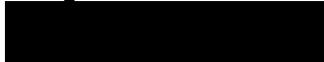




**WPD Ackron
Ornithology Data Report
Confidential Information Redacted**

May 2016



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APPENDIX 1 – VANTAGE POINT SURVEY LOCATIONS, EFFORT AND DATA

1. INTRODUCTION

1.1 Scope of Report

RPS was commissioned by wpd Scotland to undertake ornithological surveys for a proposed wind farm at Ackron near Melvich, Sutherland (Figure 1). These surveys (methodologies for which can be found in Section 2) commenced in April 2014 and continued to March 2016 to provide two full years of data on which to base an assessment of the impacts of the proposed development on ornithological interests in and around the site, as per SNH's 2014 guidance for assessment of birds at onshore wind farms.

This report presents the final update of ornithological survey activity and data collected from these surveys (Section 3), and covers the period 1 April 2014 to 31 March 2016.

Collision risk modelling results are presented (Section 4), using updated avoidance rates for red-throated diver, as well as previously adopted avoidance rates included in the most recent SNH guidance.

Two appendices detailing the survey effort and the records made are also provided, along with figures providing spatial context to observations of ornithological activity at the site.

1.2 Terms, Conditions of Use and Limitations

This report contains confidential site-specific information relating to species listed on Annex I of the EU Birds Directive and Schedule 1 of the Wildlife & Countryside Act, as amended. It has been prepared for the exclusive use of wpd Scotland and shall not be distributed or made available to any other company or person without the knowledge and written consent of wpd Scotland or RPS.

2. BASELINE SURVEY METHODOLOGIES

2.1 Background

Baseline surveys commenced in April 2014 to quantify the use of the proposed wind farm area at Ackron by breeding and non-breeding birds, and to gather data to ultimately allow an estimate of the theoretical risk of bird collision with turbine blades.

Surveys have been carried out in order to establish what species are present, their temporal and spatial distribution, abundance and flight patterns. These were undertaken by experienced surveyors familiar with Scottish Highland avian ecology.

The key ornithological issues relating to any proposed wind farm are the potential for it to adversely affect:

- bird species included in Annex I of the EU Birds Directive¹ (through habitat loss, disturbance, displacement, barrier effects and collisions with the turbines);
- geese and other wildfowl due to the risk of turbine collisions or barrier effects as they fly through the area on migration or while commuting locally;
- breeding raptors, through habitat loss, disturbance, displacement, barrier effects and collisions with the turbines;
- breeding waders, through habitat loss, disturbance, displacement, barrier effects and collisions with the turbines;
- breeding grouse species, through habitat loss, disturbance, displacement, barrier effects and collisions with the turbines;
- breeding Schedule 1 (of the Wildlife & Countryside Act, as amended) species, through habitat loss, disturbance, displacement, barrier effects and collisions with the turbines;
- breeding and non-breeding passerines listed as Birds of Conservation Concern² (BoCC), primarily through habitat loss, disturbance and displacement; and
- notified features of local statutory sites such as SPAs and SSSIs.

2.2 Desk Study

An initial desk study identified the presence of statutory international and national sites designated for their ornithological interest, as well as non-statutory conservation sites within a zone of 10km of the Proposed Development Boundary (PDB). This was done by using SNH Sitelink³ (Figure 2).

Ornithological data on the site and its surroundings was collated from a range of existing sources, including 'grey literature', and through consultation. Relevant data have been sourced from:

- SNH;
- Forestry Commission;
- National Biodiversity Network (NBN) Gateway;
- RSPB Scotland;
- Highland Raptor Study Group (HRSG);
- Other planning applications in the vicinity; and
- Highland Bird Reports.

¹ Council Directive 79/409/EEC on the conservation of wild birds (EU Birds Directive) as amended by Directive 2009/147/EC

² Eaton MA, Aebischer NJ, Brown AF, Hearn RD, Lock L, Musgrove AJ, Noble DG, Stroud DA and Gregory RD (2015) Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. British Birds 108, 708–746.

³ SNH (2014) [online] <http://gateway.snh.gov.uk/sitelink/> [accessed 08/12/14].

The breadth of different sources data utilised, along with the local knowledge of the survey and project team has resulted in a comprehensive and site-appropriate survey programme.

2.3 Field Survey Methodologies

Prior to the commencement of surveys, a range of methods for deployment at the site were identified and discussed with SNH. These are described fully below.

2.3.1 Moorland Breeding Bird Surveys

Areas of open habitat within the proposed development boundary and a 500m buffer (Figure 2) were surveyed using the standard methodology for assessing upland wader populations, as described by Brown and Shepherd (1993)⁴. Four monthly visits were made between April and July 2014 and 2015 (Table 1), in suitable weather conditions, based on the recommendations by Calladine et al. (2009)⁵, to cover each key stage of the breeding cycle. All species encountered were recorded. The surveyors followed a predetermined route across the site so that all ground was approached to within 100m or less. The location and activity of all species detected both audibly and visibly were recorded on a 1:10,000 scale field map.

2.3.2 Breeding Raptor Surveys

An area encompassing the site boundary plus a 2km buffer was walked during monthly visits between April and August 2014 and 2015 (Figure 2). All suitable habitats within this boundary (moorland, heathland and other areas of open habitat, craggy rock faces, cliffs, steep sided burns, trees along the forest edge, older stands of trees within forest habitat, farm outhouses and derelict buildings).were examined for raptor and barn owl nests using species-specific methodologies outlined in Hardey et al. (2006)⁶. Target species included white-tailed eagle, golden eagle, osprey, hen harrier, merlin, peregrine, barn owl and short-eared owl. Observations of buzzard, sparrowhawk, kestrel and raven were also noted.

2.3.3 Breeding Diver Surveys

Breeding diver surveys were undertaken during April to July 2014 and repeated again in 2015. Lochs within the site boundary and 2km buffer (Figure 2) were searched monthly following the methods described in Gilbert et al.⁷, to identify the presence of breeding red-throated and/or black-throated divers.

A numerical system was devised to identify and distinguish lochs and lochs within the study area, as many were un-named (Figure 1).

2.3.4 Diver Flight Activity Surveys

SNH (2014)⁸ guidelines stipulate that focal breeding loch watches should be undertaken on occupied nesting lochs within 1km of an application site. However, as the proposed development lies adjacent to an SPA population, these observations were extended to breeding locations within 2km that may potentially be affected, as determined by the breeding diver surveys.

⁴ Brown, A.F. & Shepherd, K.B. (1993). A Method for Censusing Upland Breeding Waders. *Bird Study* 40: 189-195.

⁵ Calladine J, Garner G., Wernham C. & Thiel A. (2009). The influence of survey frequency on population estimates of moorland breeding birds, *Bird Study*, 56:3, 381-388, DOI: 10.1080/00063650902984604.

⁶ Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. and Thompson, D. (2006). *Raptors: a field guide to survey and monitoring*. The Stationery Office, Edinburgh.

⁷ Gilbert, G. Gibbons, D. W, and Evans, J. (1998). *Bird Monitoring Methods*. RSPB, Bedfordshire.

⁸ SNH (2014). Recommended bird survey methods to inform impact assessment of onshore wind farms.

Focal point locations were selected to record incoming and outgoing flights by divers during the incubation and chick-rearing period. Surveys were completed [REDACTED] in 2015.

2.3.5 Winter Bird Surveys

Winter bird surveys were carried out in November 2014, January and February 2015 in order to document the presence of wintering moorland birds. This was achieved using a combined methodology of walkover surveys and shortened ad-hoc VP surveys. These surveys were undertaken across all areas of open moorland habitat within the PDB and a buffer of 500m during which surveyors aimed to walk to within 200m of each part of the study area.

2.3.6 Vantage Point (VP) Surveys

Flight activity surveys have been carried out from three VP locations (Appendix 1, Figure 3). The dates of these surveys are shown in Table 1. The locations and full details of the VP surveys, along with the flights recorded, are presented in Appendix 1.

TABLE 1 – DATES OF BIRD SURVEYS UNDERTAKEN AT ACKRON (APRIL 2014 – AUGUST 2015)							
Month	Moorland breeding bird surveys	Winter bird surveys	Breeding raptor surveys	Breeding diver surveys	Diver focal breeding loch VPs	VP surveys	
						Dates	Hours completed per VP
April 2014	19, 21, 22	-	6, 7	-	-	18, 19, 20	6
May 2014	12	-	24, 25	6, 28	-	8, 9, 10, 23, 25, 26, 27, 28, 30	12
June 2014	16, 17	-	12, 14	9, 10, 29, 30	10, 30	8, 9, 10, 15, 16, 27, 28, 29, 30	12
July 2014	17	-	10, 11	13, 15, 26, 27	1, 4, 8, 13	2, 3, 9, 18, 21, 22, 23, 25, 27	12
August 2014	-	-	2,3	13, 14	-	8, 13, 15, 21, 27	12
September 2014	-	-	-	-	-	8, 9, 10, 18	6
October 2014	-	-	-	-	-	6, 8, 24	6
November 2014	-	5, 6	-	-	-	19, 20, 21	6
December 2014	-	-	-	-	-	*	0
January 2015	-	14,15	-	-	-	7, 8, 9, 16, 23, 27, 28, 30	12
February 2015	-	25, 26	-	-	-	11, 12, 13, 16	6
March 2015	-	-	-	-	-	9, 10, 12, 13, 14	6
April 2015	20, 23	-	1, 2, 3, 8, 9, 17	-	-	1, 2, 3, 8, 13, 15	6
May 2015	29, 30	-	13, 14	13, 14, 29	-	6, 11, 13, 14, 27, 28, 29, 30, 31	12
June 2015	9, 10	-	11	10, 30	-	12, 15, 16, 17, 25, 26, 27, 29, 30	12
July 2015	26	-	1, 2	2, 3	7, 8, 26, 28	2, 3, 8, 10, 22, 23, 24, 25, 26, 28, 30, 31	12
August 2015	-	-	19, 24	6, 17, 19	12, 15, 16, 17, 20, 22	12, 21, 22, 24	6
September 2015						7,11,16,21,29	6
October 2015		27,29				9,22,26,28	6
November 2015						10,11,12,19	6
December 2015		16,17,18				4,7,8,11,14	6

TABLE 1 – DATES OF BIRD SURVEYS UNDERTAKEN AT ACKRON (APRIL 2014 – AUGUST 2015)

Month	Moorland breeding bird surveys	Winter bird surveys	Breeding raptor surveys	Breeding diver surveys	Diver focal breeding loch VPs	VP surveys	
						Dates	Hours completed per VP
January 2016						14,15,20,27,28	6
February 2016		23,24,25				9,10,22,23,26	6
March 2016						16,18,23,24	6

Notes

* surveys postponed until January 2015 due to poor weather

3. BASELINE CONDITIONS

3.1 Desk Study

Two SPAs, one RAMSAR site and three SSSIs with named ornithological interests are located within 10km of the PDB (Table 2, Figure 2).

Site Name	Distance from proposed development	Reason for designation
Caithness and Sutherland Peatlands SPA	0km (adjacent)	Black-throated diver (<i>Gavia arctica</i>), breeding; Common scoter (<i>Melanitta nigra</i>), breeding; Golden eagle (<i>Aquila chrysaetos</i>), breeding; Greenshank (<i>Tringa nebularia</i>), breeding; Hen harrier (<i>Circus cyaneus</i>), breeding; Red-throated diver (<i>Gavia stellata</i>), breeding; Short-eared owl (<i>Asio flammeus</i>), breeding; Golden plover (<i>Pluvialis apricaria</i>), breeding; Wigeon (<i>Anas penelope</i>), breeding; Dunlin (<i>Calidris alpina schinzii</i>), breeding; Merlin (<i>Falco columbarius</i>), breeding; Wood sandpiper (<i>Tringa glareola</i>), breeding
Caithness and Sutherland Peatlands RAMSAR	0km (adjacent)	Dunlin, breeding; Greylag goose (<i>Anser anser</i>), breeding; breeding bird assemblage
East Halladale SSSI	0km (adjacent)	Dunlin, breeding; golden plover, breeding; breeding bird assemblage
West Halladale SSSI	3km	Black-throated diver, breeding; common scoter, breeding; breeding bird assemblage
North Caithness Cliffs SPA	8km	Peregrine (<i>Falco peregrinus</i>), breeding; Seabird assemblage, breeding; Fulmar (<i>Fulmarus glacialis</i>), breeding; Guillemot (<i>Uria aalge</i>), breeding; Kittiwake (<i>Rissa tridactyla</i>), breeding; Razorbill (<i>Alca torda</i>), breeding; Puffin (<i>Fratercula arctica</i>), breeding
Red Point Coast SSSI	8km	Guillemot, breeding

3.2 Field Data

This section presents a summary of field data collected directly from 1 April 2014 to 31 August 2015 for selected key bird species (with reference to Section 2.1). All VP flights recorded are presented in Appendix 1.

3.2.1 Whooper Swan

Flight Activity

Two flights were recorded during VP surveys involving a total of 17 birds, in October 2014 and January 2015. The maximum flock size was 15 birds on 18 October.

3.2.2 Pink-footed Goose

Flight Activity

Fifteen flights were recorded during VP surveys involving 497 birds, with a maximum flock size of 90 birds. Twelve of these flights occurred during April (four in 2014, twelve in 2015), with one each recorded in September, October and March 2015.

