Technical Appendix A11.1 – Ornithology Report

Ornithology Report

Owenreagh/Craignagapple Wind Farm

Co. Tyrone

Report prepared by Woodrow APEM Group on behalf of Ørsted Onshore Ireland Midco Limited

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July 2023

Table of Contents

List of Tables

List of Figures

Statement of Authority

This report has been written by Aoife Moroney, with assistance from Giulia Mazzotti. Aoife is an Ecologist – Ornithologist with Woodrow APEM Group. She has completed a B.Sc. in Engineering at University College Dublin and M.Sc. in Environmental Engineering (specialising in Environmental Management) at the Technical University of Denmark and the Royal Institute of Technology, Sweden. She has also recently completed a Post-graduate Certificate in Ecological Survey Techniques at the University of Oxford, achieving a distinction. In addition to being a skilled bird surveyor, Aoife is highly proficient in data analysis and management as well as mapping using ArcGIS and QGIS. Aoife regularly carries out ornithological surveys and compiles ornithological reports, including carrying out Collision Risk Modelling (CRM) to inform wind farm planning submissions. She volunteers as a surveyor with Birdwatch Ireland for the Irish Wetland Bird Survey (IWeBS) and the Countryside Bird Survey (CBS), in addition to the Irish Hen Harrier Survey (coordinated by BWI along with Golden Eagle Trust Ltd., and the Irish Raptor Study Group).

Giulia Mazzotti is a Graduate Ecologist and Data Co-Ordinator with Woodrow. She has completed a B.Sc. in Biological Sciences at University of Bologna and obtained full marks with honours (110/110 Cum Laude) in Ecology and Nature Conservation M.Sc. from University of Parma. During her studies she learnt to use R for data analysis and became proficient in the use of ArcGIS and QGIS for mapping. Since joining Woodrow Giulia developed experience undertaking ecological surveys including habitat mapping using Fossitt (2000) in ROI and Phase 1 classifications in NI, mammal, bat and invertebrate surveys. She also assists senior members of staff with GIS mapping activity and reporting for Ornithology Reports, Ecological Impact Assessments (EcIA) and Biodiversity Chapters for Environmental Impact Assessment Reports (EIAR). Furthermore, Giulia leads on H&S for Woodrow, producing risk assessments and RAMS, keeping track of all the new hazards, near misses and incidents related to fieldwork. She is a qualifying member of CIEEM.

This report has been checked and approved by Mike Trewby. Mike is the company's lead ornithologist and field work manager. Mike worked for Birdwatch Ireland from 2003 to 2010 conducting research on red-billed chough, red grouse and breeding seabirds. Prior to joining Woodrow in 2016, Mike worked as an independent ornithological consultant, and he has over 20 years fieldwork and research experience in the field of ecology. Mike regularly undertakes impact assessments for large scale developments and is a full member of CIEEM (MCIEEM).

Ornithological surveys were carried out by Mike Trewby (MT), Hazel Doyle (HD), Hugh Delaney (HPD), Ken Westman (KW), Kate Bismilla (KB), Robert Vaughan (RV) and Jamie Bliss (JB).

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1 Overview

Woodrow APEM Group was commissioned by Ørsted Onshore Ireland Midco Limited to undertake ornithological survey work for Owenreagh/Craignagapple Wind Farm ("the Development"). The Development is a 14-turbine wind farm and will involve decommissioning the 15 existing turbines of the operational Owenreagh I and II Wind Farms. The operational Owenreagh I and II Wind Farms site access point is located at National Grid Reference: H 42364 97232, approximately 5 km east of Strabane, Co. Tyrone. The River Foyle flows in a northerly direction approximately 7.5 km west of the Development and is hydrologically connected via the Glenmornan River and the Owenreagh Burn.

Ornithological surveys, compliant with SNH (2017), commenced for the Development in April 2018 and were completed in June 2022.

Summer (breeding season) surveys undertaken included:

- Vantage point (VP) watches recording flight activity through the 500 m turbine buffer;
- Upland breeding bird surveys using an adapted Brown & Shepherd methodology; and
- Wider area breeding raptor surveys covering the 2 km turbine buffer, in particular targeting breeding merlin.

Winter (non-breeding season) surveys undertaken included:

- Vantage point (VP) watches recording flight activity through the 500 m turbine buffer;
- Winter site walkover surveys; and
- Wider area wintering waterbird surveys (winter 2021-22 only).

For the purpose of the breeding bird surveys, winter site walkovers and VP surveys, the "Study Area" was defined as the 500 m buffer of the proposed turbine locations – see **Figure A11.1.1**.

Curlew have been reported to be particularly sensitive to impacts from wind farms (Pearce-Higgins *et al.*, 2009; 2012) and, in line with NIEA recommendations, the search area was extended to an 800 m turbine buffer for breeding curlew ("800 m Study Area") (**Figure A11.1.2**).

Wider area breeding raptor surveys were carried out within a 2 km turbine buffer ("2 km Study Area") and wider area wintering waterbird surveys covered suitable habitat within a 5 km turbine buffer ("5 km Study Area") – see **Figure A11.1.3** and **Figure A11.1.4**.

This report documents the results from the desk study and surveys to provide the baseline ornithological information required to inform an ornithological impact assessment for the Development.

2 Desk Study

An initial desk-based review of the Study Area and wider area, taking account of appropriate distances for potential species ranges and connectivity to designated areas, was compiled to determine the appropriate surveys required to inform any potential for ornithological constraints. A preliminary assessment of avian habitat suitability and availability was undertaken using ortho-imagery and 6-inch mapping. This was further informed by scoping visits to the area.

The NPWS Designations Viewer and NIEA Natural Environment Map Viewer were used to identify any nearby Special Protection Areas (SPAs) and their respective Qualifying Interest (QI) species. Flood Maps NI (and EPA Maps) was used to investigate hydrological connectivity to SPAs using the "River Flow Direction" tool. SPAs within 15 km[1] of, or with a potential source-pathway-receptor connection to, the Development are listed in **Table A11.1.1** and shown in **Figure A11.1.5**.

A records request was made to the Centre for Environmental Data and Recording (CEDaR) for ecological records within the 10 km national grid square (H49) encompassing the Study Area. The ornithological records from this request were reviewed to investigate the target species potentially occurring within the Study Area and wider area to inform survey design and identify any potential ornithological constraints. These historical records and their conservation status (Gilbert *et al.*, 2021a; Stanbury *et al.*, 2021) are listed in **Table A11.1.2**.

The most recent Bird Atlas 2007-11 was also interrogated for ornithological records within the 10 km national grid square H49 (Balmer *et al.*, 2013). Sharrock (1976) was used to investigate historic records and changes in breeding ranges of species. Additionally, previous surveys carried out at Owenreagh/Craignagapple Wind Farm were consulted (Biosphere Environmental Services, 2014; Woodrow 2017).

