson; SJ = Steven Johnston; TE = Tom Edwards

Table A3.16. Dunlin Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
27/09/13	1	08:01	4	55	300	240	Y	GN	1328
27/09/13	1	08:16	10	42	600	150	N	GN	1330
27/09/13	1	09:03	19	61	1425	285	Y	GN	1331
01/10/13	1	07:58	2	62	150	30	Y	CC	1335

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; GN = Glenn Norris

Table A3.17. Golden Plover Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
16/10/12	1	17:14	2	100	240	150	Y	CC	1151
17/06/13	1	10:18	4	55	240	240	Y	RJ	1311
31/07/13	1	05:10	2	26	60	60	Y	GK	1325
01/10/13	1	08:45	7	67	525	105	Y	CC	1340
01/10/13	1	08:49	26	121	3510	1560	Y	CC	1342
01/10/13	1	09:03	6	96	630	180	Y	CC	1343
29/10/13	1	07:35	26	220	5850	780	Y	CC	1388
21/03/14	1	07:05	2	38	90	90	Y	EF	1556
14/04/14	1	19:13	70	31	3150	1050	Y	GN	1699
14/04/14	1	19:14	20	41	900	300	Y	GN	1700
14/04/14	1	19:14	50	63	3750	750	Y	GN	1701
15/04/14	1	07:53	15	30	675	225	Y	GN	1648
28/05/14	1	08:31	1	35	45	15	Y	CC	1941

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GK = Gus Keys; GN = Glenn Norris; RJ = Rebecca Johnson

Table A3.18. Great Skua Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
05/05/13	1	15:57	1	58	60	30	Y	TE	1228
17/06/13	1	11:21	1	217	225	150	Y	RJ	1318
27/05/14	1	20:05	1	62	75	30	N	CC	1909

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; RJ = Rebecca Johnson; TE = Tom Edwards

Table A3.19. Hen Harrier Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
15/10/13	1	17:54	1	46	60	15	Y	CC	1349

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine

Table A3.20. Lapwing Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
15/10/12	1	18:27	2	22	60	30	N	CC	1136
16/10/12	1	11:03	12	127	1620	1620	Y	CC	1130
04/05/13	1	18:34	1	204	225	90	Y	TE	1207
04/05/13	1	19:21	2	81	210	60	Y	TE	1211
05/05/13	1	14:48	2	18	60	30	Y	TE	1218
05/05/13	1	15:02	1	35	45	30	Y	TE	1221
29/05/13	1	10:44	2	16	60	30	Y	TE	1246
31/05/13	1	08:19	2	65	150	90	Y	TE	1262
16/06/13	1	20:05	1	32	45	15	Y	RJ	1288
17/06/13	1	09:10	1	62	75	45	Y	GK	1302
17/06/13	1	09:13	49	97	5145	1470	N	GK	1303
31/07/13	1	04:59	55	76	4950	1650	N	GK	1324
13/12/13	1	08:50	13	20	390	195	Y	GN	1434
24/12/13	1	09:36	16	40	960	240	Y	EF	1447
24/12/13	1	09:36	20	40	1200	600	Y	EF	1448
07/02/14	1	08:40	24	30	1080	1080	Y	SJ	1489
07/02/14	1	08:41	80	60	6000	4800	Y	SJ	1490
07/02/14	1	08:42	20	60	1500	1200	Y	SJ	1491
07/02/14	1	10:20	1	30	45	45	Y	SJ	1494
04/03/14	1	15:32	1	210	225	105	Y	EF	1505
04/03/14	1	15:32	3	180	585	270	Y	EF	1504
04/03/14	1	15:57	1	10	30	15	Y	EF	1507
05/03/14	1	08:12	7	75	630	210	Y	SJ	1514
05/03/14	1	08:45	9	60	675	135	Y	SJ	1520
20/03/14	1	16:09	1	140	150	90	Y	EF	1541
20/03/14	1	16:42	1	40	60	15	Y	EF	1548
20/03/14	1	16:47	1	50	60	45	Y	EF	1551
21/03/14	1	07:33	1	84	105	15	Y	EF	1558
21/03/14	1	07:33	1	92	105	60	Y	EF	1557

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
21/03/14	1	07:44	1	26	30	15	Y	EF	1562
21/03/14	1	08:32	1	57	75	15	Y	EF	1568
21/03/14	1	08:32	1	57	75	45	Y	EF	1569
21/03/14	1	09:07	2	30	90	30	Y	EF	1582
21/03/14	1	09:08	1	48	60	15	Y	EF	1583
21/03/14	1	09:18	1	31	60	15	Y	EF	1584
31/03/14	1	17:34	1	10	15	15	Y	GN	1612
31/03/14	1	17:39	1	9	15	15	Y	GN	1613
01/04/14	1	08:02	4	131	540	300	Y	GN	1592
01/04/14	1	09:14	3	31	135	90	Y	GN	1602
01/05/14	1	16:46	3	75	270	45	Y	SJ	1743
01/05/14	1	18:52	1	140	150	75	Y	SJ	1754
01/05/14	1	18:54	1	60	75	30	Y	SJ	1755
02/05/14	1	07:16	1	30	45	45	Y	SJ	1761
02/05/14	1	07:36	1	115	135	90	N	SJ	1764
02/05/14	1	07:56	2	220	480	270	Y	SJ	1770
02/05/14	1	08:01	1	135	150	15	Y	SJ	1771
02/05/14	1	09:13	1	85	105	105	Y	SJ	1789
02/05/14	1	09:47	1	105	120	15	Y	SJ	1799
12/05/14	1	19:34	2	48	120	60	Y	EF	1834
12/05/14	1	19:55	1	14	30	15	Y	EF	1839
12/05/14	1	19:55	1	20	30	15	Y	EF	1840
12/05/14	1	20:04	1	36	60	15	Y	EF	1845
12/05/14	1	20:28	1	76	75	60	Y	EF	1850
12/05/14	1	20:28	1	70	75	60	Y	EF	1851
12/05/14	1	20:30	2	100	240	240	Y	EF	1855
12/05/14	1	20:45	1	36	45	30	Y	EF	1858
12/05/14	1	20:45	1	78	90	30	Y	EF	1859
12/05/14	1	20:52	2	20	60	60	Y	EF	1864
12/05/14	1	20:54	1	26	45	15	Y	EF	1865
15/05/14	1	09:55	1	30	45	15	Y	SJ	1804
15/05/14	1	10:18	2	65	150	30	Y	SJ	1808
15/05/14	1	11:11	2	60	150	30	Y	SJ	1818
27/05/14	1	17:33	1	83	90	15	Y	CC	1882
27/05/14	1	18:32	1	37	45	15	Y	CC	1900
27/05/14	1	18:33	1	35	45	15	Y	CC	1902
27/05/14	1	19:06	1	31	45	30	Y	CC	1905
27/05/14	1	20:27	2	70	150	30	Y	CC	1912
27/05/14	1	20:28	1	65	75	15	Y	CC	1913
27/05/14	1	20:37	1	19	30	15	N	CC	1915
27/05/14	1	20:43	1	5	15	15	Y	CC	1917
27/05/14	1	21:06	1	9	15	15	Y	CC	1921

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
28/05/14	1	08:07	2	60	150	60	Y	CC	1933
28/05/14	1	08:07	2	80	180	150	Y	CC	1932
28/05/14	1	08:24	1	22	30	15	Y	CC	1937
28/05/14	1	08:27	1	33	45	30	N	CC	1940
28/05/14	1	08:39	1	7	15	15	Y	CC	1943
28/05/14	1	08:45	1	50	60	15	Y	CC	1944
28/05/14	1	08:45	1	66	75	30	Y	CC	1945
28/05/14	1	08:53	2	110	240	60	N	CC	1947
28/05/14	1	08:57	2	72	150	30	Y	CC	1948
28/05/14	1	08:58	2	34	90	60	Y	CC	1949
28/05/14	1	09:11	2	189	390	60	Y	CC	1950
28/05/14	1	09:18	1	80	105	30	Y	CC	1951
28/05/14	1	09:20	1	38	45	15	Y	CC	1952
28/05/14	1	09:20	2	56	120	60	Y	CC	1953
28/05/14	1	09:28	2	111	240	150	Y	CC	1954
28/05/14	1	09:33	2	60	150	30	Y	CC	1955
28/05/14	1	09:34	1	25	30	30	Y	CC	1956
10/06/14	1	18:01	1	70	90	45	Y	SJ	1966
10/06/14	1	18:02	1	45	60	15	Y	SJ	1967
10/06/14	1	18:18	2	60	150	30	Y	SJ	1969
10/06/14	1	19:55	1	55	75	60	Y	SJ	1988
10/06/14	1	20:01	1	135	150	120	Y	SJ	1990
10/06/14	1	20:11	2	85	210	150	Y	SJ	1995
11/06/14	1	13:33	1	44	60	30	N	SJ	1999
11/06/14	1	14:00	1	30	45	30	Y	SJ	2003
11/06/14	1	14:50	1	60	75	45	Y	SJ	2011
11/06/14	1	14:55	1	40	45	30	Y	SJ	2012
11/06/14	1	14:59	1	30	45	15	Y	SJ	2014
11/06/14	1	16:27	1	45	60	45	Y	SJ	2031
12/06/14	1	09:49	1	144	150	30	Y	GN	2033
12/06/14	1	09:55	1	160	165	15	Y	GN	2034
12/06/14	1	14:42	1	56	60	30	Y	GN	2057
12/06/14	1	14:47	1	51	60	45	Y	GN	2058
12/06/14	1	15:30	1	73	75	45	Y	GN	2062
02/07/14	1	11:43	1	29	45	15	Y	EF	2070
02/07/14	1	13:46	1	400	405	315	Y	EF	2079
02/07/14	1	13:48	1	40	45	30	Y	EF	2082
21/07/14	1	18:42	1	640	660	660	Y	EF	2096
21/07/14	1	18:49	1	180	195	165	Y	EF	2099
21/07/14	1	19:04	1	61	75	45	Y	EF	2100
21/07/14	1	19:05	1	32	45	15	Y	EF	2101
21/07/14	1	19:07	1	30	45	15	Y	EF	2102

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
21/07/14	1	19:20	1	160	135	90	Y	EF	2104
21/07/14	1	19:23	1	144	150	45	Y	EF	2105
21/07/14	1	19:26	1	30	45	15	Y	EF	2106
21/07/14	1	19:43	1	51	75	45	Y	EF	2108
21/07/14	1	19:44	1	19	30	15	Y	EF	2109
21/07/14	1	19:44	1	39	45	15	Y	EF	2110
21/07/14	1	19:45	1	105	120	105	Y	EF	2111
21/07/14	1	19:50	1	42	60	30	Y	EF	2113
21/07/14	1	19:53	1	60	75	30	Y	EF	2114
21/07/14	1	19:56	1	102	120	105	Y	EF	2116
21/07/14	1	20:29	1	33	45	30	Y	EF	2118
24/07/14	1	10:51	2	25	90	30	Y	SJ	2095
07/08/14	1	08:43	1	140	150	120	Y	EF	2128

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; EF = Eamonn Flood; GK = Gus Keys; GN = Glenn Norris; RJ = Rebecca Johnson; SJ = Steven Johnston; TE = Tom Edwards

Table A3.21. Redshank Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
16/11/12	1	08:19	5	127	675	600	Y	CC	1181
28/05/13	1	18:17	1	35	45	15	Y	TE	1252
31/05/13	1	09:54	1	19	30	15	Y	TE	1273
31/05/13	1	10:58	1	27	30	15	Y	TE	1233
15/10/13	1	16:24	1	280	285	30	Y	CC	1345
15/10/13	1	18:10	1	90	105	30	Y	CC	1351
16/10/13	1	08:54	15	142	2250	450	Y	CC	1363

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; TE = Tom Edwards

Table A3.22. Ringed Plover Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
10/12/12	1	13:27	18	100	2160	1080	Y	EF	1194
10/12/12	1	13:37	24	19	720	360	Y	EF	1195
10/12/12	1	13:42	10	17	150	150	Y	EF	1196
17/06/13	1	11:32	1	50	60	30	Y	RJ	1320

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: EF = Eamonn Flood; RJ = Rebecca Johnson

Table A3.23. Snipe Flights Used in Collision Risk Modelling.

Date	VP	Start Time	Number of Birds	Duration (s)	Time in Flight* (s)	Time at PCH (s)	Over site	Observer	Key number
16/10/12	1	13:34	4	187	840	600	Y	CC	1134
16/10/12	1	18:59	1	20	30	30	Y	CC	1157
16/11/12	1	08:40	2	189	390	240	Y	CC	1184
31/05/13	1	09:17	1	220	240	225	Y	TE	1268
31/05/13	1	09:29	1	135	150	135	Y	TE	1270
31/05/13	1	09:47	3	285	945	945	Y	TE	1272
31/05/13	1	11:59	1	35	45	45	Y	TE	1236
17/06/13	1	10:26	2	120	270	270	Y	RJ	1312
17/06/13	1	10:28	3	45	180	180	Y	RJ	1313
15/10/13	1	18:02	1	58	60	15	Y	CC	1350
16/10/13	1	08:59	2	37	90	60	Y	CC	1365
16/10/13	1	09:50	1	25	30	15	Y	CC	1370
28/10/13	1	16:02	2	42	90	30	Y	CC	1378
24/12/13	1	10:44	1	10	30	15	Y	EF	1451
28/05/14	1	07:56	1	54	60	15	Y	CC	1925
28/05/14	1	08:01	1	15	30	30	Y	CC	1929

** Calculated by multiplying Duration by Number of Birds.*

VP = Vantage Point;

PCH = Potential Collision Height;

Over site: Y = Yes (birds flew over the site); N = No (birds did not fly over the site)

Observer: CC = Chris Cathrine; EF = Eamonn Flood; RJ = Rebecca Johnson; TE = Tom Edwards

For each season, the proportion of the total survey time that birds were observed flying at PCH was calculated (t) for each VP. Therefore, flight activity at risk height

per hectare of visible area (F) was t / AVP. The average flight activity observed from the VP was used in subsequent calculations of collision risk as applied to the whole wind farm area.

When judging the locations of bird flight lines, observer error is considered to be up to 200m. The size of the flight risk area (Arisk) was assumed to be the envelope around the outermost proposed turbine locations bounded by a buffer of 200m to ensure inclusion of all potentially relevant flights (assuming observer error of 200m). From this, the proportion of time (trisk) that birds spend at risk height in the wind farm area was calculated by multiplying the average flight activity by the flight risk area.

Bird occupancy (n) of the flight risk area throughout the season was calculated by multiplying trisk by the number of hours they are potentially active in the study area during the season (calculated using sunrise and sunset times). Available hours for flight activity were calculated to include daylight, one hour before sunrise (dawn), one hour after sunset (dusk) and 25% of the night for waders. Available hours for flight activity were calculated to include daylight, one hour before sunrise (dawn) and one hour after sunset (dusk) for all other species. Table A3.24 provides the hours available for flight activity and observation time collected from the VP from each season used in collision risk calculations.

Table A3.24. Seasons and Observation Effort used for Random Model Collision Risk Calculations.

Species group	Season	Available hours for activity in season		Observation time (hours)	
		2012/13	2013/14	2012/13	2013/14
Waders	Breeding (March to July)	2959.18	2957.98	36.00	72.00
	Non-breeding (September to February)	2571.09	2571.71	48.00	72.00
	Spring migration (March to mid-May)*	N/A	1374.34	N/A	42.00
All other species	Breeding (mid-March to August)	3047.27	3046.63	40.00	72.00
	Non-breeding (September to mid-March)	2191.72	2192.20	48.00	78.00

**Only used for flocks of birds clearly on migration and not exhibiting breeding behaviour.*

The flight risk volume (o) was calculated by multiplying the flight risk area by the diameter of the rotors. The volume of air swept by the rotors of all proposed turbines in the wind farm was calculated by multiplying the number of turbines by the volume of air swept by one rotor ($\pi R^2 \times (d + l)$, where R is the rotor radius, d is the maximum depth of the blade and l is the length of the bird).

Bird occupancy of the volume swept by all rotors each year (b) was calculated by multiplying the bird occupancy of the flight risk area (n) by the proportion of the flight risk volume swept by the rotors.

By allowing for a typical speed of a bird (v) flying in the volume of air swept by the rotors, the number of transits (Ntransit) made by birds through the rotors each year was calculated.

Table A3.25 provides the biological parameters used in the random collision risk modelling analysis.

Table A3.25. Random Model Biometrics and Flight Speed.

Species	Length of bird (m)	Wing span of bird (m)	Typical flight speed (m/s)
	l	w	v
Arctic skua	0.440	1.120	13.8[1]
Curlew	0.550	0.900	16.3[1]
Dunlin	0.180	0.405	15.3[1]
Golden plover	0.275	0.715	13.7[2]
Great skua	0.560	1.360	14.9[3]
Hen harrier	0.480	1.100	11.5[4]
Lapwing	0.295	0.845	12.8[1]
Redshank	0.280	0.625	12.3[5]
Ringed plover	0.190	0.525	19.5[1]
Snipe	0.260	0.455	17.1[1]

[1] *Alerstam* et al. *2007.*

[2] *Alerstam* et al. *2007 (American golden plover).*

[3] *Pennycuick 1987.*

[4] *Provan and Whitfield 2006.*

[5] *Alerstam* et al. *2007 (greenshank).*

Table A3.26 shows the calculations of average flight activity per visible hectare for the VP for each species and appropriate seasons.

Table A3.26. Random Flight Activity Observed from VPs at Risk of Collision.

Species	Season	Total time at PCH (s)	Proportion of observation time at PCH	Flight activity per visible hectare (s/ha/hour)
			t	F
Arctic skua	Breeding 2013	75	0.000520833	9.85456E-07
	Breeding 2014	45	0.000173611	3.28485E-07
	Winter 2012/13	135	0.00078125	1.47818E-06
	Winter 2013/14	0	0	0
Curlew	Breeding 2013	750	0.005787037	1.09495E-05
	Breeding 2014	3690	0.014236111	2.69358E-05
	Winter 2012/13	90	0.000520833	9.85456E-07
	Winter 2013/14	30	0.000115741	2.1899E-07
Dunlin	Winter 2012/13	0	0	0
	Winter 2013/14	705	0.002719907	5.14627E-06
Golden plover	Breeding 2013	300	0.002314815	4.37981E-06
	Breeding 2014	15	5.78704E-05	1.09495E-07
	Winter 2012/13	150	0.000868056	1.64243E-06
	Winter 2013/14	2625	0.010127315	1.91616E-05
	Spring migration 2014	2415	0.015972222	3.02207E-05
Great skua	Breeding 2013	180	0.00125	2.36509E-06
	Breeding 2014	30	0.000115741	2.1899E-07

Species	Season	Total time at PCH (s)	Proportion of observation time at PCH	Flight activity per visible hectare (s/ha/hour)
			t	F
Hen harrier	Winter 2012/13	0	0	0
	Winter 2013/14	15	5.34188E-05	1.01072E-07
Lapwing	Breeding 2013	3510	0.027083333	5.12437E-05
	Breeding 2014	6600	0.025462963	4.81779E-05
	Winter 2012/13	1650	0.009548611	1.80667E-05
	Winter 2013/14	8160	0.031481481	5.95654E-05
Redshank	Breeding 2013	45	0.000347222	6.56971E-07
	Breeding 2014	0	0	0
	Winter 2012/13	600	0.003472222	6.56971E-06
	Winter 2013/14	510	0.001967593	3.72283E-06
Ringed plover	Breeding 2013	30	0.000231481	4.37981E-07
	Breeding 2014	0	0	0
	Winter 2012/13	1590	0.009201389	1.74097E-05
	Winter 2013/14	0	0	0
Snipe	Breeding 2013	1800	0.013888889	2.62788E-05
	Breeding 2014	45	0.000173611	3.28485E-07
	Winter 2012/13	870	0.005034722	9.52608E-06
	Winter 2013/14	135	0.000520833	9.85456E-07

Table A3.27 shows the calculations of the bird occupancy of the rotor risk volume.

Table A3.27. Calculation of Bird Occupancy of the Risk Volume (Assuming Turbines are Operational for 85% of the Time).

Species	Season	Average flight activity per visible hectare (s/ha/hour)	Proportion of time in risk area at PCH	Hours per year in risk area	Volume swept by rotors (m^3)	Bird occupancy of rotor volume (s)
		F	T(risk)	n	o	b
Arctic skua	Breeding 2013	9.85456E-07	1.11915E-05	0.034103601	115115.4161	1.382743928
	Breeding 2014	3.28485E-07	3.7305E-05	0.113654541	115115.4161	0.46081784
	Winter 2012/13	1.47818E-06	0.000167873	0.367929544	115115.4161	1.491788153
	Winter 2013/14	0	0	0	0	0
Curlew	Breeding 2013	1.09495E-05	0.0012435	3.679740611	118773.4081	15.39378541
	Breeding 2014	2.69358E-05	0.00305901	9.04849109	118773.4081	37.85335567
	Winter 2012/13	9.85456E-07	0.000111915	0.287743559	118773.4081	1.203743164
	Winter 2013/14	2.1899E-07	2.487E-05	0.063958433	118773.4081	0.267562986
Dunlin	Winter 2012/13	0	0	0	0	0
	Winter 2013/14	5.14627E-06	0.000584445	1.503023166	107004.2166	5.664682461
Golden plover	Breeding 2013	4.37981E-06	0.0004974	1.471896244	110026.036	5.704028252
	Breeding 2014	1.09495E-07	1.2435E-05	0.036782484	110026.036	0.142542879
	Winter 2012/13	1.64243E-06	0.000186525	0.479572599	110026.036	1.858484022
	Winter 2013/14	1.91616E-05	0.002176125	5.596362851	110026.036	21.68754213
	Spring migration 2014	3.02207E-05	0.00343206	4.7168177	110026.036	18.27904754

Species	Season	Average flight activity per visible hectare (s/ha/hour)	Proportion of time in risk area at PCH	Hours per year in risk area	Volume swept by rotors (m^3)	Bird occupancy of rotor volume (s)
		F	T(risk)	n	o	b
Great skua	Breeding 2013	2.36509E-06	0.000268596	0.818484595	118932.4512	3.428624182
	Breeding 2014	2.1899E-07	2.487E-05	0.075769694	118932.4512	0.317398527
Hen harrier	Winter 2012/13	0	0	0	0	0
	Winter 2013/14	1.01072E-07	1.14785E-05	0.025163085	116546.8043	0.103293564
Lapwing	Breeding 2013	5.12437E-05	0.00581958	17.22118606	110662.2085	67.12300583
	Breeding 2014	4.81779E-05	0.0054714	16.18429301	110662.2085	63.08150845
	Winter 2012/13	1.80667E-05	0.002051775	5.275298587	110662.2085	20.56152791
	Winter 2013/14	5.95654E-05	0.006764641	17.39669366	110662.2085	67.8070817
Redshank	Breeding 2013	6.56971E-07	7.461E-05	0.220784437	110185.0791	0.856841017
	Breeding 2014	0	0	0	0	0
	Winter 2012/13	6.56971E-06	0.0007461	1.918290395	110185.0791	7.444681877
	Winter 2013/14	3.72283E-06	0.00042279	1.087293354	110185.0791	4.219670362
Ringed plover	Breeding 2013	4.37981E-07	4.974E-05	0.147189624	107322.3028	0.556385988
	Breeding 2014	0	0	0	0	0
	Winter 2012/13	1.74097E-05	0.001977165	5.083469548	107322.3028	19.21583289
	Winter 2013/14	0	0	0	0	0
Snipe	Breeding 2013	2.62788E-05	0.0029844	8.831377466	109548.9066	34.07575594
	Breeding 2014	3.28485E-07	3.7305E-05	0.110347452	109548.9066	0.42577422

Species	Season	Average flight activity per visible hectare (s/ha/hour)	Proportion of time in risk area at PCH	Hours per year in risk area	Volume swept by rotors (m^3)	Bird occupancy of rotor volume (s)
		F	T(risk)	n	o	b
	Winter 2012/13	9.52608E-06	0.001081845	2.781521073	109548.9066	10.73246315
	Winter 2013/14	9.85456E-07	0.000111915	0.287812947	109548.9066	1.110522539

Table A3.28 shows the calculation of number of transits through rotors per year.

Table A3.28. Calculation of Number of Transits Through Rotors Per Year.

Species	Season	Bird occupancy of rotor volume (s)	Time to pass through rotors (s)	No. of transits through rotors per year
		b		N
Arctic skua	Breeding 2013	1.382743928	0.2622464	5.272690304
	Breeding 2014	0.46081784	0.2622464	1.757194304
	Winter 2012/13	1.491788153	0.2622464	5.68849862
	Winter 2013/14	0	0	0
Curlew	Breeding 2013	15.39378541	0.2290798	67.19836694
	Breeding 2014	37.85335567	0.2290798	165.2409474
	Winter 2012/13	1.203743164	0.2290798	5.254690297
	Winter 2013/14	0.267562986	0.2290798	1.16799054
Dunlin	Winter 2012/13	0	0	0
	Winter 2013/14	5.664682461	0.2198693	25.76386494
Golden plover	Breeding 2013	5.704028252	0.2524818	22.59184361

Species	Season	Bird occupancy of rotor volume (s)	Time to pass through rotors (s)	No. of transits through rotors per year
		b		N
	Breeding 2014	0.142542879	0.2524818	0.564567055
	Winter 2012/13	1.858484022	0.2524818	7.360864731
	Winter 2013/14	21.68754213	0.2524818	85.89746376
	Spring migration 2014	18.27904754	0.2524818	72.39749964
Great skua	Breeding 2013	3.428624182	0.2509396	13.66314531
	Breeding 2014	0.317398527	0.2509396	1.264840344
Hen harrier	Winter 2012/13	0	0	0
	Winter 2013/14	0.103293564	0.3186087	0.324201962
Lapwing	Breeding 2013	67.12300583	0.2717969	246.9601824
	Breeding 2014	63.08150845	0.2717969	232.0906318
	Winter 2012/13	20.56152791	0.2717969	75.65034702
	Winter 2013/14	67.8070817	0.2717969	249.4770468
Redshank	Breeding 2013	0.856841017	0.281626	3.042478209
	Breeding 2014	0	0	0
	Winter 2012/13	7.444681877	0.281626	26.4346383
	Winter 2013/14	4.219670362	0.281626	14.9832406
Ringed plover	Breeding 2013	0.556385988	0.1730256	3.215627375
	Breeding 2014	0	0	0

Species	Season	Bird occupancy of rotor volume (s)	Time to pass through rotors (s)	No. of transits through rotors per year
		b		N
	Winter 2012/13	19.21583289	0.1730256	111.0577182
	Winter 2013/14	0	0	0
Snipe	Breeding 2013	34.07575594	0.2014035	169.1914711
	Breeding 2014	0.42577422	0.2014035	2.114035762
	Winter 2012/13	10.73246315	0.2014035	53.28836234
	Winter 2013/14	1.110522539	0.2014035	5.513918529

Stage 2: Estimating risk of collision

The probability of a bird that flies through the area swept by the rotors being hit by a rotor blade depends on a number of parameters: the dimensions of the bird and type of flight (speed, and flapping or gliding), and the size and rotation speed of the rotors. Bird dimensions and flight speeds used are shown in Table A3.25. For this assessment, birds were assumed to use flapping flight, which gives the higher worst-case probability of being struck by a blade. These parameters were input into a bespoke Excel spreadsheet (available from SNH) that calculates the average collision risk for each species passing through the rotor volume, expressed as a percentage.