3.2.3 Greylag Goose

Flight Activity

Fifty eight flights were recorded during VP surveys involving 324 birds, with a maximum flock size of 49. Flights were recorded in April (7), May (9), July (1), August (1), October (3), January (6), February (1) and March (1) in 2014, and January (6), February (1),

March (1), April (11), May (11), June (2), August (5), and October (14) in 2015 and March 2016 (32)

3.2.4 Shelduck

Flight Activity

A single flight was recorded in late May 2014. In 2015, four flights consisting of seven birds were recorded in June.

3.2.5 Mallard

Flight Activity

Three flights consisting of a total of five mallards were recorded during VP surveys in 2014; two flights in May and a single flight in August. In 2015, two flights, each consisting on two birds, were recorded in May.

3.2.6 Goldeneye

Flight Activity

A single goldeneye was recorded during a VP survey in April 2014 and another in February 2016.

3.2.7 Red-throated Diver

Breeding Status Summary



Flight Activity

Fourteen flights were recorded during standard VP surveys across 2014 and 2015; ten in 2014 (Figure 4) and four in 2015 (Figure 5). These flights involved a total of 19 birds (with flights consisting of two birds recorded on five occasions). Flight activity across the site itself was recorded more regularly in 2014 than in 2015.



During focal breeding loch surveys in 2014 [redacted], there were four flights of red-throated diver and one of an unidentified diver.

[redacted] In 2015 many flights were recorded during focal watches [redacted].

Red-throated Diver Survey Records

On 9 June 2014, a pair of red-throated divers was confirmed to be breeding [REDACTED]. A single red-throated diver was flushed from the same loch during a survey on 29 June, whilst another bird (presumed to be one of the breeding pair) was observed [REDACTED]. No red-throated divers were recorded on the visits of 30 June, 13 July and 15 July, but a single bird was observed loafing [REDACTED] on 26 July. No birds were recorded on the visit of 27 July, whilst a pair of red-throated divers were recorded landing on loch 232 (Caol Loch) on 13 August, but no breeding was recorded. The final sighting of red-throated divers in 2014 was a single bird observed [REDACTED] on 14 August.

In 2015, [REDACTED] A pair of red-throated divers were seen on 9 April, with no further sightings made until a single bird was seen on 12 June. Then on 25 June a pair of adults with two chicks was recorded. An adult was sighted on 1 July, before an adult with two chicks was recorded on 3 July. Two chicks were recorded as still being present on 27 July, with a note that only one chick was present on 20 August. No further sightings of either chick after this date. Single birds were recorded up until 22 August 2015.

3.2.8 Black-throated Diver

Breeding Status

The presence of a single adult [REDACTED] on 28 May 2014 is defined as a non-breeding record for this species. This is considered by far the likeliest scenario as there were no further records made throughout the breeding season despite regular visits by surveyors.

In 2015 there was some flight activity recorded [REDACTED]. However, other than the presence of birds there was no additional evidence of breeding, and due to the survey effort applied it is considered unlikely that a breeding attempt would have been missed. Therefore this was recorded as non-breeding activity.

Flight Activity

No black-throated divers were observed during any VP surveys in 2014 (Figure 4). In 2015, five flights comprising of eight birds were recorded in April (1), May (1) and August (3) (Figure 5).

3.2.9 Grey Heron

Flight Activity

Two grey heron flights were recorded during VP surveys in 2014, with a further three in 2015. Both records were made on the same day in late May 2014, suggesting the same bird may have been recorded twice. In 2015, two observations were made on the 11 May, with a further observation in June.

3.2.10 White-tailed Eagle

Flight Activity

An immature white-tailed eagle was recorded twice on 24 May 2014 (Figure 6). The bird was observed flying over the site towards the coast on both occasions.

On 12 June 2014 an adult/near adult was recorded flying north over the site (Figure 6).

These records are likely to relate to at least one wandering individual, and as such are highly unlikely to be linked to a breeding territory.

3.2.11 Hen Harrier

Breeding Status

Due to the presence of a pair of hen harriers in early May 2014, it was initially thought possible that a breeding territory was located in the area. However, because no evidence was collected to indicate the presence of a nest, or that a breeding attempt occurred, it is considered likely that the birds moved elsewhere to breed.

[REDACTED]

A single hen harrier flight was recorded during the winter season on 13 March 2015 (Figure 7). This bird was likely an early arriver for the 2015 breeding season.

In 2015, there were sightings of a single female and a single male on 20 April and 29 May respectively (but never together). It was concluded that breeding was not occurring in the area (Figure 8).

Flight Activity

In 2014, ten flights were recorded in the breeding season (Figure 6), each involving a single bird (with a minimum of two birds present in the vicinity of the site; an adult male and adult female, though never seen together). In 2015, four flights were observed, all involving single birds (Figure 8). Three of these were seen on the same day in August, with a single flight in March. A single bird was noted on three dates in winter 2016 spread across January to March.

3.2.12 Golden Eagle

Flight Activity

One unaged individual undertook a prolonged flight south across the site on 10 June 2014 (Figure 6). A second record was made on 15 July during a diver survey, when a sub-adult was noted to the north of Beinn Ruadh (outside the PDA). A third record involved an immature (1st winter) bird, west of Caol-Loch on 9 January 2015 (Figure 7). Finally, a single flight of an unaged individual was recorded on 8 April 2015 and again in November 2015 (Figure 8).

These records are likely to relate to one or more wandering individuals and as such it is unlikely that they are linked to a breeding territory. Wandering immature eagles are common across north Scotland in areas where breeding territories do not occur.

3.2.13 Merlin

Breeding Status

Due to behavioural observations in July and the presence of two juveniles in August 2014, it is considered possible that there was a breeding territory [REDACTED]. No breeding behaviour was recorded in 2015.

Flight Activity

Four flights were recorded during the 2014 breeding season (Figure 6) with a minimum of three birds present; an adult male and two juveniles. In addition, a female was recorded

in flight during breeding bird surveys, and a single was also recorded in flight in Strath Halladale during raptor surveys.

In 2015 three flights were observed (Figure 8), including two on 1 April, one of which consisted of two birds.

3.2.14 Peregrine

Breeding Status

A minimum of three individuals (adult female, adult male and immature) were recorded during the 2014 breeding season. Surveyors noted that no suitable breeding habitat is available on site, therefore these individuals are considered to be non-breeding or wandering birds from adjacent territories.

No evidence to suggest breeding was occurring in the study area was collected in 2015.

Flight Activity

Single peregrines were observed in flight twice in June 2014 (Figure 6; one of which was an apparent juvenile), once in March 2015 (Figure 7), and twice on 30 July 2015 (Figure 8).

3.2.15 Oystercatcher

Breeding Status

Behavioural observations indicate that there was a minimum of one oystercatcher territory in the vicinity of the site in 2014 (Figure 10), and in roughly the same location in 2015 (Figure 12).

3.2.16 Common Sandpiper

Flight Activity

A single common sandpiper flight was recorded during a VP survey on 28 June 2014 (Figure 10).

3.2.17 Golden Plover

Breeding Status

Behavioural observations indicate that there was a minimum of one golden plover territory present in 2014 [REDACTED] and 2015 [REDACTED].

Flight Activity

In total three golden plover flights (involving four birds) were recorded in 2014 (during the breeding season; Figure 10). Non-breeding season flights were recorded in January (two flights, 50 birds), February (two flights, 8 birds) and March (one flight by a single bird) (Figure 11). In addition, flights of single birds were recorded twice during the 2015 breeding season, in May and June (Figure 12).

3.2.18 Lapwing

Breeding Status

Behavioural observations indicate that there was a minimum of two breeding pairs of lapwings in area in 2014 (Figure 10). There was a post-breeding flock of 18 birds in Strath

Halladale (south of Halladale Bridge) on 17 July 2014. In 2015, it is believed that there was a minimum of one lapwing territory (Figure 12), in roughly the same locations as where activity had been recorded in 2014.

Flight Activity

In total three lapwing flights (involving three birds) were recorded in the 2014 breeding season (Figure 10). Four flights comprising of seven birds were recorded during the 2015 breeding season (Figure 12).

3.2.19 Dunlin

Breeding Status

Behavioural observations indicate that there was a dunlin territory [REDACTED] in 2014 [REDACTED]. In 2015, the presence of two alarming bird records suggested a single territory was present [REDACTED]. This was in a different location to the 2014 record.

Flight Activity

Five flights (comprising of six birds) were recorded in the 2014 breeding season (Figure 10), all in the vicinity of VP3. In 2015, two flights, each comprising of a single bird, were recorded in May and June (Figure 12).

3.2.20 Snipe

Breeding Status

Behavioural observations indicate that there was a minimum of three snipe territories in 2014 (Figure 10). In 2015 it is likely that there were three to four snipe territories present (Figure 12) in a similar area to those recorded in 2014.

Flight Activity

In the 2014 breeding season 16 snipe flights were recorded (Figure 10), 14 of which were noted as displaying or 'drumming' flights. The greatest amount of flight activity was recorded in June (14 flights). During 2015, 12 flights were recorded (Figure 12), with several of these identified as display flights. Six flights occurred in May and six in June.

3.2.21 Curlew

Breeding Status

Behavioural observations (Figure 10) indicate that there was a minimum of five curlew territories in 2014. In 2015 there were a minimum of three territories (Figure 12).

Flight Activity

In the 2014 breeding season 21 curlew flights were recorded (Figure 10) between April and August. During the 2015 breeding season 33 flights were recorded between April and June (Figure 12).

3.2.22 Wood Sandpiper

Flight Activity

In 2015 a single wood sandpiper flight was recorded approximately 1km north of the PDB on 17 August (Figure 12). No other activity for this species was recorded. It is very likely that this bird was a passage migrant.

3.2.23 Greenshank

Breeding Status

Observations do not indicate that there were any breeding greenshanks within the survey area in 2014. One bird was heard calling outside of the survey area around or over Caol Loch on 21 April. During a diurnal VP on 30 May a greenshank was observed at a pool near VP3. In 2015, no breeding greenshank activity was recorded at the site.

Flight Activity

One greenshank flight was observed in May 2014 (Figure 10). In 2015 a single flight was observed in June (Figure 12). Both observations were made from VP3.

3.2.24 Arctic Tern

Flight Activity

Ten arctic tern flights, comprising of eleven birds, were recorded in 2014. The bulk of these observations (eight flights) were recorded during a two day period in late July. It is not known how many individual birds were involved. No observations of this species were made in 2015.

3.2.25 Great Skua

Flight Activity

Four great skua flights were recorded during VP surveys in 2014, in May and July. No observations of this species were made during VP surveys in 2015.

3.2.26 Short-eared Owl

Breeding Status

Behavioural observations indicated possible breeding, due to a bird in suitable breeding habitat in the breeding season, in 2014 [REDACTED]. No breeding behaviour by this species was recorded in 2015.

Flight Activity

Two flights of single short-eared owls were observed during standard VP surveys in 2014 (June and July), at dawn and dusk. The short-eared owl observations are shown on Figure 5.1. No observations of this species were made during VP surveys in 2015.

3.2.27 Skylark

Breeding Status

43 singing skylarks were recorded in April 2014, which represents an observed density of 6.05 singing skylarks/ km². In 2015, 34 singing skylarks were recorded during the corresponding survey, representing a density of 4.78 singing skylarks/ km².

4. COLLISION RISK ANALYSIS

4.1 Collision Risk Modelling and Defining the Risk Area/Volume

An estimate of the likely number of collisions with turbines was calculated using the two methods described by SNH (2000)⁹ utilising the data collected between 1 April 2014 and 31 August 2015.

The analysis was implemented in the Python programming language (Python.org, 2013) and utilises ArcGIS (ESRI 2013) and PostgreSQL/PostGIS relational database management system (Postgresql.org 2013, Postgis.net 2013).

4.2 Calculation of Probability of Collision

The probability of collision of a single rotor transit was calculated following SNH (2000). Morphometric measurements were taken from BTO.org (2013)¹⁰ with flight speeds primarily from Alerstam *et al.* (2007)¹¹, or alternatively from Bruderer and Boldt (2001)¹². Turbine specifications are those of the Siemens SWT-101 provided by wpd.

4.3 Calculation of Number of Collisions

The estimated number of collisions was determined by combining the estimated number of rotor transits with their probability of collision, an assumed 85% turbine operational rate, and the avoidance rate(s) specified in SNH (2010)¹³.

4.4 Collision Risk Modelling

The flight activity data for the target species highlighted in the species accounts were extrapolated to estimates of their total annual flights through the Risk Volume. The annual totals were then entered into the collision risk model to generate estimates of the annual frequency of turbine collisions for each species (summarised in Table 3).

Calculations were undertaken for species which had greater than three flights 'at risk' in a particular season. On this basis, CRM has been carried out for three species which form part of the Caithness and Sutherland Peatlands SPA population. Other such species, i.e. golden eagle, were not undertaken as no flight activity was recorded within the 'at risk' flight height bands within the polygons.

⁹ SNH (2000) Windfarms and birds: Calculating a theoretical collision risk assuming no avoiding action. [online] Available at: <http://www.snh.gov.uk/docs/C205425.pdf> [Accessed: 30 May 2013].

¹⁰ BTO.org (2013) *Welcome to BirdFacts | BTO - British Trust for Ornithology*. [online] Available at: <http://www.bto.org/about-birds/birdfacts> [Accessed: 23rd September 2014].