Based on SNH (2017) guidelines, migratory populations of wintering geese and swans are considered as species notably sensitive to wind farm developments. To characterise the distribution of these, population data from recent population monitoring have been reviewed, including:

- Frost *et al.* (2021) for Wetland Bird Survey (WeBS) counts;
- Boland & Crowe (2008) for greylag goose distribution;
- Burke *et al.* (2021) for whooper swan distribution; and
- Fox *et al.* (2021) for Greenland white-fronted goose distribution.

2.1 Special Protection Areas (SPAs) and Ramsar sites

There are no SPAs or Ramsar sites within 15 km of the proposed wind turbine locations. There is, however, a downstream hydrological connection to the River Foyle SPA and Ramsar site, which is designated for several wetland and waterbirds, see **Table A11.1.1**.

[1] The Appropriate Assessment Guidelines (DoEHLG, 2010) derive a guideline distance of 15 km from UK Guidance (Scott Wilson *et al.,* 2006). However, the potential Zone of Influence can be less than 15 km (*e.g.* noise and airborne pollution) or greater than 15 km (*e.g.* if there is a significant and direct hydrological pathway or if a QI/SCI species ranges over areas which are greater than 15 km from a European Site).

This connection is via the Glenmornan River (river segment code: GBNI0102203)[2] in the north and the Owenreagh Burn (river segment code: GBNI0102202) in the west of the Study Area. Both rivers meet *c.* 3 km north-west of the Study Area and eventually flow into the River Foyle and, subsequently, Lough Foyle.

SNH guidelines recommend that core foraging ranges of species should be examined to assess connectivity between the site and surrounding SPAs (SNH, 2016; 2017). As detailed in **Table A11.1.1**, the closest SPA to the Study Area is Lough Foyle SPA, which lies *c.* 22.9 km north-west. As such, the Study Area lies outside of any reported core or maximum foraging ranges for the QI species of this SPA (SNH, 2016). The Study Area is also *c.* 40 km from the SPA via watercourse and therefore has limited potential to cause impacts to the QI species due to dilution effects. There will be a strict requirement for appropriate water quality mitigation to be in place during construction (see Technical Appendix A3.1 - Decommissioning and Construction Environmental Management Plan (DCEMP)). Potential impacts and mitigation are discussed further within the Chapter 11 – Ornithology of the ES and the shadow Habitats Regulations Assessment (sHRA) (Woodrow, 2023a).

Table A11.1.1: Special Protection Areas (SPAs) within 15 km of or with a hydrological connection to the Study Area

SPA	Distance to 500 m turbine buffer	Qualifying Interests (QIs)
Lough Foyle SPA Co. Derry Site code: UK9020031	*c.* 22.9 km north-west and 40 km via watercourse	• In winter regularly supports internationally important numbers of whooper swan, light-bellied brent goose and bar-tailed godwit. • Supports over 20,000 internationally and nationally important migratory waterfowl including whooper swan, light-bellied brent goose, bar-tailed godwit, red-throated diver, great crested grebe, mute swan, Bewick's swan, greylag geese, shelduck, teal, mallard, wigeon, eider, red-breasted merganser, oystercatcher, golden plover, grey plover, lapwing, knot, dunlin, curlew, redshank and greenshank. Also supports a small wintering population of Slavonian grebe.
Lough Foyle Ramsar site Site No: 974	*c.* 23.7 km north-west and 40 km via watercourse	• Ramsar criterion 1: this is a particularly good representative example of a wetland complex including intertidal sand and mudflats with extensive seagrass beds, saltmarsh, estuaries and associated brackish ditches and of a wetland, which plays a substantial hydrological, biological and ecological system role in the natural functioning of a major river basin which is in a trans-border position.

[2] NI Rivers Map Viewer- WFD. Available at: Interactive Web Map of Northern Ireland Rivers (azimap.com) (Accessed December 2022)

SPA	Distance to 500 m turbine buffer	Qualifying Interests (QIs)
		• Ramsar criterion 2: the site supports an appreciable assemblage of rare, vulnerable or endangered species or sub-species of plant and animal. • Ramsar criterion 3: the site supports a diverse assemblage of wintering waterfowl which are indicative of wetland values, productivity and diversity. These include internationally important populations of whooper swan, light-bellied brent goose and bar-tailed godwit. Additional wildfowl species which are nationally important in an all-Ireland context are red-throated diver, great crested grebe, mute swan, Bewick's Swan, greylag geese, shelduck, teal, mallard, wigeon, eider, and red-breasted merganser. Nationally important wader species are oystercatcher, golden plover, grey plover, lapwing, knot, dunlin, curlew, redshank and greenshank. • Ramsar criterion 5: the site supports about 29,000 migrating birds. • Ramsar criterion 6: species/populations occurring at levels of international importance.
Lough Foyle SPA Co. Donegal Site code: 004087	*c.* 26.7 km north-west and 40 km via watercourse	• Red-throated Diver *(Gavia stellata)* [A001] • Great Crested Grebe *(Podiceps cristatus)* [A005] • Bewick's Swan *(Cygnus columbianus bewickii)* [A037] • Whooper Swan *(Cygnus cygnus)* [A038] • Greylag Goose *(Anser anser)* [A043] • Light-bellied Brent Goose *(Branta bernicla hrota)* [A046] • Shelduck *(Tadorna tadorna)* [A048] • Wigeon *(Anas penelope)* [A050] • Teal *(Anas crecca)* [A052] • Mallard *(Anas platyrhynchos)* [A053] • Eider *(Somateria mollissima)* [A063] • Red-breasted Merganser *(Mergus serrator)* [A069] • Oystercatcher *(Haematopus ostralegus)* [A130] • Golden Plover *(Pluvialis apricaria)* [A140] • Lapwing *(Vanellus vanellus)* [A142] • Knot *(Calidris canutus)* [A143] • Dunlin *(Calidris alpina)* [A149] • Bar-tailed Godwit *(Limosa lapponica)* [A157] • Curlew *(Numenius arquata)* [A160] • Redshank *(Tringa totanus)* [A162] • Black-headed Gull *(Chroicocephalus ridibundus)* [A179] • Common Gull *(Larus canus)* [A182]

SPA	Distance to 500 m turbine buffer	Qualifying Interests (QIs)
		• Herring Gull *(Larus argentatus)* [A184] • Wetland and Waterbirds [A999]

2.2 Wintering waterbirds

There are no waterbodies within the Study Area that can support significant densities of wintering waterbirds. The closest larger waterbody is Moor Lough, which is situated *c.* 1.2 km north-east of the nearest proposed turbine location. Although Moor Lough is in a relatively remote area, it is accessible to the public and has been developed as a Department of Culture, Arts and Leisure fishery. The Lough has several beaches and a cordoned off paddle area, as well as public restrooms. It may therefore be more suitable for waterbirds during the winter when human disturbance is lower. The only other lake within 5 km of the Study Area is Lough Ash which, similarly, is accessible for anglers.