From the above results, the number of birds colliding with the rotors during each season was calculated, assuming that birds take no avoiding action. Note that the assumption has been made that turbines are operational for a maximum of 85% of the time, therefore the number of bird transits through rotor swept area has been adjusted, and reduced by 15%, as birds would not be at risk from collision mortality with stationary rotors (BWEA 2007).

Table A3.29 shows the mean percentage risk of being struck by a rotor if the bird flies through the volume of air swept by the rotors.

Table A3.29. Percentage Chance of a Bird Being Struck by a Rotor when Passing Through the Rotor Volume.

Species	% collision risk
Arctic skua	7.5
Curlew	7.5
Dunlin	5.5
Golden plover	6.3
Great skua	8.1
Hen harrier	8.3
Lapwing	6.6
Redshank	6.5
Ringed plover	5.4
Snipe	5.8

The above calculations make an estimate of collision risk, assuming that birds take no action to avoid being struck by the operating rotor blades. In reality, a very high proportion of birds are likely to take avoiding action. Where data is not available for species specific avoidance rates (as is commonly the case), an avoidance rate of 98% is recommended (SNH 2010b). However, this rate has been shown to be over-precautionary for a number of species.

The number of birds that may collide with the rotors was estimated assuming that birds take no action to avoid being struck by the operating rotor blades. In reality, a very high proportion of birds are likely to take avoiding action. Table A3.30 presents the collision risk estimates for no avoiding action and with appropriate avoidance rates. This table also provides weighted averages where appropriate.

Table A3.30. Collision Risk for Random Model Species (shaded cells indicate figures used for consideration in baseline description)

Species: Season	Avoidance Rate	Year / Weighted Average*	Collisions per Year		Years per Collision	
			No Avoiding Action	Avoiding Action	No avoiding Action	Avoiding Action
Arctic skua: breeding	98.0%[1]	2013	0.34	0.01	2.98	148.85
		2014	0.11	0.00	8.93	446.65
		Average	0.19	**0.00**	5.20	**260.24**
Arctic skua: non-breeding	98.0%[1]	2012/13	0.36	0.01	2.76	137.97
		2013/14	0.00	0.00	0.00	0.00
		Average	0.14	**0.00**	7.29	**364.53**
Curlew: breeding	98.0%[1]	2013	4.30	0.09	0.23	11.63
		2014	10.57	0.21	0.09	4.73
		Average	8.48	**0.17**	0.12	**5.90**

Species: Season	Avoidance Rate	Year / Weighted Average*	Collisions per Year		Years per Collision	
			No Avoiding Action	Avoiding Action	No avoiding Action	Avoiding Action
Curlew: non-breeding	98.0%[1]	2012/13	0.34	0.01	2.98	148.75
		2013/13	0.07	0.00	13.38	669.23
		Average	0.18	**0.00**	5.62	**280.87**
Dunlin: non-breeding	98.0%[1]	2012/13	0.00	0.00	0.00	0.00
		2013/14	1.19	0.02	0.84	41.86
		Average	0.71	**0.01**	1.40	**70.03**
Golden plover: breeding	98.0%[1]	2013	1.21	0.02	0.82	41.17
		2014	0.03	0.00	32.95	1647.49
		Average	0.42	**0.01**	2.36	**118.14**
Golden plover: non-breeding	98.0%[1]	2012/13	0.40	0.01	2.53	126.36
		2013/14	4.62	0.09	0.22	10.83
		Average	2.93	**0.06**	0.34	**17.05**
Golden plover: spring migration	98.0%[1]	2014	3.89	**0.08**	0.26	**12.85**
Great skua: breeding	98.0%[1]	2013	0.94	0.02	1.06	53.07
		2014	0.09	0.00	11.47	573.32
		Average	0.39	**0.01**	2.54	**127.05**
Hen harrier: non-breeding	99.0%[2]	2013/14	0.02	**0.00**	43.77	**4376.74**
Lapwing: breeding	98.0%[1]	2013	13.96	0.28	0.07	3.58
		2014	13.12	0.26	0.08	3.81
		Average	13.41	**0.27**	0.07	**3.73**
Lapwing: non-breeding	98.0%[1]	2012/13	4.27	0.09	0.23	11.70
		2013/14	14.10	0.28	0.07	3.55
		Average	10.17	**0.20**	0.10	**4.92**
Redshank: breeding	98.0%[1]	2013	0.17	0.00	5.97	298.64
		2014	0.00	0.00	0.00	0.00
		Average	0.06	**0.00**	17.65	**882.59**
Redshank: non-breeding	98.0%[1]	2012/13	1.45	0.03	0.69	34.37
		2013/14	0.82	0.02	1.21	60.64
		Average	1.07	**0.02**	0.93	**46.64**
Ringed plover: breeding	98.0%[1]	2013	0.15	0.00	6.72	336.10
		2014	0.00	0.00	0.00	0.00
		Average	0.05	**0.00**	20.01	**1000.27**
Ringed plover: non-breeding	98.0%[1]	2012/13	5.14	0.10	0.19	9.73
		2013/14	0.00	0.00	0.00	0.00
		Average	2.06	**0.04**	0.49	**24.32**
Snipe: breeding	98.0%[1]	2013	8.28	0.17	0.12	6.04
		2014	0.10	0.00	9.66	483.10
		Average	2.83	**0.06**	0.35	**17.69**
Snipe: non-breeding	98.0%[1]	2012/13	2.61	0.05	0.38	19.17
		2013/14	0.27	0.01	3.70	185.22
		Average	1.21	**0.02**	0.83	**41.45**

** Average weighted against proportion of available hours in season observed during surveys.*

[1] SNH 2010b

[2] Whitfield and Madders 2006

APPENDIX 4: Breeding Bird Survey Results 2013/2014

Tables A4.1 and A4.2 provide a full species list based upon the results of the three visit breeding bird survey of 2013 and four visits survey of 2014. The tables also indicate whether the bird is listed on Schedule 1 of the Wildlife and Countryside Act (as amended) or as Red or Amber on the Birds of Conservation Concern List (BoCC). Species have been arranged alphabetically as opposed to taxonomically for convenience.

Meadow pipit territory densities are often too high for accurate recording and mapping by a surveyor. In order to estimate territory densities for meadow pipits, the survey area was divided into 500mx500m quadrats, and the number of meadow pipits observed were tallied for each quadrat during each of the three visits. The maximum value for each quadrat was then calculated. All maximum values were summed to provide an estimate of the density of meadow pipits within the study area.

For all other species, the total number of registrations (whether indicative of breeding or not) were tallied per visit. The maximum number of registration recorded during any single visit was then used as an estimate of density per species.

Table A4.1. Breeding bird survey 2013 results.

Species	Conservation Status	Breeding	Estimated Territories
Arctic skua		N	
Blackbird		N	
Buzzard		N	
Carrion crow		N	
Chaffinch		Y	2
Collared dove		Y	1
Common gull		N	
Corn bunting		N	
Cuckoo		Y	N/A
Curlew		Y	3
Dotterel	**Schedule 1**	N	
Dunnock		Y	2
Dunlin		N	
Feral pigeon		N	
Golden plover		N	
Goldfinch		N	
Great black-backed gull		N	
Greenfinch		N	
Greylag goose		N	
Herring gull		N	
Hooded crow		N	
House sparrow		Y	1
Jackdaw		N	
Kestrel		N	
Lapwing		Y	3

Species	Conservation Status	Breeding	Estimated Territories
Lesser black-backed gull		N	
Lesser redpoll		N	
Linnet		N	
Mallard		N	
Meadow pipit		Y	219
Mistle thrush		N	
Oystercatcher		Y	1
Pheasant		N	
Pied wagtail		N	
Pink-footed goose		N	
Raven		N	
Redshank		Y	1
Ringed plover		N	
Robin		N	
Rock dove		N	
Rook		N	
Sand martin		N	
Sedge warbler		N	
Skylark		Y	68
Snipe		Y	3
Song thrush		N	
Starling		N	
Swallow		N	
Teal		N	
Twite		Y	1
Wheatear		N	
Whimbrel	**Schedule 1**	N	
Whinchat		N	
Willow warbler		Y	10
Wood pigeon		N	
Wren		Y	5
Yellowhammer		Y	4

Colours indicate whether species is Green, Amber or Red listed in BoCC.

Table A4.2. Breeding bird survey 2014 results.

Species	Conservation Status	Breeding	Estimated Territories
Black-headed gull			
Blackbird		Y	2
Blue tit			
Bullfinch			
Buzzard			
Carrion crow			
Chaffinch		Y	2
Collared dove			
Common gull			
Corn bunting			
Curlew		Y	3
Dunnock			
Dunlin			
Feral pigeon			
Golden plover			
Goldfinch			
Great black-backed gull			
Great tit			
Greenfinch			
Grey heron			
Herring gull			
Hooded crow			
House martin			
House sparrow			
Jackdaw			
Kestrel			
Lapwing		Y	2
Lesser black-backed gull			
Linnet			
Mallard			
Meadow pipit		Y	158
Mistle thrush			
Oystercatcher			
Pheasant			
Pied wagtail			
Pink-footed goose			
Raven			
Redshank			
Ringed plover			
Robin			
Rook			

Species	Conservation Status	Breeding	Estimated Territories
Sedge warbler			
Skylark		Y	53
Snipe			
Song thrush			
Starling			
Swallow			
Twite			
Wheatear			
Whinchat			
Willow warbler			
Wood pigeon			
Wren		Y	8
Yellowhammer		Y	3

Colours indicate whether species is Green, Amber or Red listed in BoCC.

APPENDIX 5: Winter Bird Survey Results

Table A5.1 provides a full species list based upon the results of the three visit winter bird survey completed at Hill of Forss. The table also indicated whether the bird is listed on Schedule 1 of the Wildlife and Countryside Act (as amended) or as Red or Amber on the Birds of Conservation Concern List (BoCC). Species have been arranged alphabetically as opposed to taxonomically for convenience. Surveys for both areas were completed in winter 2012/2013.

Meadow pipit territory densities are often too high for accurate recording and mapping by a surveyor. In order to estimate territory densities for meadow pipits, the survey area was divided into 500mx500m quadrats, and the number of meadow pipits displaying breeding behaviour (e.g. singing, alarming, territorial fights, nests etc.) were tallied for each quadrat during each of the four visits. In order to provide comparable results, the same approach was taken for winter bird surveys, although in this case any registration was included (whether or not it was indicative of breeding). The maximum value for each quadrat was then calculated. All maximum values summed to provide an estimate of the density of meadow pipits within each area, and then the totals for both areas were summed to provide an estimate for the site.

For all other species, the total number of registrations (whether indicative of breeding or not) were tallied per visit. The maximum number of registrations per visit was then used as an estimate of density per species.

Table A5.1. Winter bird survey results.

Species	Conservation Status	Maximum number recorded
Blackbird		4
Blue tit		1
Buzzard		3
Carrion Crow		35
Chaffinch		27
Collared dove		8
Dunnock		4
Feral pigeon		12
Fieldfare	Schedule 1	93
Golden plover		8
Great black-backed gull		2
Greenfinch		1
Grey heron		3
Greylag goose		327
Hen harrier	Schedule 1	1
Herring gull		41
Hooded crow		4
House sparrow		34
Jackdaw		32
Meadow pipit		13

Species	Conservation Status	Maximum number recorded
Pied wagtail		1
Raven		29
Redshank		1
Redwing	**Schedule 1**	8
Robin		7
Rook		274
Snipe		3
Song thrush		1
Starling		36
Twite		14
Wren		6
Yellowhammer		35

Colours indicate whether species is Green, Amber or Red listed in BoCC.

APPENDIX 6: Correspondence

From: Chris Cathrine [mailto:chris.cathrine@caledonianconservation.co.uk]

Sent: 01 April 2014 17:03

To: Ian Sargent

Cc: Eamonn Flood

Subject: Hill of Forss Wind Farm Ecology & Ornithology Consultation

Hi Ian,

As discussed, Caledonian Conservation Ltd has been commissioned to undertake ornithology and ecology surveys for the proposed Hill of Forss Wind Farm. There is not currently a site design, and the candidate turbine model is yet to be selected. The results of the ecology and ornithology surveys will inform the site design and turbine model, alongside other constraints. It is anticipated that turbines will have a tip height of up to 125m, and flight activity surveys have been designed to cover this range. However, no turbine model has yet been agreed with the client.

I have attached a document that sets out our proposed methods, and also highlights the known sensitivities that we are considering. The document also indicates the vantage point location and viewshed analysis for flight activity surveys. As the project is not yet in the public domain, I would appreciate it if you treat this as confidential. (Please refer to the Consultation Report CC0111/R2).

Bird survey work began in September 2012 and is ongoing. A potential sensitivity identified is wildfowl associated with Caithness Lochs SPA, and targeted survey effort has been undertaken to inform a robust assessment of effects on these receptors, including foraging goose surveys in the wider area alongside flight activity surveys. Ecology surveys and additional ornithology surveys are scheduled for 2014, as detailed in the document. Due to changes in SNH wind farm bird guidance, earlier work was designed with reference to 2010 guidance and work since September 2013 has been designed with reference to 2013 guidance.

Survey results to date (up to and including January 2014) for Greenland white-fronted geese, greylag geese and whooper swans have been included in the document to provide an indication of the flight and feeding patters we are observing. The main flight corridors appear to follow low lying land around the site, with relatively few flights actually crossing over the higher ground of the site itself.

I would greatly appreciate any feedback, suggestions or recommendations SNH may have and aim to seek agreement over the approach.

If you would like to discuss this in greater detail, please do not hesitate to contact me by any method.

I look forward to hearing from you in due course.

Kind regards,

Chris

Chris Cathrine BSc(Hons) MCIEEM FLS

Director

Caledonian Conservation Ltd

On 2 April 2014 10:43, Ian Sargent <Ian.Sargent@snh.gov.uk> wrote:

Hi Chris

Thank you for sending through the report and information. I have passed this case onto my colleague Sian Haddon, as I am going to be out of the office over the next few weeks, and this should speed up a response from us.

Just to let you know that as we are bound to the Freedom of Information (FOI) and Environmental Information Regulations (EIR), we cannot guarantee confidentiality should we receive a FOI/EIR request. If you want any more information on this, or if you are concerned that quantifiable harm would occur if the information was released then please let me know.

All the best,

Ian

Ian Sargent

Operations Officer, Caithness

From: Chris Cathrine [mailto:chris.cathrine@caledonianconservation.co.uk]

Sent: 03 April 2014 13:22

To: Ian Sargent

Cc: Sian Haddon

Subject: Re: Hill of Forss Wind Farm Ecology & Ornithology Consultation

Hi Ian,

Thanks for sending the document to an appropriate member of SNH staff, and for the information regarding FOI and EIR. I appreciate SNH must comply with FOI and EIR legislation where appropriate.

My client, RES UK & Ireland Ltd, have requested that I forward on the below response from their legal team:

"We appreciate that you have obligations in respect of FOI and EIR and that confidentiality cannot always be guaranteed. We would respectfully ask that SNH bear in mind that this is ongoing work and that we are still in the process of gathering data. As our interests (including interests in relation to confidential information) in the reports need to be balanced against the public interest in any proposed disclosure, please consider these carefully before making any such disclosure, and communicate with us in respect of any such request."

Just let me know if you require any further information, and thanks again for your help.

I look forward to hearing from Sian in due course.

Kind regards,

Chris

Chris Cathrine BSc(Hons) MCIEEM FLS

Director

Caledonian Conservation Ltd

From: Sian Haddon <Sian.Haddon@snh.gov.uk>

Date: 17 April 2014 at 13:12

Subject: RE: Hill of Forss Wind Farm Ecology & Ornithology Consultation

To: Chris Cathrine <chris.cathrine@caledonianconservation.co.uk>

Dear Mr Catherine,

Hill of Forss Wind Farm – Ecology and Ornithology Consultation

Thank you for your e-mail, dated 1 April 2014, regarding the ecological and ornithological surveys for the above proposal. I am currently going through the report and thought it best to highlight a couple of points regarding the proposed bat surveys:

a) Section 3.3.3 of the report states that these surveys will be carried out May – September 2014. This does not appear to be in-line with BCT guidelines (2nd edition) which outlines that surveys should be carried out April – October. Therefore, we recommend that this period is extended to include this month (April) and October in order to fully assess the level of bat activity at this site. As we are currently part of the way through April, I thought it best to quickly e-mail you now to allow some time for surveys to be conducted this month.

b) In addition, it would be useful to clarify the level of survey effort selected for the bat surveys, prior to the surveys being carried out. Specifically, it would be useful to clarify whether a low risk or medium risk level has been selected in this case. We advise that the level of survey effort should be either one or the other (low risk or medium risk), rather than a mix of elements from both levels. However, we further advise that you should allow for flexibility, so that if unexpected results are recorded within the early part of the survey work, then the survey effort can be adjusted accordingly. For example, if a higher risk species or more survey activity is recorded, then this is likely to require an increase in survey effort to the next level for the remaining part of the season (as touched on in section 3.3.3.4 of your report). Further information is outlined in section 10.6 of the BCT guidelines (2nd edition).

I am aiming to have our full comments on the report completed for you before the 29 April 2014. In the meantime, if you have any questions or require any further information in relation to this proposal, please do not hesitate to contact me. Please note that our comments are given 'without prejudice' to the views which we may wish to express at a later stage in response to a formal consultation as part of the EIA or planning process.

Kind regards,

Sian

Siân Haddon

Operations Officer, Caithness

Scottish Natural Heritage | The Links | Golspie Business Park | Golspie | Sutherland | KW10 6UB

From: Chris Cathrine <chris.cathrine@caledonianconservation.co.uk>

Date: 22 April 2014 at 10:25

Subject: Re: Hill of Forss Wind Farm Ecology & Ornithology Consultation

To: Sian Haddon <Sian.Haddon@snh.gov.uk>

Hi Sian,

Thanks very much for getting back to me so quickly with those time critical queries - I really appreciate it.

I have prepared the following with my associate, Stuart Spray (the bat expert who designed the approach), which I hope clarifies the methods, and explains why we believe the proposed approach is appropriate to this site in our professional judgement.

The methodology for all bat surveys on wind farm sites is prepared using a combination of local knowledge, professional judgement (i.e experience of undertaking bat surveys and personal knowledge of bat ecology) and current guidance (as indicated in the consultation documet). It is important that the approach to surveys reflects the specific circumstances of the site being surveyed, and that these are designed to reflect this. To clarify, in this case we have assessed Hill of Forss to be a low risk site, although we would revised our approach as appropriate should the desk study or our survey results indicate that there are greater bat sensitivities such as Nathusius' pipistrelle, as indicated in the consultation document. However, it should be noted that the survey conducted as part of the National Bat Wind Farm Survey in 2011 at the nearby operational Forss Wind Farm site did not find Nathusius' pipistrelles to be present. Therefore our approach is designed to address the site as low risk, but takes a precautionary approach so as to allow the detection of greater bat sensitivities in the unlikely event that they are present. More detail is provided below on your specific queries.

a) Section 3.3.3 of the report states that these surveys will be carried out May – September 2014. This does not appear to be in-line with BCT guidelines (2nd edition) which outlines that surveys should be carried out April – October. Therefore, we recommend that this period is extended to include this month (April) and October in order to fully assess the level of bat activity at this site. As we are currently part of the way through April, I thought it best to quickly e-mail you now to allow some time for surveys to be conducted this month.

- BCT guidance recommends one transect per season (spring, summer and autumn) for low risk sites. Experience has shown that there is little or no bat activity in April and October in the north of Scotland. As a result May, July and September have been chosen as the preferred survey months, as they maximize the chance of detection of bats if present (whereas if visits were completed in April and October we may not detect bats due to low or no activity in these months, even if they are present). May and September also correspond to the preferred months recommended by BCT for recording migrating bats, which may be at risk of collision with wind turbines. This also targets the period when Nathusius' pipistrelles would pass through the area if the site does lie on a migration route, and so would maximize the chance of us detecting this sensitivity if present.

b) In addition, it would be useful to clarify the level of survey effort selected for the bat surveys, prior to the surveys being carried out. Specifically, it would be useful to clarify whether a low risk or medium risk level has been selected in this case. We advise that the level of survey effort should be either one or the other (low risk or

medium risk), rather than a mix of elements from both levels. However, we further advise that you should allow for flexibility, so that if unexpected results are recorded within the early part of the survey work, then the survey effort can be adjusted accordingly. For example, if a higher risk species or more survey activity is recorded, then this is likely to require an increase in survey effort to the next level for the remaining part of the season (as touched on in section 3.3.3.4 of your report). Further information is outlined in section 10.6 of the BCT guidelines (2ndedition).

We have assessed the proposed Hill of Forss wind farm as being of low risk to bats and designed the survey approach to reflect specific site circumstances, for the following reasons:

- Due to its northerly location, the proposed site is unlikely to affect high flying, high risk bat species such as noctule or Leisler's which are known to be present in central and southern Scotland but not in the far north of Scotland. Species likely to be recorded if bats are present at this site include medium risk species such as common and soprano pipistrelle bats and low risk species including Natterer's and Daubenton's bats. In addition, a survey conducted as part of the National Bat Wind Farm Survey in 2011 at the nearby Forss Wind Farm only recorded common pipistrelle, soprano pipistrelle, brown long-eared and Myotis bats (which will either be Daubenton's or Nattere's bats, both of which are low risk species) supporting the preliminary assessment that the proposed Hill of Forss Wind Farm is unlikely to affect any high risk species of bats.

- Recent records of Nathusius' pipistrelle bats recorded on North Sea oil rigs, on Shetland and Orkney and along the eastern coast of Scotland and north eastern-England in September strongly suggest that this species may be migratory. Although there are no known local records for this species, it is possible that Nathusius, a high risk bat species, could be present at a certain time of the year and we believe it is important that the survey design for Hill of Forss maximizes the chance of us detecting this sensitivity if present. Transects and remote bat detector surveys have, therefore, been timed to take place in September (and May which is another potential migration month), to coincide with a time of year when Nathusius' pipistrelle bats may have started migrating and when most of the records for this species have been recorded elsewhere. It should be noted that Nathusius' pipistrelle was not detected during the National Bat Wind Farm Survey in September 2011.

- Roosting opportunities are limited with no trees and just handful of farm buildings.

- The site is extremely exposed and offers poor quality foraging habitat that is not connected to the wider landscape by linear features such as scrub, tree lines or steams. Although there is pond located in the middle of the site, the connectivity to the wider landscape remains poor.

I hope the above information clarifies our approach, although would reiterate that we will adjust our survey methods should the desk study or novel fieldwork reveal any additional sensitivities. Our precautionary survey approach has been specifically designed to ensure the chance of detecting potential sensitivities is as likely as possible.

We are keen to seek agreement with SNH on this approach, and I would be pleased to provided further information or discuss the project in greater detail if this would be helpful. Please do not hesitate to contact me by any method, and I will respond as quickly as I am able.

From: Sian Haddon <Sian.Haddon@snh.gov.uk>

Date: 29 April 2014 at 16:53

Subject: RE: Hill of Forss Wind Farm Ecology & Ornithology Consultation

To: Chris Cathrine <chris.cathrine@caledonianconservation.co.uk>

Hi Chris,

Hill of Forss Wind Farm – Ecology and Ornithology Consultation

Thank you for your e-mail, dated 22 April 2014, clarifying the level of survey effort selected for the proposed bat surveys. I apologise for not getting back to you sooner, as I have been out of the office over the past couple of days. Please find attached our pre-application comments on the above proposal. We have included our advice on the proposed bat surveys within this response (section 3.1 of the attached letter).

Please let me know if you require any further information or advice in relation to this proposal.

Kind regards,

Sian

Siân Haddon

Operations Officer, Caithness

Scottish Natural Heritage
Dualchas Nàdair na h-Alba
All of nature for all of Scotland
Nàdar air fad airson Alba air fad

BY EMAIL

Chris Cathrine
Director
Caledonian Conservation Ltd.
chris.cathrine@caledonianconservation.co.uk

29 April 2014
Our ref: CPA130113
[redacted]

Dear Mr Cathrine,

Hill of Forss wind farm – pre-application comments on ecology and ornithology surveys

Thank you for your e-mail, dated 1 April 2014, requesting pre-application comments on the ecology and ornithology surveys carried out for the above proposal.

We would like to highlight our general scoping and pre-application advice[1], which outlines some recommended guidance and sources of information that will be relevant when considering a wind farm development. In addition there is a host of information and guidance for onshore wind developments available on our website including topics such as landscape, birds and protected species (http://www.snh.gov.uk/planning-and-development/renewable-energy/onshore-wind/).

1. Summary

We are broadly in agreement with the completed and proposed survey methods for this proposal. The main sensitivities of the site have been identified and the proposed/completed surveys appear to be appropriate for the site. We include specific advice below in relation to protected areas, bats and landscape.

2. Comments on completed/proposed ornithological surveys

We are aware that our bird survey guidance was updated during the course of this survey work (August 2013). Based on the information provided, the completed/proposed bird survey work appears to follow our guidance. We are pleased to see that both sets of guidance have been used to inform different years of survey work.

However, we cannot comment on the suitability of the duration of each Vantage Point (VP) survey or their spread throughout the breeding and non-breeding season as this information has not been provided.