¹¹ Alerstam T, Rosén M, Bäckman J, Ericson PGP, Hellgren O (2007) Flight speeds among bird species: Allometric and phylogenetic effects. *PLoS Biol* 5(8): e197. doi:10.1371/journal.pbio.0050197.

¹² Bruderer, B. and Boldt, A. (2001), Flight characteristics of birds. *Ibis*, 143: 178–204. doi: 10.1111/j.1474-919X.2001.tb04475.x.

¹³ SNH (2010) *Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model*. [online] Available at: <http://www.snh.gov.uk/docs/B721137.pdf> [Accessed: 23rd September 2014].

TABLE 3 – SUMMARY OF FLIGHT ACTIVITY DATA & RESULTS OF COLLISION RISK MODELLING UNDERTAKEN FOR TARGET SPECIES AT ACKRON (2014/2015)

Receptor	Avoid- ance rate (%)	Season	No. of at risk flights	No. of birds at risk	Predicted Collision Mortality		
					Season collision rate	Mean annual collision rate*	Approx years per collision
Pink-footed Goose	0.998	Breeding 2014	0	0	0	0.2022	4.9
		Non-breeding 2014-15	5	173	0.4045		
		Breeding 2015	0	0	0		
		Non-breeding 2015-16	0	0	0		
Greylag Goose	0.998	Breeding 2014	1	3	0.0065	0.1034	9.7
		Non-breeding 2014-15	3	34	0.0837		
		Breeding 2015	5	38	0.0795		
		Non-breeding 2015-16	3	15	0.0371		
Red-throated Diver	0.995*	Breeding 2014	4	6	0.0275	0.0181	55.1
		Non-breeding 2014-15	0	0	0		
		Breeding 2015	1	2	0.0088		
		Non-breeding 2015-16	0	0	0		
Grey Heron	0.98	Breeding 2014	2	2	0.0242	0.0216	46.2
		Non-breeding 2014-15	0	0	0		
		Breeding 2015	3	3	0.0191		
		Non-breeding 2015-16	0	0	0		
Hen Harrier	0.99	Breeding 2014	2	2	0.0059	0.0031	327.5
		Non-breeding 2014-15	1	1	0.0002		
		Breeding 2015	0	0	0		
		Non-breeding 2015-16	0	0	0		
Common Snipe	0.98	Breeding 2014	1	1	0.0029	0.0186	53.9
		Non-breeding 2014-15	0	0	0		
		Breeding 2015	4	5	0.0342		
		Non-breeding 2015-16	0	0	0		
Curlew	0.98	Breeding 2014	2	2	0.0061	0.0165	60.5
		Non-breeding 2014-15	0	0	0		
		Breeding 2015	4	7	0.027		
		Non-breeding 2015-16	0	0	0		

Notes

Calculated by summing each breeding season with the subsequent non-breeding season, then taking the mean of these values

* SNH have suggested changing avoidance rate for Red throated diver from 98% to 99.5% over the course of this project.

5. CONCLUSIONS

A number of species listed on Annex I of the EU Birds Directive and Schedule 1 of the Wildlife & Countryside Act, as amended, were recorded at Ackron during surveys between April 2014 and August 2015. Of these, only five species were deemed breeding or were likely to have bred in or close to the survey area, as detailed below:

1. Red-throated diver (one breeding location);
2. Merlin (one possible breeding territory);
3. Golden plover (one breeding territory);
4. Dunlin (one breeding territory); and
5. Short-eared owl (one possible breeding location).

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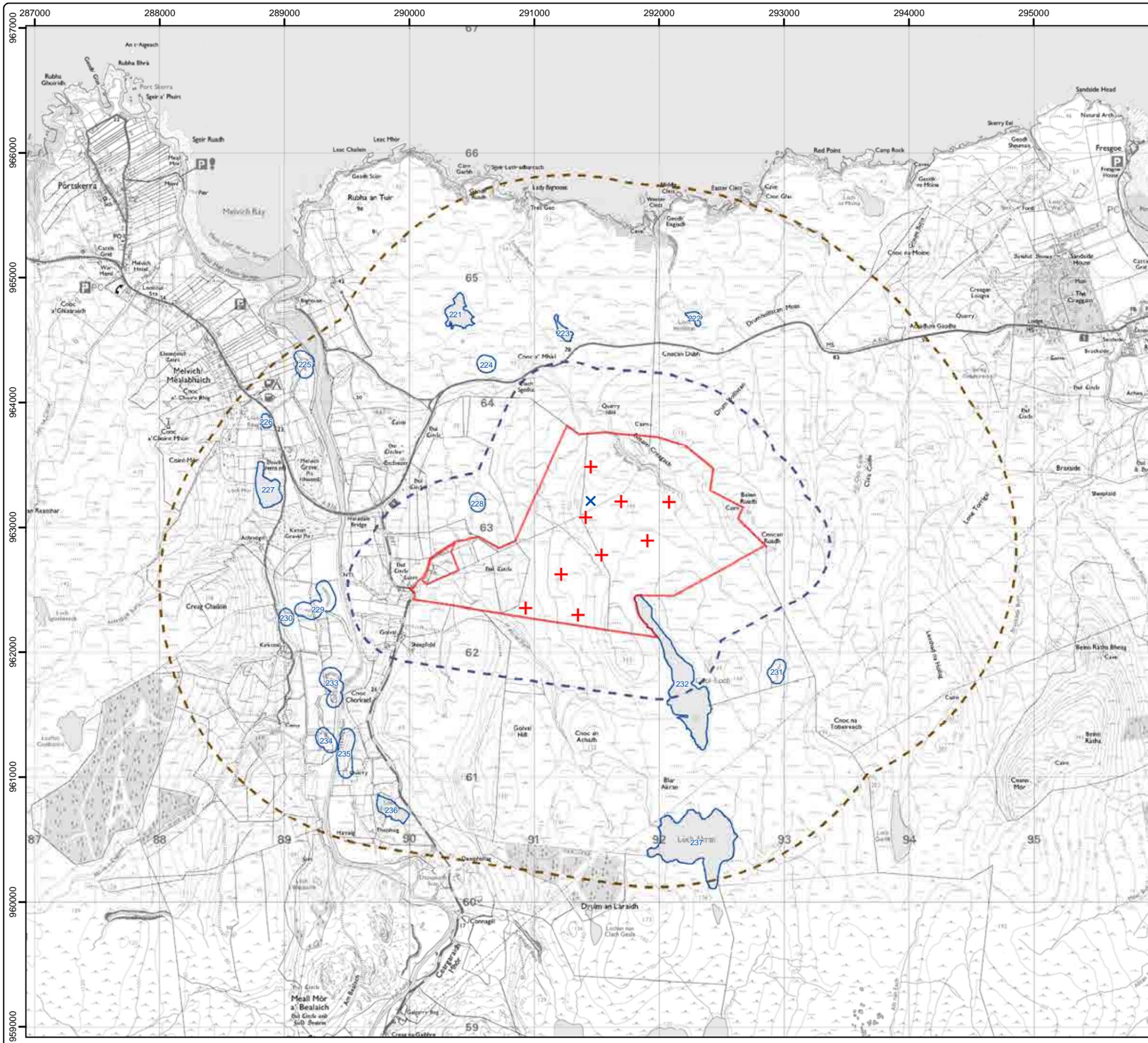
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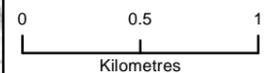
Figure 12 – Wader Records 2015 Breeding Season (1 April to 31 August)

Figure 13 – Wader Records 2015/16 Winter Season (1 September 2015 to 31 March 2016)

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- Project area
 - + Turbine location
 - X Meteorological mast
- Survey type
- Moorland breeding bird survey
 - Breeding raptor and diver surveys
 - Lochs for breeding diver survey (displaying Loch IDs)



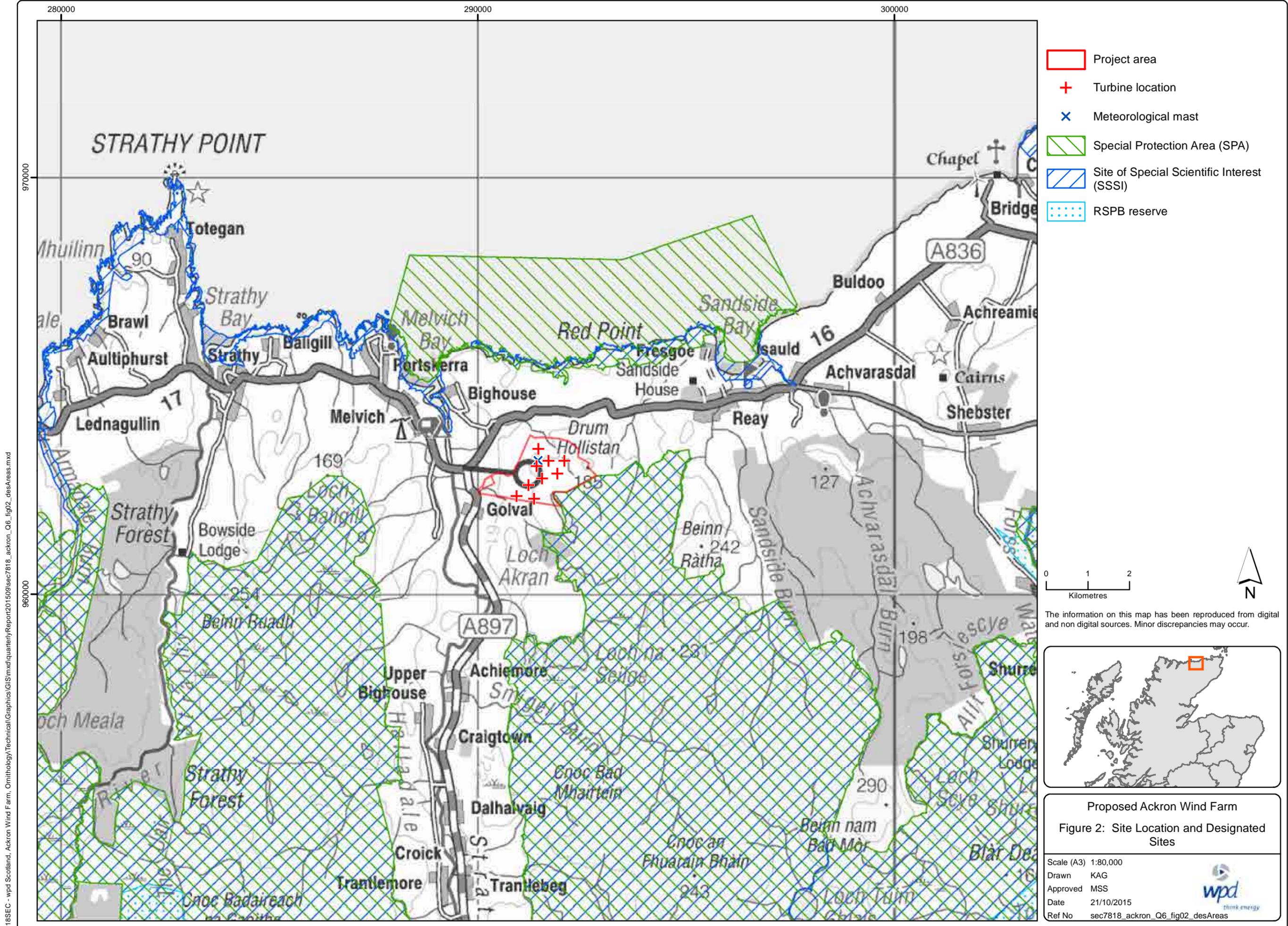
The information on this map has been reproduced from digital and non digital sources. Minor discrepancies may occur.



Proposed Ackron Wind Farm
Figure 1: Site Location and Ornithological Survey Areas 2014 / 2015

Scale (A3) 1:30,000
 Drawn CH
 Approved MSS
 Date 21/10/2015
 Ref No sec7818_ackron_Q6_fig01_surveyAreas





- Project area
- + Turbine location
- x Meteorological mast
- Special Protection Area (SPA)
- Site of Special Scientific Interest (SSSI)
- RSPB reserve



The information on this map has been reproduced from digital and non digital sources. Minor discrepancies may occur.