The watercourses within the Study Area are small 1st or 2nd order streams and drains which are not capable of supporting significant densities of waterbirds. There are no significant rivers within the 5 km Study Area, the closest being the River Mourne which lies *c.* 6.5 km west of the nearest proposed turbine location. The Study Area is not documented as supporting any nationally or internationally important numbers of wintering waterbirds or sensitive wintering wetland species, especially swans or geese (Frost *et al.*, 2021). The nearest area containing internationally/nationally important populations of waterbirds is Lough Foyle, which is designated as an SPA and Ramsar Site – see **Figure A11.1.5**. The nearest flocks of whooper swan, greylag goose and Greenland white-fronted goose are also associated with the margins of the River Foyle and Lough Foyle (Balmer *et al.*, 2013; Burke *et al.*, 2021; Boland & Crowe, 2008; Fox *et al.*, 2021; Lewis *et al.*, 2019). The Study Area is therefore considered to lie outside of reported core foraging areas of whooper swan (<5 km) and Greenland white-fronted goose (5-8 km) populations (SNH, 2016). The Study Area is, however, considered to lie within core foraging ranges for greylag goose (15-20 km), though the habitat suitability within the Study Area is limited, with this species favouring low-lying agricultural land (Balmer *et al.*, 2013). As geese and swans are species which take regular, commuting flights, care was taken during VP surveys to identify whether the Study Area lies within a commuting route for greylag goose.

In terms of wintering waders, several species can often be found inland away from coastal hotspots, in particular snipe, golden plover and lapwing, as well as curlew, black-tailed godwit and ringed plover. The large areas of upland bog and grassland are considered suitable for wintering curlew, snipe and golden plover. Golden plover on passage have also been reported within the Study Area, with approximately 34 birds recorded in breeding plumage in April 2010 (Biosphere Environmental Services, 2014). Additionally, the areas of wet grassland along the margins of Moor Lough are suitable for wintering lapwing and the presence of forestry adjacent to open bog has potential for wintering woodcock to occur. Overall, the Study Area and surrounding environs is considered to provide a mosaic of suitable habitats for wintering waders.

2.3 Breeding waders

The large areas of open bog and grassland habitat provide potential suitable habitat for upland breeding waders such as snipe and curlew and there are breeding records of these species in the area (Balmer *et al.*, 2013). Curlew are known to have historically bred within an area north of the Glenmornan Road (Biosphere Environmental Services, 2014). Reports from 2014 and 2016 found no breeding attempts within the Study Area (Biosphere Environmental Services, 2014; Woodrow, 2017) but in May 2017, a pair was seen displaying together *c.* 800 m south of the Study Area during a VP survey carried out by Woodrow

surveyors. Previous breeding curlew territories are shown in **Figure A11.1.7.2** in **Appendix VII**.

There are no recent or historical records of breeding golden plover within the Study Area or surrounding environs (Balmer *et al.*, 2013; Sharrock, 1976). A recent reduction in the breeding range of woodcock in Ireland means that this wader species is also unlikely to breed within the Study Area (Balmer *et al.*, 2013; Sharrock, 1976).

2.4 Birds of prey

Hen harrier

Due to the upland nature of the landscape and the presence of large areas of open bog, the 2 km Study Area (see **Figure A11.1.3**) is considered to have some potential to support this ground-nesting species within areas of more dense heather cover and there are breeding records within the 10 km grid square encompassing the Study Area (Balmer *et al.*, 2013). Though traditionally hen harriers prefer to nest within heather, following the decline of this habitat in Ireland, pairs are increasingly being recorded utilising young conifer plantations (Wilson *et al.,* 2006). At present, forestry within the 2 km Study Area is closed thicket, though it is important to note that, depending on ongoing forestry operations in the area, habitat suitability has the potential to change over the next 5-10 years, leading to areas of clearfell/second rotation potentially becoming occupied prior to or during construction and operation of the Development. Hen harrier are known to hunt within the Study Area, though there are no known breeding records (Biosphere Environmental Services, 2014; Woodrow, 2017).

The closest SPA designated for hen harrier is the Slieve Beagh - Mullaghfad – Lisnaskea SPA, *c.* 48 km south of the Study Area. As such, in accordance with SNH (2016), the Study Area lies outside of the core foraging range of this QI population (max 10 km).

Merlin

The presence of conifer plantation and older woodland adjacent to open bog provides suitable breeding habitat for merlin and there are breeding records of this species in the environs of the Study Area (Balmer *et al.*, 2013). Previous studies carried out at the site in 2009, 2010, 2014 and 2016 did not pin down a nesting location for merlin but noted that they were largely associated with the conifer plantation in the south-west of the Study Area and the southern slopes of Owenreagh Hill (Biosphere Environmental Services, 2014; Woodrow, 2017). Like hen harrier, traditionally, merlin was a ground-nesting species in Ireland but have taken to utilising old tree nests of other species, in particular those of corvids, due to the absence of suitable habitat (Lusby *et al.*, 2017). Merlin breed in upland areas and tend to favour nests located on the edges of conifer plantation, adjacent to areas of heathland and moor. As such, the Study Area is suitable for this species.

The closest SPA designated for merlin is the Derryveagh and Glendowan Mountains SPA, *c.* 42 km north-west of the Study Area. As such, the Study Area lies outside of the core foraging range (5 km) of this QI population (SNH, 2016).

Other raptors

Buzzard, sparrowhawk and kestrel are widespread resident species in Ireland and, based on habitat availability, are likely to be breeding within the 2 km Study Area. While buzzard and sparrowhawk are both green listed, the BoCCI conservation status for kestrel was upgraded over the course of the baseline study from amber to red (Colhoun & Cummins, 2013; Gilbert

et al., 2021). Both breeding numbers and distribution of kestrels have declined significantly, which is thought to have been driven by changes in prey availability due to agricultural intensification (Wilson-Parr & O'Brien, 2019), as well as secondary rodenticide poisoning. Flight behaviour means kestrels are also a species emerging as notably susceptible to collision with turbines and this is acknowledged within the Collision Risk Model (CRM), which is run with a lowered avoidance rate for kestrel (95% avoidance rate) (see Technical Appendix A11.2).

In Ireland, cliffs in quarries can provide suitable nesting ledges for breeding peregrines (Moore *et al.,* 1997) as well as ruined buildings and churches. There are no quarries or suitable structures for nesting peregrine within the 2 km Study Area, though there are breeding records within the 10 km national grid square encompassing the Study Area (Balmer *et al.*, 2013). The closest SPA designated for peregrine is the Derryveagh and Glendowan Mountains SPA, c. 42 km north-west of the Study Area. As such, the Study Area lies outside of the core foraging range (max 18 km) of this QI population (SNH, 2016).

Owls

The lower-lying, open agricultural areas of the 2 km Study Area with old growth woodland/treelines and derelict buildings may provide suitable nesting and foraging habitat for barn owl, and there are contemporary records for the species in the wider area (Balmer *et al.*, 2013; **Table A11.1.2**). In Ireland, foraging distances from nest sites can extend up to 6 km and even as far as 9 km; however, the core breeding season home range is documented to be 4 to 5 km from the nest (Lusby & Cleary, 2014, TII 2021).