2.1 Caithness Lochs Special Protection Area (SPA)

The proposal lies approximately 5.7km from this SPA, which is classified for its wintering populations of Greenland white-fronted geese, (Icelandic) greylag geese and whooper swans[2].

[1] Available at: http://www.snh.gov.uk/docs/A1150291.pdf
[2] Further information on the site's qualifying features and conservation objectives can be found through our SiteLink service at: http://www.snh.gov.uk/publications-data-and-research/snhi-information-service/sitelink/

The proposal lies close to known favoured feeding fields for Greenland white-fronted geese. From the information provided, this species has not been recorded feeding in close proximity to the proposal site. However, this species is site-faithful and they are likely to return to favoured feeding fields during the lifetime of the development. Therefore, we advise that the design of the development site should aim to avoid impacts on fields known to be regularly used by Greenland white-fronted geese (and other species connected with the SPA).

Information on the location of these fields is included in the Greenland white-fronted goose study's small wintering sites report[3]. Page 64 of this report is specific to the Westfield area, close to the proposal site. In addition, more information on the feeding regime of geese and swans in Caithness is available in our commissioned report on the Caithness Lochs SPA[4].

In relation to this SPA, the completed and proposed survey work appears to follow our bird survey guidance. We note that only 4 hours of VP survey work was completed during the 2013 spring migration period. Although this is less than our recommended survey effort, we note that 36 hours of VP survey will be completed during the 2014 spring migration period. Given the change in our bird survey guidance and that 1 full year of wintering and migratory period (autumn and spring) will have been covered this year, we are happy to accept 1 years' worth of spring migration survey effort in this case. The report states that goose flights have remained fairly similar between both years of survey despite different weather conditions. We encourage you to refer to the above reports to confirm that the flights are representative of the usual pattern of activity. Please note that for other developments, 2 years' worth of survey effort over the wintering and migratory periods (autumn and spring) would be required as outlined in our 2013 bird survey guidance.

Due to the introduction of foraging goose surveys in our 2013 guidance, we are happy to accept 1 years' worth of foraging goose survey effort. We note that the wintering bird surveys (carried out in 2012/13) recorded no geese or swan foraging within the proposal site. Again, we would encourage you to refer to the above reports when making an assessment of the likely impacts of disturbance and displacement from the proposal.

2.2 North Caithness Cliffs SPA

The proposal site lies approximately 1.5km from this SPA, which is classified for its cliff nesting seabirds and population of peregrine falcon. We note that Table 1 of the report states that species from this SPA are unlikely to fly inland. However, the proposal site lies within core foraging range for peregrine falcon, which can fly inland to hunt. Due to this connectivity, an assessment of the likely impacts on this SPA will be required. Therefore, it would be useful to clarify whether this species has been included as a target species within the completed and proposed survey work.

2.3 Further Assessment

Following completion of VP survey work, Collision Risk Modelling[5] should be undertaken (where appropriate) and an assessment should be made against the conservation objectives for the above SPAs[1]. In relation to bird populations from the wider countryside, an assessment should be made against the relative Natural Heritage Zone (NHZ). In this case the relevant zone would be NHZ 2: Orkney and Northern Caithness and further information can be found at http://www.snh.gov.uk/docs/A306319.pdf and http://www.snh.gov.uk/docs/A306318.pdf (2009 update).

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[3] Full report is available from: http://greenlandwhitefront.org/publications/small-sites-report/

[4] Available from: http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=2054

[5] Further information on Collision Risk Modelling can be found on our website at: http://www.snh.gov.uk/planning-and-development/renewable-energy/onshore-wind/bird-collision-risks-guidance/.

Given the number of proposals and built wind farms in the area, a cumulative assessment for birds will be very important. We refer you to Section 4 of our cumulative guidance[6] which is specific to cumulative assessment on birds. In addition, where a collision risk is identified, we would be happy to advise you on the appropriate development and figures to include in a cumulative collision risk assessment.

[redacted]

2.4 Meteorological met mast

We also note that the proposed development is likely to include the installation of a meteorological met mast. If this is likely to be a guyed met mast, it could pose a collision risk to birds flying through the proposal site. Therefore, we recommend that the guy wires are appropriately marked with bird deflectors in order to increase the visibility of these wires. These deflectors should be regularly maintained to ensure they remain in place throughout the lifetime of the development. Please refer to our recently published guidance on guyed meteorological masts for further information[7].

3. Comments on completed/proposed ecological surveys (non-avian)

We note that surveys for protected species (otter, wildcat, water vole, pine marten and badger) and habitats are proposed to take place this year (2014). From the information provided, these surveys appear to follow recognised methodologies. More information on protected species/habitats and the protection afforded to them is available from our website (http://www.snh.gov.uk/protecting-scotlands-nature/protected-species/).

3.1 Bats

Thank you for clarifying the level of survey effort selected for this site in relation to bats (e-mail dated 22 April 2014). As a low risk level has been selected, we are happy to see that surveys are proposed during each season (spring, summer and autumn).

[redacted]

However, we would like to clarify that the remote static bat surveys should be carried out over 5 consecutive nights during each season (April – October) rather than 5 days as outlined in section 3.3.3.5 of the report. Also, it is not clear if the roost surveys will cover the proposal site and an appropriate buffer around it. Section 10.5.3 of the BCT guidelines (2nd edition) recommends that roost surveys for wind farm sites should extend to a 200m buffer around the proposal site.

We note that both the activity line transects and the remote static bat surveys will start 15 minutes before sunset, rather than 30 minutes as outlined in the BCT guidelines. We recognise the reasoning for this in terms of the walked transects. However, as the remote detectors will be automatically timed to start, we recommend that these surveys should start 30 minutes before sunset. Currently, we are unable to comment on the suitability of the location of the automated recorders or transects as this information has not been provided.

Depending on the results of the initial surveys, the suitability of the site for bats may need to be reviewed in accordance with BCT guidelines (2nd edition).

In relation to Natterer's bats (mentioned in your e-mail) we are unaware of any records of this species this far north. If this species is recorded within the surveys, this would be the most northerly record.

[redacted]

4. Landscape and Visual Impact Assessment (LVIA)

We would like to highlight at this stage that there may be landscape and visual impact issues at this site which would require careful consideration during the design and layout stage of the proposal. Therefore, we would be grateful if you could pass this information onto the developer.

[redacted]

[6] Available at: http://www.snh.gov.uk/docs/A675503.pdf
[7] Available at: http://www.snh.gov.uk/docs/A1240025.pdf

[redacted]

[redacted]

We recommend that the developer refers to our scoping response of May 2013 for a development near Tresdale Farm, Canisbay. This proposal is located in a similar coastal location and our response outlines what is likely to be required in terms of a landscape assessment. This response is publically available online via the Highland Council's e-planning website (http://wam.highland.gov.uk/wam/) using the planning reference 13/01473/SCOP. However, we also strongly recommend that the developer seeks pre-application advice from the Highland Council regarding landscape and visual impacts.

[redacted]

5. Service Level Statement (SLS)

Our SLS[8] sets out the level of engagement you may expect from us during the planning process. In line with our SLS, where the impacts on the natural heritage warrant further input, we would be happy to provide further advice prior to the submission of the planning application.

[redacted]

Please note that while SNH is supporting of the principle of renewable energy, our advice is given without prejudice to a full and detailed consideration of the impacts of the proposal if submitted for formal consultation as part of the EIA or planning process.

Please let me know if you need any further information or advice from us in relation to this proposal.

Yours sincerely

[redacted]

Siân Haddon
Operations Officer, Caithness
Sian.Haddon@snh.gov.uk

[redacted]

[6] Available from: http://www.snh.gov.uk/planning-and-development/renewable-energy/our-approach-to-renewables/managing-applications/

[redacted]

From: Chris Cathrine <chris.cathrine@caledonianconservation.co.uk>

Date: 23 May 2014 at 13:31

Subject: Re: Hill of Forss Wind Farm Ecology & Ornithology Consultation

To: Sian Haddon <Sian.Haddon@snh.gov.uk>

Hi Sian,

Thanks for sending through the detailed response. We are pleased that SNH broadly support the approach to surveys at the site.

With regards to specific points within the document:

- 2.2 - I can confirm that peregrine, as well as all other Schedule 1 raptors, are always included as target species for flight activity surveys. We are also surveying for breeding peregrine during raptor surveys.

- 3.1 - We are happy to complete an assessment of bat roost potential for all buildings within 200m of potential turbine locations. Any building which is rated as having medium or high bat roost potential within 50m of potential turbine locations will then be subjected to emergence/re-entry surveys as described in the consultation document. 50m is the buffer recommended in Natural England guidance (2012). We will ensure remote bat detectors are timed to include 30m before sunset.

I hope the above addresses your queries, but please do not hesitate to contact me should you require further information or wish to discuss the project in greater detail. I would appreciate it if you could confirm that the approach is acceptable to SNH, with the above clarifications.

Kind regards,

Chris

Chris Cathrine BSc(Hons) MCIEEM FLS

Director

Caledonian Conservation Ltd

From: Chris Cathrine <chris.cathrine@caledonianconservation.co.uk>

23 May 2014 13:34

To: Sian Haddon

Subject: Re: Hill of Forss Wind Farm Ecology & Ornithology Consultation

Hi Sian,

Apologies, I forgot to ask if SNH would be able to share data regarding known peregrine nest locations historically at North Caithness Cliffs SPA (even if only Site Condition Monitoring data is available)? This would be very helpful for providing context for our assessment, but we will complete a second year of novel survey effort in 2014 regardless.

Kind regards,

Chris

Chris Cathrine BSc(Hons) MCIEEM FLS

Director

Caledonian Conservation Ltd

From: Sian Haddon <Sian.Haddon@snh.gov.uk>

Date: 2 June 2014 at 16:16

Subject: RE: Hill of Forss Wind Farm Ecology & Ornithology Consultation

To: Chris Cathrine <chris.cathrine@caledonianconservation.co.uk>

Hi Chris,

Apologies for the delay in replying to you. I'm just catching up with e-mails as I've been out of the office for a few days last week.

I can confirm that from the information provided, we are happy with your approach to the ecological and ornithological surveys proposed for the Forss Wind Farm. In terms of information regarding peregrine nest locations, I will need to check with an advisor what data we would be able to provide you with. I will let you know what I've heard back from them.

I also wanted to let you know that the information relating to the Forss 3 development, which you sent to my colleague Ian Sargent, has been passed onto me to reply. I am aiming to provide you with some comments by the 18 June 2014. Could you please let me know if this will be a problem?

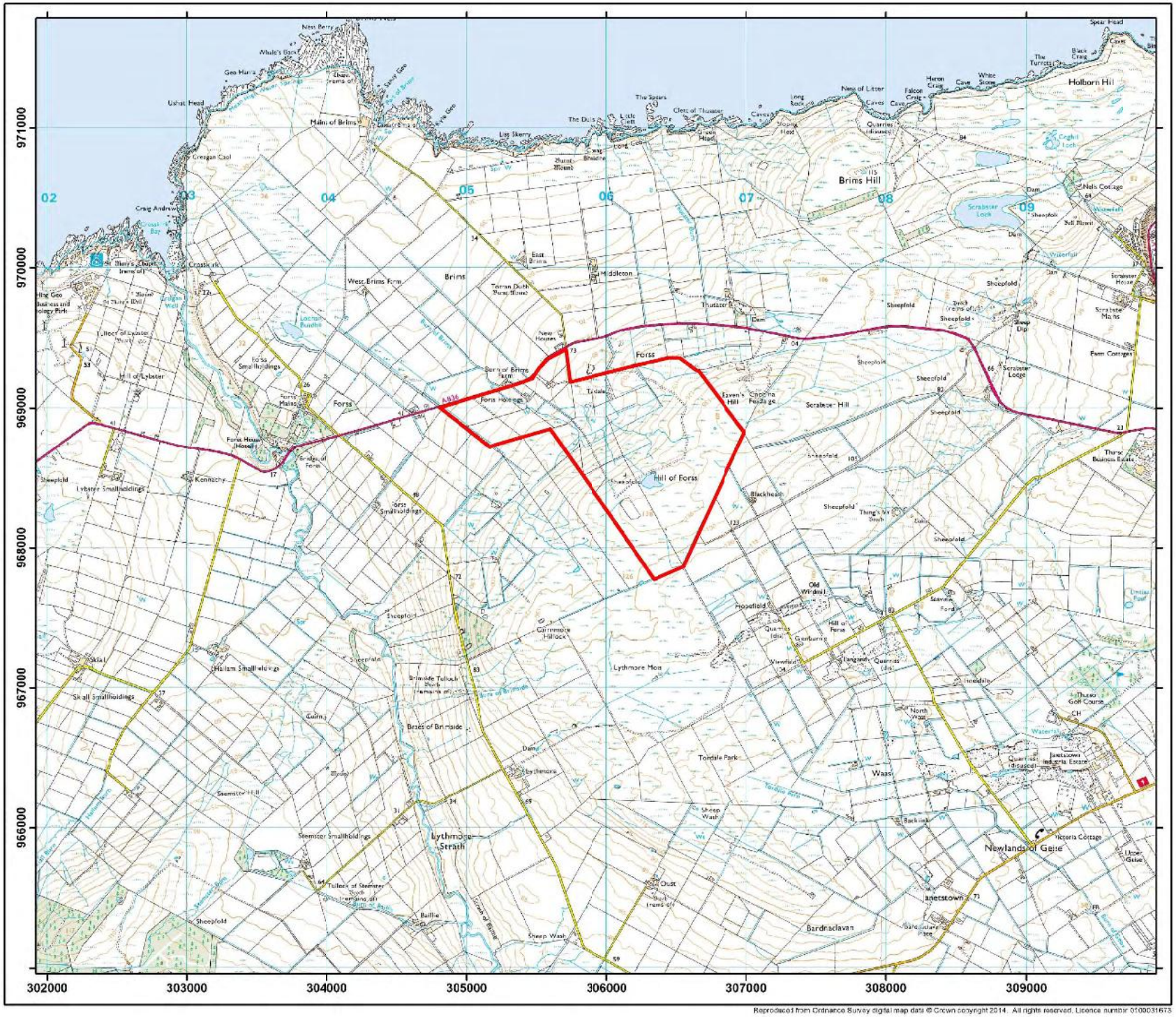
Kind regards,

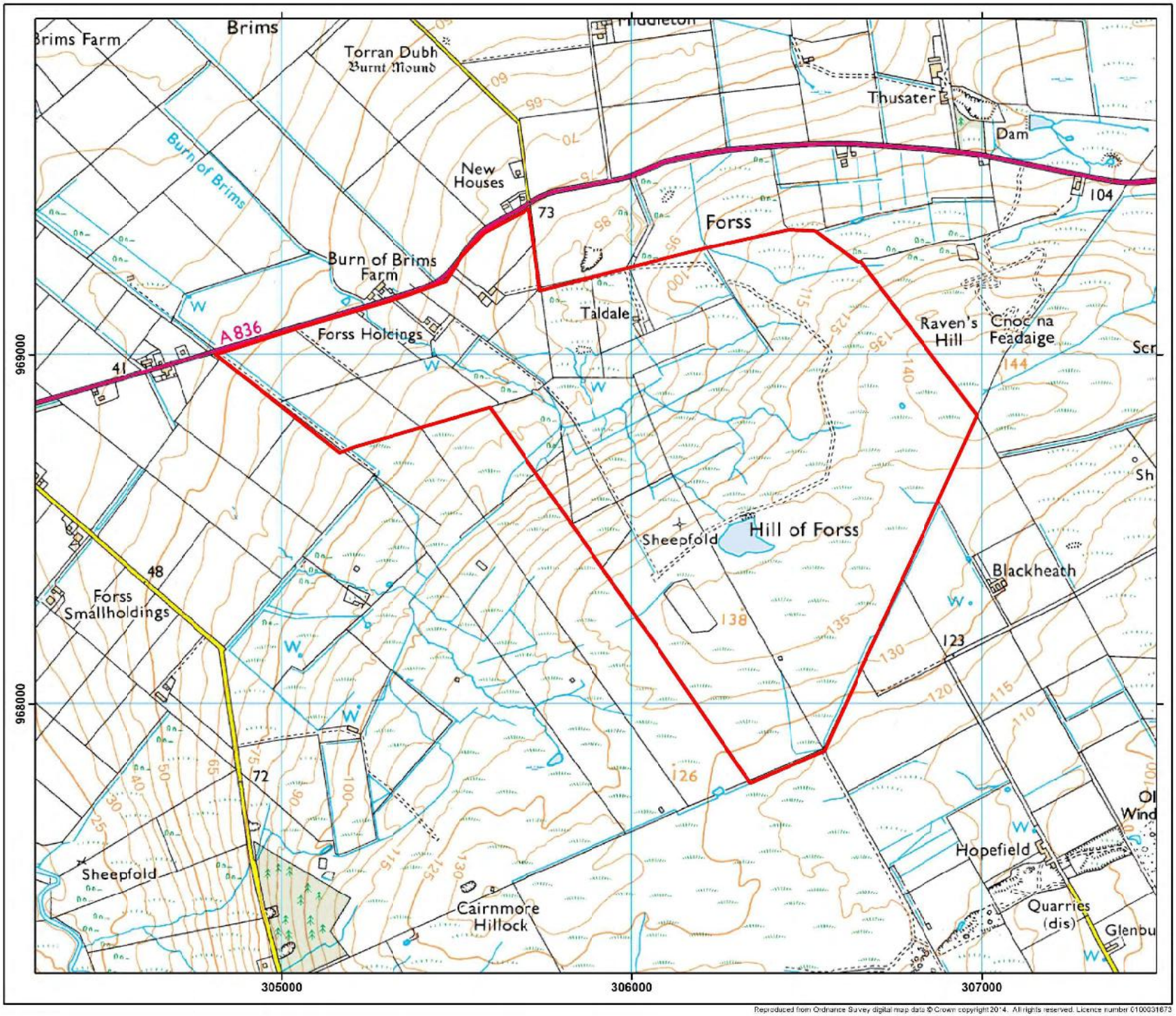
Sian

Siân Haddon

Operations Officer, Caithness

APPENDIX 7: Figures





res

Caledonian Conservation Ltd

Key

Site boundary

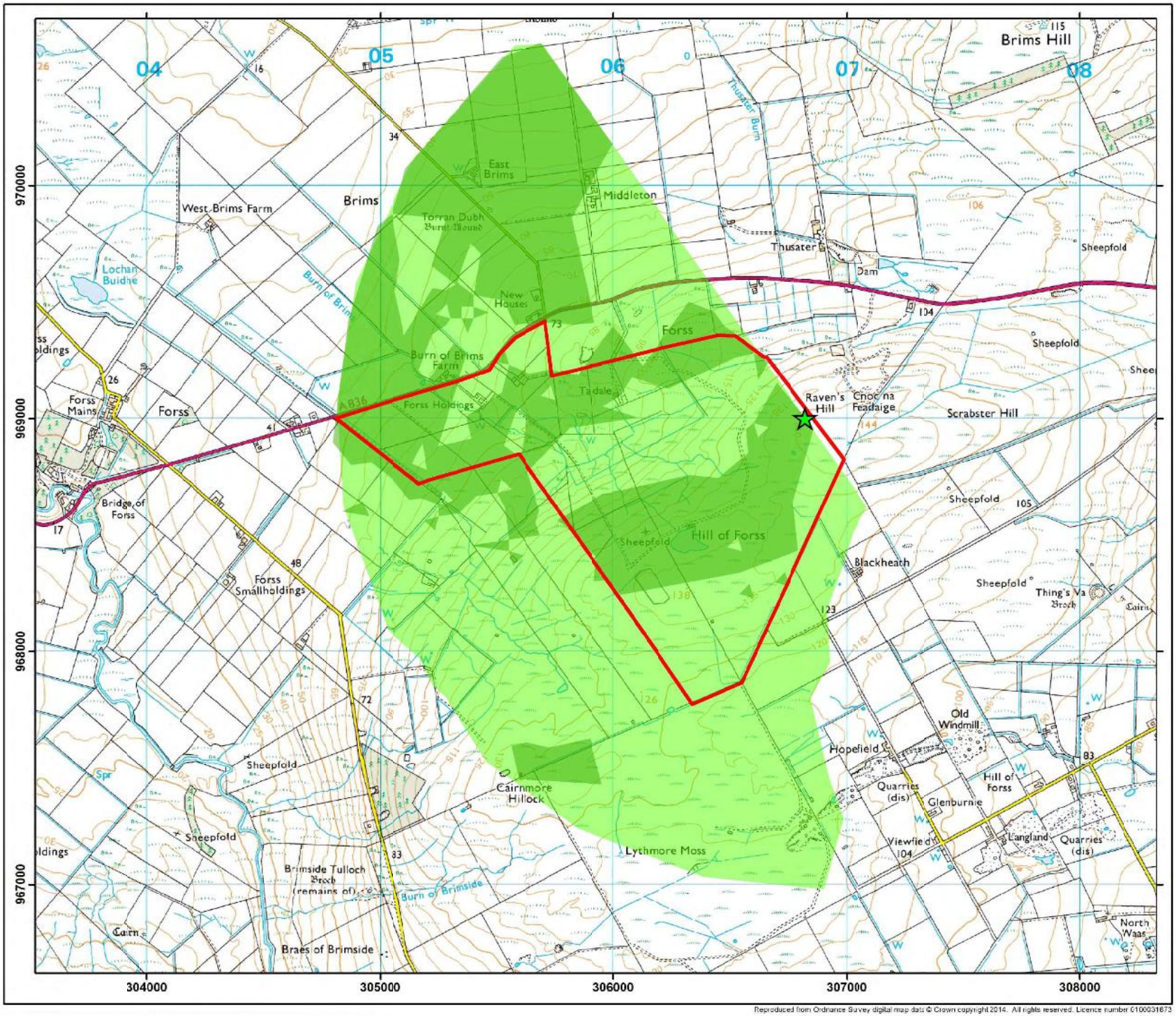
Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 2
Site Boundary

Hill of Forss
Ornithology



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Caledonian Conservation Ltd

Key

- VP Viewshed (visible at 0m)
- VP Viewshed (visible at 20m)
- Site boundary

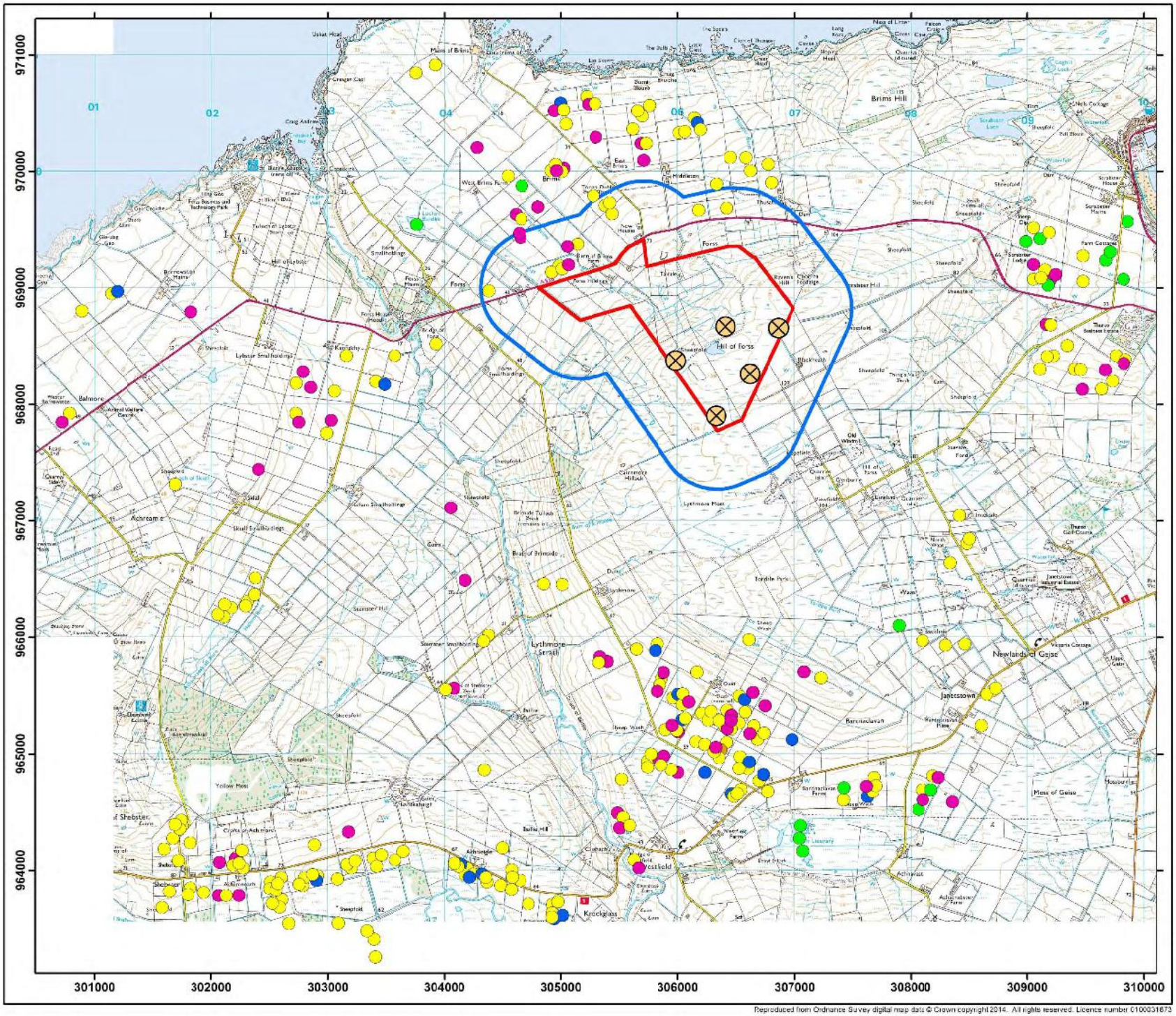
Scale 1:15,000 @ A3

0 125 250 500 m

N

Figure 3
Vantage Point Viewshed

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- Bean goose
- Greylag goose
- Pink-footed goose
- Greenland white-fronted goose
- Whooper swan
- 500m buffer
- Site boundary