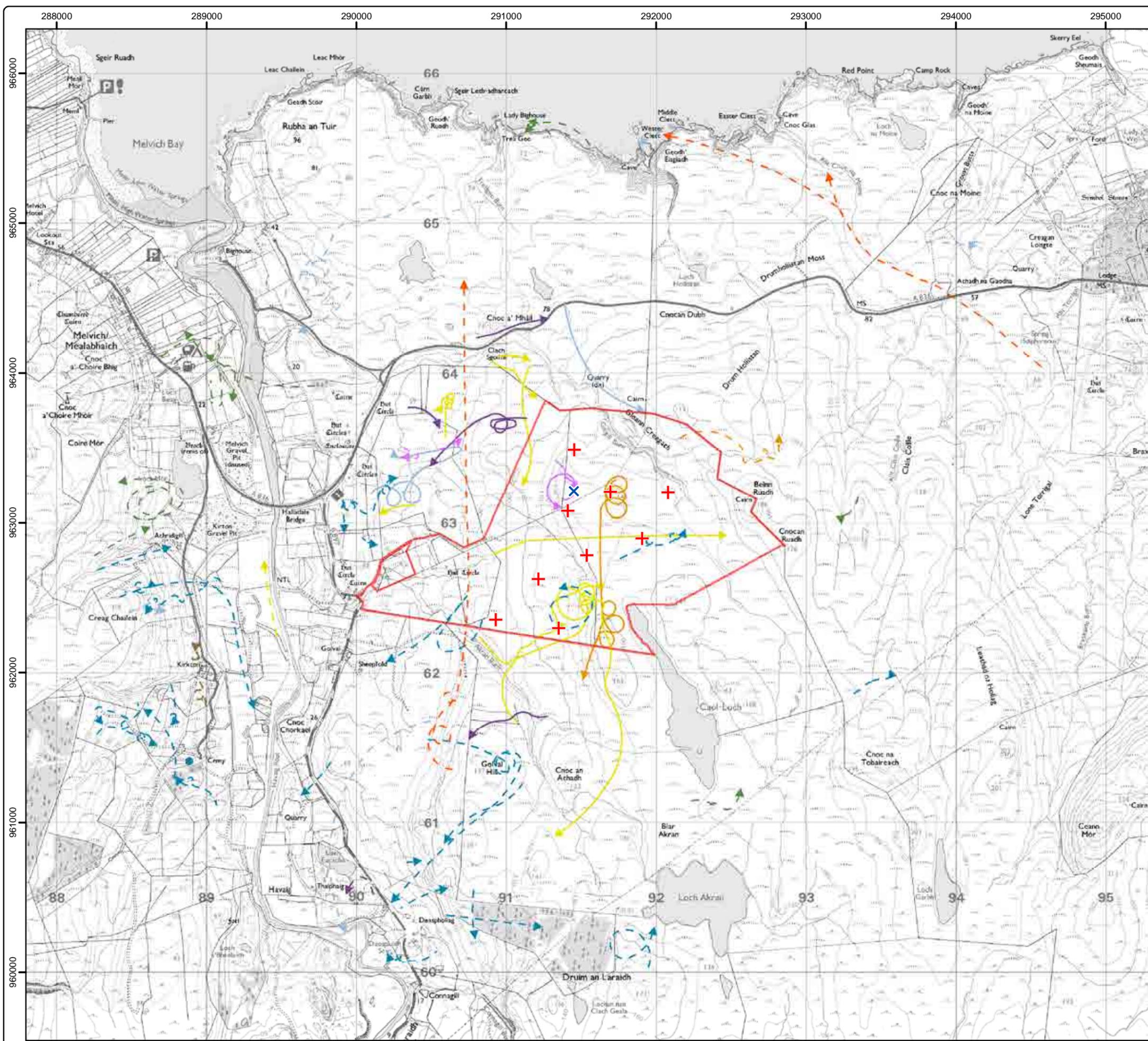


Proposed Ackron Wind Farm
Figure 2: Site Location and Designated Sites

Scale (A3)	1:80,000
Drawn	KAG
Approved	MSS
Date	21/10/2015
Ref No	sec7818_ackron_Q6_fig02_desAreas

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- Project area
- + Turbine location
- × Meteorological mast
- VP flights
 - Golden eagle
 - Hen harrier
 - Merlin
 - Peregrine
 - Short-eared owl
- Non-VP flights
 - - ➤ Golden eagle
 - - ➤ White-tailed eagle
 - - ➤ Hen harrier
 - - ➤ Merlin
 - - ➤ Peregrine
 - - ➤ Short-eared owl
 - - ➤ Buzzard
 - - ➤ Sparrowhawk
 - - ➤ Kestrel
 - Buzzard occupied nest



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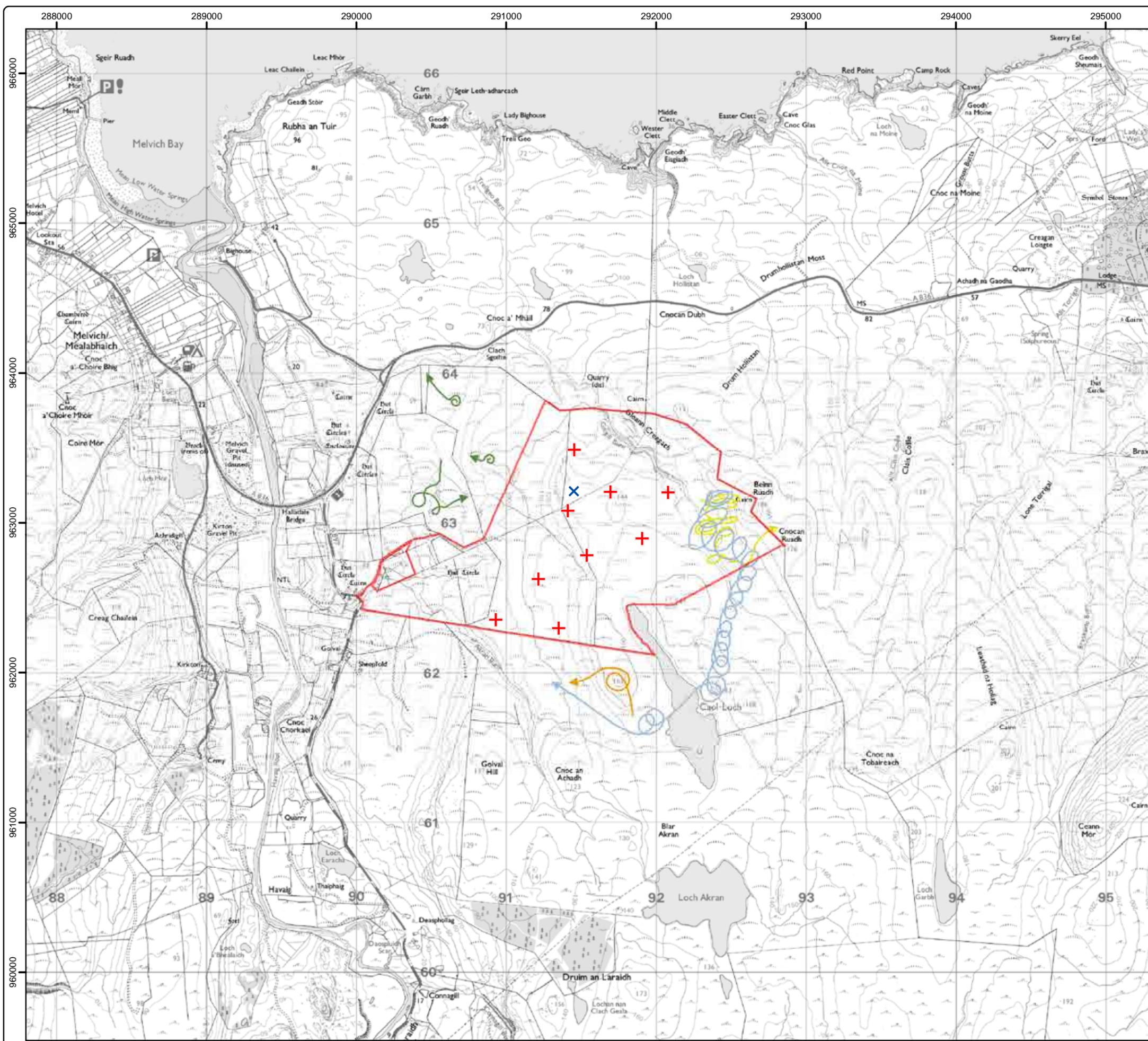


Proposed Ackron Wind Farm
Figure 6: Raptor Records 2014 Breeding Season (1 April to 31 August)

Scale (A3) 1:25,000
 Drawn CH
 Approved MSS
 Date 11/04/2016
 Ref No sec7818_ackron_Q6_fig04_to_11_birdObs



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- Project area
- + Turbine location
- × Meteorological mast
- VP flights
 - ➔ Golden eagle
 - ➔ Hen harrier
 - ➔ Peregrine
 - ➔ Kestrel



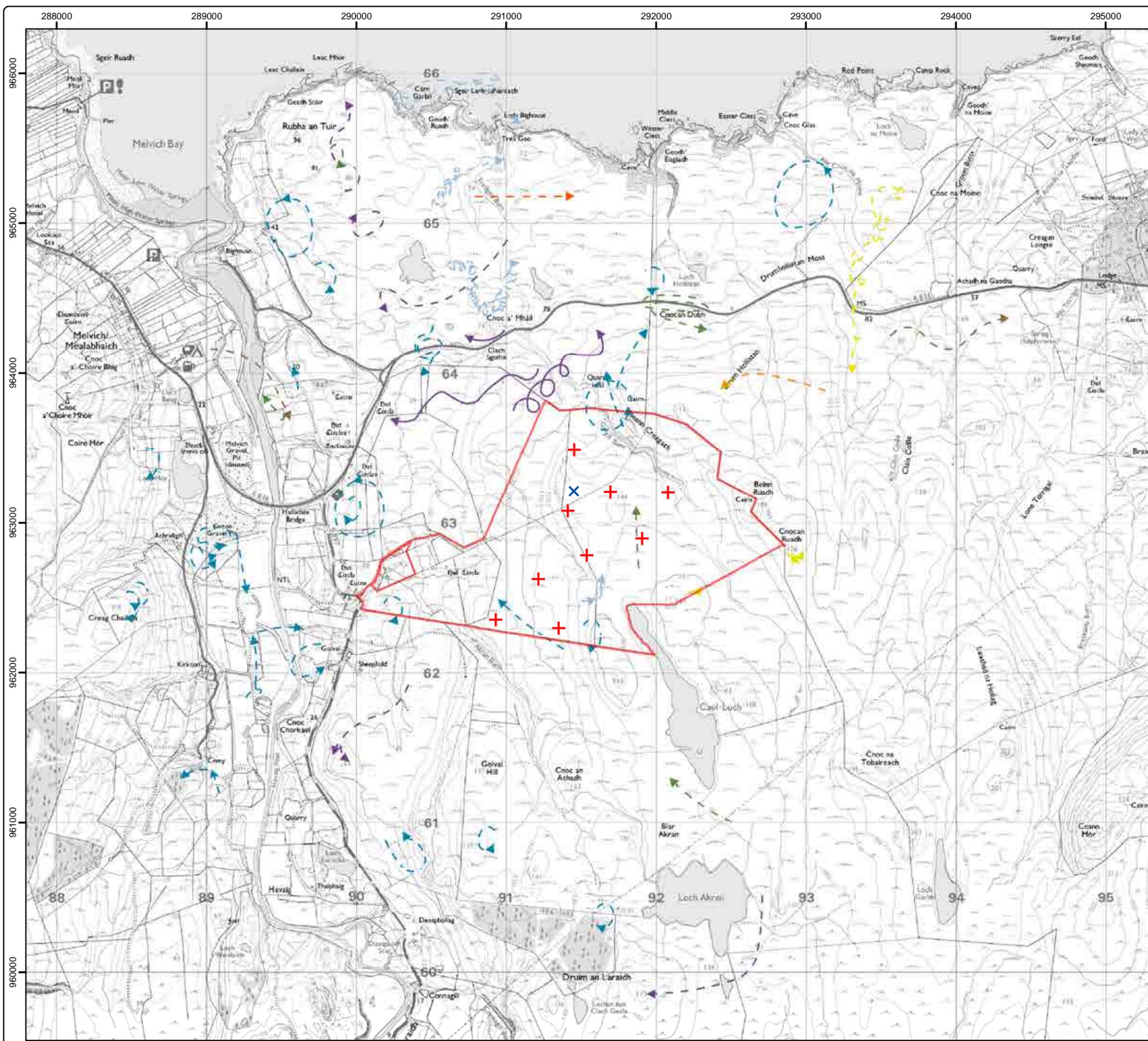
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Proposed Ackron Wind Farm
 Figure 7: Raptor Records 2014/15 Winter Season (1 September 2014 to 31 March 2015)

Scale (A3) 1:25,000
 Drawn CH
 Approved MSS
 Date 11/04/2016
 Ref No sec7818_ackron_Q6_fig04_to_11_birdObs

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- Project area
- + Turbine location
- × Meteorological mast
- VP flights
 - Hen harrier
 - Merlin
 - Peregrine
- Non-VP flights
 - Golden eagle
 - White-tailed eagle
 - Hen harrier
 - Merlin
 - Peregrine
 - Buzzard
 - Sparrowhawk
 - Kestrel



