Technical Appendix

Drummarnock Wind Farm

Technical Appendix 7-1: Ornithology Baseline Surveys

Drummarnock Wind Farm Limited

July 2024

Contents

Contents

Tables

Figures

Annexes

Glossary of Terms

Term	Definition
Collision Risk Modelling	The approach developed to estimate the number of bird collisions over a period of time
Environmental Impact Assessment	A means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development
Potential Collision Height	This encompasses the rotor swept height (i.e., the lowest height above ground up to tip height)
The Proposed Development	Drummarnock Wind Farm
The Proposed Development Site	The land enclosed by the red line shown on Figure 1-1
Study Area	The study area used for the surveys undertaken to inform the Ornithological Impact Assessment differs according to receptor as recommended by relevant good practice survey guidance, as defined by NatureScot (NS) (formerly SNH) guidelines (SNH, 2017). These are summarised in the Survey Methodology Section
Wind Farm Polygon	The area encompassing the outer turbine blades buffered by 500m. This is created in GIS, as a convex hull of the turbine locations buffered by the blade length + 500m

List of Abbreviations

Abbreviation	Description
BoCC	Bird of Conservation Concern
BTO	British Trust for Ornithology
CIEEM	Chartered Institute of Ecology and Environmental Management
CRM	Collision Risk Modelling
EU	European Union
JNCC	Joint Nature Conservation Committee
LBAP	Local Biodiversity Action Plan
RSPB	Royal Society for the Protection of Birds
SBL	Scottish Biodiversity List
SLR	SLR Consulting Ltd (Ornithology Consultants)
SNH	Scottish Natural Heritage (now NatureScot)
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
VP	Vantage Point
WP	Windfarm Polygon
WTG	Wind Turbine Generator

1 Executive Summary

Baseline ornithology surveys for the Proposed Development were undertaken during September 2019 to September 2020, followed by further surveys during April 2021 to August 2021. This followed a data review undertaken in October 2020, which was provided to NatureScot to determine the requirement for a second year of breeding bird surveys. NatureScot agreed that a reduced scope of surveys was acceptable.

The following survey work was undertaken:

- Vantage Point (VP) Surveys. Six hours of surveys were completed per month from a single VP September 2019 to September 2020 and May to August 2021, from a single VP covering the proposed turbine layout and a 500m buffer. From May to August 2020 the survey effort was doubled to 12 hours per month. Activity was recorded by eight primary target species:
  - Greylag goose
  - Hen harrier
  - Red kite
  - Osprey
  - Kestrel
  - Curlew
  - Golden plover
  - Short-eared owl
- Moorland Breeding Wader Surveys. Four surveys between April and July 2020 using an adapted Brown & Shepherd (1993) methodology covering the Proposed Development Site plus a 500m buffer. Three wader species were recorded holding territories:
  - Lapwing
  - Curlew
  - Common snipe
- Breeding Raptor Surveys. Four surveys of suitable habitat within 2km between April and July 2020. Methods following Hardey *et al*. (2013). Two survey visits targeting short-eared owl were undertaken in April 2021. The VP surveys undertaken from May to August 2021 were also primarily focussed on short-eared owl.
  - No raptors were confirmed breeding within a 2km buffer of the Proposed Development Site. Territorial behaviour was recorded by short-eared owl, but there was no evidence of successful breeding.
  - Regular buzzard and kestrel foraging activity occurred over the site and the presence of these species on all the raptor surveys in the 2km buffer indicated territories off site in suitable habitats.
- Black Grouse Surveys. Four dawn surveys were undertaken within 1.5km, three in April and one in May 2020.
  - A maximum of two male black grouse were observed north of Craigengelt Farm, c. 1km from the Proposed Development Site. These birds were in flight and no leks were recorded.

2 Introduction

2.1 Background

SLR Consulting was commissioned to conduct baseline ornithology surveys for the Proposed Development in September 2019.

Surveys were first undertaken during September 2019 to September 2020.

SLR then undertook a data review for the Proposed Development in October 2020, which was provided to NatureScot to determine the requirement for a second year of breeding bird surveys (i.e., until August 2021).

NatureScot agreed that a second year was not required[1]; however, during April 2021 to August 2021 a reduced scope of surveys was undertaken, i.e., in order to target short-eared owls and other primary target raptor species (to establish whether the activity recorded in 2020 was typical for the Proposed Development Site).

2.1.1 Site Description

The site is located on the lower eastern slopes of Touchadam Muir and Earl's Hill, approximately 8km southwest of Stirling. The main land-uses within the site are sheep and cattle grazing, and grouse shooting. The operational windfarm at Earlsburn is located to the west between Craigengelt Law and Earl's Hill. Craigengelt windfarm (8 turbines) is adjacent to the south- west of the site.

2.2 Purpose of This Report

This report outlines the surveys undertaken and methods used. It goes on to summarise the survey data obtained and provides descriptions of the legal and conservation status of the species recorded.

The report supports a separate Environmental Impact Assessment Report.

2.3 Desk Study

2.3.1 Designated Sites

A desk study was undertaken via the NatureScot SiteLink website (NatureScot, 2023) to identify statutorily designated sites within 10km for nationally designated sites (SSSIs) and 20km for Natura 2000 sites (SPAs) of the Proposed Development which are designated for their avian interest.

There are two designated sites (SPAs) for ornithological interests located within 20km of the site boundary, and no SSSIs within 10km designated for ornithological interests.

Table 7-1-2-1 details the sites and their distance and direction from the application site, which are shown in relation to the Proposed Development Site on Figure 7-1-1.

[1] Email from Megan Jones (NatureScot) to Rhys Bullman (SLR Consulting) dated 5 November 2020.

Table 7-1-2-1: Statutory Designated Sites

Site Name and Designation	Distance/ Direction from Application Site	Qualifying features
Firth of Forth SPA/ Ramsar	12.8km/ NE	Supports internationally important migratory species including populations of: Red-throated diver *Gavia stellata* Slavonian grebe *Podiceps auritus* Golden plover *Pluvialis apricaria* Bar-tailed godwit *Limosa lapponica* Pink-footed goose *Anser brachyrhynchus* Shelduck *Tadorna tadorna* Knot *Calidris canutus* Redshank *Tringa totanus* Turnstone *Arenaria interpres* Sandwich tern *Thalasseus sandvicensis* Waterfowl assemblage (in excess of 20,000)
Slamannan Plateau SPA	13.4km/ SE	Supports internationally important migratory species population of: Taiga bean goose *Anser fabalis fabalis*

2.3.2 Other Ornithological Data

Data Review and Consultation with NatureScot

The data review undertaken by SLR in October 2020 (SLR 2020) considered contextual ornithology data from:

- The previous Muirpark application for an 11-turbine wind farm development (Planning Ref. 09/00170/FUL); and
- The application for the adjacent Craigengelt 8-turbine wind farm development (06/01052/DET), which was consented and is now operational.