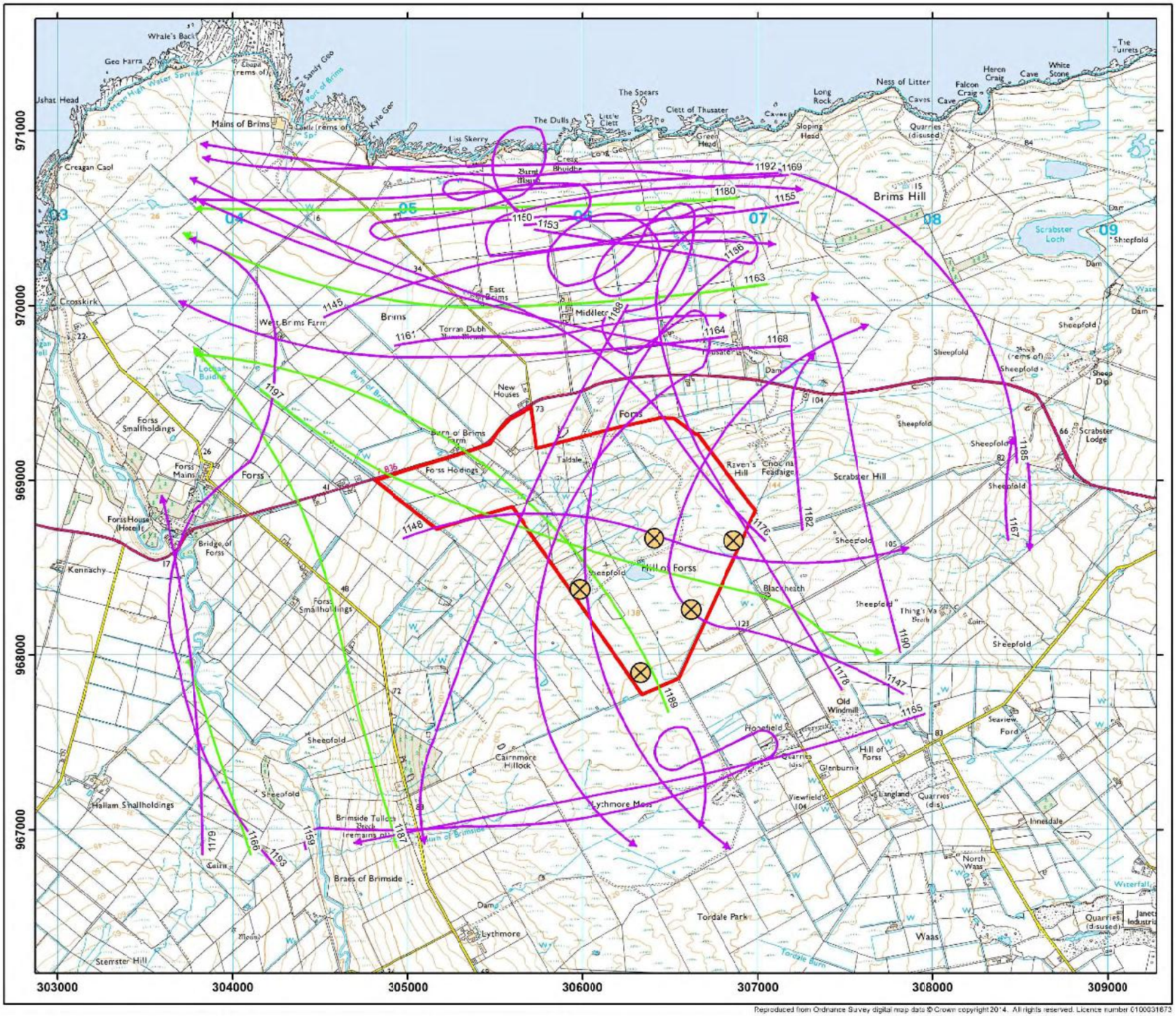
Scale 1:30,000 @ A3

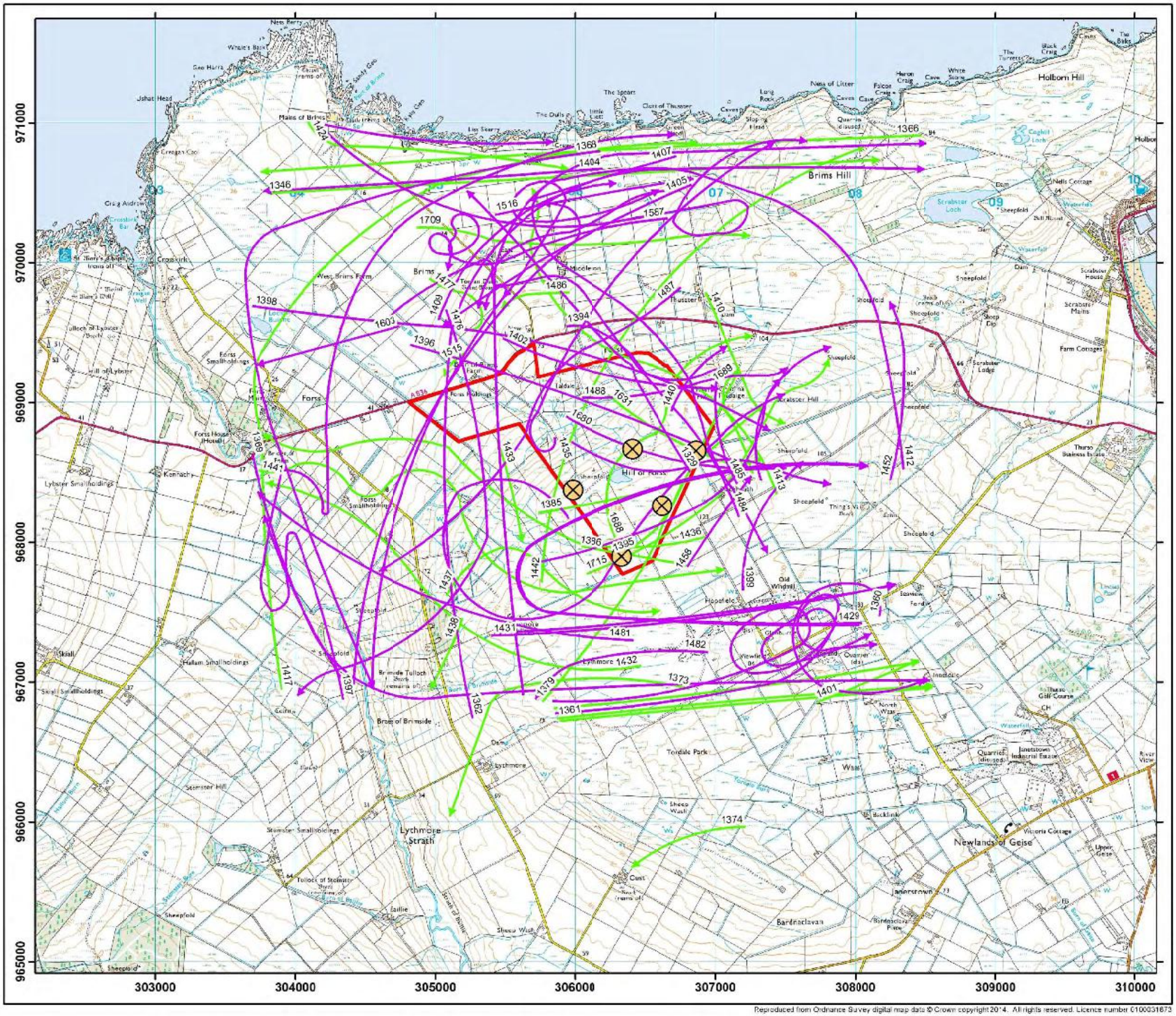
0 250 500 1,000 m

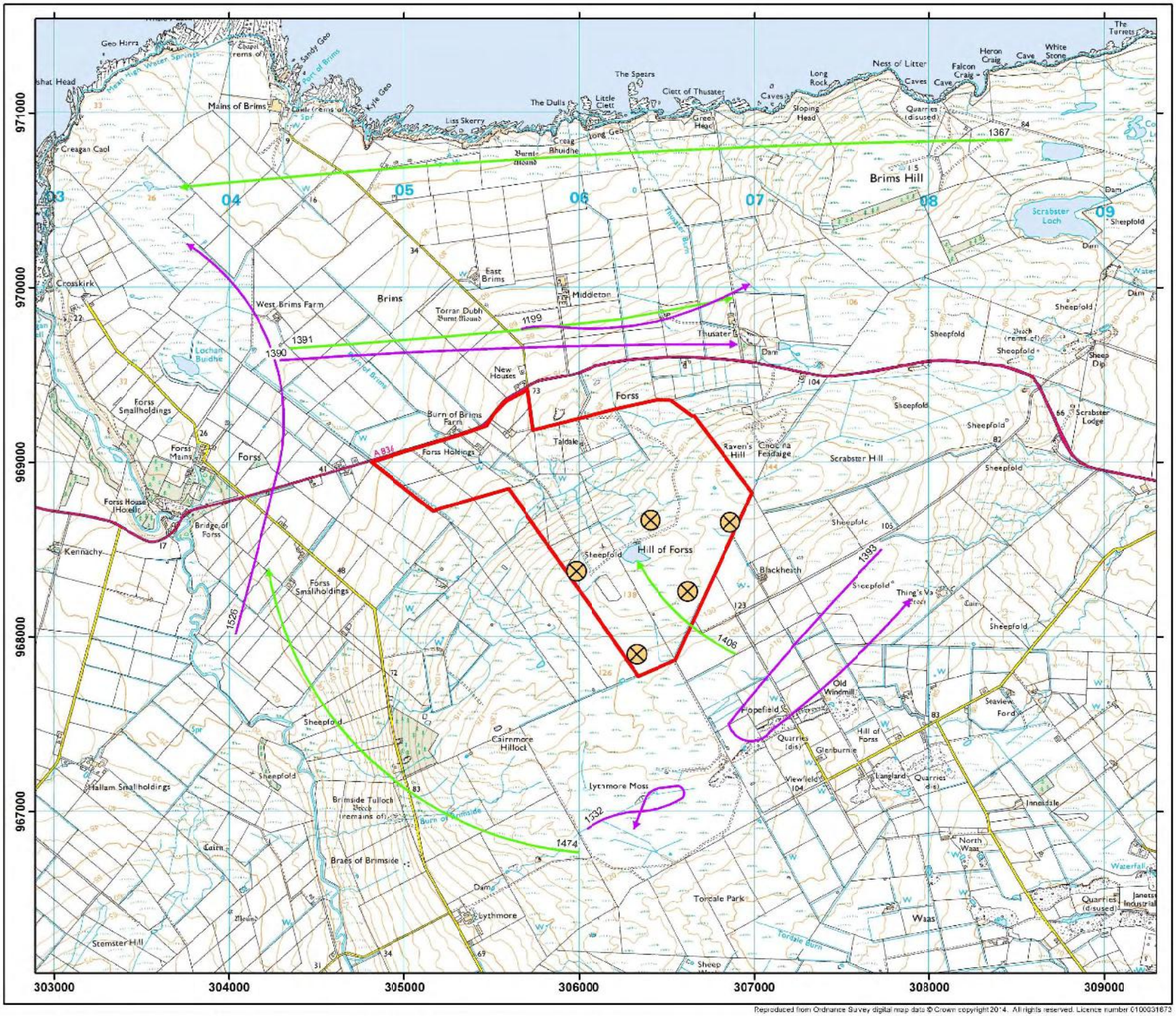
N

Figure 4
Foraging Goose Survey

Hill of Forss
Ornithology







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Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

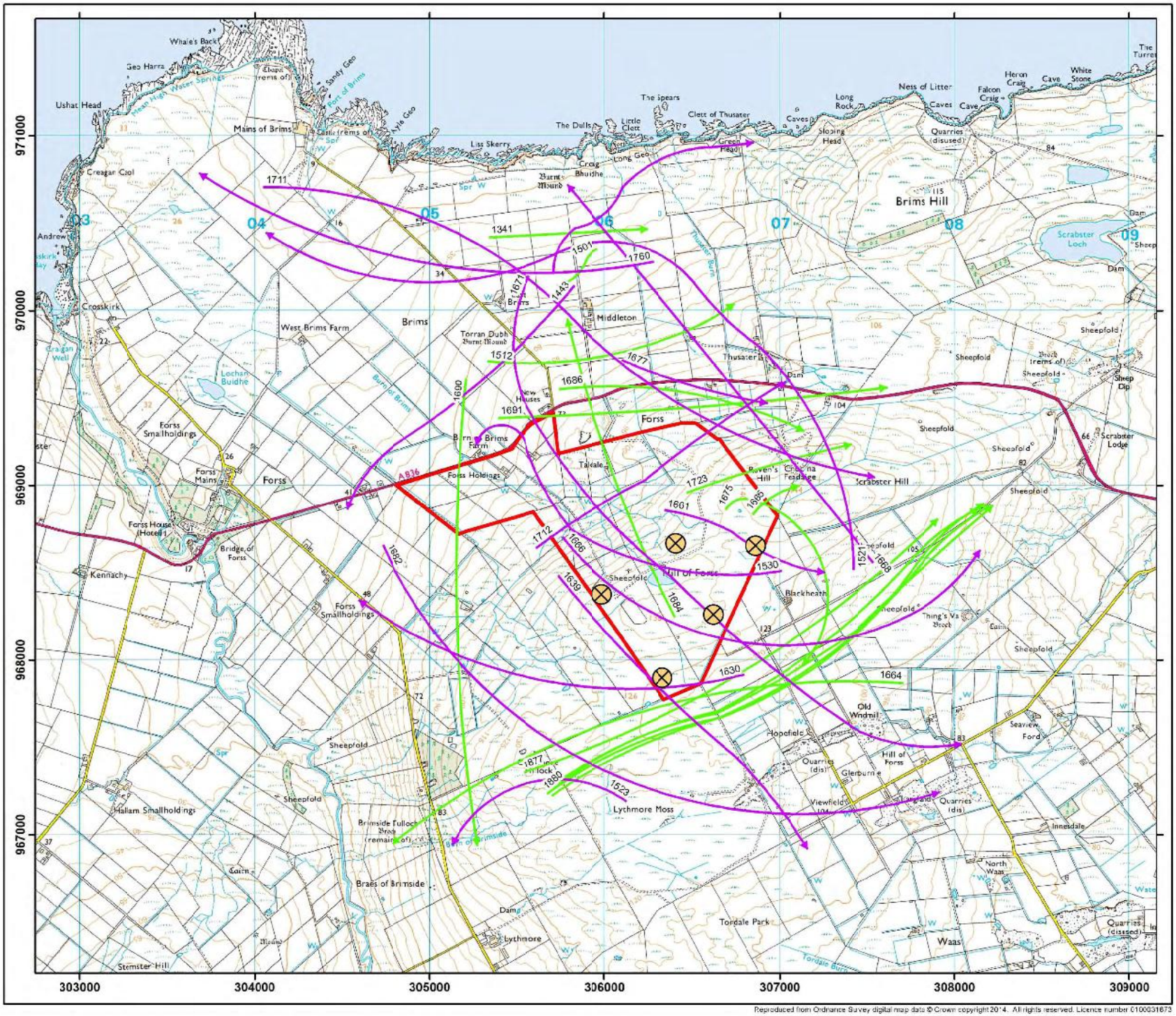
Scale 1:20,000 @ A3

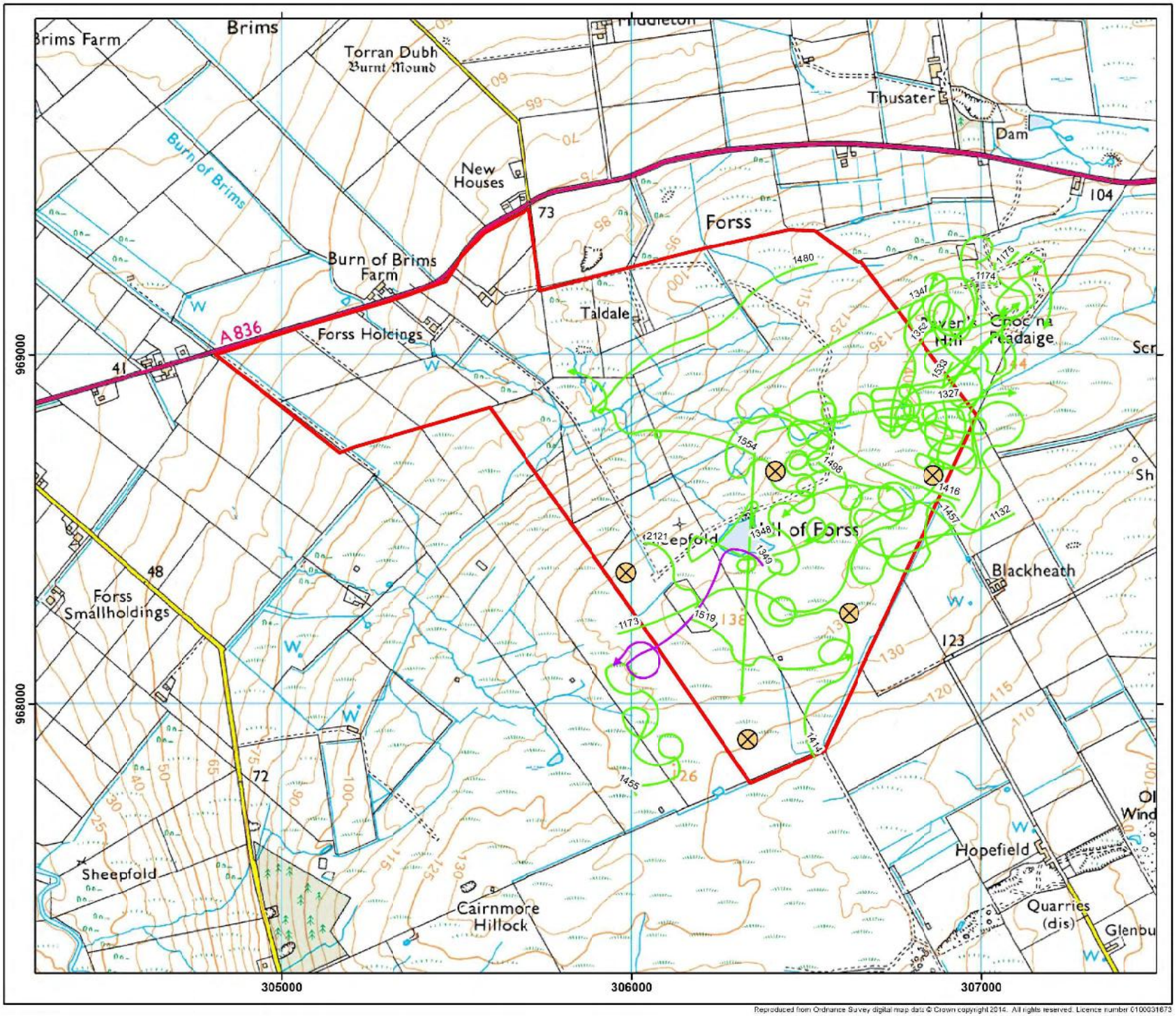
0 250 500 1,000 m

N

Figure 7
Whooper Swan

Hill of Forss
Ornithology





res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

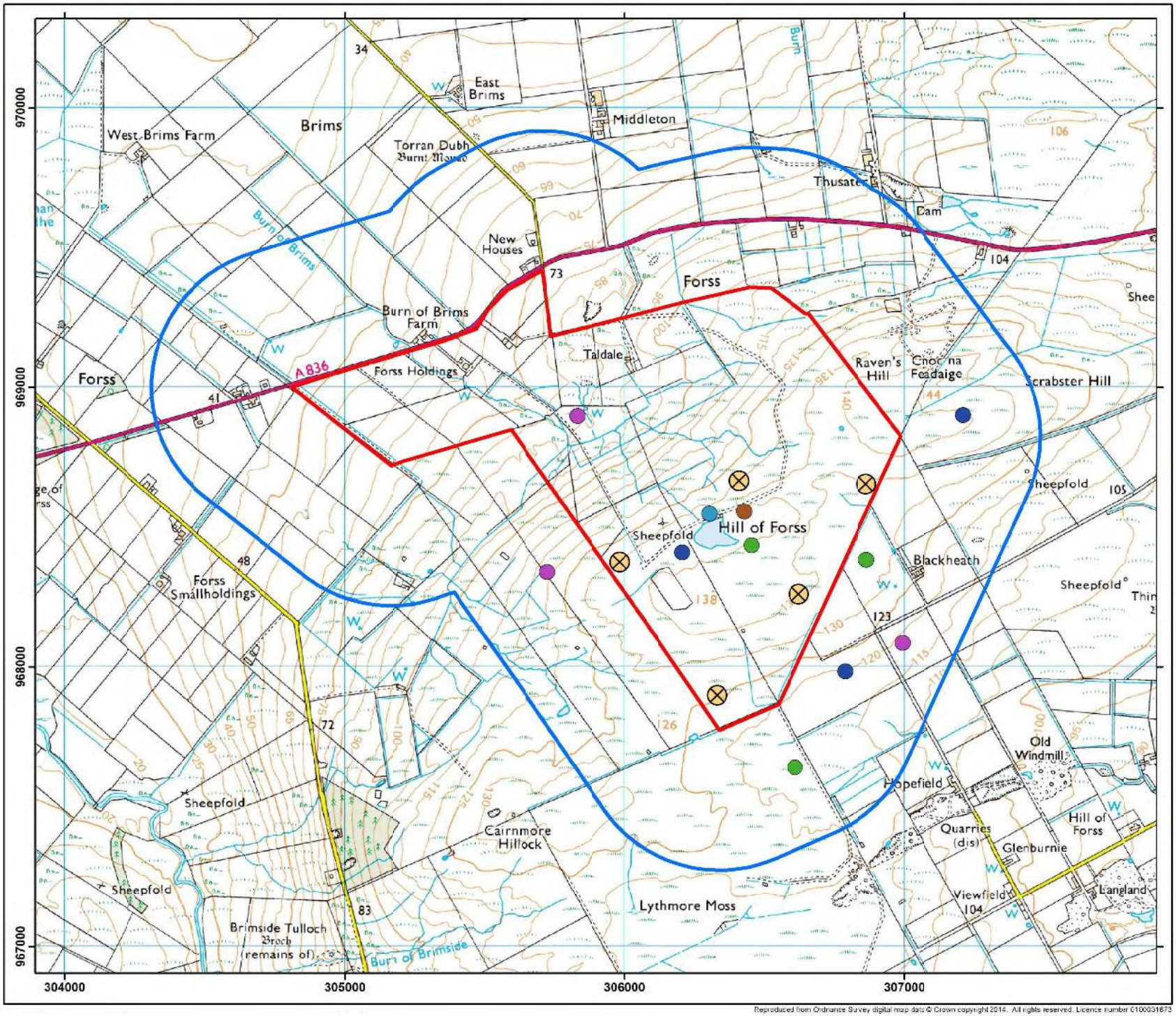
Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 9
Hen Harrier

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- Curlew
- Lapwing
- Oystercatcher
- Redshank
- Snipe
- 500m Buffer
- Site boundary

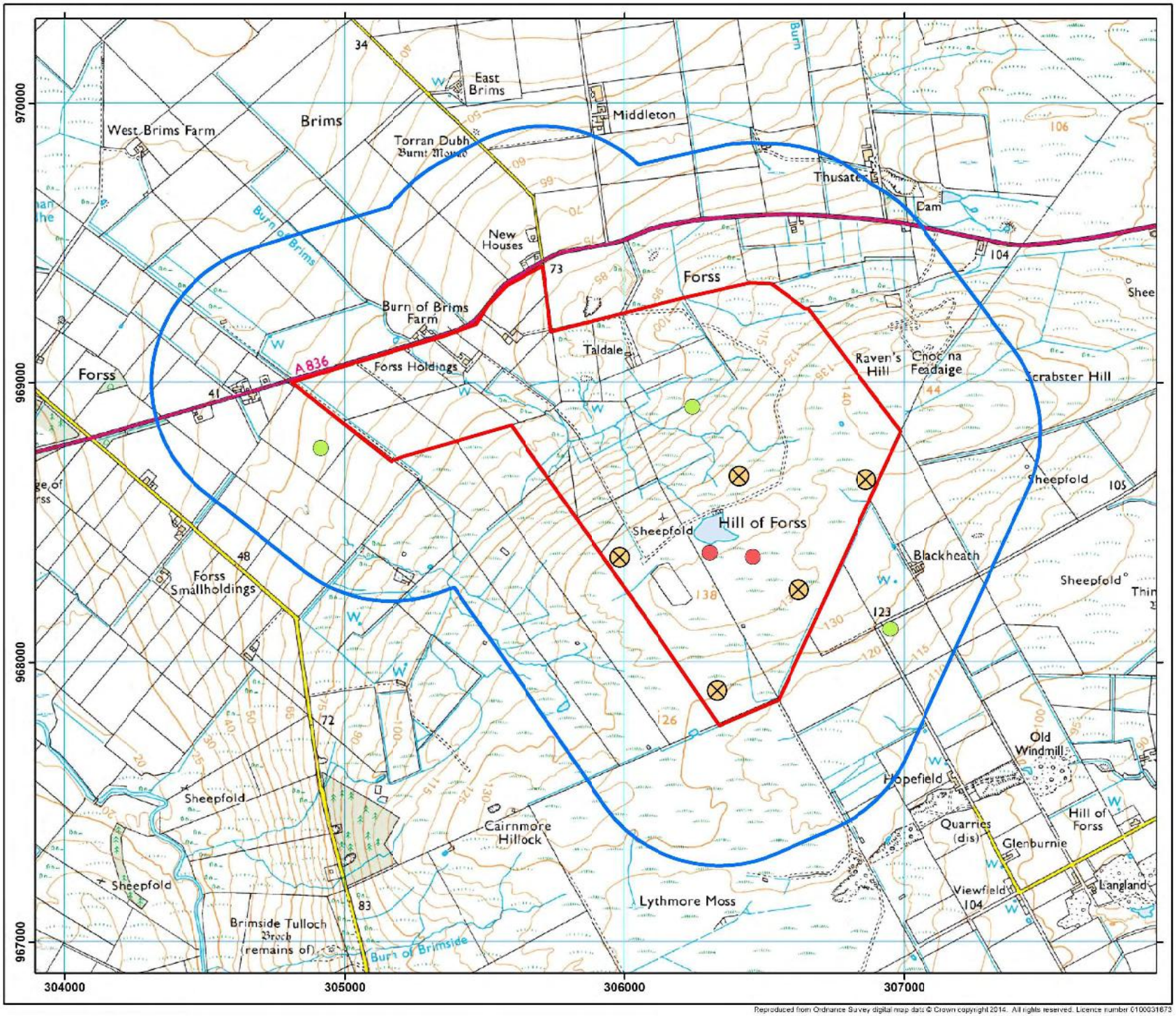
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 10
Wader Territories
Breeding Season 2013