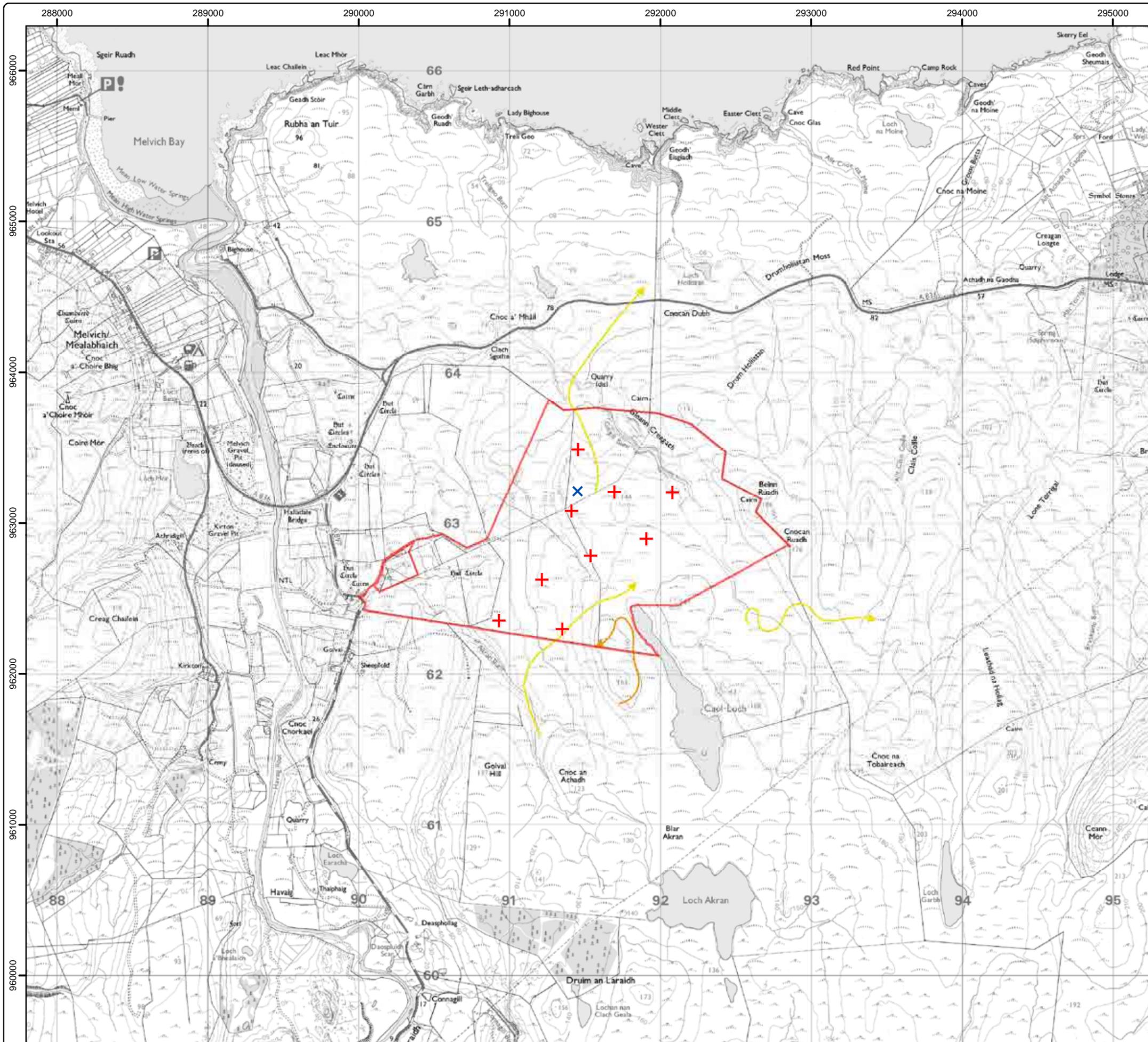
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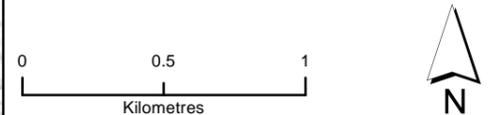
Proposed Ackron Wind Farm
 Figure 8: Raptor Records 2015 Breeding Season (1 April to 31 August)

Scale (A3) 1:25,000
 Drawn CH
 Approved MSS
 Date 11/04/2016
 Ref No sec7818_ackron_Q6_fig04_to_11_birdObs

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- Project area
- + Turbine location
- × Meteorological mast
- VP flights
 - Golden eagle
 - Hen harrier



The information on this map has been reproduced from digital and non digital sources. Minor discrepancies may occur.

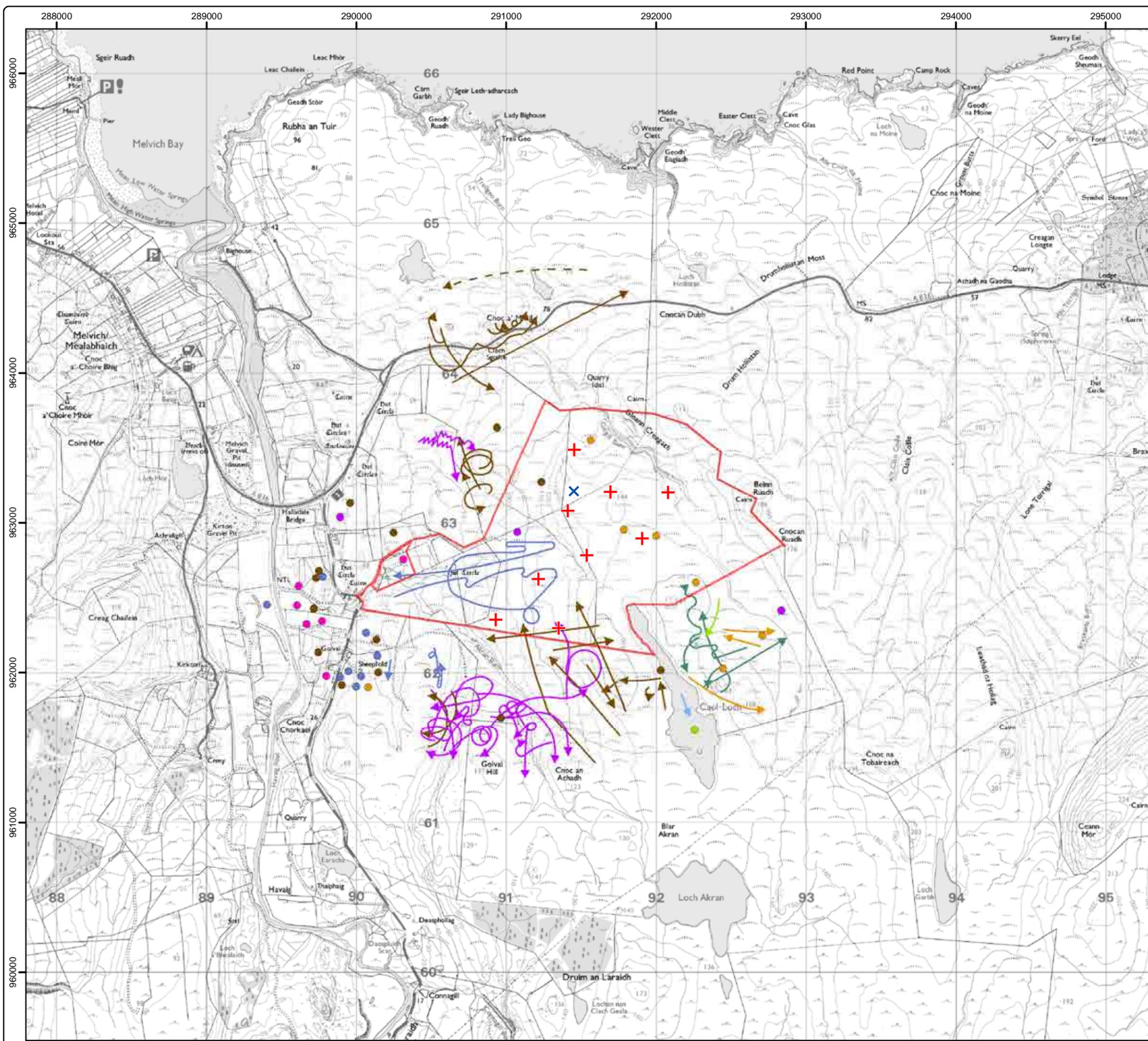


Proposed Ackron Wind Farm
 Figure 9: Raptor Records 2015/16 Winter Season (1 September 2015 to 31 March 2016)

Scale (A3) 1:25,000
 Drawn CH
 Approved MSS
 Date 11/04/2016
 Ref No sec7818_ackron_Q6_fig04_to_11_birdObs



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Project area
+ Turbine location
x Meteorological mast

VP flights

- Curlew
- Greenshank
- Golden plover
- Dunlin
- Lapwing
- Snipe
- Common sandpiper

Non-VP flights

- - → Curlew

Breeding bird survey observations

- Curlew (13)
- Greenshank (1)
- Golden plover (7)
- Lapwing (8)
- Oystercatcher (6)
- Snipe (3)

0 0.5 1
Kilometres

N

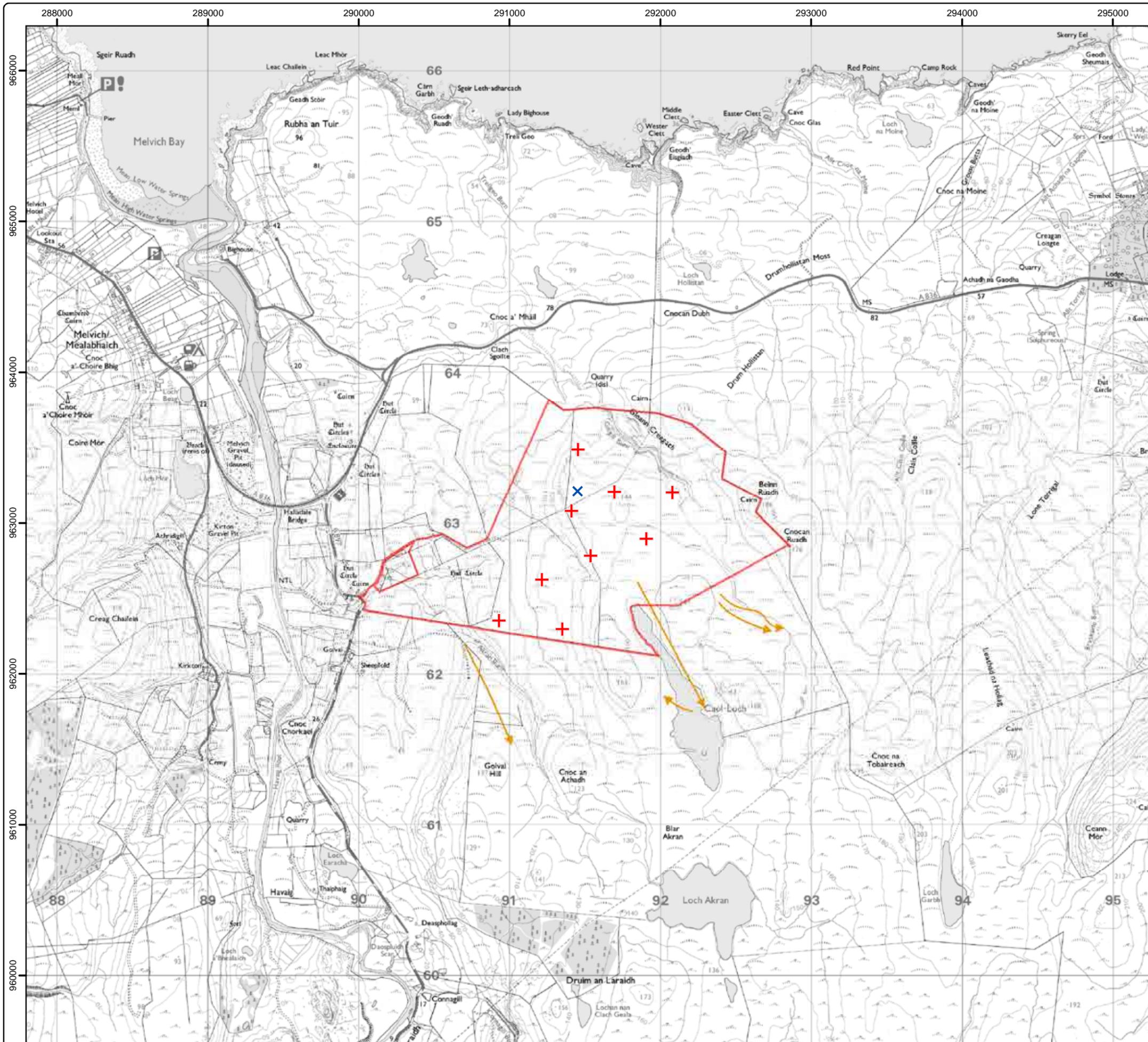
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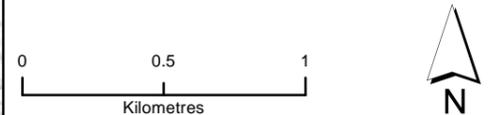
Proposed Ackron Wind Farm
Figure 10: Wader Records 2014 Breeding Season (1 April to 31 August)

Scale (A3) 1:25,000
 Drawn CH
 Approved MSS
 Date 11/04/2016
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- Project area
- + Turbine location
- x Meteorological mast
- VP flights
- Golden plover



The information on this map has been reproduced from digital and non digital sources. Minor discrepancies may occur.