Barn owls are reported as successfully breeding at a large wind farm in Scotland, with the number of pairs increasing after the provision of nest boxes, *e.g.,* Crystal Rig Wind Farm[3]. It is generally considered that low level flight behaviour of barn owls (typically < 3-4 m) limits collision risk with larger turbines in the UK (and Ireland) where lattice towers are not commonly employed (Barn Owl Trust, 2015).

The woodland habitats within the Study Area are suitable for long-eared owls and it is likely that this green listed species breeds within the 2 km Study Area. There are also contemporary records for this species in the area (see **Table A11.1.2**). As for barn owls, impacts from wind farm developments are more likely to be associated with removal of suitable habitats than potential collision risk.

The occurrence of heathland/bog in association with plantations within the 2 km Study Area provides potential habitat for breeding short-eared owl. This species is a notably rare and occasional breeder in Ireland (Hutchinson, 1989), largely associated with the Mullaghareirk Mountains, Counties Limerick/Cork/Kerry and the Antrim Hills, though the Sperrin Mountains have been noted as 'Possible' breeding in Balmer *et al.* (2013). This species is also highly nomadic, with recent GPS data recording one female breeding in both Scotland and Norway within the same year (Darvill, 2020). As such, it may be less vulnerable to land use changes than barn owl, which remain in the same territory throughout their lives with traditional nest sites sometimes being occupied by successive generations (Lusby & O'Cleary, 2014).

3 As reported at: http://www.pes.eu.com/wind/ornithological-plan-leads-to-barn-owl-success/

The Development will not result in the loss of any suitable owl habitat (old buildings, suitable mature trees, forestry and woodland).

2.5 Other species of conservation concern

Red grouse

Red grouse occur almost exclusively in open bog and heathland and suitable habitat is distributed throughout the majority of the Study Area. There are both historical and contemporary records of this species occurring within the Study Area (Biosphere Environmental Services, 2014; Woodrow, 2017; Balmer *et al.*, 2013; Sharrock, 1976). Grouse species have been shown to be prone to collision mortality with man-made structures such as fencing and power lines and have been reported to potentially be more likely to collide with turbine towers rather than rotor blades (Coppes *et al*., 2020; Stokke *et al*., 2020; Bioscan, 2001). They are also sensitive to land use changes resulting in habitat loss and fragmentation, which has been attributed to a severe decline in their population and distribution (National Red Grouse Steering Committee, 2013; Cummins *et al.*, 2010).

Swift

The conservation status of swifts was upgraded over the course of the baseline study from amber to red in both the UK and Ireland (Stanbury *et al.*, 2021; Gilbert *et al.*, 2021). There is potential for swifts to forage through the Study Area over the summer months while nesting in the buildings of nearby towns and villages. Depending on weather conditions, swifts often forage at heights of 50 to 100 m placing them within the collision risk zone of wind turbines. As swifts are habituated to manmade structures, it is considered unlikely that foraging birds will be displaced by operational turbines. Conversely, this species (along with swallows and other hirundines) may be actively drawn towards turbines to glean insects that are attracted to/more active around turbine towers and hardstands (Rydell *et al.*, 2012). While the mechanism and potential effects are poorly understood at this stage, it is considered likely that this behaviour leads to heightened collision risk for this species. In Germany 3% of 1,192 reported fatalities due to collisions with wind turbines between 1989 and 2010 were swifts, which when combined with swallow mortality was proportionally higher than would be expected for small, fast-flying and mobile species like swifts and hirundines (Dürr, 2010 in Rydell *et al.*, 2012).

Nightjar

Areas of forestry plantation in upland habitats, specifically drier areas in young plantation and clearfell, as well as associated scrub and bracken have the potential to support the crepuscular/nocturnal breeding species nightjar. This red listed species is a very rare breeder in Ireland with plantations on the Galtees and Knockmealdowns in Counties Tipperary/Waterford supporting the limited number of contemporary breeding records. There are no contemporary or historic records of nightjar within the Study Area (Balmer *et al.*, 2013; Sharrock, 1976) and it is considered very unlikely that nightjars occur in the vicinity of the Study Area.

Rare passerines

As detailed in SNH (2017), it is considered that most passerines are at low risk from collision with wind turbines due to flight behaviour. Population dynamics (*e.g.* high fecundity and rapidly attaining sexual maturity) also make passerines less vulnerable to displacement impacts. This means that the Development is unlikely to impact on passerine communities at the population level. The exception may be rarer breeding passerines, which in an Irish

context would include whinchat, ring ouzel, tree sparrow and yellowhammer. There are no documented populations of rare breeding passerines occurring in the wider area (Balmer *et al.,* 2013; **Table A11.1.2**).

Table A11.1.2: CeDAR bird records for target species within the 10 km national grid square (H49) from 2011-2022

The BOCCI4 column refers to whether conservation concern status applies to wintering (Win) or breeding (Br) populations.

Common Name	Scientific Name	EU Birds Directive Annex I	NI Priority Species (2023)	BoCC5 Status (UK)	BoCCI4 status (RoI)	Date of last record
Cuckoo	*Cuculus canorus*		✓	Red	Green	2015
Swift	*Apus apus*		✓	Red	Red [Br]	2014
Merlin	*Falco columbarius*	✓	✓	Red	Amber [Br]	2013
Hen harrier	*Circus cyaneus*	✓	✓	Red	Amber [Br]	2011
Spotted flycatcher	*Musciapa striata*		✓	Red	Amber [Br]	2011
Sparrowhawk	*Accipiter nisus*			Amber	Green	2011
Kestrel	*Falco tinnunculus*		✓	Amber	Red [Br]	2013
Cattle egret	*Bubulcus ibis*			Amber	Green	2012
Jay	*Garrulus glandarius*			Green	Green	2011
Buzzard	*Buteo buteo*			Green	Green	2013
Barn owl	*Tyto alba*		✓	Green	Red [Br]	2016
Long-eared owl	*Asio otus*			Green	Green	2014
Rosy starling	*Pastor roseus*			Green	Green	2013