Data Requests

To support the current assessment, the following consultees have been approached:

- RSPB Scotland Data Unit; and
- The Central Scotland Raptor Study Group.

2.4 Scope of Work

The scope of the bird survey work undertaken for the Proposed Development is provided below (Table 7-1-2-2).

Surveys were carried out in accordance with current NatureScot guidance on bird survey methods for onshore wind farms (SNH 2017).

Table 7-1-2-2: Ornithology Surveys Undertaken 2019-2021

Survey Type	Scope of Works
Vantage Point (VP) Surveys	Six hours of surveys were completed per month from a single VP September 2019 to September 2020 and May to August 2021, from a single VP covering the site and a 500m buffer. **From May to August 2020 the survey effort was doubled to 12 hours per month.** Total hours of survey were: September 2019 – March 2020 = 42:15 hrs:mins April 2020 – September 2020 = 54:05 hrs:mins May 2021 – August = 24:50 hrs:mins Primary target species included: All raptors and owls listed on Annex I of the Birds Directive or Schedule 1 of the Wildlife and Countryside Act 1981 (with kestrel included in 2019/2020 but not 2021); All wader species; All wild goose, swan and duck species, with the exception of Canada goose and mallard; and Black grouse Secondary target species considered were: All other waterfowl (e.g. mallard and grey heron); All other raptor and owl species (kestrel in 2021); Gull species; Raven; and Any large aggregations of passerines that are red-listed or appear in the SBL or LBAP.
Moorland Breeding Wader Surveys	Four surveys between April and July 2020 using an adapted Brown & Shepherd (1993) methodology covering the site development area plus a 500m buffer.
Breeding Raptor Survey	Four surveys of suitable habitat within 2km between April and July 2020. Methods following Hardey et al. (2013). Two survey visits targeting short-eared owl undertaken in April 2021. The VP surveys undertaken from May to August 2021 were also primarily focussed on short-eared owl.
Black Grouse Lek Surveys	Four dawn surveys, three in April and one in May 2020.

3 Survey Methodology

3.1 Survey Logistics

Surveys were undertaken by Daniel Hulmes (Ornithologist and Terrestrial Ecologist with SLR), Rhys Bullman (Principal Ornithologist with SLR), Ida Bailey (Associate Ecologist, now Natural Capital & Nature Lead with SLR), Mike Austin (Senior Consultant, now Associate Consultant Ecologist with SLR) and Kirstie Hazelwood (Senior Ecologist with SLR). All surveyors either held or were agents on the appropriate Schedule 1 licence issued by NatureScot.

The project was project managed by Rhys Bullman during the baseline survey period.

The ornithology survey areas including the appropriate buffers are shown on Figure 7-1-2.

A survey log is provided in Annex A of this report.

3.2 Flight Activity Surveys

A single vantage point (VP) was used, located to the west of the site, with a 2km viewshed as per NatureScot guidelines (SNH 2017).

As stated in Table 7-1-2-2, approximately 121 hours of flight activity surveys were conducted during September 2019 to August 2021. Survey effort is summarised in Table 7-1-3-1.

The VP location is shown on Figure 7-1-3, along with the associated area of visibility at 17m above ground level, i.e., the lowest likely rotor swept height (the viewshed).

VP watches aimed to quantify the flight activity of primary and secondary target species (as defined in Table 7-1-2-2) within the study area.

The main purpose of VP watches is to collect data on primary target species that will enable estimates to be made of:

- The time spent flying over the site;
- The relative use by birds of different parts of the site; and
- The proportion of flying time spent within the provisional upper and lower risk height limits as determined by the potential rotor diameter and rotor hub height.

For each primary target species observation, the following details were recorded:

- Time of observation;
- Duration of flying event;
- Species, age and sex (where determinable); and
- Time spent within each height band.

Information regarding the possible dimensions of the turbines likely to be used was not available at the time of survey. Height bands were therefore selected based on a generic survey methodology as follows:

- 1 = <30m
- 2 = 30-150m
- 3 = >150m

In addition, a summary of observations of secondary target species was recorded at the end of each five-minute period during VP watches to provide an index of flight activity for secondary target species within the Site, in accordance with current NS guidance.

Table 7-1-3-1: VP Surveys undertaken at Drummarnock, Sept 2019 – Aug 2021

VP Number	Grid Coordinates (x,y)	Hours of Survey Completed (hrs:mins)				
		Sep 2019-Mar 2020	Apr 2020-Aug 2020	Sep 2020	May 2021-Aug 2021	Total
1	272489, 687728	42:15	48:05	06:00	24:50	121:10

3.3 Moorland Breeding Wader Surveys

Breeding wader surveys were undertaken on open ground within the Proposed Development site boundary and a 500m buffer (where accessible) (Figure 7.1.2).

The survey followed an adapted Brown and Shepherd method (1993) with four survey visits between mid-April to mid-July 2020, approaching all areas of the open ground to within 100m, as set out in Calladine *et al.* (2009). All wader species were recorded during each visit. Registrations were marked onto 1:25,000 scale survey maps using standard British Trust for Ornithology (BTO) species and activity codes for use in post-survey analysis.

Birds were considered to be confirmed breeding if:

- They were observed displaying or singing on one visit (with the exception of obvious passage migrants in spring);
- Nests, eggs, or young were located;
- Adults repeatedly alarm called;
- Distraction displays were seen; and/ or
- Territorial disputes were observed.

Other records were considered to be of non-breeding birds, failed breeders, birds loafing, feeding or on passage to other areas.

Data collected during VP surveys and black grouse surveys were also used to define territories within the survey area.