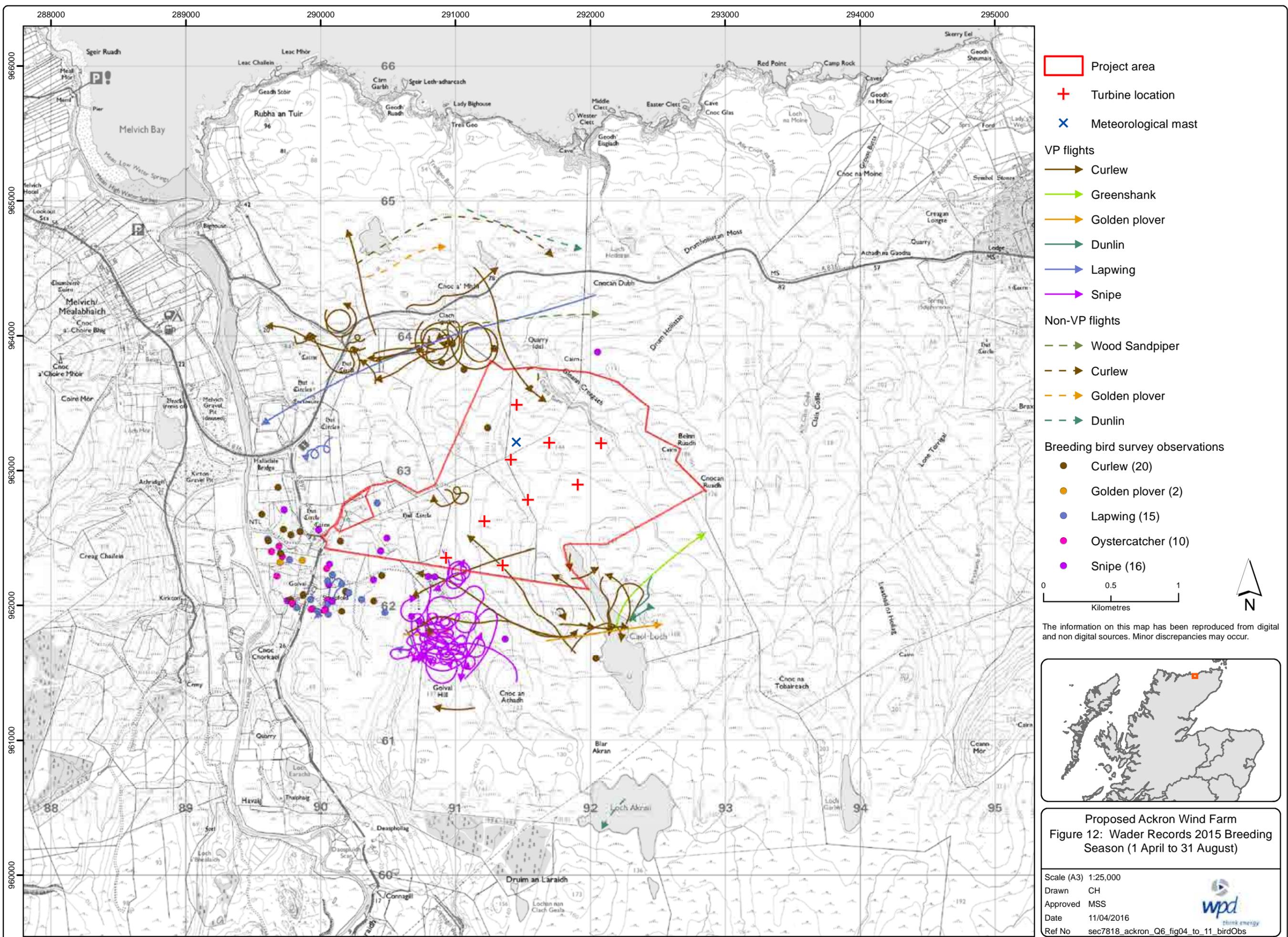


Proposed Ackron Wind Farm
Figure 11: Wader Records 2014/15 Winter Season (1 September 2014 to 31 March 2015)

Scale (A3) 1:25,000
 Drawn CH
 Approved MSS
 Date 11/04/2016
 Ref No sec7818_ackron_Q6_fig04_to_11_birdObs



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Project area

Turbine location

Meteorological mast

VP flights

- Curlw
- Greenshank
- Golden plover
- Dunlin
- Lapwing
- Snipe

Non-VP flights

- - - → Wood Sandpiper
- - - → Curlw
- - - → Golden plover
- - - → Dunlin

Breeding bird survey observations

- Curlw (20)
- Golden plover (2)
- Lapwing (15)
- Oystercatcher (10)
- Snipe (16)

0 0.5 1
Kilometres

N

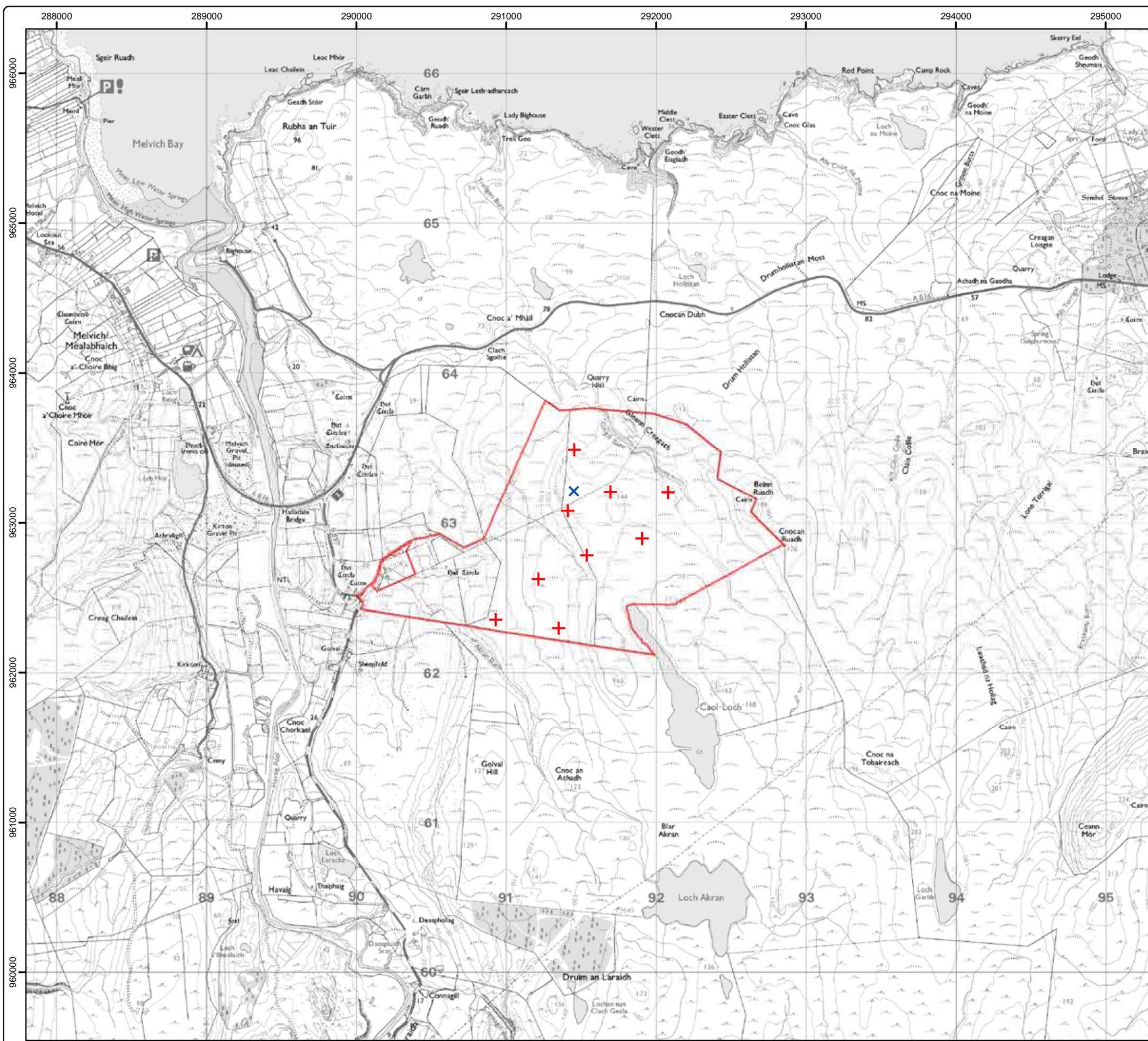


Proposed Ackron Wind Farm
Figure 12: Wader Records 2015 Breeding Season (1 April to 31 August)

Scale (A3) 1:25,000
 Drawn CH
 Approved MSS
 Date 11/04/2016
 Ref No sec7818_ackron_Q6_fig04_to_11_birdObs



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- Project area
- + Turbine location
- X Meteorological mast



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Proposed Ackron Wind Farm
Figure 13: Wader Records 2015/16 Winter Season (1 September 2015 to 31 March 2016)

Scale (A3) 1:25,000
 Drawn CH
 Approved MSS
 Date 11/04/2016
 Ref No sec7818_ackron_Q6_fig04_to_11_birdObs



APPENDIX 1 – VANTAGE POINT SURVEY LOCATIONS, EFFORT AND DATA

TABLE A1 – ACKRON VANTAGE POINT LOCATIONS APRIL 2014 – MARCH 2016		
Vantage Point (VP) Number	Grid reference	View bearing
1	290900, 961541	010
2	290874, 964295	165
3	292421, 961941	330

TABLE A2 – ACKRON VANTAGE POINT SURVEY EFFORT APRIL 2014 – MARCH 2016					
Date	VP	Observer	Start	Finish	Time at VP (hrs:mins)
18/04/2014	2	JB	14:20	17:20	03:00
18/04/2014	2	JB	18:30	21:30	03:00
19/04/2014	3	JB	13:00	16:00	03:00
19/04/2014	3	JB	18:10	21:10	03:00
20/04/2014	1	JB	14:15	17:15	03:00
20/04/2014	1	JB	18:15	21:15	03:00
08/05/2014	1	TGr	18:50	21:50	03:00
09/05/2014	3	TGr	14:45	17:45	03:00
09/05/2014	2	TGr	18:55	21:55	03:00
10/05/2014	1	JB	14:50	17:50	03:00
23/05/2014	1	JB	04:25	07:25	03:00
23/05/2014	2	JB	17:25	19:10	01:45
25/05/2014	3	JB	04:15	07:15	03:00
26/05/2014	2	TJS	15:20	18:20	03:00
26/05/2014	3	TJS	20:00	23:00	03:00
27/05/2014	1	TJS	11:00	14:00	03:00
28/05/2014	2	TJS	03:45	06:45	03:00
30/05/2014	3	TJS	09:20	12:20	03:00
30/05/2014	2	TJS	13:05	14:35	01:30
08/06/2014	1	JB	11:00	14:00	03:00
09/06/2014	2	DPB	19:00	22:00	03:00
10/06/2014	3	DPB	11:45	14:45	03:00
15/06/2014	2	TGr	14:55	17:55	03:00
16/06/2014	1	TJS	08:40	11:40	03:00
27/06/2014	3	JB	15:25	18:25	03:00
27/06/2014	1	JB	19:30	22:30	03:00
28/06/2014	3	TJS	04:15	07:15	03:00
28/06/2014	2	TJS	09:20	12:20	03:00
29/06/2014	2	TGr	04:00	07:00	03:00
30/06/2014	1	CR	04:05	07:05	03:00
30/06/2014	3	JB	19:30	22:30	03:00
02/07/2014	2	JB	19:30	22:30	03:00
03/07/2014	1	JB	10:15	13:15	03:00
03/07/2014	3	DPB	13:40	16:40	03:00
09/07/2014	2	JB	17:00	20:00	03:00
13/07/2014	4	MSc	10:05	13:05	03:00
18/07/2014	1	CR	04:20	07:20	03:00
18/07/2014	3	CR	08:25	11:25	03:00
21/07/2014	1	JB	13:50	16:50	03:00
22/07/2014	1	JB	19:05	22:05	03:00
23/07/2014	2	TGr	04:45	07:45	03:00
25/07/2014	2	JB	14:00	17:00	03:00
25/07/2014	3	JB	19:00	22:00	03:00
27/07/2014	3	JB	04:50	07:50	03:00
08/08/2014	2	JB	11:05	14:05	03:00
13/08/2014	1	TGr	14:15	17:15	03:00
15/08/2014	3	TGr	09:50	12:50	03:00
21/08/2014	2	TGr	08:05	11:05	03:00
21/08/2014	1	JB	16:10	19:10	03:00
27/08/2014	3	DPB	09:35	12:35	03:00