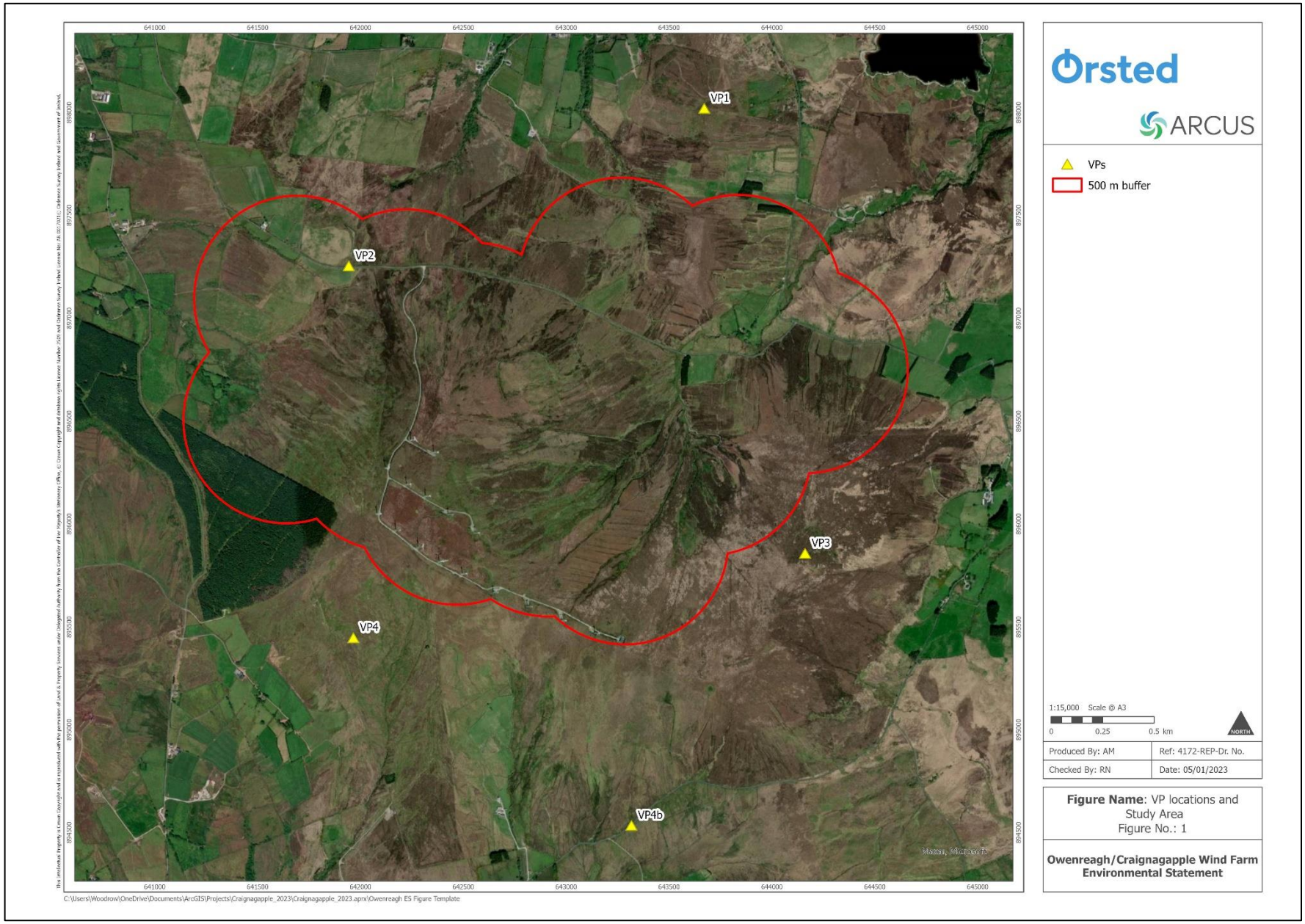

Figure A11.1.1: VPs used for collecting flight line data and Study Area (500 m turbine buffer)