The survey visits were carried out as follows:

- Visit 1: April 15
- Visit 2: May 6
- Visit 3: June 11
- Visit 4: July 17

3.3.1 Territory Analysis

Records from each survey visit were collated and then combined into a final visit map, enabling territory analysis to be carried out following the methods in Brown and Shepherd (1993). Birds were considered to be breeding if adults are encountered within 500m of the same location two or more visits in a row, or if definite breeding behaviour is observed (as described above).

This was generally undertaken by marking by eye the centre of clusters of bird registrations on the combined map, weighted slightly towards areas of higher activity where these were noted.

3.4 Breeding Raptor Surveys

3.4.1 2020

Species-specific surveys were undertaken in 2020 for all raptors likely to occur. Surveys followed methods outlined within Hardey *et al*. (2013), within 2km of the Site boundary (Figure 7.1.2).

During the surveys all accessible suitable raptor breeding habitat within this area, including open heath/moorland/ rough grassland, forest/ forest edge, rock crags and outcrops, was covered. Data collected during VP surveys and wader surveys were also used to define territories within the survey buffer.

Surveys were carried out as follows:

- Visit 1: April 15
- Visit 2: May 6
- Visit 3: June 18
- Visit 4: July 17

3.4.2 2021

Surveys for short-eared owls were repeated in 2021, using a combination of VP watches and walk-over surveys covering the Proposed Development Site where birds were present in 2020. April surveys were conducted on 22nd and 28th, followed by the monthly VP surveys summarised in Table 7-1-3-1 (May to August).

3.5 Black Grouse Lek Surveys

The survey methodology was based on the methodology written for the 1995-96 national black grouse survey by Etheridge and Baines (1995) and described by Gilbert *et al*. (1998). All habitats considered suitable for lekking black grouse (tracks, old quarries, heavily grazed upland pasture, heather clearings within forest and heather moorland), both on-site and within a 1.5km buffer of the Proposed Development site boundary (Figure 7.1.2), were surveyed within two to three hours of sunrise. Surveys were conducted on foot and from a vehicle on publicly assessable roads, with frequent stops to listen for the 'bubbling' calls of displaying birds, which are audible up to 1km away.

A four-visit survey approach was undertaken, carried out between the first week in April and mid-May in order to survey areas of suitable habitat with the potential to support lekking black grouse to establish presence/absence and to provide an accurate count of the number of lekking birds present.

Black grouse surveys were carried out on the following dates:

- Visit 1: April 7
- Visit 2: April 17
- Visit 3: April 29
- Visit 3: May 14

3.6 Survey Limitations

Not all areas within the extensive survey buffers were accessible, or viewable from publicly accessible areas. However, the entire area within the red line boundary, which is much larger than the Proposed Development Site, were accessed for surveys. Therefore, the spatial extent of the surveys is considered sufficient to inform a robust assessment.

The majority of VP surveys for the Proposed Development were undertaken in optimal weather conditions during the breeding and non-breeding seasons, with a number of surveys being re-scheduled due to low cloud where necessary.

Due to the topography within the site, there is a gap in viewshed coverage in the north-east part of the turbine layout, around WTG 4 (based on a surface offset of 17m above ground level) (Figure 7-1-3).

However, the overall viewshed coverage of the 500m buffer of the turbine layout at this 17m offset is calculated at 71.7%. In addition, flights were recorded in this area, which were allocated to the lowest height band (<30m) and these were all used for CRM. Therefore, overall, the data collected are considered to be representative of the site as a whole and sufficient to inform a robust assessment.

It should be noted that although surveys were concluded in 2021, there have been no subsequent changes in habitats and land use within the Proposed Development Site. Therefore, the survey data are considered sufficient to inform a robust assessment.

4 Survey Results

4.1 Flight Activity Surveys

4.1.1 Summary of Primary Target Species Flight Activity September 2019 to September 2020 and May to August 2021

Flight activity recorded from VPs by primary target species is summarised in Table 7-1-4-1 and Table 7-1-4-2 for both periods respectively. Full details of primary target species flights are provided in Annex B. Primary target species flights from all VPs are shown on Figures 7-1-4 to 7-1-8 inclusive.

Brief species accounts are provided below.

Greylag Goose

All greylag goose flights were in the breeding season (April and May) and involved pairs of birds. There were no flights of migratory flocks of any goose species. Flightlines were both directional and random in nature as shown on Figure 7-1-4.

Teal

A single flight of one male teal was recorded flying through the viewshed on 20 March 2020 (Figure 7-1-4).

Hen Harrier

Flights of single birds were recorded in April 2020 (an adult female), in September 2020 (a ringtail) and in July 2021 ((an adult male). Only one flight was recorded within 500m of the proposed turbine layout. Birds were commuting through the area (Figure 7-1-5).

Red Kite

Red kite flights were irregular, with flights in October, January, March, May and July. Five flights were of the same bird on one day (27 May 2021). Flightlines are shown on Figure 7-1-5.

Osprey

A single flight of a commuting osprey was recorded on 24 June 2020 (Figure 7-1-5).

Kestrel

Kestrel activity peaked in the late breeding and post-breeding season period 2020 (July - September), with up to three individuals foraging inside and outside the WP. As noted for short-eared owl, this activity was probably related to high numbers of voles on site in 2020. Flightlines are shown on Figure 7-1-6.

Curlew

Curlews were only present in the breeding season. Activity peaked in June 2020, with 10 out of the total of 15 flights being recorded on one date (24 June 2020). Flightlines are shown on Figure 7-1-7.

Golden Plover

Golden plover was only present on one date (29 September 2020) when two flocks (of 23 and 3 birds) were commuting through the site (Figure 7-1-7).

Short-eared Owl

Short-eared owls were only present in the breeding season 2020 (May – July), which coincided with a peak vole year on site (as noted during walkover surveys). No breeding was confirmed. Of the 25 flights, 14 were on one date (14 May). None was present in 2021. Flightlines are shown on Figure 7-1-8.