TABLE A2 – ACKRON VANTAGE POINT SURVEY EFFORT APRIL 2014 – MARCH 2016

Date	VP	Observer	Start	Finish	Time at VP (hrs:mins)
08/09/2014	3	DPB	13:45	16:45	03:00
08/09/2014	3	DPB	17:30	20:30	03:00
09/09/2014	1	DPB	13:50	16:50	03:00
09/09/2014	1	DPB	17:30	20:30	03:00
10/09/2014	2	DPB	12:45	15:45	03:00
18/09/2014	2	DPB	06:10	09:10	03:00
06/10/2014	2	DPB	12:20	15:20	03:00
06/10/2014	2	DPB	16:00	19:00	03:00
08/10/2014	1	DPB	07:10	10:10	03:00
08/10/2014	1	DPB	10:50	13:50	03:00
24/10/2014	3	YB	08:10	11:10	03:00
24/10/2014	3	YB	11:40	14:40	03:00
19/11/2014	1	DPB	09:40	12:40	03:00
19/11/2014	1	DPB	13:30	16:30	03:00
20/11/2014	3	DPB	09:50	12:50	03:00
20/11/2014	3	DPB	13:30	16:30	03:00
21/11/2014	2	DPB	07:40	10:40	03:00
21/11/2014	2	DPB	12:05	15:05	03:00
07/01/2015	1	DPB	13:10	16:10	03:00
08/01/2015	2	DPB	08:10	11:10	03:00
08/01/2015	2	DPB	12:25	15:25	03:00
09/01/2015	3	DPB	12:55	15:55	03:00
16/01/2015	1	DPB	10:20	13:20	03:00
23/01/2015	3	DPB	08:10	11:10	03:00
23/01/2015	1	DPB	12:15	15:15	03:00
27/01/2015	2	JB	09:35	12:35	03:00
27/01/2015	3	JB	13:45	16:45	03:00
28/01/2015	3	JB	09:50	12:50	03:00
28/01/2015	2	JB	14:00	17:00	03:00
30/01/2015	1	DPB	08:05	11:05	03:00
11/02/2015	2	DPB	07:15	10:15	03:00
11/02/2015	3	DPB	11:05	14:05	03:00
12/02/2015	3	DPB	07:35	10:35	03:00
12/02/2015	2	DPB	11:30	14:30	03:00
13/02/2015	1	DPB	08:35	11:35	03:00
16/02/2015	1	DPB	14:40	17:40	03:00
09/03/2015	1	DPB	14:10	17:10	03:00
10/03/2015	1	DPB	09:05	12:05	03:00
12/03/2015	2	JB	11:00	14:00	03:00
13/03/2015	3	JB	10:05	13:15	03:10
13/03/2015	2	JB	15:30	18:30	03:00
14/03/2015	3	JB	15:45	18:45	03:00
01/04/2015	2	CMc	10:15	13:15	03:00
02/04/2015	1	CMc	11:30	14:30	03:00
03/04/2015	2	CMc	06:45	09:45	03:00
08/04/2015	3	JHo	06:45	09:45	03:00
13/04/2015	3	TGr	12:20	15:20	03:00
15/04/2015	1	JHo	06:05	09:05	03:00
06/05/2015	2	DM	09:45	12:45	03:00
11/05/2015	1	JHO	18:30	21:30	03:00
13/05/2015	3	JHO	18:30	21:33	03:03
14/05/2015	2	JHO	18:30	21:30	03:00
27/05/2015	1	DM	09:30	12:30	03:00
28/05/2015	1	JHo	19:05	22:05	03:00
29/05/2015	1	JHo	15:30	18:30	03:00
29/05/2015	2	DM	11:45	14:45	03:00
30/05/2015	2	DM	19:00	22:00	03:00
30/05/2015	3	JHo	12:45	15:45	03:00
31/05/2015	3	TJS	16:00	19:00	03:00
31/05/2015	3	TJS	19:30	22:30	03:00
10/06/2015	1	JHo	12:35	15:35	03:00
12/06/2015	3	TGR	04:00	07:00	03:00
12/06/2015	2	TGR	07:55	10:55	03:00
15/06/2015	2	TJS	09:20	12:20	03:00
15/06/2015	3	TJS	03:55	06:55	03:00
16/06/2015	2	TJS	03:45	06:45	03:00
16/06/2015	1	TJS	09:10	12:10	03:00

TABLE A2 – ACKRON VANTAGE POINT SURVEY EFFORT APRIL 2014 – MARCH 2016

Date	VP	Observer	Start	Finish	Time at VP (hrs:mins)
17/06/2015	1	TJS	03:50	06:50	03:00
17/06/2015	3	TJS	07:25	10:25	03:00
25/06/2015	2	TGR	03:55	06:55	03:00
25/06/2015	3	TGR	13:55	16:55	03:00
26/06/2015	1	JB	03:55	06:55	03:00
27/06/2015	3	JB	04:05	07:05	03:00
29/06/2015	2	JHo	04:10	07:10	03:00
30/06/2015	1	JHo	04:10	07:10	03:00
02/07/2015	1	JHo	17:15	20:15	03:00
03/07/2015	2	JHo	09:00	12:00	03:00
08/07/2015	3	JHo	12:45	15:45	03:00
10/07/2015	2	MSS	09:45	12:45	03:00
22/07/2015	2	TJS	15:40	18:40	03:00
22/07/2015	3	TJS	19:30	22:30	03:00
23/07/2015	2	TJS	20:30	22:30	02:00
24/07/2015	2	TJS	13:40	14:40	01:00
25/07/2015	1	JHo	18:45	21:53	03:08
26/07/2015	2	DM	18:50	21:50	03:00
26/07/2015	3	JHo	08:30	11:30	03:00
28/07/2015	1	JB	12:00	15:00	03:00
30/07/2015	1	JHo	19:00	22:00	03:00
31/07/2015	3	JHo	18:30	21:30	03:00
12/08/2015	2	DM	14:30	17:30	03:00
19/08/2015	3	JHo	13:15	16:15	03:00
21/08/2015	1	JHo	09:30	12:30	03:00
21/08/2015	2	JHo	05:40	08:40	03:00
22/08/2015	1	DM	05:50	08:50	03:00
24/08/2015	3	DM	05:55	08:55	03:00
07/09/2015	1	DPB	08:40	11:40	03:00
11/09/2015	1	DPB	05:55	08:55	03:00
16/09/2015	2	DPB	17:15	20:15	03:00
16/09/2015	2	DPB	12:20	15:20	03:00
21/09/2015	3	DPB	13:10	16:10	03:00
29/09/2015	3	DPB	16:40	19:40	03:00
09/10/2015	3	DPB	06:50	09:50	03:00
22/10/2015	2	DPB	10:45	13:45	03:00
22/10/2015	2	DPB	07:15	10:15	03:00
26/10/2015	1	DPB	14:15	17:15	03:00
26/10/2015	1	DPB	10:45	13:45	03:00
28/10/2015	3	DPB	13:20	16:20	03:00
10/11/2015	1	DPB	13:05	16:05	03:00
11/11/2015	2	DPB	07:10	10:10	03:00
11/11/2015	3	DPB	11:20	14:20	03:00
12/11/2015	2	DPB	11:20	14:20	03:00
12/11/2015	3	DPB	07:15	10:15	03:00
19/11/2015	1	DPB	13:30	16:30	03:00
04/12/2015	3	DPB	08:20	11:20	03:00
07/12/2015	3	DPB	12:50	15:50	03:00
08/12/2015	1	DPB	09:00	12:00	03:00
08/12/2015	2	DPB	12:55	15:55	03:00
11/12/2015	2	DPB	08:50	11:50	03:00
14/12/2015	1	DPB	12:50	15:50	03:00
14/01/2016	2	DPB	08:10	11:10	03:00
15/01/2016	1	DPB	08:20	11:20	03:00
20/01/2016	2	DPB	12:20	15:20	03:00
20/01/2016	3	DPB	08:15	11:15	03:00
27/01/2016	1	DPB	12:20	15:20	03:00
28/01/2016	3	DPB	08:40	11:40	03:00
09/02/2016	2	DPB	14:25	17:25	03:00
10/02/2016	3	DPB	14:30	17:30	03:00
10/02/2016	3	DPB	09:25	12:25	03:00
22/02/2016	1	DPB	13:10	16:10	03:00
23/02/2016	2	DPB	08:45	11:45	03:00
26/02/2016	1	DPB	06:55	09:55	03:00
16/03/2016	1	DPB	11:10	14:10	03:00
16/03/2016	2	DPB	15:00	18:00	03:00
18/03/2016	3	DPB	06:10	09:10	03:00

TABLE A2 – ACKRON VANTAGE POINT SURVEY EFFORT APRIL 2014 – MARCH 2016

Date	VP	Observer	Start	Finish	Time at VP (hrs:mins)
23/03/2016	1	MSc	05:45	08:45	03:00
23/03/2016	3	MSc	12:00	15:00	03:00
24/03/2016	2	MSc	05:40	08:40	03:00

TABLE A3 – ACKRON VANTAGE POINT SURVEY OBSERVATIONS APRIL 2014 – MARCH 2016

Date & observation time	VP number	Flight ID	BTO code	Species name	Count
18/04/2014 14:53	2	6	PG	Pink-footed goose	8
18/04/2014 14:58	2	7	GJ	Greylag goose	2
18/04/2014 15:20	2	8	CU	Curlew	1
18/04/2014 15:54	2	9	ML	Merlin	1
18/04/2014 16:33	2	10	CU	Curlew	1
18/04/2014 17:05	2	11	PG	Pink-footed goose	17
18/04/2014 18:56	2	12	GJ	Greylag goose	1
18/04/2014 19:25	2	13	GJ	Greylag goose	2
18/04/2014 19:30	2	14	PG	Pink-footed goose	5
18/04/2014 21:10	2	15	RH	Red-throated diver	2
18/04/2014 21:14	2	16	GJ	Greylag goose	1
19/04/2014 15:16	3	17	RH	Red-throated diver	1
19/04/2014 15:19	3	18	GJ	Greylag goose	7
19/04/2014 15:45	3	19	GJ	Greylag goose	8
19/04/2014 18:24	3	20	GP	Golden plover	1
19/04/2014 18:27	3	21	GP	Golden plover	1
19/04/2014 18:51	3	23	GN	Goldeneye	1
19/04/2014 21:00	3	22	GJ	Greylag goose	4
20/04/2014 16:00	1	1	CU	Curlew	1
20/04/2014 16:01	1	2	PG	Pink-footed goose	3
20/04/2014 18:41	1	3	SN	Snipe	1
20/04/2014 19:35	1	4	SN	Snipe	1
20/04/2014 20:45	1	5	L.	Lapwing	1
08/05/2014 19:59	1	24	GJ	Greylag goose	1
08/05/2014 21:09	1	25	HH	Hen harrier	1
08/05/2014 21:13	1	26	HH	Hen harrier	1
08/05/2014 21:44	1	28	GJ	Greylag goose	2
09/05/2014 16:52	3	29	CU	Curlew	1
09/05/2014 19:28	2	30	GJ	Greylag goose	1
09/05/2014 19:34	2	31	MA	Mallard	1
09/05/2014 19:43	2	32	GJ	Greylag goose	2
09/05/2014 19:43	2	33	GJ	Greylag goose	1
09/05/2014 20:25	2	34	GJ	Greylag goose	1
09/05/2014 20:48	2	35	HH	Hen harrier	1
09/05/2014 20:48	2	38	HH	Hen harrier	1
09/05/2014 20:56	2	39	HH	Hen harrier	1
09/05/2014 21:30	2	40	MA	Mallard	2
09/05/2014 21:50	2	41	GJ	Greylag goose	1
10/05/2014 15:22	1	42	L.	Lapwing	1
23/05/2014 19:06	2	49	GJ	Greylag goose	2
25/05/2014 06:45	3	50	AE	Arctic tern	1
26/05/2014 20:05	3	51	DN	Dunlin	2
26/05/2014 20:55	3	52	NX	Great skua	1
26/05/2014 21:00	3	53	DN	Dunlin	1
27/05/2014 12:00	1	64	CU	Curlew	1
28/05/2014 04:05	2	54	GJ	Greylag goose	2
28/05/2014 04:35	2	55	CU	Curlew	1
28/05/2014 05:05	2	56	H.	Grey heron	1
28/05/2014 05:10	2	57	CU	Curlew	1
28/05/2014 05:15	2	58	H.	Grey heron	1
28/05/2014 05:30	2	59	SU	Shelduck	4
28/05/2014 06:00	2	60	CU	Curlew	1
28/05/2014 06:10	2	61	HH	Hen harrier	1
28/05/2014 06:15	2	62	HH	Hen harrier	1
28/05/2014 06:40	2	63	CU	Curlew	1
30/05/2014 10:50	3	66	GK	Greenshank	1
30/05/2014 13:35	2	65	CU	Curlew	1
08/06/2014 11:25	1	44	SN	Snipe	1
08/06/2014 11:37	1	45	SN	Snipe	1