Hill of Forss
Ornithology



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res

Caledonian Conservation Ltd

Key

- Indicative turbine
- Curlew
- Lapwing
- 500m Buffer
- Site boundary

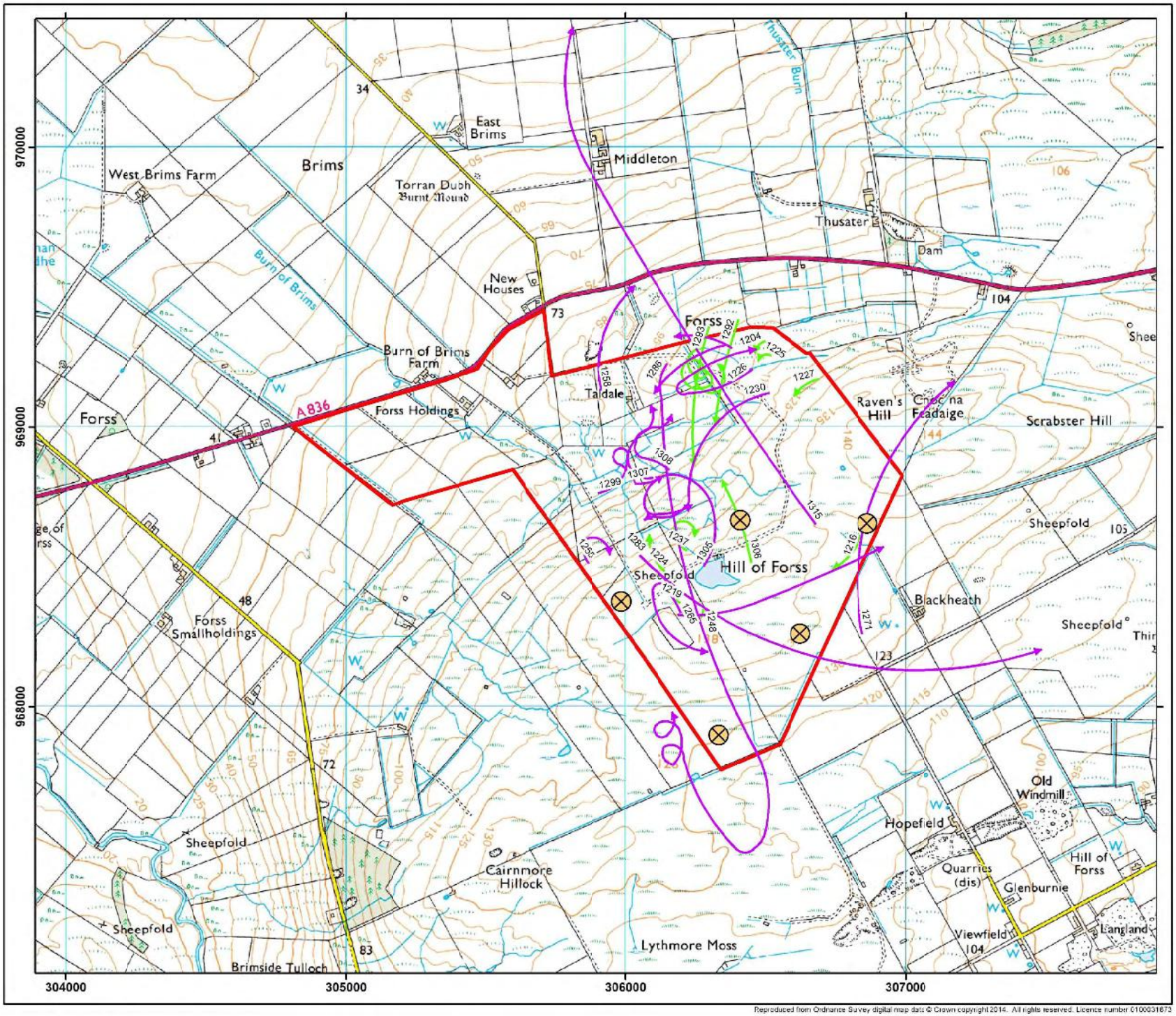
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 11
Wader Territories
Breeding Season 2014

Hill of Forss
Ornithology



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Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

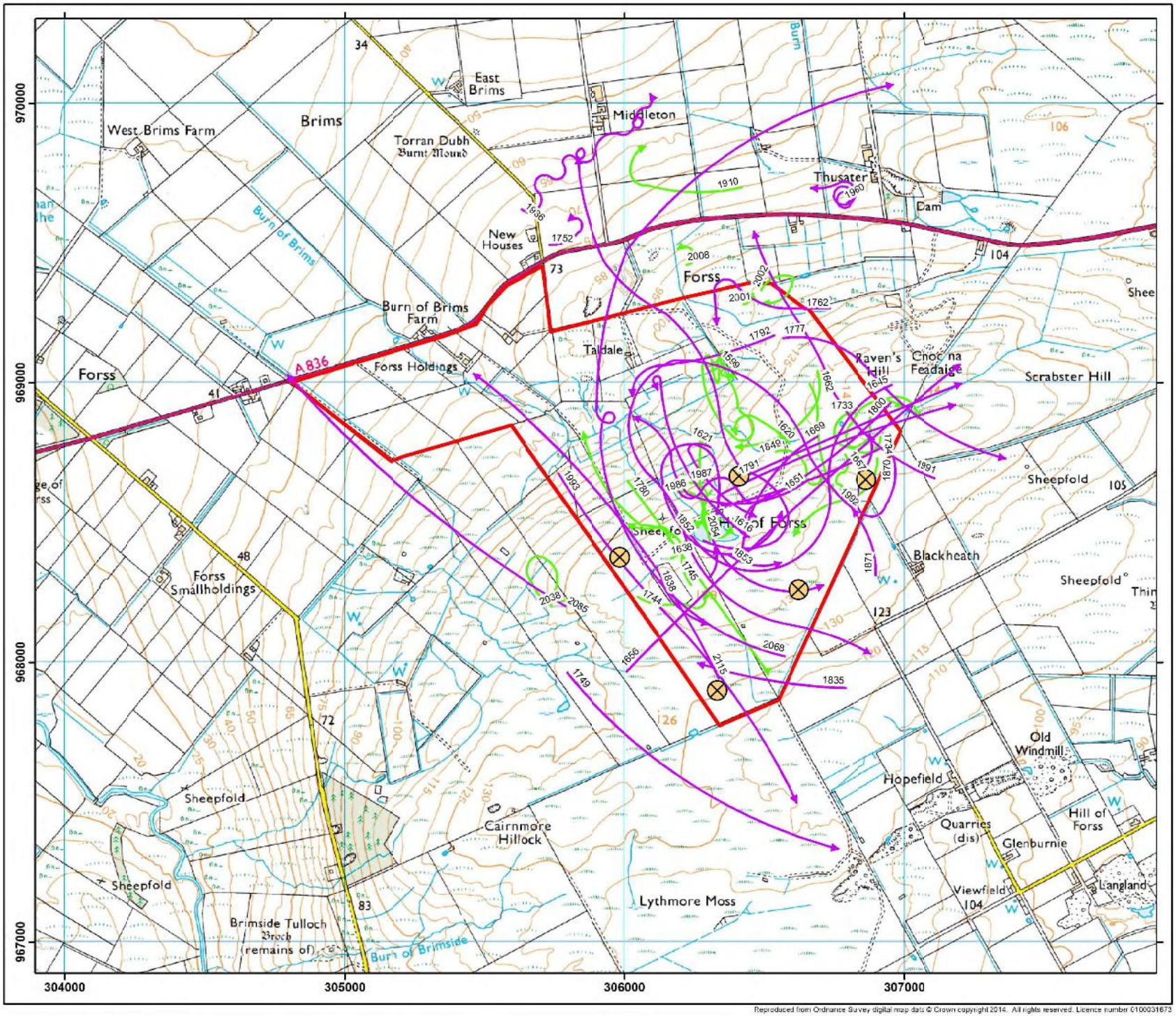
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 12
Curlew
Breeding Season 2013

Hill of Forss
Ornithology



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Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

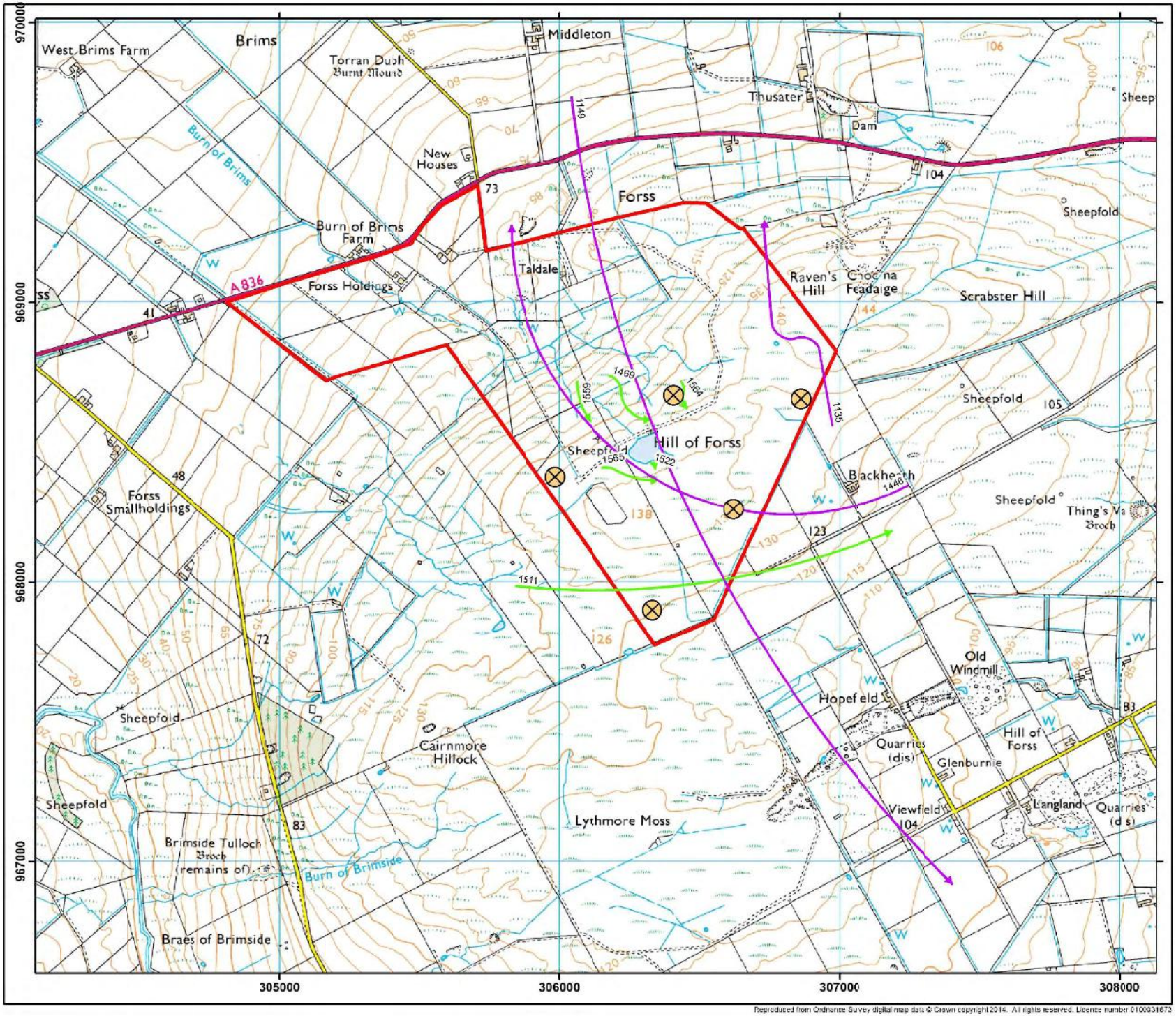
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 13
Curlew
Breeding Season 2014

Hill of Forss
Ornithology



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Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

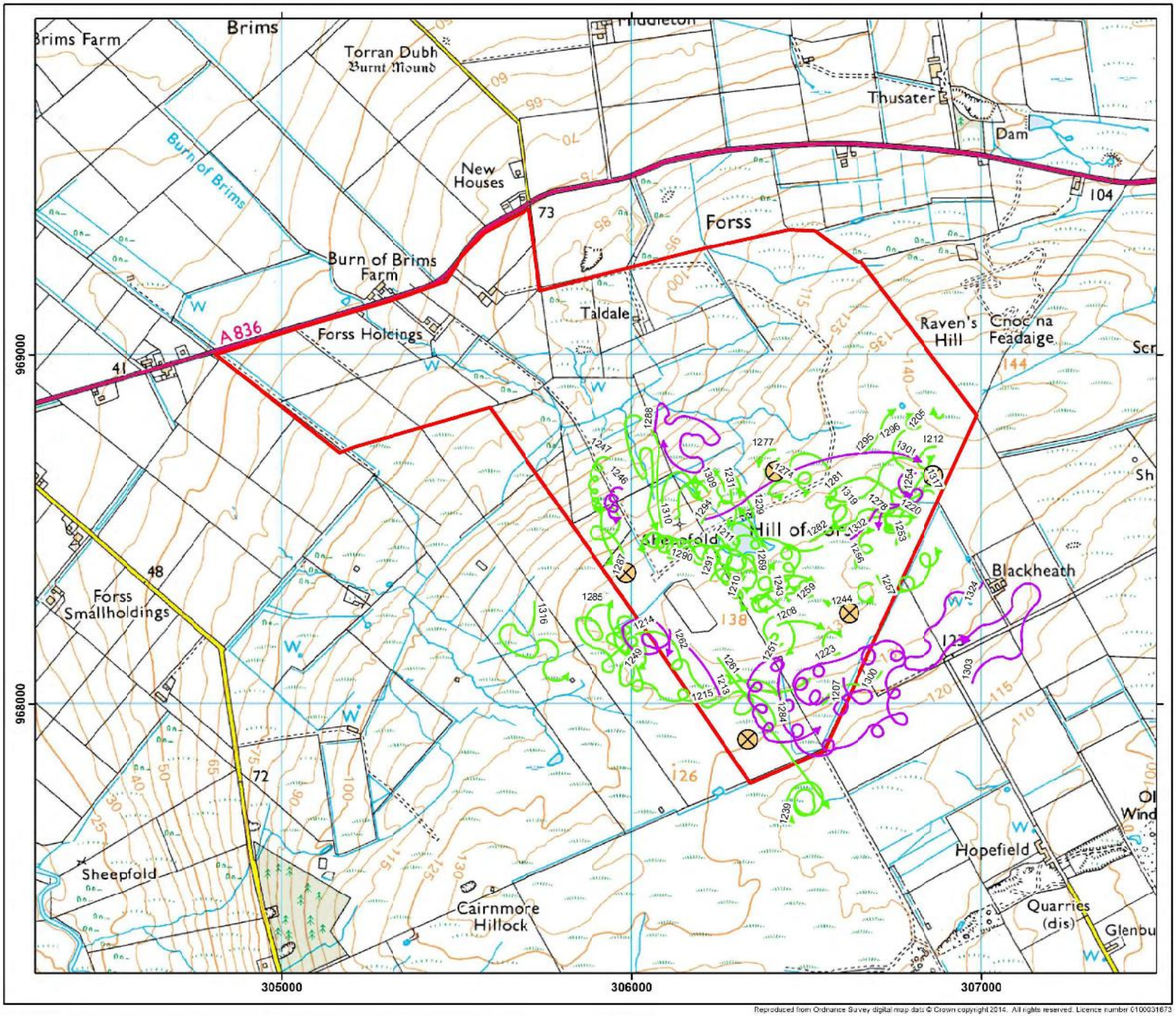
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 14
Curlew
Non-breeding Season

Hill of Forss
Ornithology



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Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

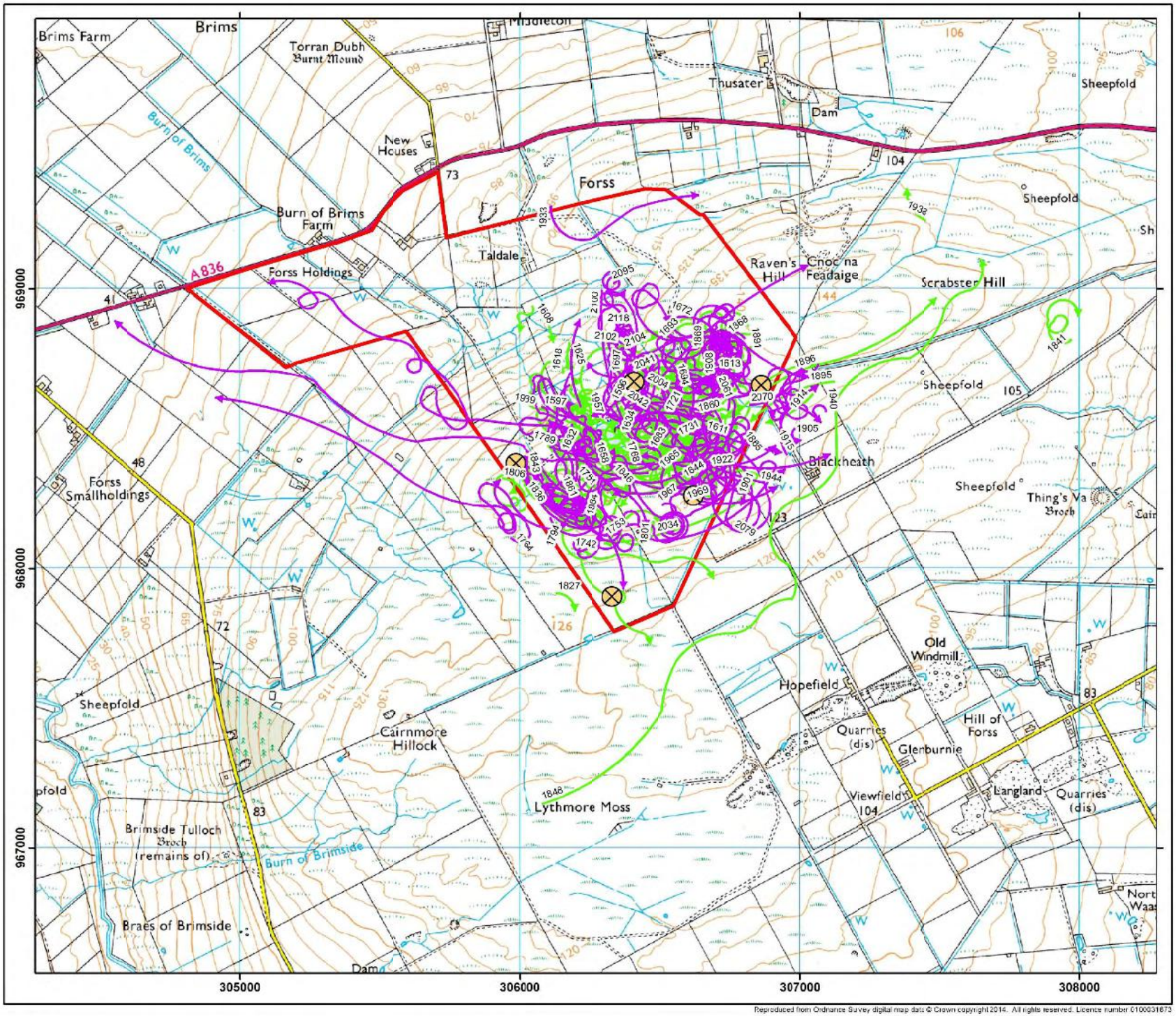
Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 15
Lapwing
Breeding Season 2013

Hill of Forss
Ornithology



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Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