Table 7-1-4-1: Number of Primary Target Species Flights from VP 1 (Sept 2019 - Sept 2020)

Species	Number of flights by month													Total number of flights	Total number of birds in flight
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep		
Greylag goose	0	0	0	0	0	0	0	2	2	0	0	0	0	4	8
Teal	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1
Hen harrier	0	0	0	0	0	0	0	1	0	0	0	0	1	2	2
Red kite	0	2	0	0	1	0	1	0	0	0	0	0	0	4	4
Osprey	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
Kestrel	1	1	0	0	1	1	0	0	0	0	7	10	7	28	34
Curlew	0	0	0	0	0	0	0	1	1	10	0	0	0	12	13
Golden plover	0	0	0	0	0	0	0	0	0	0	0	0	2	2	26
Short-eared owl	0	0	0	0	0	0	0	0	16	4	5	0	0	25	26

Table 7-1-4-2: Number of Primary Target Species Flights from VP 1 (May 2021 – Aug 2021)

Species	Number of flights by month				Total Number of flights	Total number of birds in flight
	May	June	July	Aug		
Greylag goose	9	0	0	0	9	18
Hen harrier	0	0	1	0	1	1
Red kite	5	0	1	0	6	6
Curlew	2	0	0	0	2	2

4.1.2 Summary of Secondary Target Species Flight Activity

Buzzard, lesser black-backed gull and raven were recorded in low numbers throughout as secondary species. Kestrel was recorded as a primary target species in 2019/2020 and a secondary target species in 2021.

A summary of the secondary species activity is presented in Table 7-1-4-3 and Table 7-1-4-4.

Table 7-1-4-3: Number of Secondary Target Species (Sept 2019 - Sept 2020)

Species	Number of 5-minute periods recorded by month [Total sum of birds (maximum counts] by month)]													Total number of 5-minute periods	Total sum of birds [maximum counts]
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		
Buzzard	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)	2 (2)	2 (5)	0 (0)	0 (0)	8 (21)	4 (6)	5 (5)	0 (0)	23	41
Lesser black-backed gull	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (12)	6 (12)	2 (7)	0 (0)	13	31
Raven	4 (5)	0 (0)	0 (0)	0 (0)	7 (10)	3 (5)	2 (3)	0 (0)	0 (0)	5 (25)	0 (0)	0 (0)	0 (0)	21	48

Table 7-1-4-4: Number of Secondary Target Species (May 2021 – Aug 2021)

Species	Number of 5-minute periods recorded by month [Total sum of birds (maximum counts] by month)]				Total number of 5-minute periods	Total sum of birds [maximum counts]
	May	Jun	Jul	Aug		
Buzzard	0 (0)	0 (0)	3 (3)	1 (1)	4	4
Kestrel	0 (0)	0 (0)	3 (3)	6 (7)	9	10
Lesser black-backed gull	0 (0)	0 (0)	3 (3)	0 (0)	3	3
Raven	0 (0)	0 (0)	3 (4)	2 (4)	5	8

4.2 Breeding Wader Surveys

Three species of wader, lapwing, curlew and snipe were observed apparently holding territories within the Study Area (i.e., the 500m buffer of the site boundary). These were located as follows (Table 7-1-4-5).

Table 7-1-4-5: Summary of Wader Territory Locations, Drummarnock

Species	Total no. of territories within 500m buffer of Proposed Development Site boundary	No. of territories within Proposed Development Site boundary	No. of territories within 500m buffer of Turbine Layout	No. of territories within 500m buffer of Access Track
Lapwing	3	1	1	2
Curlew	3	1	2	0
Snipe	3	1	1	2

Wader territory locations are shown in Figure 7-1-9.

4.3 Breeding Raptor Surveys

Territorial raptor activity within the Proposed Development Site was limited to short-eared owl. Territorial behaviour was first observed in May 2020 just to the south of the proposed turbine envelope and by June it was apparent that with the presence of three birds at once on site there was probably also a territory to the north of the turbine layout.

However, there was no confirmed evidence that short-eared owl bred successfully in 2020, as there were no sightings of birds carrying prey or of fledged young. The first appearance of birds in May is later than is typical for this species to establish a territory (early March to mid-April, Hardey *et al.* 2013).

Regular buzzard and kestrel foraging activity over the site and the presence of these species on all the raptor surveys in the 2km buffer indicated territories off site in suitable habitats.

No raptor territories have been mapped within the Study Area.

4.4 Black Grouse Surveys

A maximum of two male black grouse were observed north of Craigengelt Farm, c. 1km from the Proposed Development Site. These birds were in flight and no leks were recorded. The locations of the black grouse observations are shown in Figure 7-1-10.

At Craigengelt Farm there has historically been a large lek (i.e., in 2006), prior to the construction of Craigengelt wind farm. Survey data indicate a lek is still active in the area but at some distance from the Proposed Development Site.

4.5 Incidental Records

One barn owl sighting was made at dawn during a black grouse survey, c. 800m from the Proposed Development Site. For a full list of all species recorded, including incidentals, see Table 7-1-5-1.

5 Legal, Conservation and Site Status of Bird Species

Table 7-1-5-1 summarises the legal and conservation status of the target and incidental species recorded during all surveys.

Table 7-1-5-1: Legal, Conservation and Site Status of Bird Species Recorded in Baseline Surveys

Species	Legal & Conservation Status in Scotland	Summary of Site Status
Greylag goose *Anser anser*	Schedule 1.2; BoCC5 Amber	In flight only during VP surveys, pairs of birds recorded in the breeding season only.
Eurasian teal *Anas crecca*	General WCA; BoCC5 Amber	Single flight of one bird only during VP surveys.
Red grouse *Lagopus lagopus*	General WCA; BoCC5 Green	Low numbers recorded (maximum of 6 birds).
Black grouse *Lyrurus tetrix*	General WCA; BoCC5 Red; SBL	Single birds recorded during black grouse surveys, nearest 1km distance (measured from closest proposed turbine location).
Red kite *Milvus milvus*	Schedule 1 & 1A; Annex 1; BoCC5 Green; SBL	Ten records of single birds recorded in flight during VP surveys. No breeding within 2km.
Hen harrier *Circus cyaneus*	Schedule 1 & 1A; Annex 1; BoCC5 Red; SBL	Single birds recorded in flight during VP surveys, and single bird recorded during breeding raptor survey. No breeding with 2km.
Common buzzard *Buteo buteo*	General WCA; BoCC5 Green	Frequently recorded during VP surveys, maximum of 4 birds recorded. No confirmed breeding within 2km.
Osprey *Pandion haliaetus*	Schedule 1; Annex 1; BoCC5 Amber; SBL	Single flight of one bird only during VP surveys.
Common kestrel *Falco tinnunculus*	General WCA; BoCC5 Amber; SBL	Frequently recorded during VP surveys, maximum of 3 birds recorded. No confirmed breeding within 2km.
Golden plover *Pluvialis apricaria*	General WCA; Annex 1; BoCC5 Green; SBL	Recorded on a single date during VP surveys, involving a minimum of 23 birds.
Lapwing *Vanellus vanellus*	General WCA; BoCC5 Red; SBL	Three territories recorded, one of which was located within 500m of proposed turbine layout. No flight activity recorded within Proposed Development Site.
Curlew *Numenius arquata*	General WCA; BoCC5 Red; SBL	Three territories recorded, two of which were located within 500m of proposed turbine layout. Also recorded in flight within the Proposed Development Site.