TABLE A3 – ACKRON VANTAGE POINT SURVEY OBSERVATIONS APRIL 2014 – MARCH 2016

Date & observation time	VP number	Flight ID	BTO code	Species name	Count
08/06/2014 13:22	1	46	HH	Hen harrier	1
08/06/2014 13:35	1	47	PE	Peregrine	1
08/06/2014 13:39	1	48	L.	Lapwing	1
10/06/2014 12:11	3	67	EA	Golden eagle	1
15/06/2014 15:36	2	78	CU	Curlew	1
15/06/2014 16:56	2	79	PE	Peregrine	1
16/06/2014 08:45	1	100	CU	Curlew	1
16/06/2014 08:50	1	101	SN	Snipe	1
16/06/2014 10:18	1	102	HH	Hen harrier	1
27/06/2014 16:12	3	95	RH	Red-throated diver	2
27/06/2014 19:52	1	89	SN	Snipe	1
27/06/2014 20:16	1	90	CU	Curlew	1
27/06/2014 20:36	1	91	CU	Curlew	1
27/06/2014 20:39	1	92	CU	Curlew	1
27/06/2014 22:01	1	93	SN	Snipe	1
27/06/2014 22:08	1	94	SN	Snipe	1
28/06/2014 05:00	3	69	RH	Red-throated diver	1
28/06/2014 05:45	3	70	DN	Dunlin	1
28/06/2014 06:20	3	71	CS	Common sandpiper	1
28/06/2014 06:50	3	72	DN	Dunlin	1
28/06/2014 10:55	2	68	CU	Curlew	1
29/06/2014 04:18	2	96	RH	Red-throated diver	2
29/06/2014 06:05	2	97	SN	Snipe	1
29/06/2014 06:06	2	98	SN	Snipe	1
29/06/2014 06:31	2	99	RH	Red-throated diver	1
30/06/2014 05:12	1	73	SE	Short-eared owl	1
30/06/2014 06:05	1	74	SN	Snipe	1
30/06/2014 06:25	1	75	SN	Snipe	1
30/06/2014 06:41	1	76	SN	Snipe	1
30/06/2014 06:44	1	77	SN	Snipe	1
30/06/2014 20:25	3	86	CU	Curlew	1
30/06/2014 20:33	3	87	CU	Curlew	1
30/06/2014 20:50	3	88	CU	Curlew	1
02/07/2014 22:02	2	84	RH	Red-throated diver	1
02/07/2014 22:17	2	85	RH	Red-throated diver	1
03/07/2014 10:43	1	80	SN	Snipe	1
03/07/2014 12:19	1	81	CU	Curlew	1
03/07/2014 12:44	1	82	CU	Curlew	1
03/07/2014 12:50	1	83	SN	Snipe	1
18/07/2014 09:00	3	103	DN	Dunlin	1
18/07/2014 09:04	3	104	GP	Golden plover	2
22/07/2014 20:10	1	105	NX	Great skua	1
22/07/2014 20:11	1	106	NX	Great skua	1
22/07/2014 21:44	1	107	SE	Short-eared owl	1
23/07/2014 06:12	2	108	ML	Merlin	1
25/07/2014 16:27	2	109	ML	Merlin	1
25/07/2014 16:45	2	110	GJ	Greylag goose	5
25/07/2014 20:40	3	111	AE	Arctic tern	1
25/07/2014 20:54	3	112	AE	Arctic tern	1
25/07/2014 20:54	3	113	AE	Arctic tern	1
27/07/2014 05:58	3	114	AE	Arctic tern	1
27/07/2014 06:13	3	115	AE	Arctic tern	1
27/07/2014 06:17	3	116	AE	Arctic tern	1
27/07/2014 06:37	3	117	AE	Arctic tern	2
27/07/2014 06:50	3	118	AE	Arctic tern	1
27/07/2014 06:59	3	119	AE	Arctic tern	1
27/07/2014 07:22	3	120	NX	Great skua	1
27/07/2014 07:42	3	121	RH	Red-throated diver	2
08/08/2014 12:37	2	122	GJ	Greylag goose	3
08/08/2014 13:26	2	123	MA	Mallard	2
13/08/2014 15:21	1	124	ML	Merlin	2
15/08/2014 11:49	3	125	RH	Red-throated diver	1
18/09/2014 07:23	2	126	PG	Pink-footed goose	36
08/10/2014 07:25	1	127	PG	Pink-footed goose	32
08/10/2014 08:51	1	128	GJ	Greylag goose	7
08/10/2014 11:23	1	129	GJ	Greylag goose	18
08/10/2014 12:33	1	130	WS	Whooper swan	15

TABLE A3 – ACKRON VANTAGE POINT SURVEY OBSERVATIONS APRIL 2014 – MARCH 2016

Date & observation time	VP number	Flight ID	BTO code	Species name	Count
24/10/2014 10:40	3	131	GJ	Greylag goose	28
08/01/2015 10:26	2	143	WS	Whooper swan	2
09/01/2015 13:57	3	144	EA	Golden eagle	1
27/01/2015 09:51	2	132	GJ	Greylag goose	1
27/01/2015 09:51	2	133	GJ	Greylag goose	16
27/01/2015 10:14	2	134	GJ	Greylag goose	1
27/01/2015 10:21	2	135	K.	Kestrel	1
27/01/2015 10:47	2	136	K.	Kestrel	1
27/01/2015 10:49	2	137	K.	Kestrel	1
27/01/2015 10:52	2	138	GJ	Greylag goose	1
27/01/2015 12:00	2	139	GJ	Greylag goose	4
27/01/2015 15:25	3	140	GP	Golden plover	15
27/01/2015 15:25	3	141	GP	Golden plover	35
28/01/2015 14:26	2	142	GJ	Greylag goose	2
12/02/2015 08:38	3	145	GJ	Greylag goose	18
12/02/2015 09:26	3	146	GP	Golden plover	1
13/02/2015 09:11	1	147	GP	Golden plover	7
10/03/2015 10:51	1	148	GJ	Greylag goose	17
13/03/2015 10:27	3	149	GP	Golden plover	1
13/03/2015 12:47	3	150	HH	Hen harrier	1
13/03/2015 12:47	3	151	PE	Peregrine	1
14/03/2015 15:46	3	152	PG	Pink-footed goose	41
01/04/2015 10:51	2	153	CU	Curlew	1
01/04/2015 11:36	2	154	ML	Merlin	2
01/04/2015 12:26	2	155	ML	Merlin	1
02/04/2015 14:02	1	156	CU	Curlew	2
03/04/2015 07:02	2	157	GJ	Greylag Goose	1
03/04/2015 07:38	2	158	PG	Pink-footed Goose	4
03/04/2015 08:03	2	159	PG	Pink-footed Goose	41
03/04/2015 08:19	2	160	GJ	Greylag Goose	1
03/04/2015 08:46	2	161	PG	Pink-footed Goose	82
03/04/2015 09:22	2	162	CU	Curlew	1
03/04/2015 09:36	2	163	GJ	Greylag Goose	2
08/04/2015 06:53	3	168	GJ	Greylag Goose	2
08/04/2015 06:59	3	169	GJ	Greylag Goose	3
08/04/2015 07:08	3	170	BV	Black-throated Diver	1
08/04/2015 07:13	3	171	GJ	Greylag Goose	2
08/04/2015 08:16	3	172	PG	Pink-footed Goose	38
08/04/2015 08:20	3	177	PG	Pink-footed Goose	35
08/04/2015 08:36	3	176	GJ	Greylag Goose	3
08/04/2015 08:52	3	173	GJ	Greylag Goose	2
08/04/2015 08:53	3	174	GJ	Greylag Goose	1
08/04/2015 08:57	3	175	PG	Pink-footed Goose	28
08/04/2015 09:11	3	199	PG	Pink-footed Goose	37
13/04/2015 12:33	3	164	PG	Pink-footed Goose	90
13/04/2015 12:50	3	165	GJ	Greylag Goose	9
13/04/2015 13:12	3	166	GJ	Greylag Goose	2
13/04/2015 13:36	3	167	CU	Curlew	2
15/04/2015 08:10	1	179	CU	Curlew	2
06/05/2015 10:10	2	180	CU	Curlew	1
06/05/2015 10:38	2	181	GJ	Greylag Goose	6
06/05/2015 11:08	2	182	GJ	Greylag Goose	2
06/05/2015 11:16	2	183	GJ	Greylag Goose	1
06/05/2015 11:34	2	184	CU	Curlew	1
06/05/2015 12:10	2	185	CU	Curlew	1
06/05/2015 12:21	2	186	GJ	Greylag Goose	2
06/05/2015 12:21	2	187	GJ	Greylag Goose	1
11/05/2015 19:50	1	188	CU	Curlew	1
11/05/2015 20:06	1	189	H	Grey Heron	1
11/05/2015 20:17	1	190	CU	Curlew	1
11/05/2015 20:20	1	191	H	Grey Heron	1
11/05/2015 20:25	1	192	SN	Snipe	1
13/05/2015 20:04	3	193	CU	Curlew	1
13/05/2015 20:19	3	194	GP	Golden Plover	1
13/05/2015 20:20	3	195	CU	Curlew	1
13/05/2015 20:38	3	196	CU	Curlew	1
13/05/2015 20:45	3	197	GJ	Greylag Goose	2

TABLE A3 – ACKRON VANTAGE POINT SURVEY OBSERVATIONS APRIL 2014 – MARCH 2016

Date & observation time	VP number	Flight ID	BTO code	Species name	Count
13/05/2015 21:28	3	198	BV	Black-throated Diver	2
27/05/2015 10:11	1	211	OP	Osprey	1
27/05/2015 10:23	1	212	MA	Mallard	2
27/05/2015 11:50	1	214	L	Lapwing	2
27/05/2015 11:53	1	213	CU	Curlew	1
28/05/2015 19:14	1	215	SN	Snipe	1
28/05/2015 19:15	1	216	SN	Snipe	2
28/05/2015 19:21	1	217	SN	Snipe	4
28/05/2015 19:22	1	218	SN	Snipe	2
28/05/2015 19:23	1	219	SN	Snipe	1
29/05/2015 12:24	2	224	CU	Curlew	1
29/05/2015 13:09	2	222	CU	Curlew	2
29/05/2015 13:25	2	226	CU	Curlew	1
29/05/2015 13:49	2	223	CU	Curlew	1
29/05/2015 14:08	2	225	RH	Red-throated Diver	2
29/05/2015 14:18	2	220	CU	Curlew	1
29/05/2015 14:24	2	221	MA	Mallard	2
29/05/2015 14:40	2	227	CU	Curlew	1
30/05/2015 19:48	2	236	GJ	Greylag Goose	2
30/05/2015 20:15	2	232	OP	Osprey	1
30/05/2015 21:04	2	233	CU	Curlew	1
30/05/2015 21:16	2	234	CU	Curlew	1
30/05/2015 21:29	2	231	RH	Red-throated Diver	1
30/05/2015 21:31	2	235	GJ	Greylag Goose	2
30/05/2015 21:44	2	237	GJ	Greylag Goose	2
30/05/2015 21:53	2	230	GJ	Greylag Goose	2
31/05/2015 20:50	3	238	DN	Dunlin	1
31/05/2015 22:20	3	239	GJ	Greylag Goose	2
10/06/2015 15:25	1	240	CU	Curlew	2
12/06/2015 05:35	3	200	DN	Dunlin	1
12/06/2015 05:37	3	201	CU	Curlew	2
12/06/2015 05:43	3	202	CU	Curlew	1
12/06/2015 05:43	3	203	CU	Curlew	1
12/06/2015 05:44	3	204	GK	Greenshank	1
12/06/2015 05:44	3	205	CU	Curlew	1
12/06/2015 05:50	3	206	CU	Curlew	1
12/06/2015 05:51	3	207	CU	Curlew	1
12/06/2015 08:37	2	208	SU	Shelduck	2
12/06/2015 09:53	2	209	SU	Shelduck	1
12/06/2015 10:17	2	210	CU	Curlew	2
15/06/2015 04:30	3	241	GJ	Greylag Goose	19
15/06/2015 05:10	3	242	CU	Curlew	2
15/06/2015 10:55	2	243	SU	Shelduck	2
16/06/2015 05:10	2	247	GJ	Greylag Goose	4
16/06/2015 06:20	2	248	SU	Shelduck	2
16/06/2015 06:40	2	249	CU	Curlew	1
16/06/2015 09:30	1	244	L	Lapwing	2
16/06/2015 10:20	1	245	SN	Snipe	1
16/06/2015 10:25	1	246	L	Lapwing	1
25/06/2015 04:47	2	228	CU	Curlew	1
25/06/2015 14:09	3	229	OP	Osprey	1
26/06/2015 05:37	1	250	GP	Golden Plover	1
26/06/2015 05:44	1	251	SN	Snipe	1
26/06/2015 06:25	1	252	SN	Snipe	1
26/06/2015 06:25	1	253	SN	Snipe	1
26/06/2015 06:39	1	254	SN	Snipe	1
26/06/2015 06:47	1	255	SN	Snipe	1
29/06/2015 05:33	2	256	L	Lapwing	2
29/06/2015 05:36	2	257	H	Grey Heron	1
30/07/2015 21:32	1	259	PE	Peregrine	1
30/07/2015 21:53	1	260	PE	Peregrine	1
12/08/2015 16:15	2	266	GJ	Greylag Goose	49
12/08/2015 17:00	2	267	GJ	Greylag Goose	32
19/08/2015 14:01	3	261	BV	Black-throated Diver	3
21/08/2015 05:57	2	262	GJ	Greylag Goose	2
21/08/2015 06:35	2	263	BV	Black-throated Diver	1
21/08/2015 06:48	2	264	ML	Merlin	1

TABLE A3 – ACKRON VANTAGE POINT SURVEY OBSERVATIONS APRIL 2014 – MARCH 2016

Date & observation time	VP number	Flight ID	BTO code	Species name	Count
21/08/2015 10:05	1	265	BV	Black-throated Diver	1
22/08/2015 05:54	1	268	GJ	Greylag Goose	2
22/08/2015 06:21	1	269	GJ	Greylag Goose	5
22/08/2015 07:23	1	270	RH	Red-throated Diver	1
22/08/2015 08:27	1	271	RH	Red-throated Diver	1
24/08/2015 06:24	3	272	HH	Hen Harrier	1
24/08/2015 07:11	3	273	HH	Hen Harrier	1
24/08/2015 07:13	3	274	HH	Hen Harrier	1
07/09/2015 10:11	1	275	PG	Pink-footed Goose	11
26/10/2015 13:26	1	276	GJ	Greylag Goose	14
11/11/2015 12:43	3	277	GJ	Greylag Goose	8
11/11/2015 14:06	3	278	EA	Golden Eagle	1
14/01/2016 10:51	2	279	HH	Hen Harrier	1
20/01/2016 13:51	2	280	GJ	Greylag Goose	1
10/02/2016 10:04	3	281	GN	Goldeneye	1
26/02/2016 07:24	1	282	HH	Hen Harrier	1
16/03/2016 13:27	1	283	GJ	Greylag Goose	18
18/03/2016 08:43	3	284	GJ	Greylag Goose	32
23/03/2016 13:40	3	285	HH	Hen Harrier	1