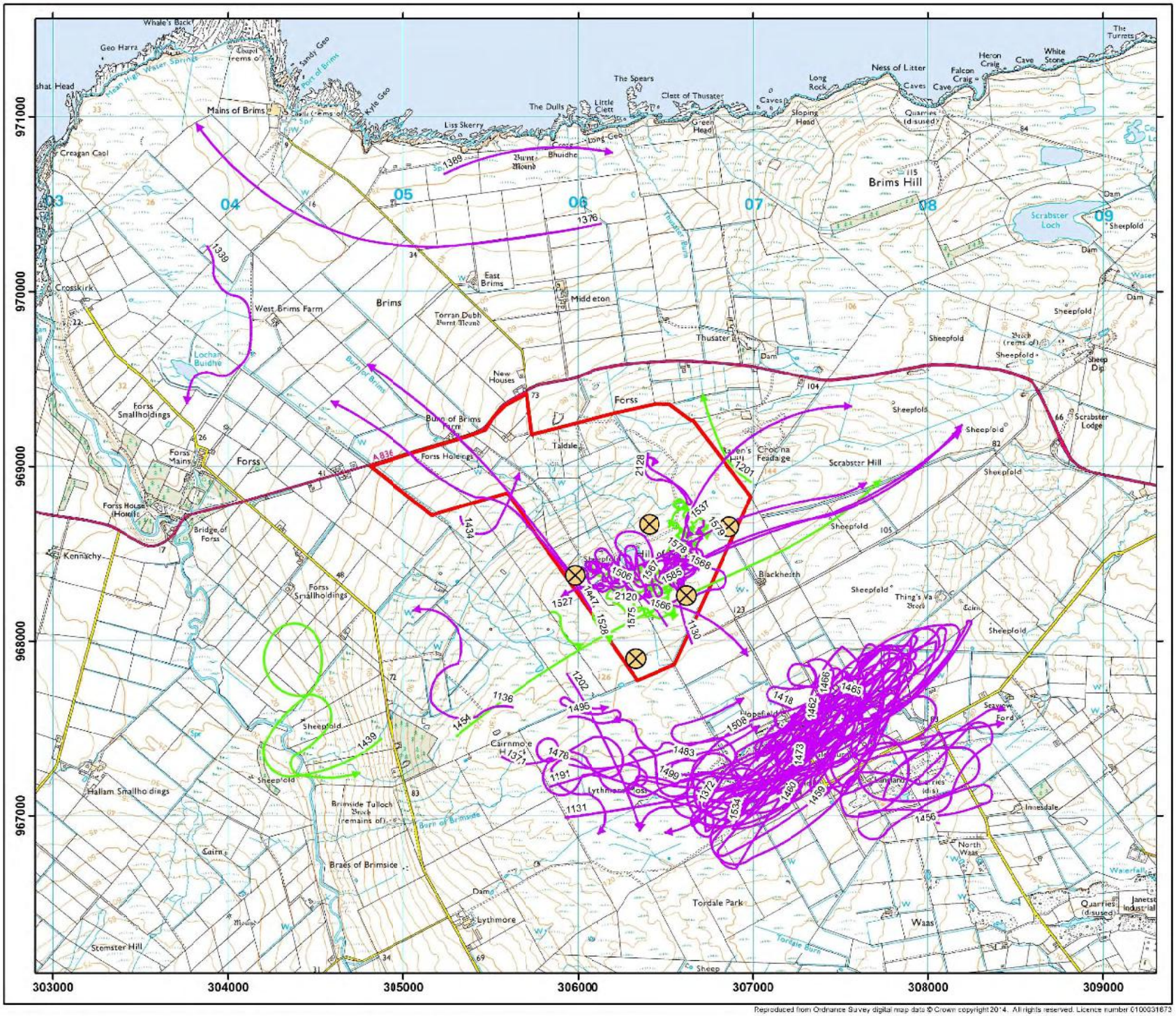
Scale 1:12,500 @ A3

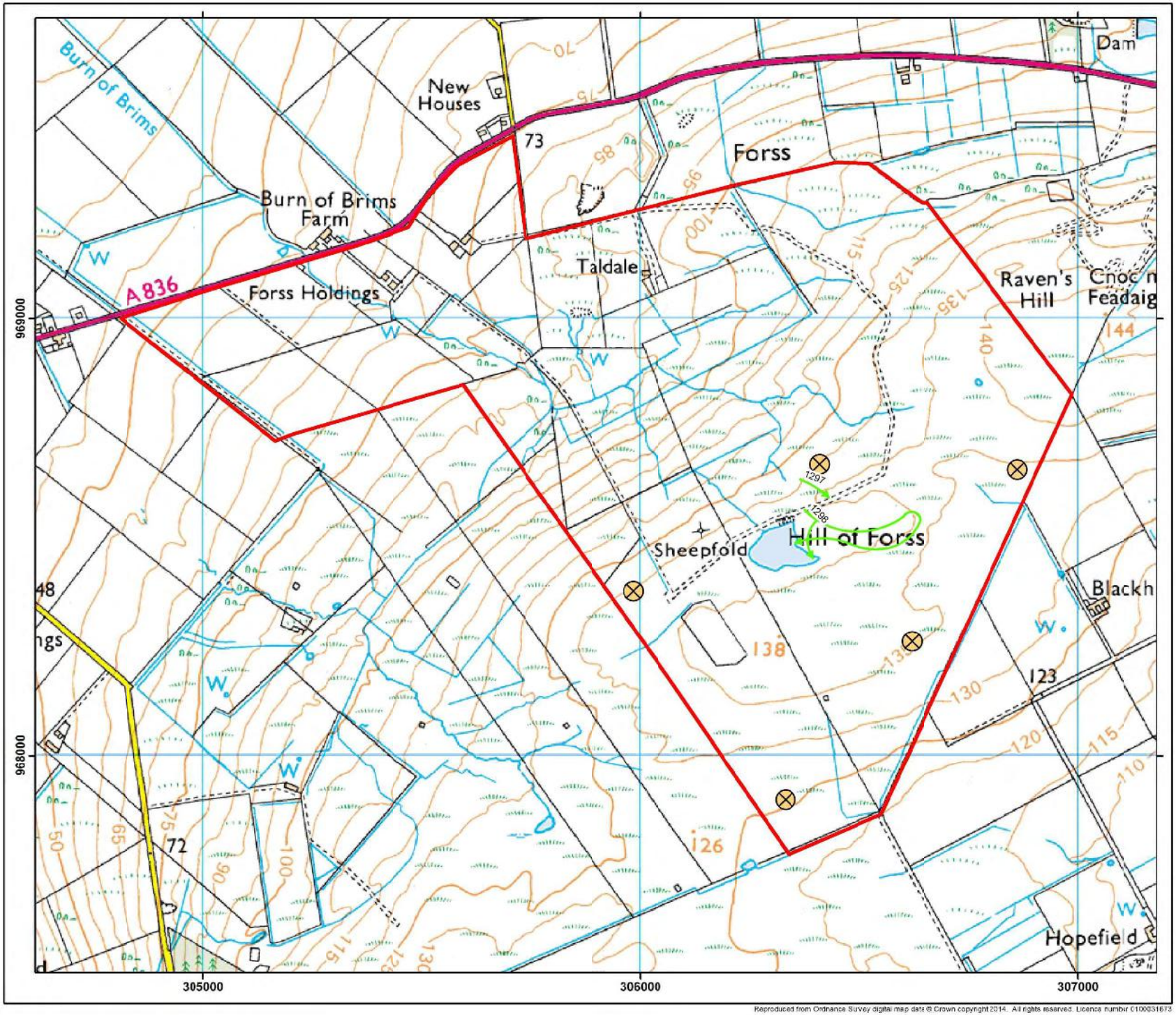
0 125 250 500 m

N

Figure 16
Lapwing
Breeding Season 2014

Hill of Forss
Ornithology





res

Caledonian Conservation Ltd

Key

- Indicative turbine
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

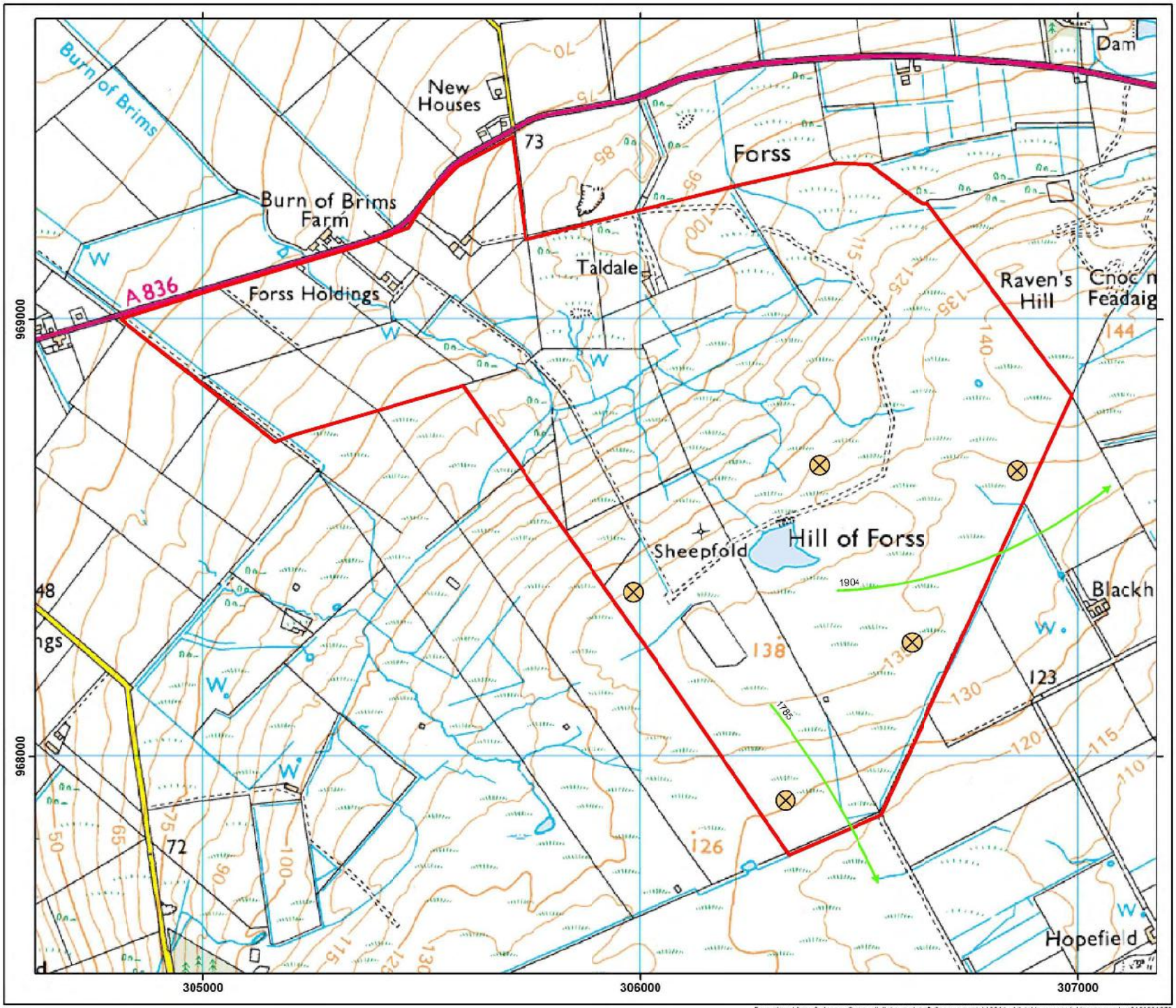
Scale 1:8,000 @ A3

0 100 200 400 m

N

Figure 18
Oystercatcher Breeding Season 2013

Hill of Forss Ornithology



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Caledonian Conservation Ltd

Key

- Indicative turbine
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

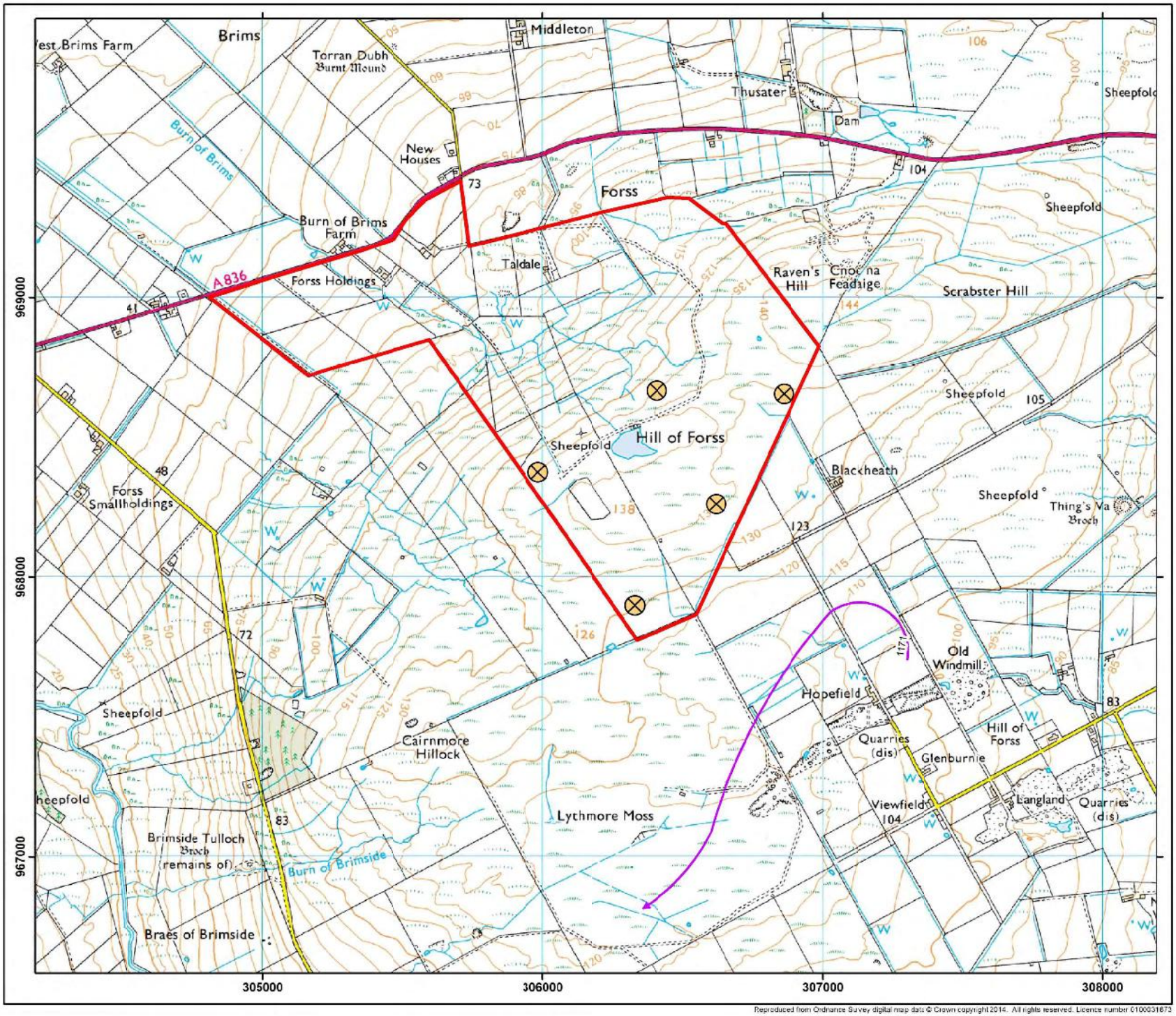
Scale 1:8,000 @ A3

0 100 200 400 m

N

Figure 19
Oystercatcher
Breeding Season 2014

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

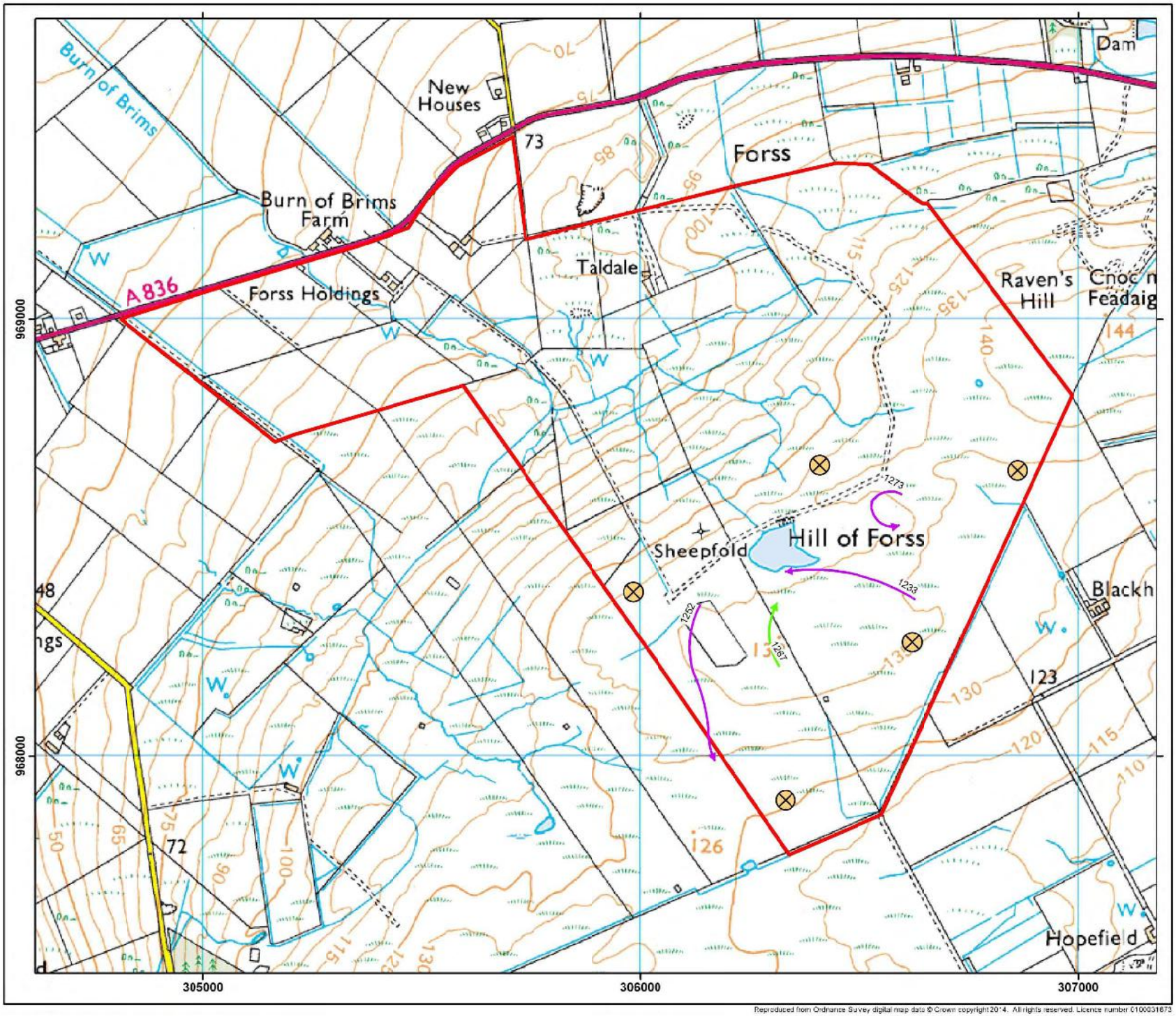
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 20
Oystercatcher
Non-breeding Season

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

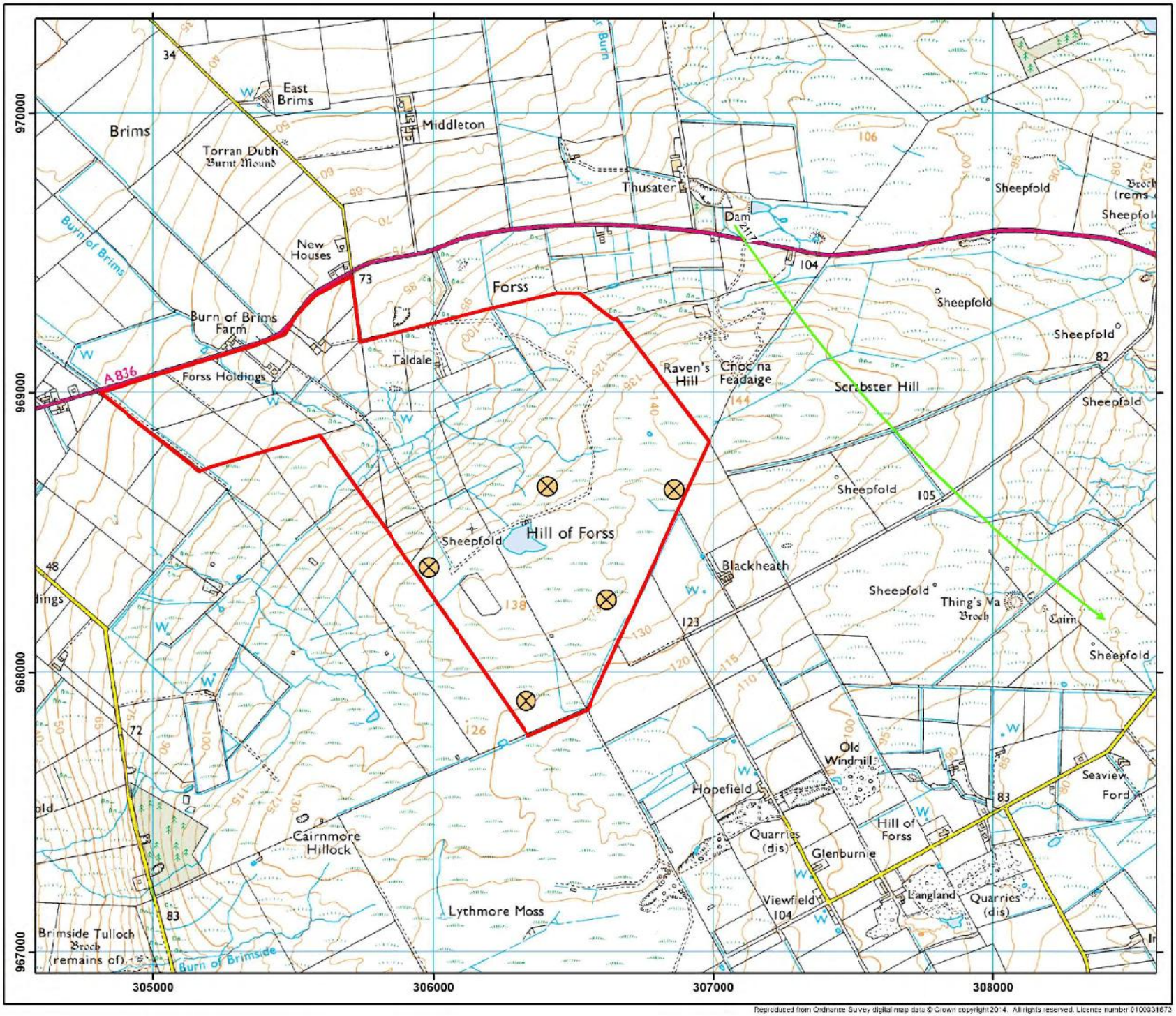
Scale 1:8,000 @ A3

0 100 200 400 m

N

Figure 21
Redshank
Breeding Season 2013

Hill of Forss
Ornithology



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Caledonian Conservation Ltd

Key

- Indicative turbine
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

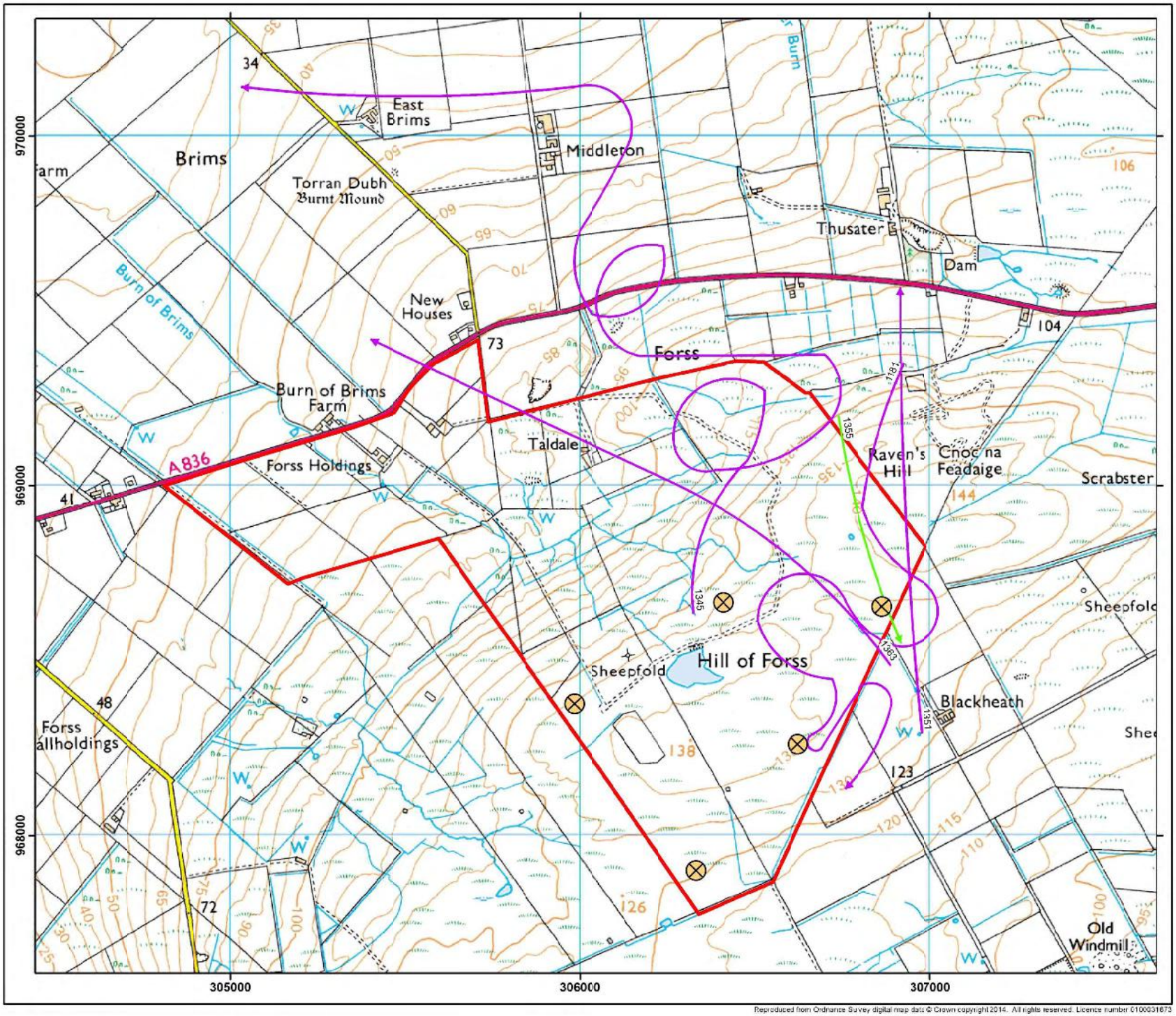
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 22
Redshank
Breeding Season 2014

Hill of Forss
Ornithology



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res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

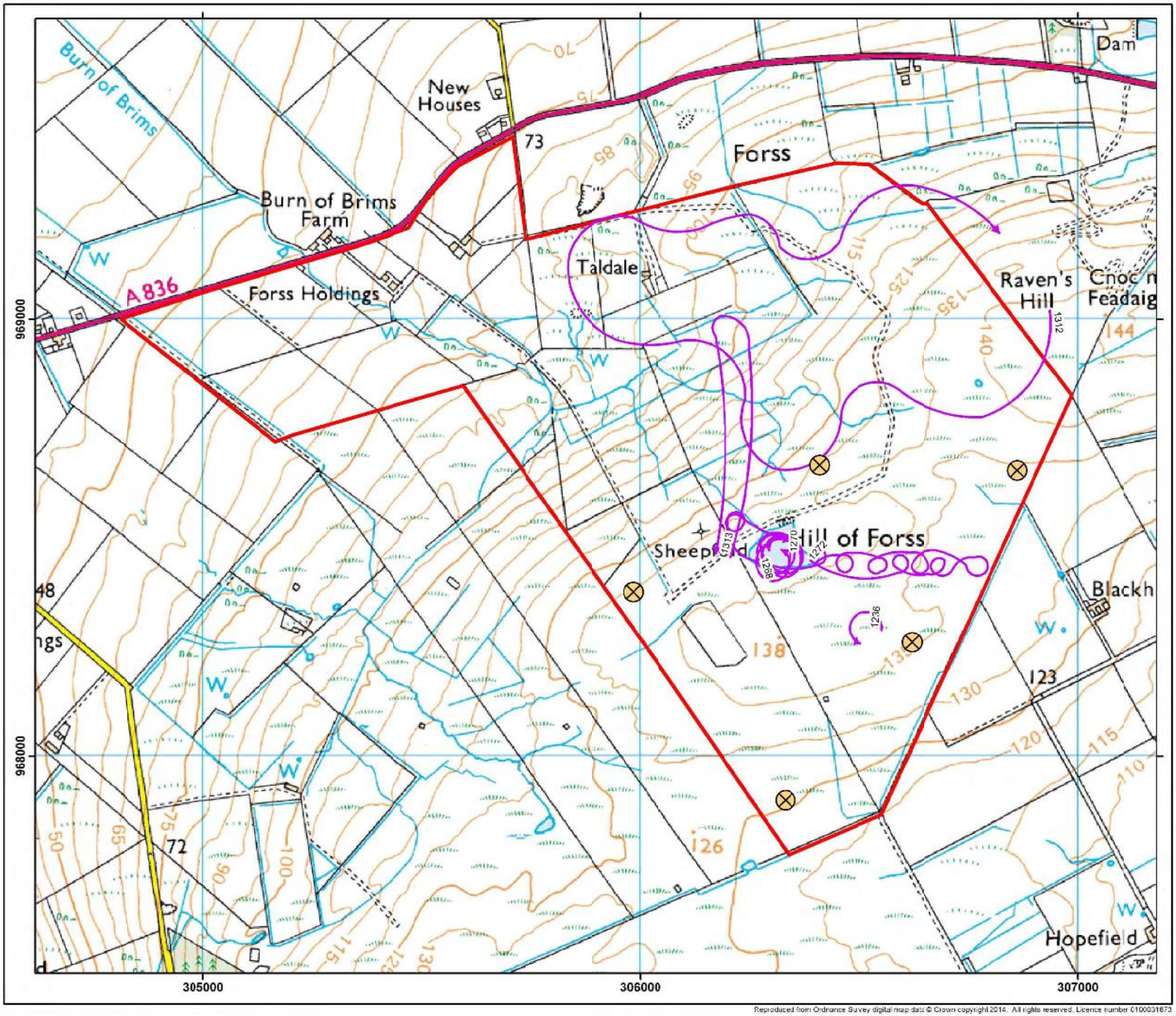
Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 23
Redshank
Non-breeding Season

Hill of Forss
Ornithology



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Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