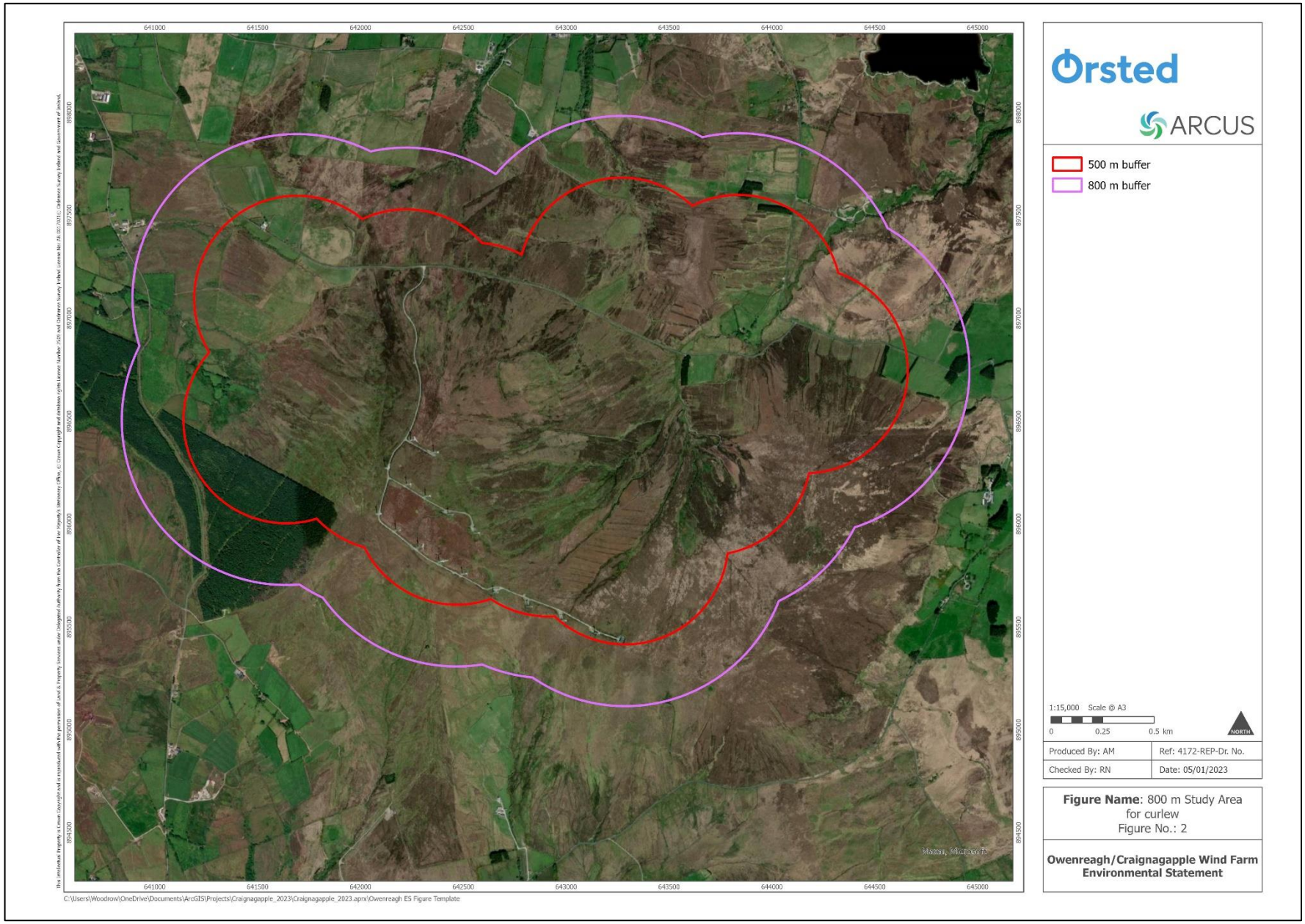

Figure A11.1.2: 800 m Study Area for breeding curlew

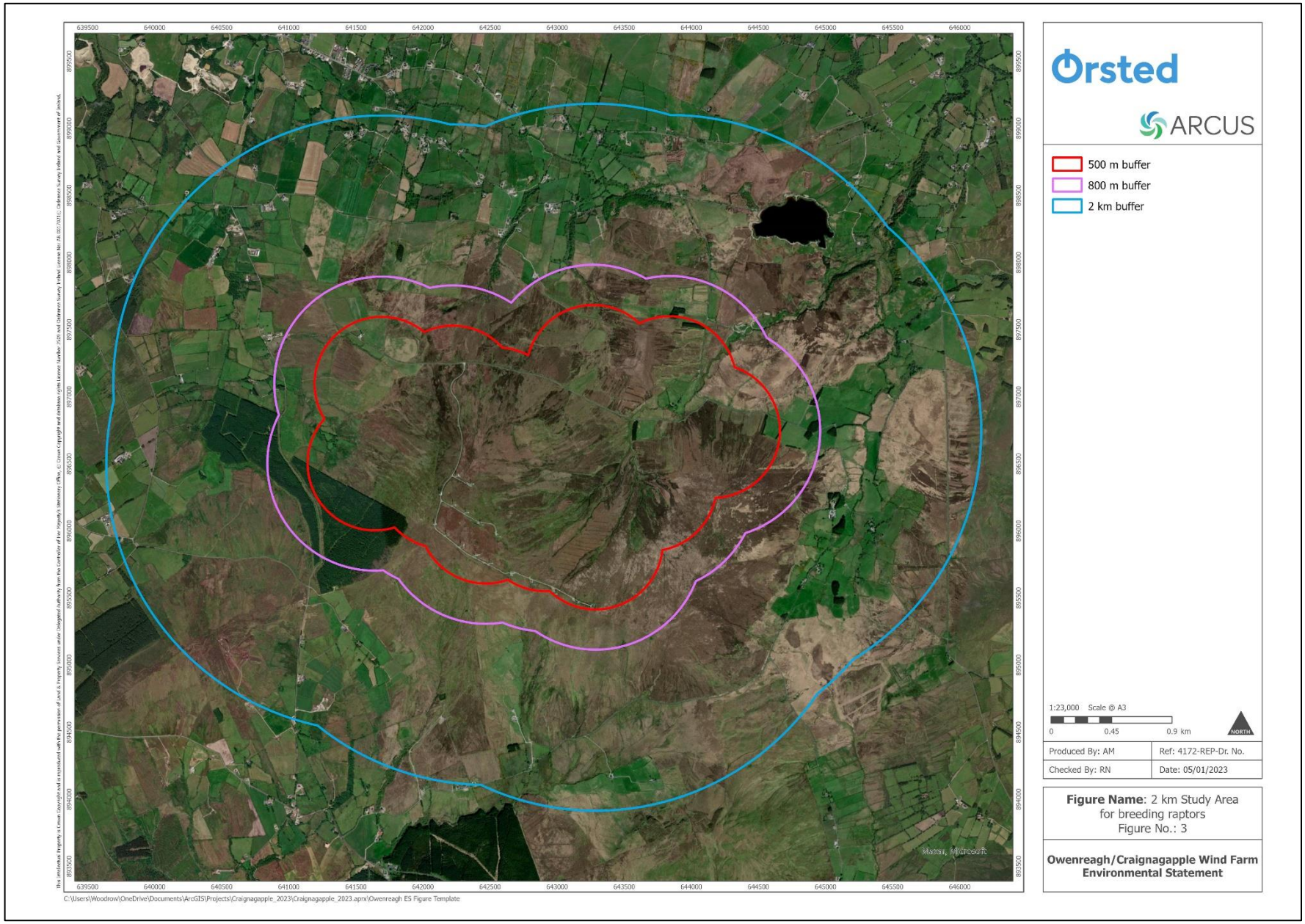

Figure A11.1.3: 2 km Study Area for breeding raptors

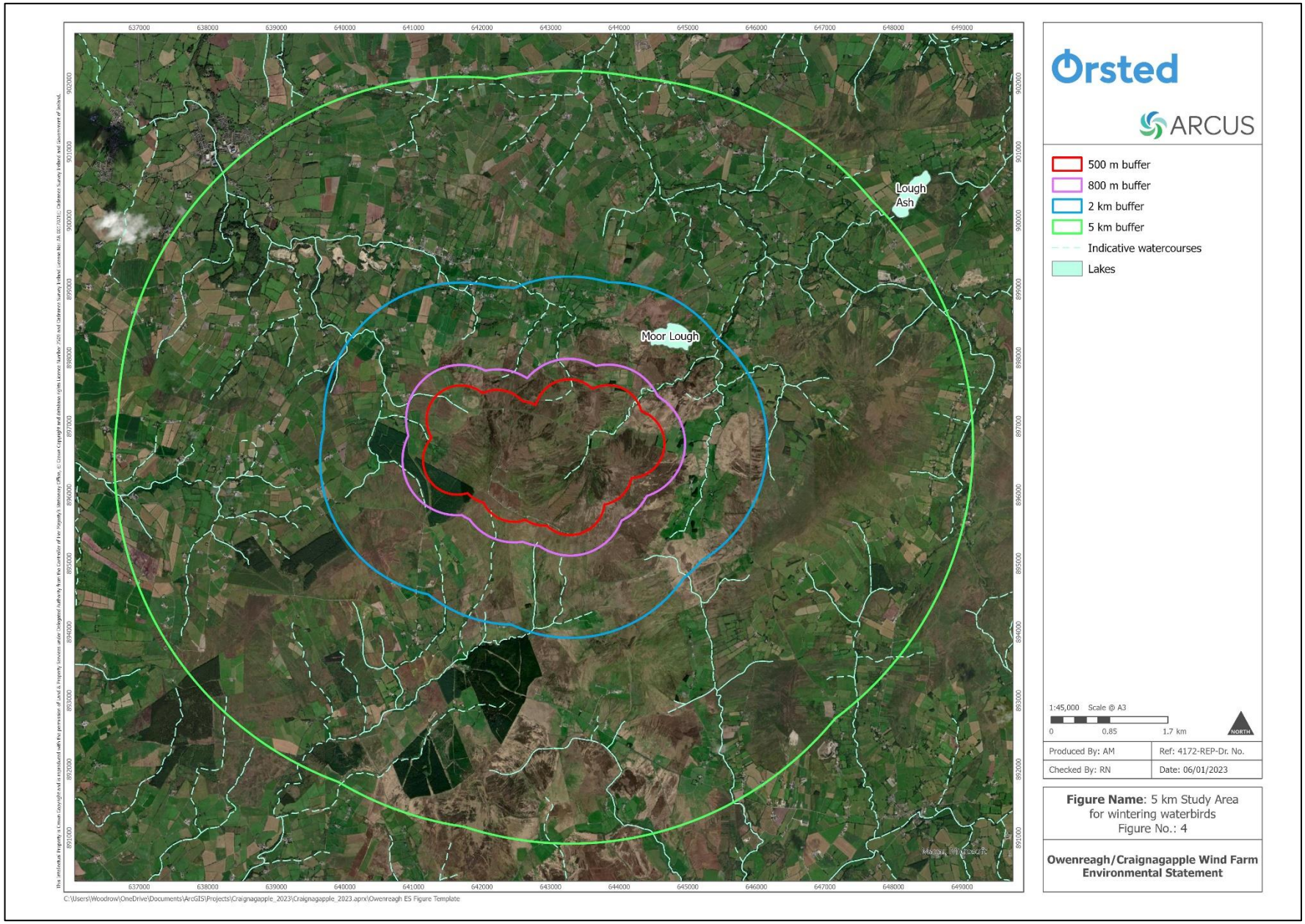

Figure A11.1.4: 5 km Study Area for wintering waterbirds, showing indicative watercourses and waterbodies