Species	Legal & Conservation Status in Scotland	Summary of Site Status
Common snipe *Gallinago gallinago*	General WCA; BoCC5 Amber	Three territories recorded, one of which was located within 500m of proposed turbine layout. No flight activity recorded within Proposed Development Site.
Lesser black-backed gull *Larus fuscus*	General WCA; BoCC5 Amber	Low numbers recorded during VP surveys, maximum of 6 birds recorded.
Barn owl *Tyto alba*	Schedule 1; BoCC5 Green; SBL	Single bird recorded at dawn during a black grouse survey, approximately 800m distance (measured from closest proposed turbine location).
Short-eared owl *Asio flammeus*	General WCA; Annex 1; BoCC5 Amber; SBL	Up to three birds recorded during May to July 2020. No breeding confirmed within 2km.
Swift *Apus apus*	General WCA; BoCC5 Red; SBL	Incidentally recorded in flight during walkover surveys.
Skylark *Alauda arvensis*	General WCA; BoCC5 Red; SBL	Numerous breeding species (minimum of 25 recorded during walkover surveys).
Swallow *Hirundo rustica*	General WCA; BoCC5 Green	Incidentally recorded during walkover surveys.
Meadow pipit *Anthus pratensis*	General WCA; BoCC5 Amber	Numerous breeding species (minimum of 135 recorded during walkover surveys).
Stonechat *Saxicola rubicola*	General WCA; BoCC5 Green	Incidentally recorded during walkover surveys (one breeding territory).
Carrion crow *Corvus corone*	General WCA; BoCC5 Green	Incidentally recorded during all surveys.
Raven *Corvus corax*	General WCA; BoCC5 Green	Frequently recorded during VP surveys, maximum of 5 birds recorded.
Reed bunting *Emberiza schoeniclus*	General WCA; BoCC5 Amber; SBL	Incidentally recorded during walkover surveys.
Key	• Annex 1 - the species is listed in Annex 1 of the EC Birds Directive. Since the UK's exit from the EU, the Scottish Parliament have passed legislation to ensure that Scotland's nature will remain protected to the same standard as before (https://www.nature.scot/eu-exit-brexit-information) • General WCA - the species is afforded general protection by the Wildlife and Countryside Act 1981 (as amended). • Schedule 1 & 1A - the species is listed in Schedule 1 or 1A of the Wildlife and Countryside Act 1981 (as amended). For any wild bird species listed on Schedule 1, it is an offence to disturb: 1) any bird while it is building a nest; 2) any bird while it is in, on, or near a nest containing eggs or young; 3) any bird while lekking; and 4) the dependent young of any bird. For any wild bird species listed on Schedule 1A, it is an offence to intentionally or recklessly harass any bird. • Schedule 1.2 - the species is listed in Schedule 1.2 of the Wildlife and	

Species	Legal & Conservation Status in Scotland	Summary of Site Status
	Countryside Act 1981 (as amended) (i.e., is protected during the close season only). • BoCC5 status (green, amber or red) – indicates the current Birds of Conservation Concern status category (Stanbury et al. 2021). • SBL – on the Scottish Biodiversity List.	

6 References

Brown, A. F & Shepherd, K. B. (1993). A method for censusing upland breeding waders. *Bird Study* 40: 189-195.

Etheridge, B. & Baines, D. (1995). *Instructions for the Black Grouse Survey 1995/6: a Joint RSPB/GCT/JNCC/SNH Project.* Unpublished.

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

Hardey, J., Crick, H.Q.P., Wernham, C., Riley, H., Etheridge, B., Thompson, D. (2013). *Raptors: A field guide for surveys and monitoring* (3rd Edition). The Stationery Office Edinburgh.

J. Calladine et al. (2009). The influence of survey frequency on population estimates of moorland breeding birds. *Bird Study, 56:3, 381-388.* DOI: 10.1080/00063650902984604

NatureScot. (2021). SiteLink. Available at: https://sitelink.nature.scot/home

Scottish Biodiversity List (webarchive.org.uk)

Scottish Natural Heritage (SNH) (2017). Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms. Version 2.

Stanbury A, Eaton MA, Aebischer NJ, Balmer D, Brown A, Douse A, Lindley P, McCulloch N and Win I (2021). The Status of our Bird Populations: the Fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and Second IUCN Red List Assessment of Extinction Risk for Great Britain. *British Birds* 114, 723–747.