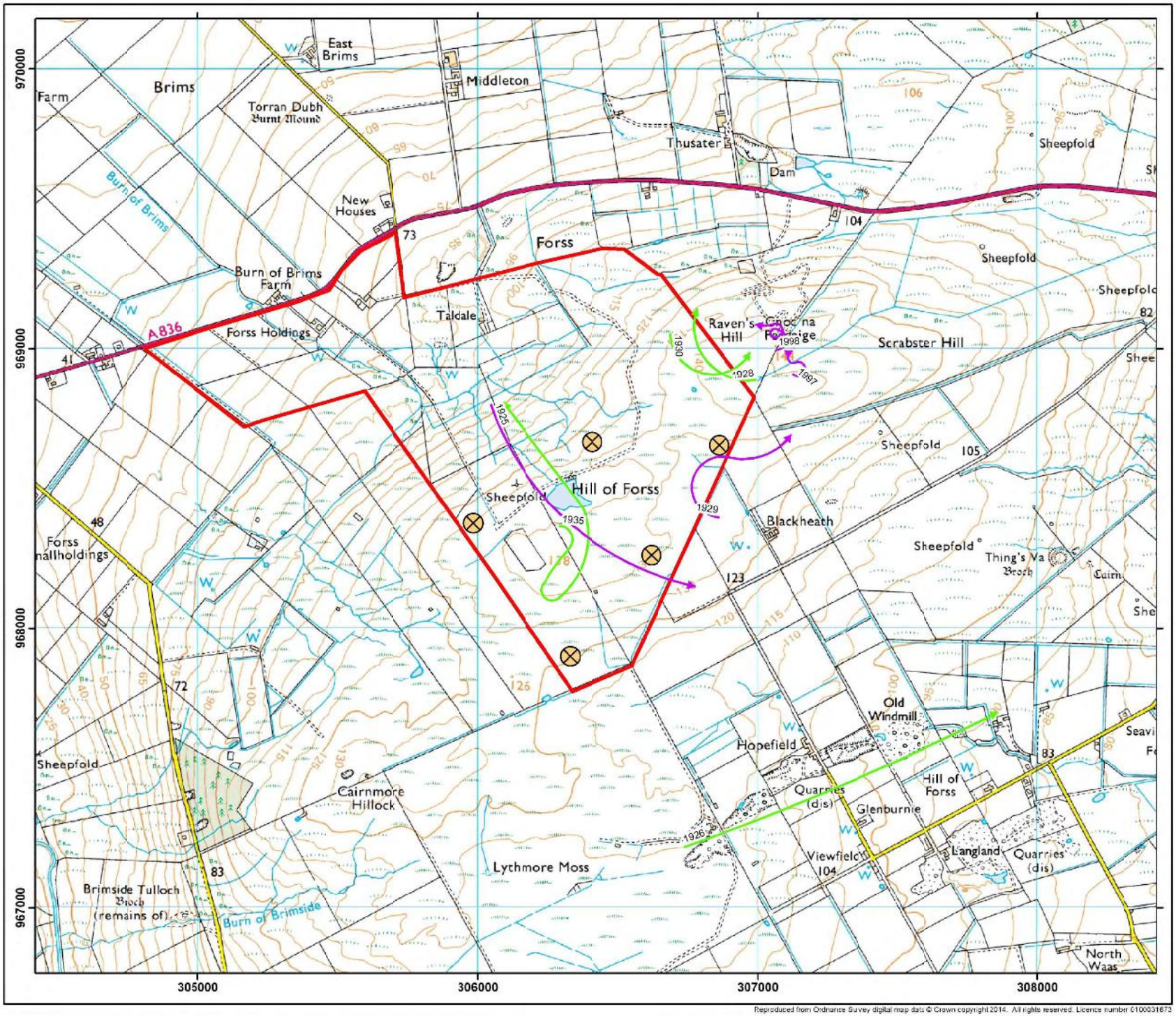
Scale 1:8,000 @ A3

0 100 200 400 m

N

Figure 24
Snipe
Breeding Season 2013

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

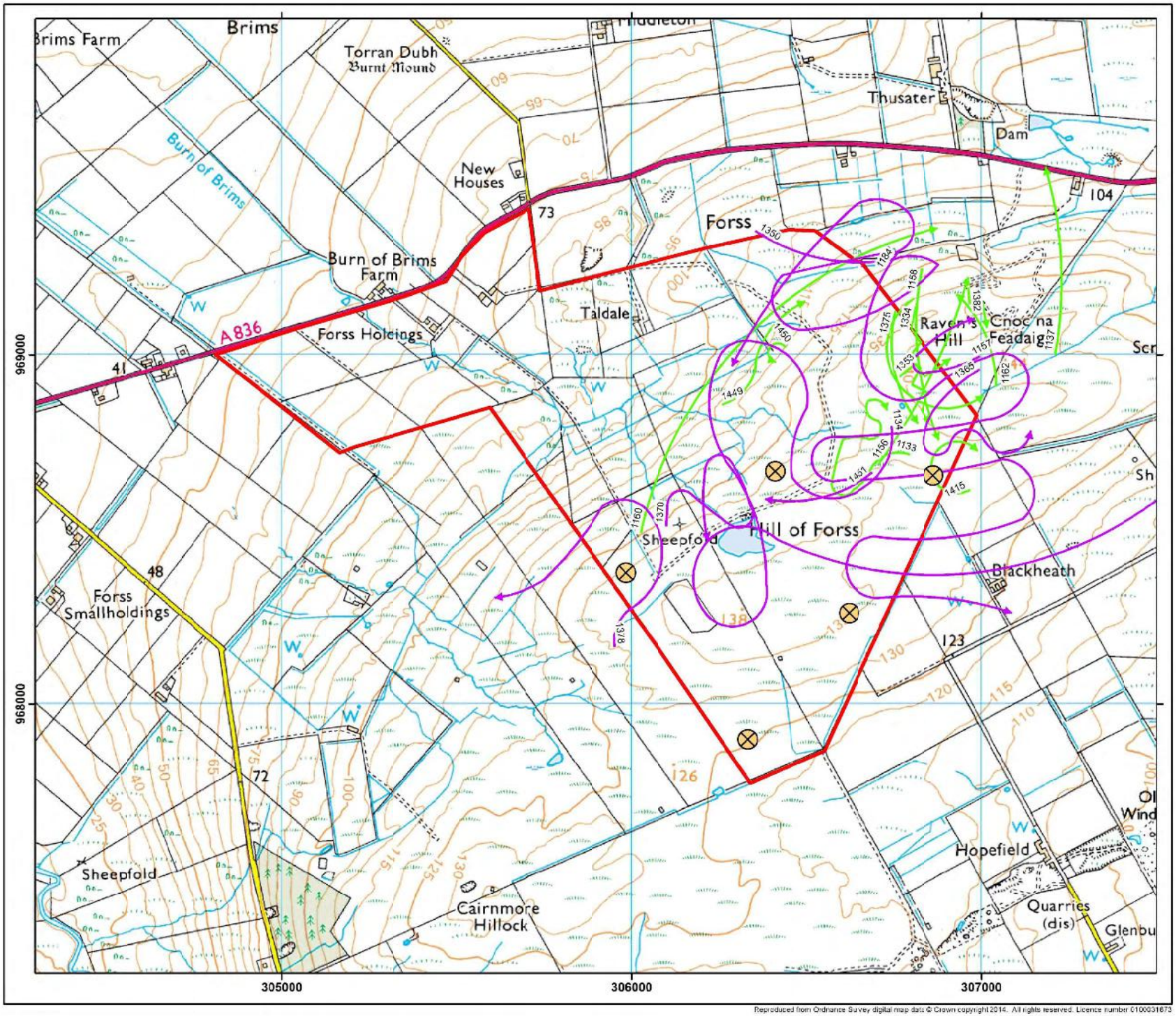
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 25
Snipe
Breeding Season 2014

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

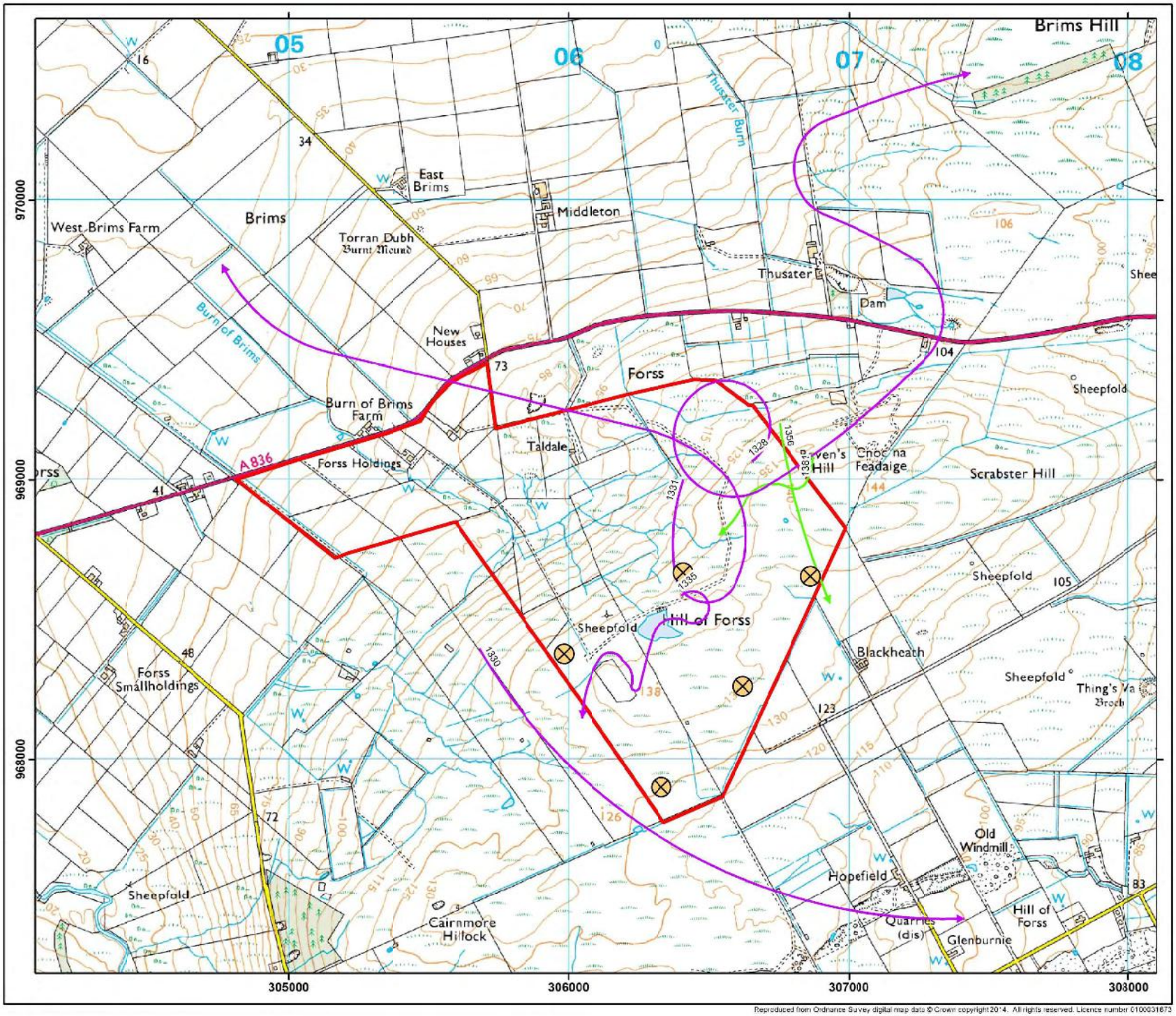
Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 26
Snipe
Non-breeding Season

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

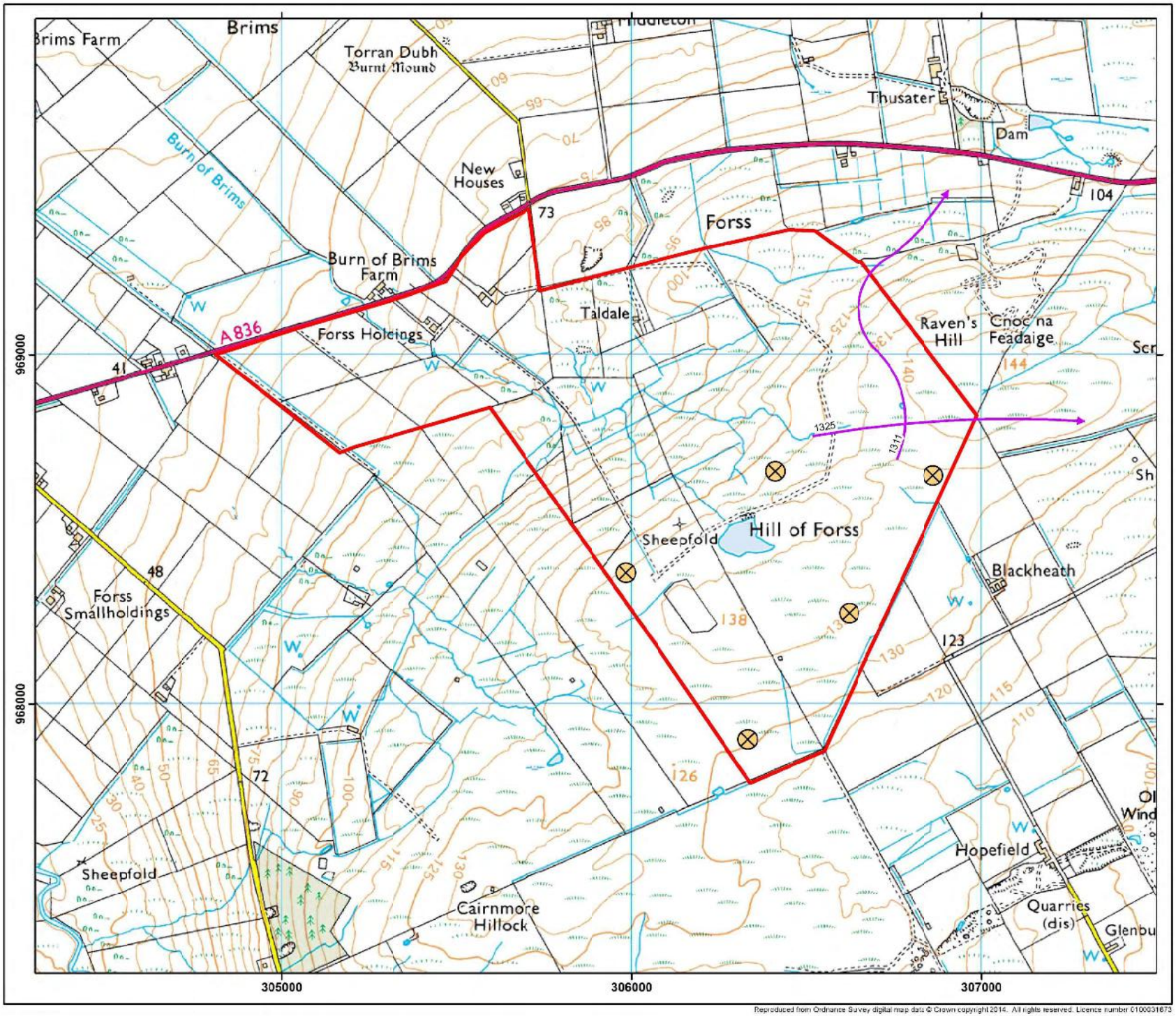
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 27
Dunlin
Non-breeding Season

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

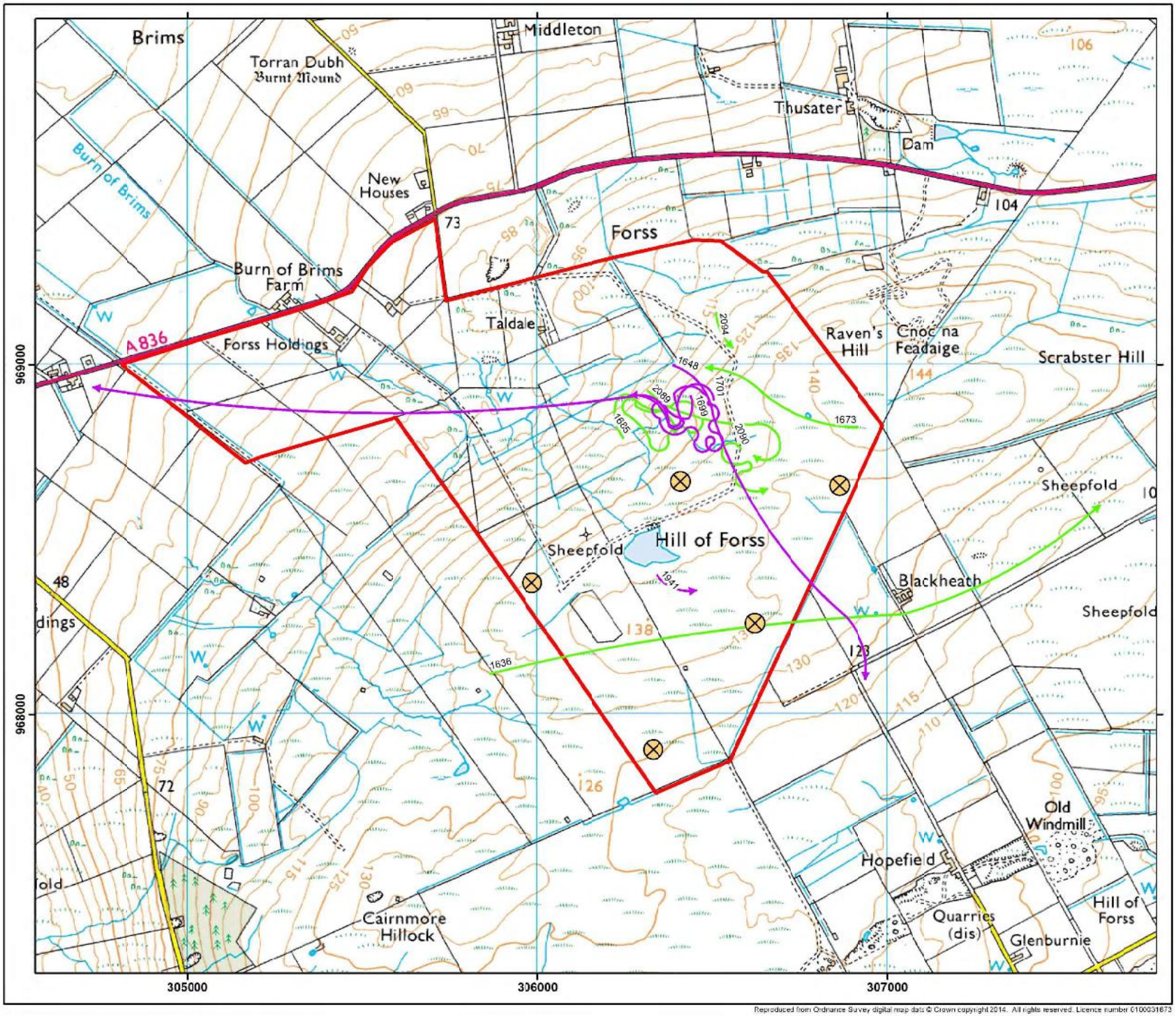
Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 28
Golden Plover
Breeding Season 2013

Hill of Forss
Ornithology



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Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 29
Golden Plover
Breeding Season 2014

Hill of Forss
Ornithology

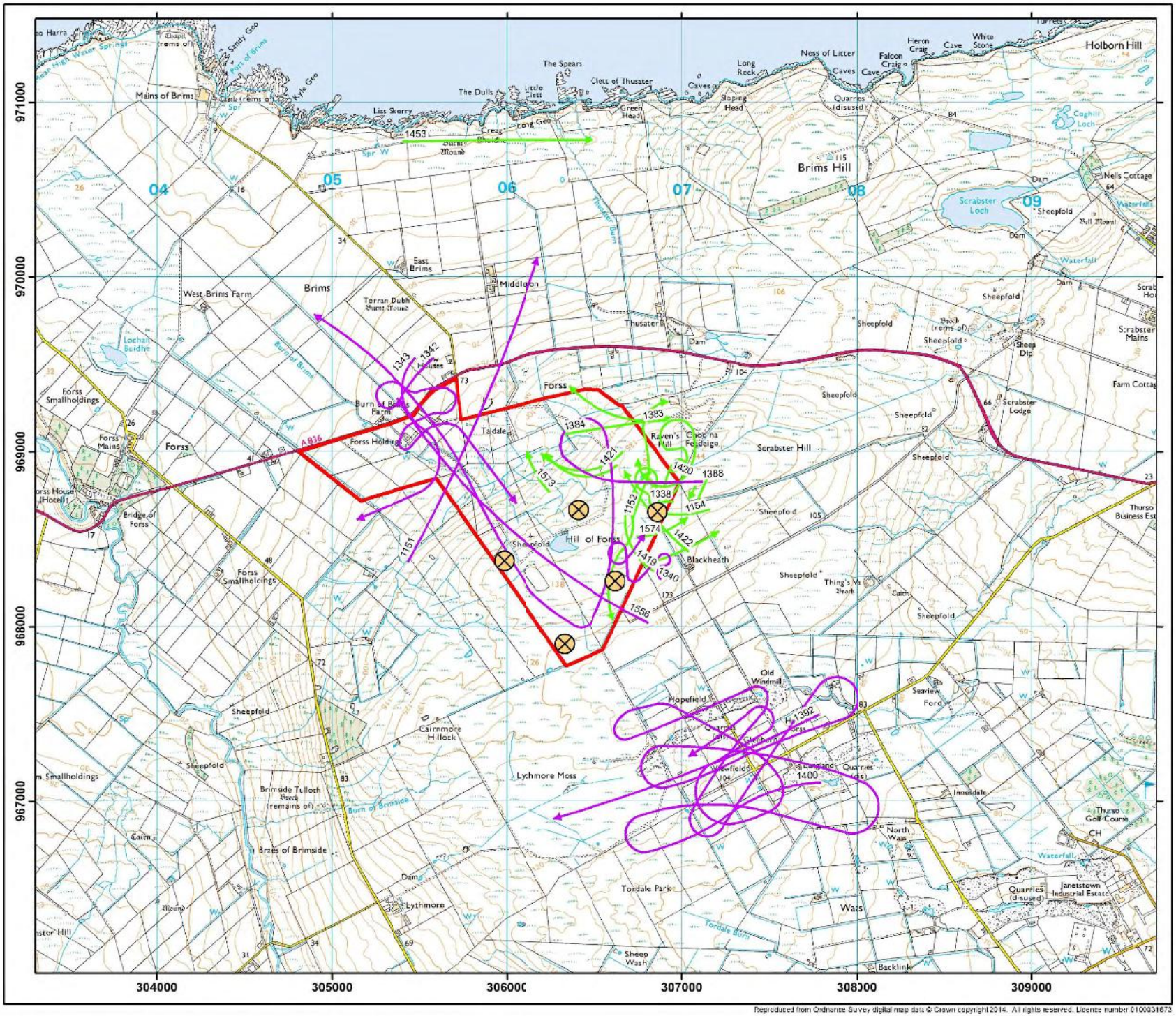
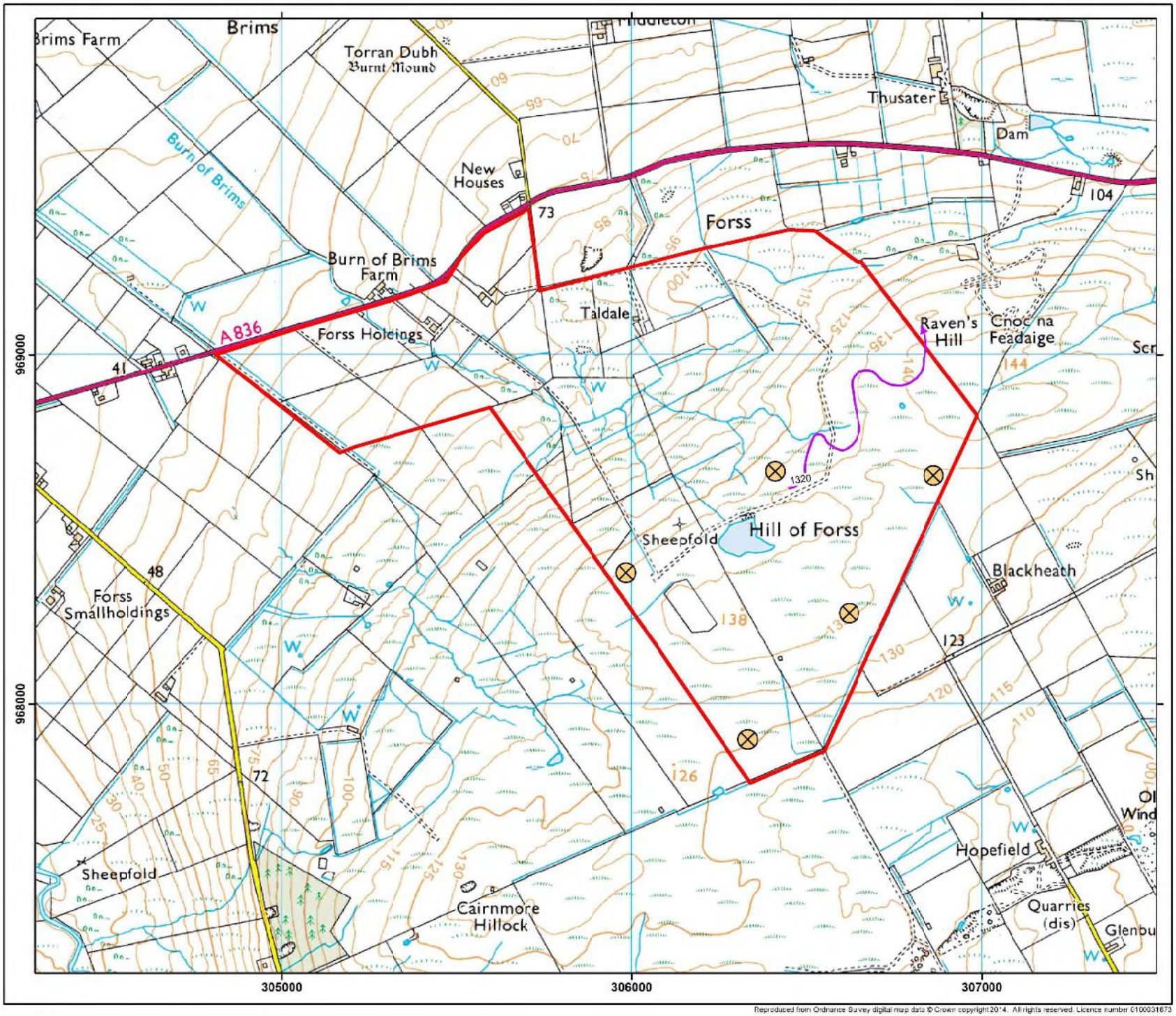