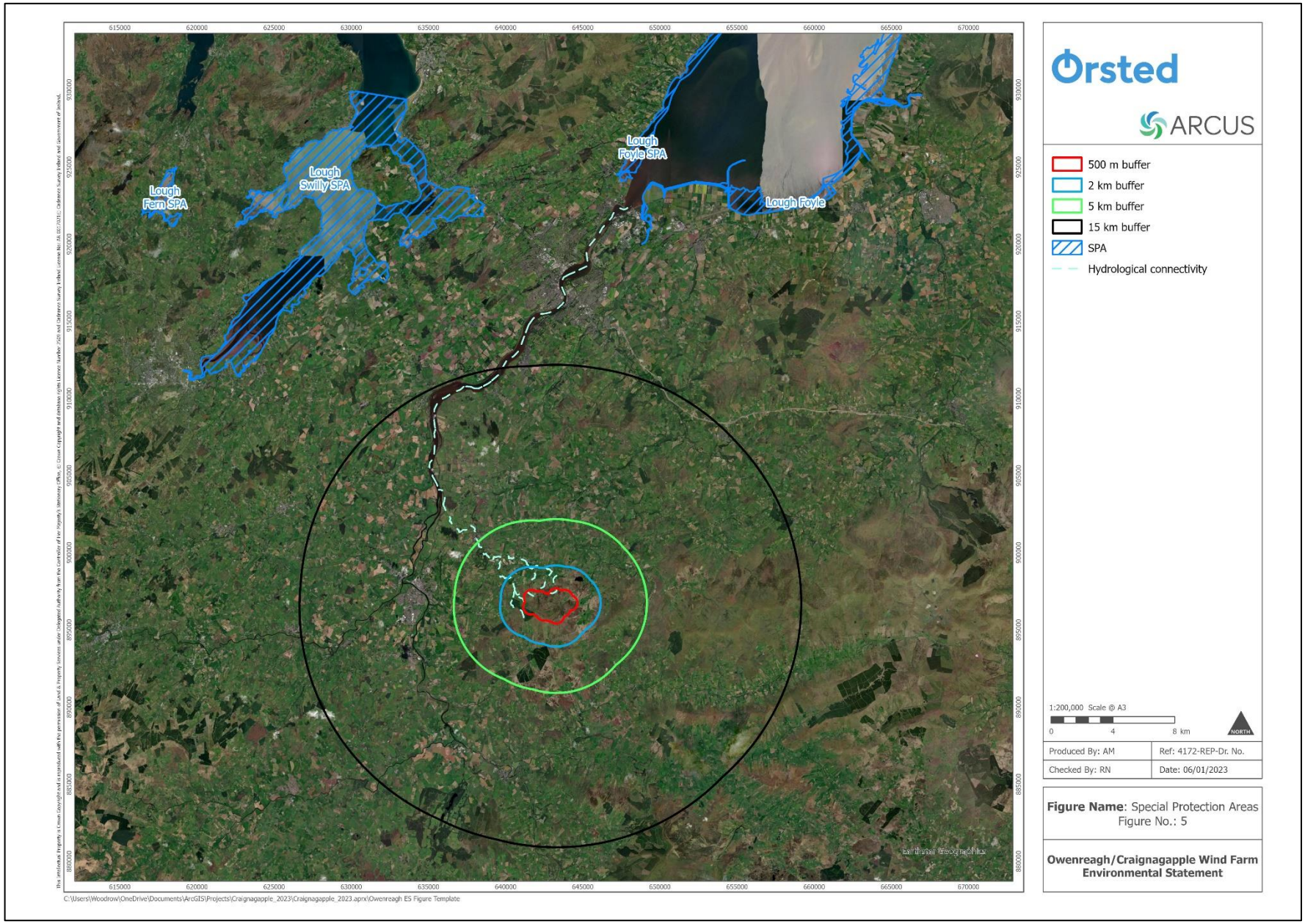

Figure A11.1.5: SPAs within 15 km of or with a hydrological connection to the Study Area, showing hydrological connectivity to Lough Foyle

3 Methodology & survey effort

Scottish Natural Heritage (SNH) (2017) guidelines provide recommended survey methodologies for the assessment of avian populations within and adjacent to onshore wind farms. Survey methodologies utilised for ornithological surveys are outlined in the following sections and adhere to the relevant SNH guidance.

Two-years of ornithological surveys are recommended by the SNH guidelines, unless it can be clearly demonstrated that a single year of data is sufficiently robust and appropriate for assessing the potential impacts of the proposal. In this case, 6 full seasons of data were collected, including an additional 7th season of targeted breeding merlin and snipe surveys. Surveys were repeated in order to keep the data up to date prior to planning submission.

3.1 Vantage Point (VP) watches

VP watches record flight-line activity in relation to the 500 m turbine buffer (Study Area) to provide data on selected target species for assessing avian collision risk. Four VPs were used to cover the Study Area the locations of which are shown in **Figure A11.1.1**. These four VPs provide sufficient coverage (93.49%) of the 500 m buffer around proposed wind turbine locations and the airspace above each of the proposed wind turbines is visible – see **Figure A11.1.2.1** in **Appendix II**. The VPs selected to cover the Study Area are compliant with the SNH (2017) guidelines, which stipulate that viewsheds from VPs should not extend more than 2 km and that the angle of view should also not be extended beyond an arc of 180 degrees.

Based on viewsheds extending 2 km, some of the viewsheds of the VPs overlap (see **Figure A11.1.2.1**). Therefore, it is acknowledged that as a function of coverage (survey effort), the flight seconds reported cumulatively for all the VP watches will provide an overestimate for flight times. In order to avoid any duplication of flight records, an effort was made to limit conducting VP surveys simultaneously by two or more surveyors from VPs with overlapping viewsheds. In the rare case that VP watches were conducted simultaneously for VPs with overlapping viewsheds, surveyors communicated between one another if a bird was seen to fly to/from another viewshed. This overlap is also corrected for in the CRM (see Technical Appendix A11.2).

To limit observer fatigue, surveyors did not typically undertake VP watches of more than 3-hours in duration without a break, unless inclement periods of weather meant watches were paused for short durations until conditions improved.