Annex A: Survey Dates, Times and Observers

Table 7-1-6-1: Details of Surveys undertaken at Drummarnock

Date	Survey Type	Surveyor	Survey Start (hr:min)	Survey End (hr:min)	Survey Duration (hr:min)
27/09/2019	VP	DH	11:00	14:00	03:00
27/09/2019	VP	DH	17:45	20:45	03:00
25/10/2019	VP	DH	10:10	13:10	03:00
25/10/2019	VP	DH	13:40	16:40	03:00
18/11/2019	VP	DH	09:25	12:35	03:10
18/11/2019	VP	DH	13:00	16:00	03:00
30/12/2019	VP	RB	08:45	11:50	03:05
08/01/2020	VP	DH	09:30	12:30	03:00
08/01/2020	VP	DH	13:30	16:30	03:00
10/01/2020	VP	DH	12:15	15:15	03:00
12/02/2020	VP	DH	10:30	13:30	03:00
12/02/2020	VP	DH	14:10	17:10	03:00
06/03/2020	VP	DH	12:46	15:46	03:00
20/03/2020	VP	DH	06:30	09:30	03:00
07/04/2020	Black grouse	DH	05:00	09:00	04:00
08/04/2020	VP	DH	06:31	09:31	03:00
08/04/2020	VP	DH	11:00	14:00	03:00
15/04/2020	Raptor/wader	DH	06:00	15:00	09:00
17/04/2020	Black grouse	DH	05:00	09:00	04:00
29/04/2020	Black grouse	DH	05:00	09:00	04:00
05/05/2020	VP	DH	06:30	09:30	03:00
06/05/2020	Raptor/Wader	DH	06:00	16:00	10:00
14/05/2020	Black grouse	DH	05:00	09:00	04:00
14/05/2020	VP	DH	18:30	21:30	03:00
03/06/2020	VP	MA	11:20	14:20	03:00
03/06/2020	VP	MA	14:54	17:54	03:00
11/06/2020	Raptor/wader	MA	09:15	15:50	06:35
18/06/2020	Raptor/wader	MA	06:15	14:00	07:45
24/06/2020	VP	MA	06:30	09:30	03:00
24/06/2020	VP	MA	10:00	13:00	03:00
06/07/2020	VP	IB	15:45	18:45	03:00
08/07/2020	VP	DH	15:28	18:28	03:00
15/07/2020	VP	DH	15:40	18:40	03:00
15/07/2020	VP	DH	19:00	22:00	03:00
17/07/2020	Raptor/wader	DH	07:15	15:00	07:45
07/08/2020	VP	RB	09:30	12:30	03:00
07/08/2020	VP	RB	17:45	20:45	03:00
22/08/2020	VP	RB	18:25	21:25	03:00
23/08/2020	VP	RB	06:45	09:50	03:05

Date	Survey Type	Surveyor	Survey Start (hr:min)	Survey End (hr:min)	Survey Duration (hr:min)
29/09/2020	VP	RB	11:30	14:30	03:00
29/09/2020	VP	RB	15:00	18:00	03:00
22/04/2021	Owl survey	IB	07:00	10:00	03:00
28/04/2021	Owl survey	IB	16:30	19:30	03:00
17/05/2021	VP	IB	17:00	20:00	03:00
27/05/2021	VP	IB	07:30	11:20	03:50
07/07/2021	VP	KH	09:35	12:35	03:00
07/07/2021	VP	KH	13:05	16:05	03:00
21/07/2021	VP	KH	09:30	12:30	03:00
21/07/2021	VP	KH	13:00	16:00	03:00
17/08/2021	VP	MA	07:30	10:30	03:00
17/08/2021	VP	MA	11:00	14:00	03:00

Key to observers:
DH: Daniel Hulmes
IB: Ida Bailey
KH: Kirstie Hazelwood
MA: Mike Austin
RB: Rhys Bullman

Annex B: Flight Activity Survey Data

Table 7-1-6-2: VP1 Flight Data

Date	Species	Count	Age	Sex	Start Time (hr:min)	Total time (s)
27/09/2019	Kestrel	1	U	M	15:43	30
25/10/2019	Red kite	1	U	U	11:36	90
25/10/2019	Kestrel	1	A	F	11:42	30
25/10/2019	Red kite	1	U	U	12:09	60
08/01/2020	Red kite	1	A	U	11:22	45
10/01/2020	Kestrel	1	A	F	15:07	60
12/02/2020	Kestrel	1	A	F	16:03	30
06/03/2020	Red kite	1	A	U	13:53	105
20/03/2020	Teal	1	A	M	08:05	60
20/03/2020	Greylag goose	2	U	U	08:25	180
08/04/2020	Hen harrier	1	A	F	n/a	90
08/04/2020	Greylag goose	2	A	U	n/a	240
08/04/2020	Curlew	2	A	U	n/a	90
08/04/2020	Greylag goose	2	A	U	n/a	120
08/04/2020	Greylag goose	2	A	U	n/a	90
05/05/2020	Greylag goose	2	U	U	06:53	90
05/05/2020	Short-eared owl	1	A	U	07:14	45
05/05/2020	Short-eared owl	1	A	U	07:26	75
05/05/2020	Curlew	1	U	U	08:12	30
05/05/2020	Greylag goose	2	U	U	08:35	120
14/05/2020	Short-eared owl	1	A	U	18:32	45
14/05/2020	Short-eared owl	1	A	U	18:44	90
14/05/2020	Short-eared owl	1	A	U	18:48	150
14/05/2020	Short-eared owl	1	A	U	18:56	30
14/05/2020	Short-eared owl	1	A	U	19:02	105
14/05/2020	Short-eared owl	2	A	U	19:18	150
14/05/2020	Short-eared owl	1	A	U	19:24	240
14/05/2020	Short-eared owl	1	A	U	19:34	45
14/05/2020	Short-eared owl	1	A	U	19:48	105
14/05/2020	Short-eared owl	1	A	U	19:54	30
14/05/2020	Short-eared owl	1	A	U	20:06	75
14/05/2020	Short-eared owl	1	A	U	20:35	45
14/05/2020	Short-eared owl	1	A	U	20:43	90
14/05/2020	Short-eared owl	1	A	U	20:57	30
03/06/2020	Short-eared owl	1	A	U	11:36	30
03/06/2020	Curlew	1	A	U	12:39	60
03/06/2020	Short-eared owl	1	A	U	13:11	165
03/06/2020	Short-eared owl	1	A	U	17:31	60
03/06/2020	Short-eared owl	1	A	U	17:53	15