Figure 30
Golden Plover
Non-breeding Season

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

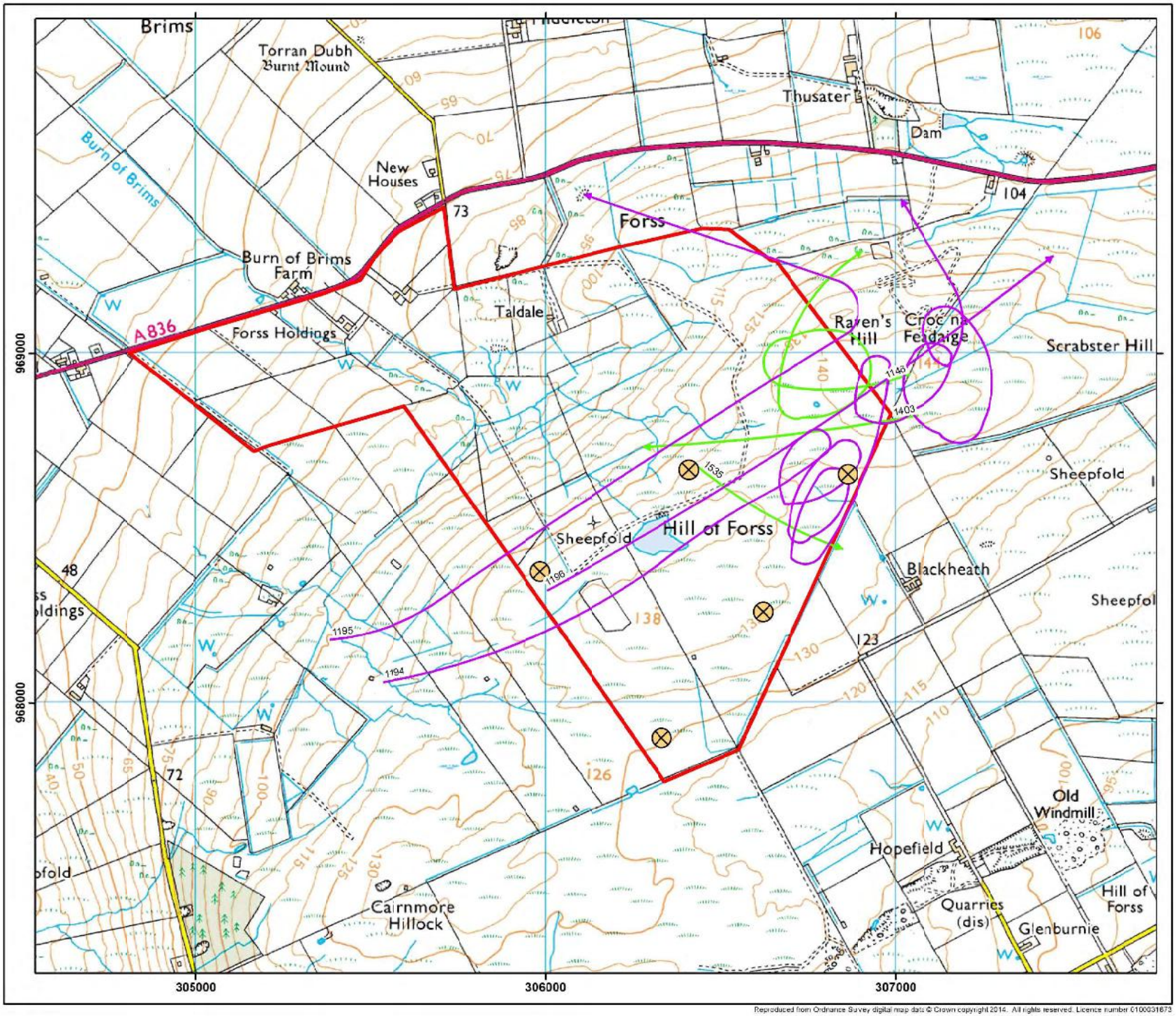
Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 31
Ringed Plover
Breeding Season 2013

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

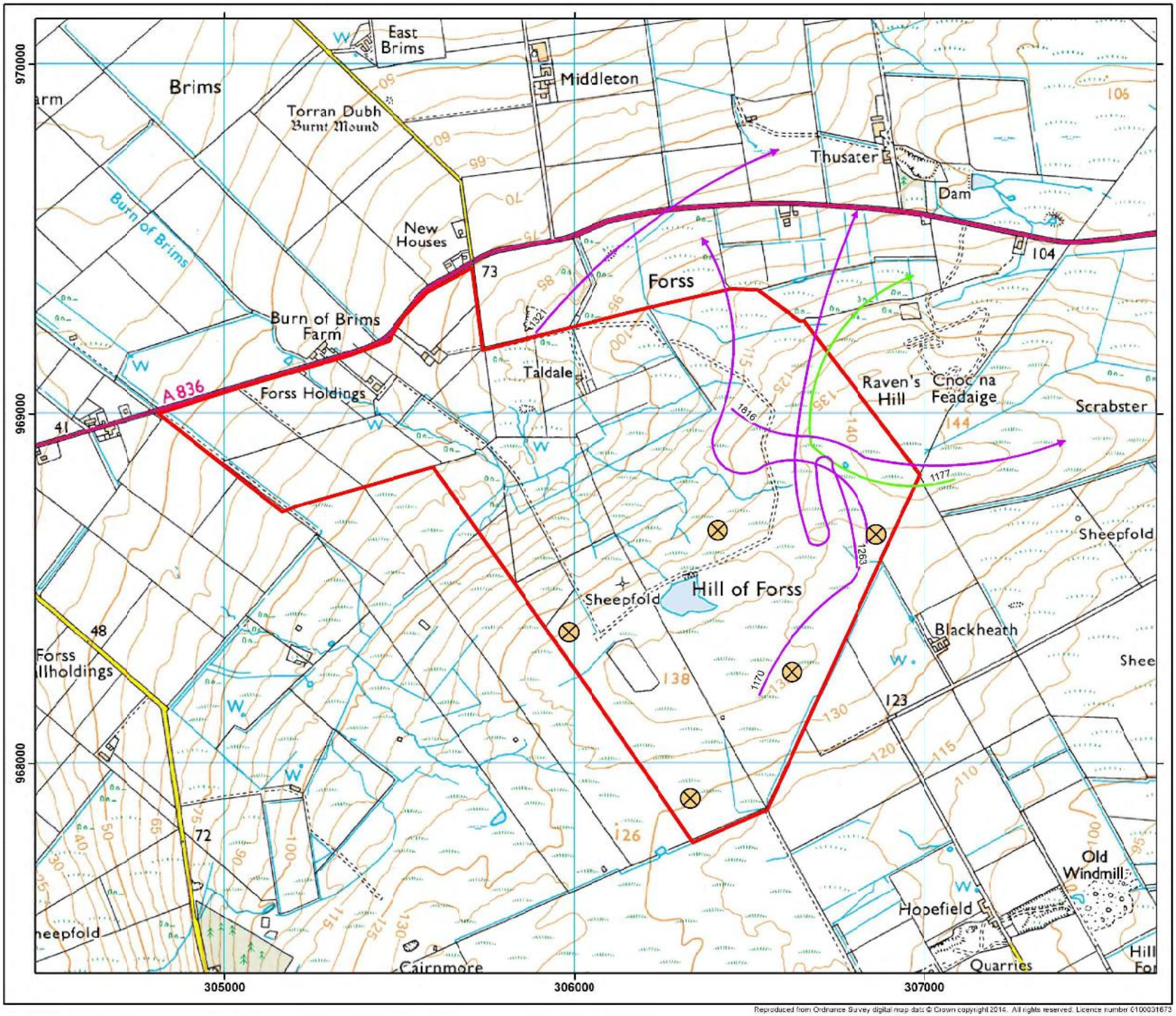
Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 32
Ringed Plover
Non-breeding Season

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

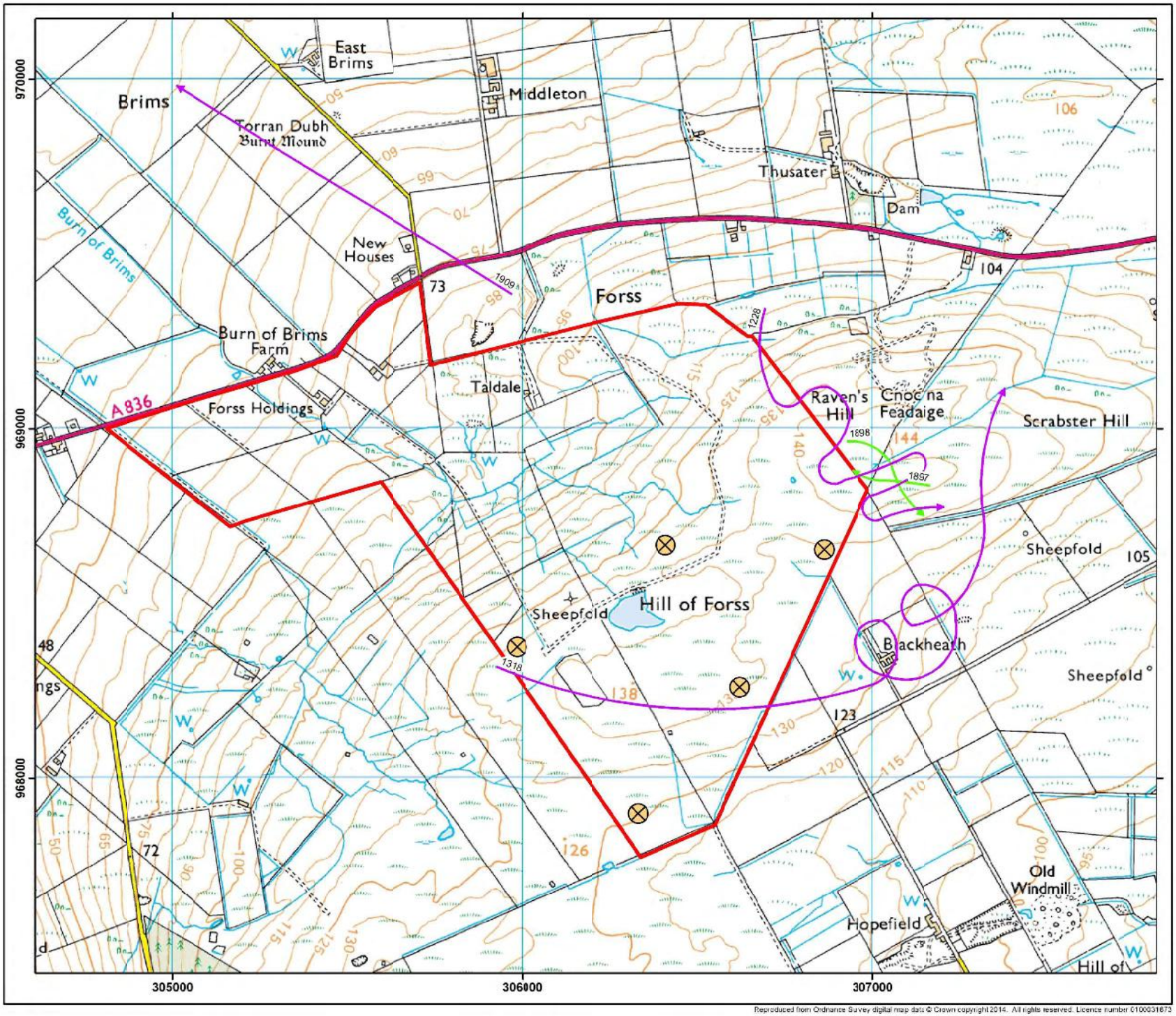
Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 33
Arctic Skua

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Not at PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

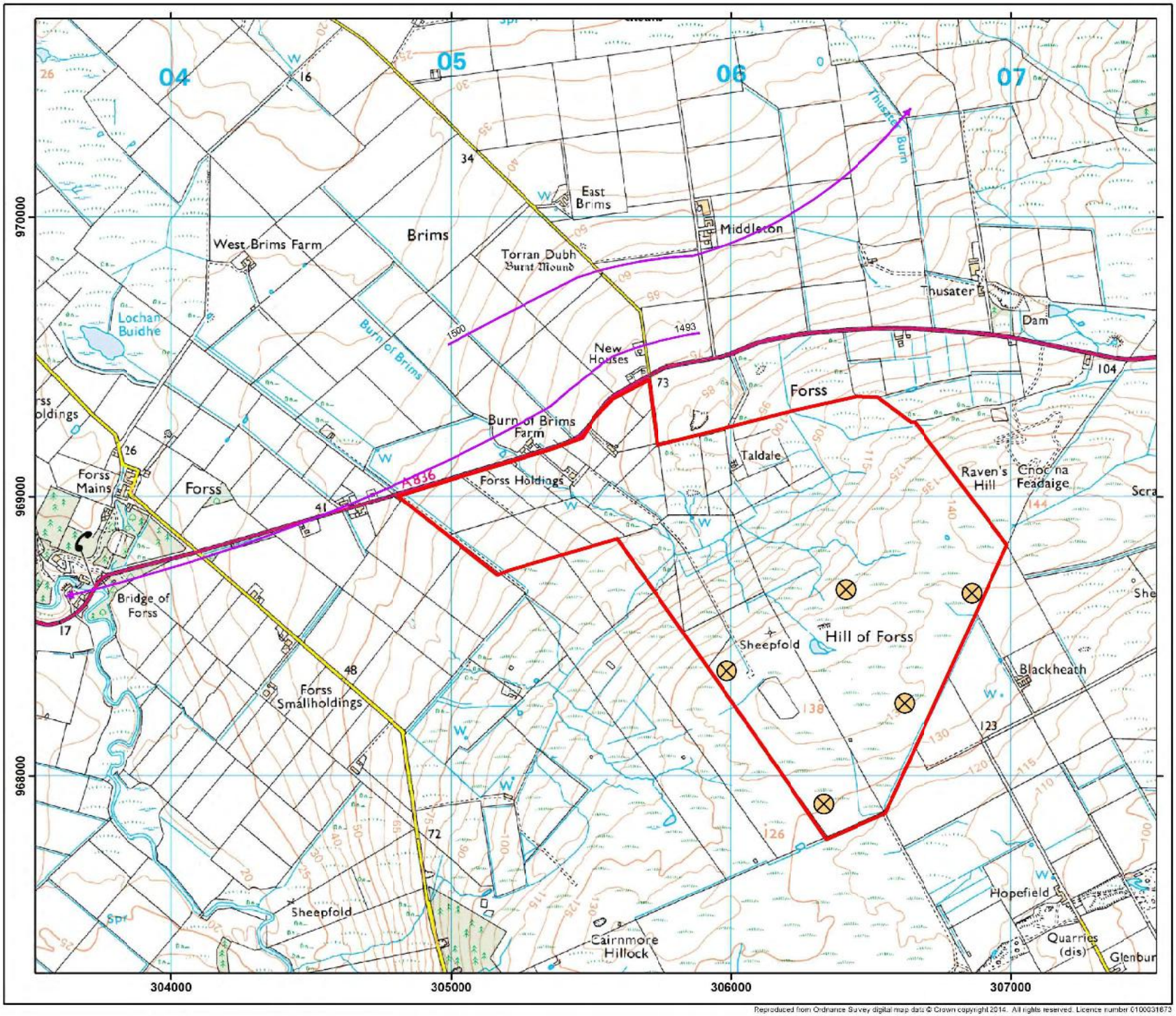
Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 34
Great Skua

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- At PCH
- Site boundary

Flight Key Numbers are located at the start of each flight line to allow cross reference with data presented in relevant tables.

PCH = Potential Collision Height

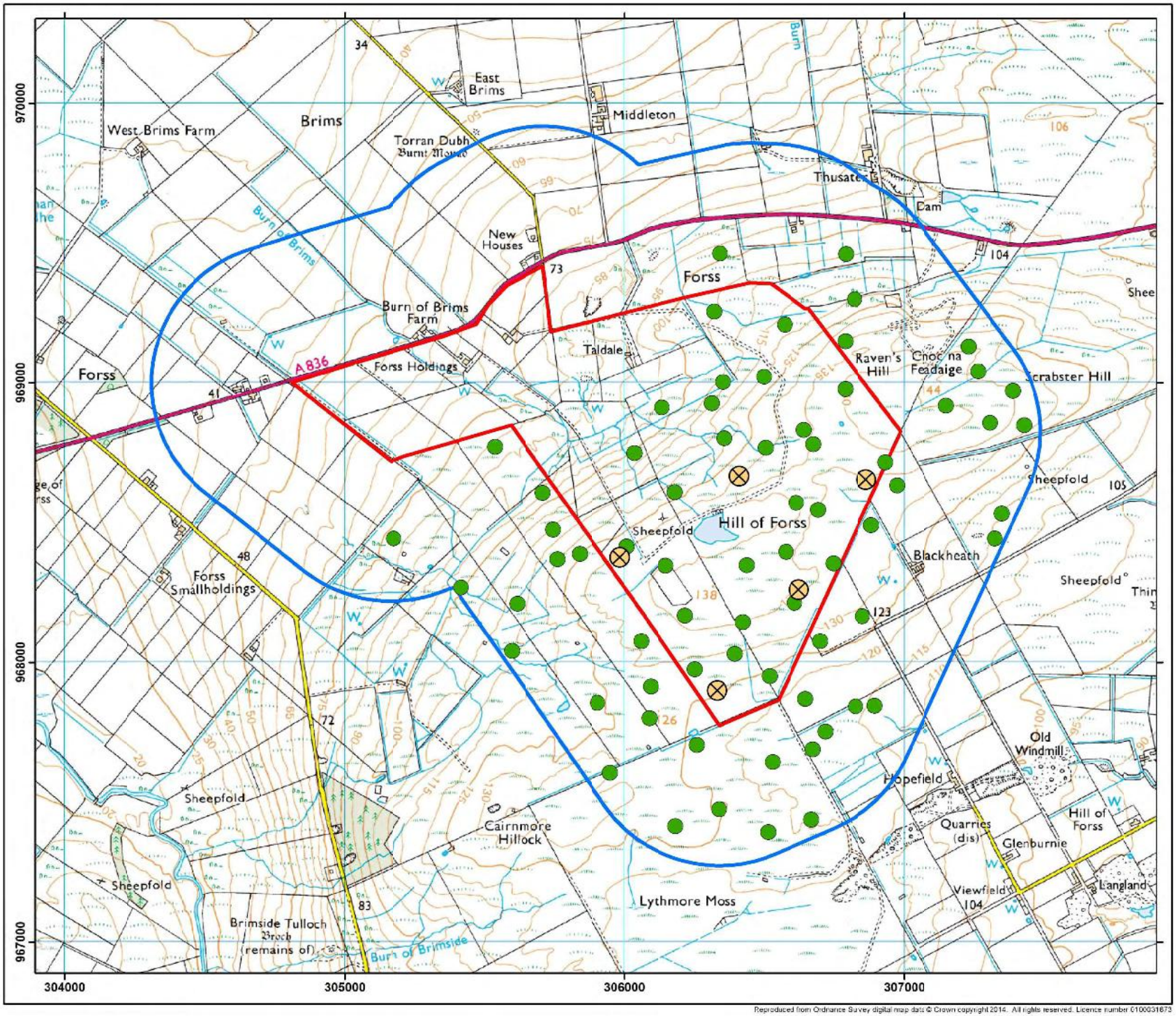
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 35
Cormorant

Hill of Forss
Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- Skylark territories
- 500m Buffer
- Site boundary

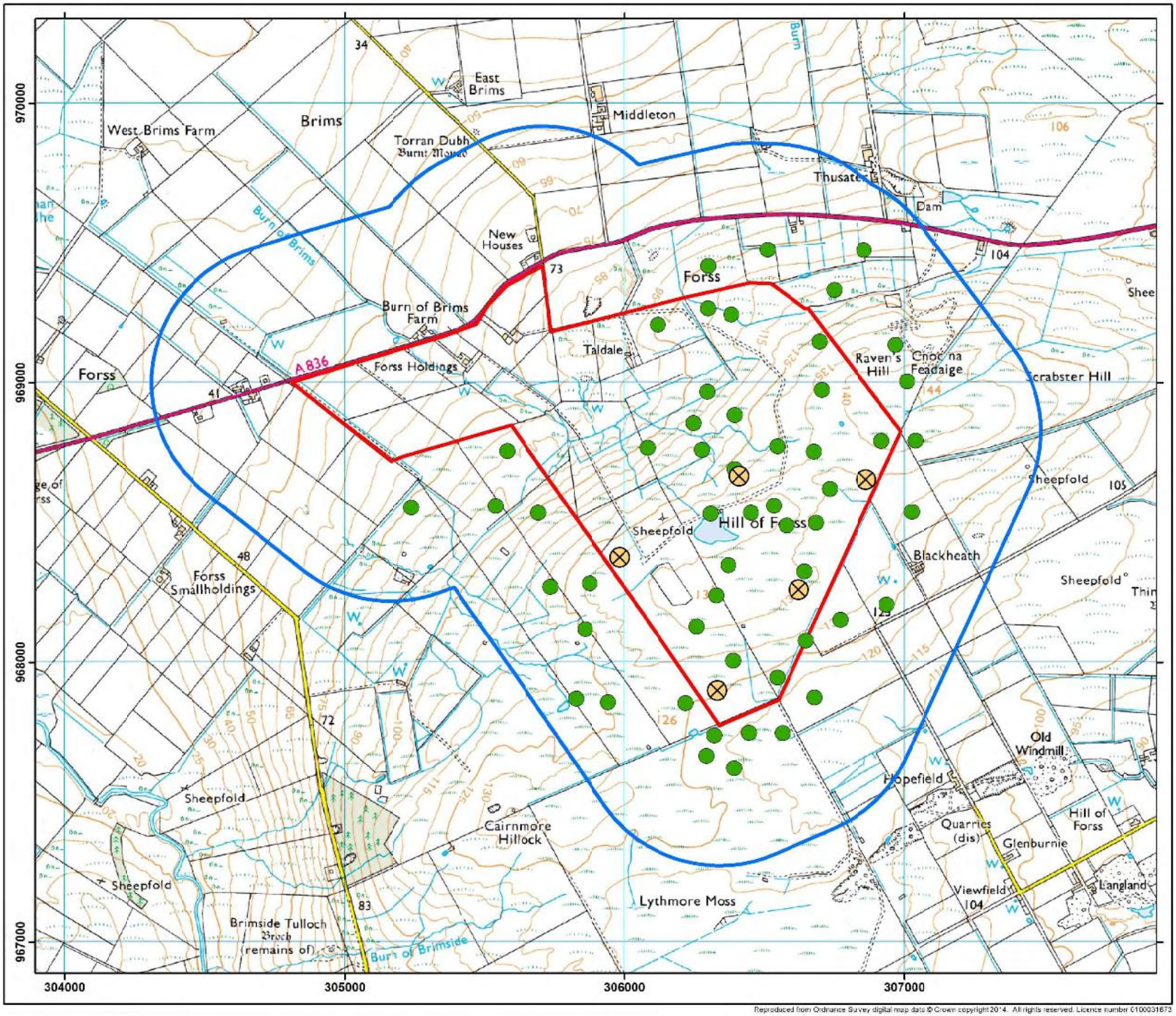
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 36
Skylark Territories 2013

Hill of Forss Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- Skylark territory
- 500m Buffer
- Site boundary

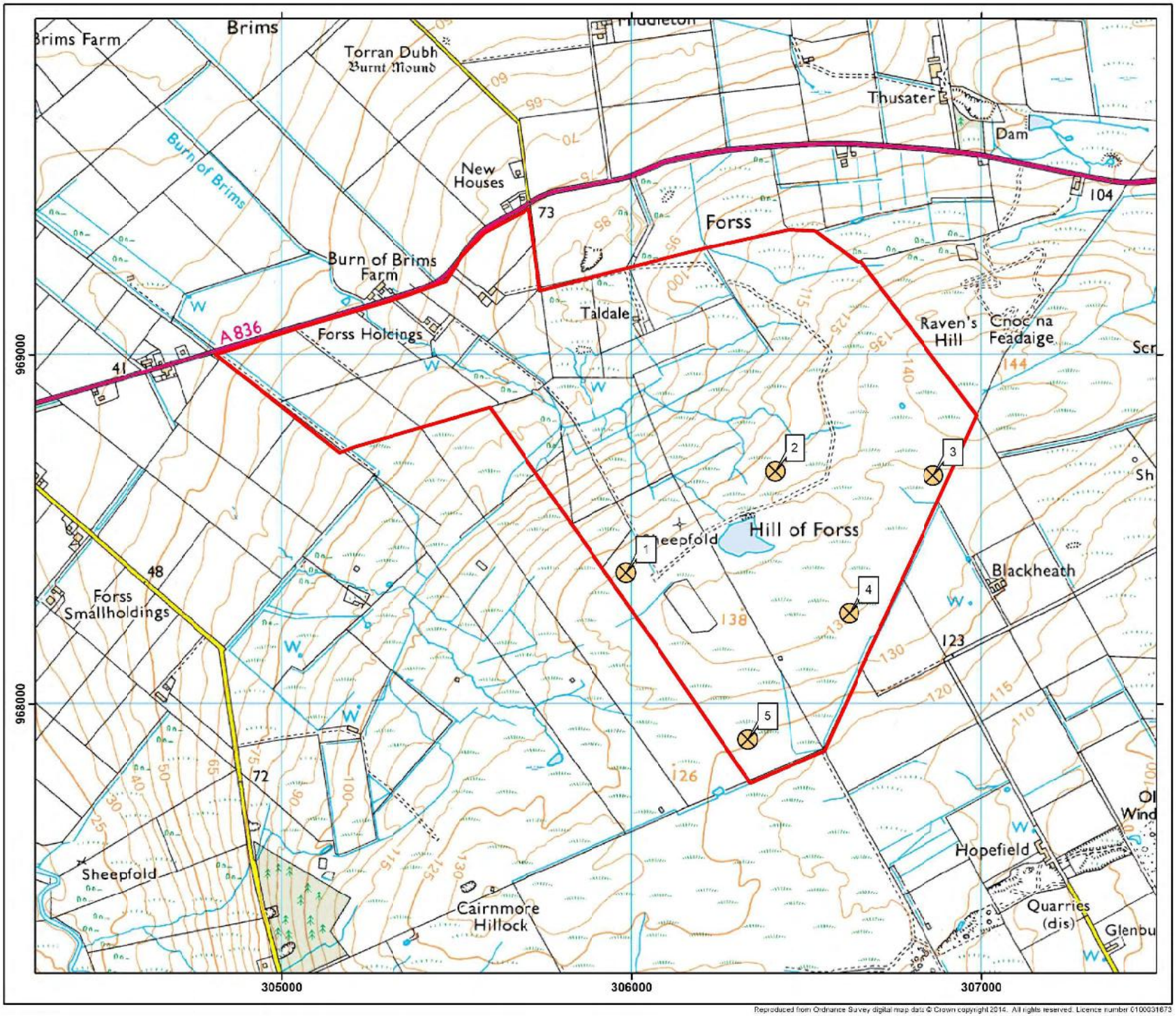
Scale 1:12,500 @ A3

0 125 250 500 m

N

Figure 37
Skylark Territories 2014

Hill of Forss Ornithology



res

Caledonian Conservation Ltd

Key

- Indicative turbine
- Site boundary

Scale 1:10,000 @ A3

0 125 250 500 m

N

Figure 38
Indicative Turbine Locations

Hill of Forss
Ornithology