Date	Species	Count	Age	Sex	Start Time (hr:min)	Total time (s)
24/06/2020	Curlew	1	A	U	06:51	60
24/06/2020	Curlew	1	A	U	06:52	60
24/06/2020	Curlew	1	A	U	07:48	30
24/06/2020	Curlew	1	A	U	07:48	30
24/06/2020	Curlew	1	A	U	07:48	30
24/06/2020	Osprey	1	A	U	07:48	45
24/06/2020	Curlew	1	A	U	08:12	15
24/06/2020	Curlew	1	A	U	08:12	105
24/06/2020	Curlew	1	A	U	09:01	225
24/06/2020	Curlew	1	A	U	09:28	15
24/06/2020	Curlew	1	A	U	12:46	45
06/07/2020	Kestrel	1	A	U	15:50	15
06/07/2020	Kestrel	2	A	U	16:11	60
06/07/2020	Kestrel	1	A	U	16:22	30
06/07/2020	Short-eared owl	1	A	U	16:37	15
06/07/2020	Short-eared owl	1	A	U	16:47	135
06/07/2020	Short-eared owl	1	A	U	17:35	240
06/07/2020	Short-eared owl	1	A	U	17:46	360
06/07/2020	Short-eared owl	1	A	U	18:05	480
15/07/2020	Kestrel	1	A	M	15:48	30
15/07/2020	Kestrel	1	A	M	17:23	45
15/07/2020	Kestrel	1	A	F	20:11	60
15/07/2020	Kestrel	1	A	M	20:34	30
07/08/2020	Kestrel	1	A	M	10:00	45
07/08/2020	Kestrel	2	A	M/F	11:47	120
07/08/2020	Kestrel	1	A	M	18:50	30
07/08/2020	Kestrel	1	A	M	18:58	45
07/08/2020	Kestrel	1	A	M	19:40	30
22/08/2020	Kestrel	1	A	M	19:05	30
22/08/2020	Kestrel	2	A	M/F	19:42	90
22/08/2020	Kestrel	1	A	M	20:40	30
23/08/2020	Kestrel	1	A	M	08:40	45
23/08/2020	Kestrel	1	A	M	09:00	15
29/09/2020	Kestrel	2	A	M/F	12:04	30
29/09/2020	Kestrel	1	A	M	12:41	60
29/09/2020	Kestrel	3	A	MMF	12:57	225
29/09/2020	Kestrel	1	A	F	12:59	75
29/09/2020	Hen harrier	1	RT	RT	13:17	75
29/09/2020	Kestrel	1	A	F	13:55	240
29/09/2020	Kestrel	1	A	F	14:02	240
29/09/2020	Golden plover	23	U	U	15:37	690
29/09/2020	Golden plover	3	U	U	15:40	90
29/09/2020	Kestrel	1	A	F	16:12	240

Date	Species	Count	Age	Sex	Start Time (hr:min)	Total time (s)
17/05/2021	Curlew	1	A	U	19:07	30
27/05/2021	Greylag goose	2	A	U	08:38	30
27/05/2021	Greylag goose	2	A	U	08:46	150
27/05/2021	Greylag goose	2	A	U	08:54	30
27/05/2021	Red kite	1	A	U	09:13	15
27/05/2021	Greylag goose	2	A	U	09:15	150
27/05/2021	Greylag goose	2	A	U	09:16	60
27/05/2021	Greylag goose	2	A	U	09:17	120
27/05/2021	Red kite	1	A	U	09:26	60
27/05/2021	Greylag goose	2	A	U	09:33	150
27/05/2021	Red kite	1	A	U	09:38	120
27/05/2021	Red kite	1	A	U	09:45	210
27/05/2021	Greylag goose	2	A	U	10:51	90
27/05/2021	Curlew	1	A	U	11:01	30
27/05/2021	Red kite	1	A	U	11:12	45
21/07/2021	Hen harrier	1	A	M	10:29	30
21/07/2021	Red kite	1	U	U	13:13	225

Key:
Age: A – Adult; U – Unknown; RT – Ring-tail hen harrier (adult female or immature female / male)
Sex: F – Female; M - Male

Drummarnock Wind Farm

wind2

Figure 7-1-1 Site Location in relation to Ornithology Designated Sites within 20km

Key

- Site boundary
- Drummarnock Designated Site Buffers - 10 and 20km
- Special Protection Area

SLR atmos CONSULTING

0 2.5 5 10

Kilometers

N

Scale @ A3: 1:160,000

23/05/2024 40419/OR/125a

Drawn by: LB Checked by: TH Approved by: LK

Drummarnock Wind Farm

wind2

Figure 7-1-2
Ornithology Survey Areas

Key

- Site boundary

Drummarnock Survey Buffers

- 500m - Breeding Wader
- 1500m - Black Grouse Lek
- 2000m - Breeding Raptor

SLR atmos CONSULTING

0 0.25 0.5 1
Kilometers

N

Scale @ A3:
1:28,000

23/05/2024 40419/OR/126a

Drawn by: LB Checked by: TH Approved by: LK

Drummarnock Wind Farm

wind2

Figure 7-1-3
Ornithology Vantage Point Location and Viewshed

Key

- Site boundary
- Turbine Locations
- Vantage Point (NS 72489 87728)
- Wind farm area for CRM (500m turbine buffer)
- Theoretical Viewshed
- Viewshed Area

Note:
Viewshed created using OS Terrain 5 data.
Predicted visibility is for observer eye level at 2m and an offset of 17m above ground level.

SLR

atmos CONSULTING

0 0.25 0.5 1
Kilometers

N

Scale @ A3:
1:22,000

23/05/2024	TL026	40419/OR/127a
Drawn by: LB	Checked by: TH	Approved by: LK

Drummarnock Wind Farm

wind2

Figure 7-1-4
Flight Activity Surveys:
Wildfowl Flightlines

Key

- Site boundary
- Turbine Locations
- Vantage Point (NS 72489 87728)

Wildfowl Flightlines

- Greylag Goose (GJ)
- Teal (T.)

SLR atmos CONSULTING

0 0.25 0.5 1
Kilometers

N

Scale @ A3:
1:20,000

23/05/2024	TL026	40419/OR/128a
Drawn by: LB	Checked by: TH	Approved by: LK

Drummarnock Wind Farm

wind2

Figure 7-1-5
Flight Activity Surveys:
Schedule 1 Raptor Flightlines

Key

- Site boundary
- Turbine Locations
- Vantage Point (NS 72489 87728)

Raptors Schedule 1 Flightlines

- Hen Harrier (HH)
- Red Kite (KT)
- Osprey (OP)

SLR atmos CONSULTING

0 0.25 0.5 1
Kilometers

N

Scale @ A3:
1:20,000

23/05/2024	TL026	40419/OR/129a
Drawn by: LB	Checked by: TH	Approved by: LK

Drummarnock Wind Farm

wind2

Figure 7-1-6
Flight Activity Surveys:
Kestrel Flightlines

Key

- Site boundary
- Turbine Locations
- Vantage Point (NS 72489 87728)
- Kestrel Flightlines

SLR
atmos CONSULTING

0 0.25 0.5 1
Kilometers

N

Scale @ A3:
1:20,000

23/05/2024 | TL026 | 40419/OR/130a
Drawn by: LB | Checked by: TH | Approved by: LK

Drummarnock Wind Farm

wind2

Figure 7-1-7
Flight Activity Surveys:
Wader Flightlines

Key

- Site boundary
- Turbine Locations
- Vantage Point (NS 72489 87728)

Waders Flightlines

- Curlew (CU)
- Golden Plover (GP)

SLR atmos CONSULTING

0 0.25 0.5 1
Kilometers

N

Scale @ A3:
1:20,000

23/05/2024	TL026	40419/OR/131a
Drawn by: LB	Checked by: TH	Approved by: LK

Drummarnock Wind Farm

wind2

Figure 7-1-8
Flight Activity Surveys:
Short-eared Owl Flightlines

Key

- Site boundary
- Turbine Locations
- Vantage Point (NS 72489 87728)
- Short-eared Owl Flightlines

SLR
atmos CONSULTING

0 0.25 0.5 1
Kilometers

N

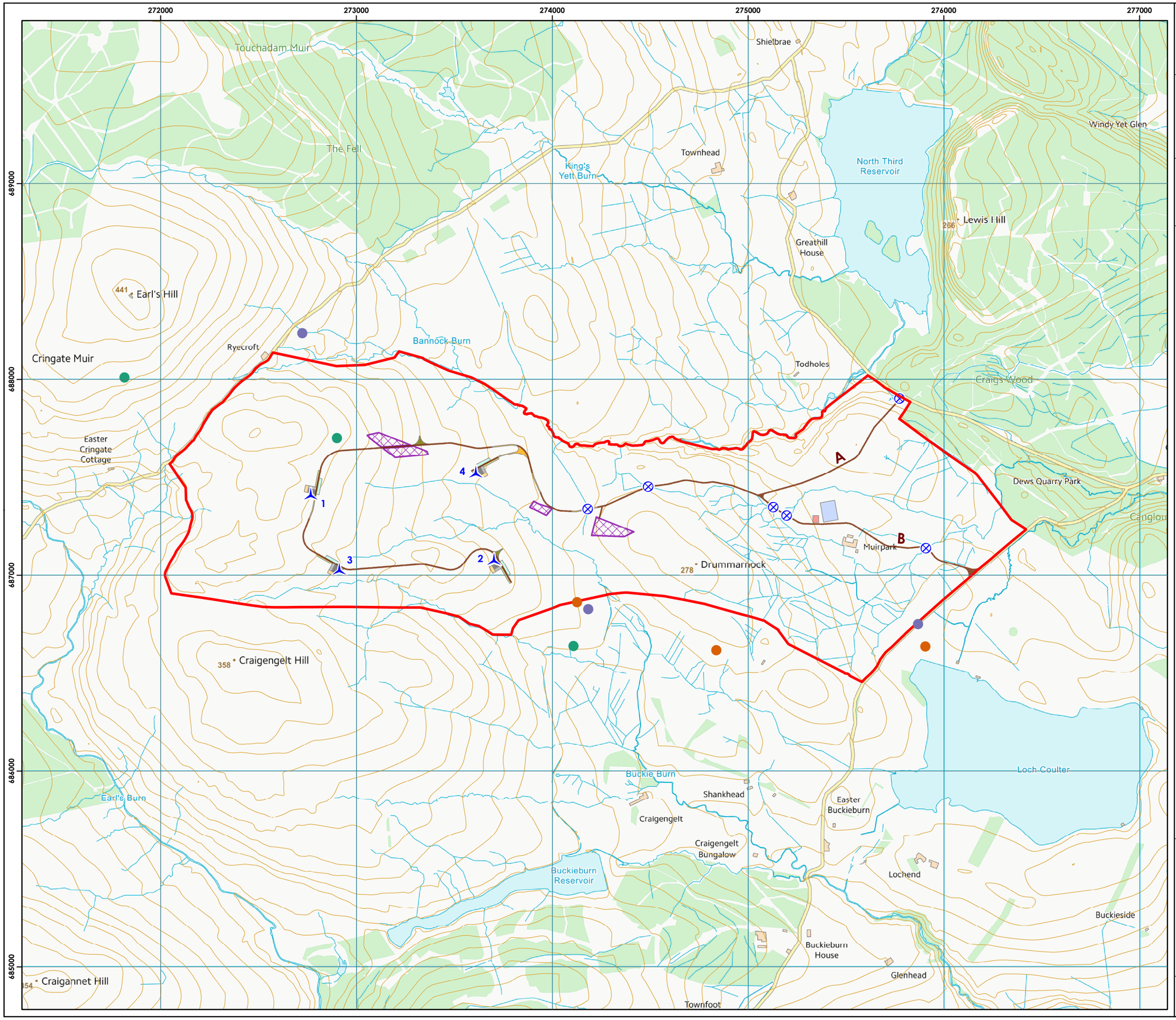
Scale @ A3:
1:20,000

23/05/2024 TL026 40419/OR/132a
Drawn by: LB Checked by: TH Approved by: LK

Drummarnock Wind Farm

wind2

Figure 7-1-9
Wader Territories



Key

- Site boundary
- Turbine Locations

Proposed infrastructure

- Crane hardstanding
- Auxiliary crane hardstanding
- Blade storage area
- Nacelle storage area
- Tower storage area
- Boom assembly area
- Turning head
- Borrow pit
- Substation
- Construction compound
- Onsite access track - cut
- Onsite access track - floating
- Watercourse crossing

Wader territories 2020

- Curlew (CU)
- Lapwing (L.)
- Snipe (SN)

SLR
atmos CONSULTING

0 0.25 0.5 1
Kilometers

N

Scale @ A3:
1:18,000

23/05/2024	TL026	40419/OR/133a
Drawn by: LB	Checked by: TH	Approved by: LK

Drummarnock Wind Farm

wind2

Figure 7-1-10
Black Grouse Survey Results

Key

- Site boundary
- Turbine Locations
- Watercourse crossing

Proposed infrastructure

- Crane hardstanding
- Auxiliary crane hardstanding
- Blade storage area
- Nacelle storage area
- Tower storage area
- Boom assembly area
- Turning head
- Borrow pit
- Substation
- Construction compound
- Onsite access track - cut
- Onsite access track - floating
- Black Grouse 2020 records

SLR
atmos CONSULTING

0 0.25 0.5 1
Kilometers

N

Scale @ A3:
1:18,000

23/05/2024	TL026	40419/OR/134a
Drawn by: LB	Checked by: TH	Approved by: LK