Target species are those identified as being at risk from displacement effects caused by wind farm developments or from collision with turbines. Target species for which flight-line data was captured included the following species groups:

- Waterbirds;
- Raptors & owls;
- Any species listed on Annex I of the Birds Directive;
- Any species listed as Red on the BoCCI4 (Gilbert *et al.*, 2021) and BoCC5 (Stanbury *et al.*, 2021) (NI Priority species);
  Note: During the study swifts were upgraded to red listed and, consequently, in the final breeding season (2021) swifts were included as target species during VP surveys.

VP watches involve the surveyor observing birds from a stationary position using binoculars and a telescope. In accordance with SNH (2017), the viewshed of the VP is scanned at 5-

minute intervals. When a target species is seen, the surveyor estimates the height of the bird and its usage of the area by drawing its flight path on a map and noting its behaviour. Flight heights are estimated visually. Other data collected includes the number of birds, time of detection and duration of flight, as well as sex and age class if relevant. A list of all non-target species encountered within the environs of the development area is also compiled during watches, though priority is given to recording target species in the case of busier survey days.

The aim for a given season is to conduct a minimum of 36 hours of watches per VP, ensuring that watches are spread relatively evenly over the study period. Two VPs fell just short of this 36 hour minimum (VP4 breeding 2019 and VP3 non-breeding 2021-22), however, as there were 6 seasons of surveys carried out as opposed to the recommended 4 seasons, and some VPs received in excess of 36 hours, it is considered that the flightline data collected is sufficient to identify any potential ornithological constraints which may arise as a result of the Development. Survey dates for vantage point watches are given in **Table A11.1.3**, **Table A11.1.4** and **Table A11.1.5** and further details on survey effort and weather are provided in **Appendix V.**

Upon commencing VP watches in April 2018 there were restrictions on accessing the operational Owenreagh I and II Wind Farms and surveyors had to conduct watches from an alternative VP4 (see VP4b in **Figure A11.1.1**) from which 15 hours of VP watches were conducted. Access to the optimally located VP4 was restored from May onwards. The airspace covered by both VPs was considered comparable, especially for the core area of interest along the southern slopes of the operational Owenreagh I Wind Farm.

3.2 Collision Risk Modelling

VP watches are conducted to collect flight line data which can then be used to model collision risk. For target species generating sufficient levels of flight time within the Collision Risk Zone (CRZ) (defined as within the 500 m turbine buffer at a height of 20–160 m, a precautionary range based on the Vestas V136 turbine model with a tip height of 156.5 m and a rotor diameter of 136 m), data sets are run through a CRM, as detailed in SNH (2000) and Band *et al.* (2007), employing avoidance rates as given in SNH (2018). This provides estimates of the number of collisions per annum and for the lifetime of the proposed wind turbines.

The CRM was run for both the operational wind farm (baseline) and proposed wind farm (Development), to provide a comparison between the two scenarios. It should be noted that the operational Owenreagh I and II Wind Farms consist of an original array (Zond Z-40) and an extension (Vestas V52). To address both turbine types, the baseline model was run twice, once with the Z-40 dimensions and once with the V52 dimensions. As such, a collision risk range is provided for the baseline. As the application is for a 40-year consent period, the collision risk over the 40-year life span of the Development was also assessed. The detailed methodology, along with results, is provided in Technical Appendix A11.2 – Collision Risk Modelling Report.

Table A11.1.3: Dates and duration of VP watches undertaken in the Study Area during summer 2018 and winter 2018-19

Breeding 2018				
Date	**VP1**	**VP2**	**VP3**	**VP4**
16/04/2018	2	2	2	2
19/04/2018	3	3	3	3
25/04/2018	3	3	3	3
27/04/2018	3	3	3	3
01/05/2018		3		
02/05/2018		3		3
03/05/2018	3			
18/05/2018			2	2
01/06/2018	3		2	3
14/06/2018			6	
15/06/2018		3		
18/06/2018	3	4		
19/06/2018				5
25/06/2018	4	3		
28/06/2018			3	
29/06/2018		3		
10/07/2018		3		3
12/07/2018	3		3	
19/07/2018	3	3		
31/07/2018			3	3
01/08/2018		3		
02/08/2018	3			3
09/08/2018			3	
22/08/2018		3	3	
29/08/2018	3			3
Total	**36**	**42**	**36**	**36**

Non-breeding 2018-19				
Date	**VP1**	**VP2**	**VP3**	**VP4**
10/10/2018		2.5		
15/10/2018		0.5	3	
30/10/2018	3	3		
02/11/2018	2		1.5	4
06/11/2018			4.5	2
08/11/2018	3	3		3
20/11/2018				3
22/11/2018	4	3		
06/12/2018			3	2.25
12/12/2018	6	6		
13/12/2018			6	6
06/01/2019		3		
09/01/2019	3	3	3	3
22/01/2019	3	3		
30/01/2019			3	3
06/02/2019	3		3	3
13/02/2019	3	3		
21/02/2019	3	3	3	3.75
28/02/2019			3	1
03/03/2019				5
06/03/2019	3	3	3	3
Total	**36**	**36**	**36**	**42**

Table A11.1.4: Dates and duration of VP watches undertaken in the Study Area during summer 2019 and winter 2019-20

Breeding 2019				
Date	**VP1**	**VP2**	**VP3**	**VP4**
09/03/2019			2	
22/03/2019	3	3	3	3
29/03/2019	3	3		
03/04/2019			3	
04/04/2019	3	3		
12/04/2019			3	3
02/05/2019	3	3	3	3
09/05/2019	2	2		1
23/05/2019	4	4	4	4
04/06/2019		3		
05/06/2019	3		3	3
18/06/2019	3		3	
26/06/2019		3		3
03/07/2019	3		3	
10/07/2019		3		3
18/07/2019	3		3	
25/07/2019		3		3
07/08/2019	3		3	
15/08/2019		3		3
20/08/2019	3		3	
30/08/2019		3		
04/09/2019				3
Total	**36**	**36**	**36**	**32**

Non-breeding 2019-20				
Date	**VP1**	**VP2**	**VP3**	**VP4**
02/10/2019	3			3
09/10/2019		3	3	
16/10/2019	3			3
31/10/2019		3	3	
21/11/2019			3	3
29/11/2019	3	3	3	3
06/12/2019	3	3		
15/12/2019			3	3
22/12/2019	3	3	3	3
29/12/2019	3	3		
08/01/2020	3	3		
10/01/2020			3	3
20/01/2020	3	3		
25/01/2020			3	3
27/01/2020	3	3		
31/01/2020			3	3
07/02/2020	3	3		
18/02/2020			6	
20/02/2020				3
22/02/2020		3		3
08/03/2020			3	3
11/03/2020	6	3		
Total	**36**	**36**	**36**	**36**

Table A11.1.5: Dates and duration of VP watches undertaken in the Study Area during summer 2021 and winter 2021-22

Breeding 2021				
Date	**VP1**	**VP2**	**VP3**	**VP4**
20/03/2021				3
21/03/2021			6	3
23/03/2021	3	6		
26/03/2021	3			
03/04/2021	6			
04/04/2021		6		
08/04/2021				3
05/05/2021	3	3		
06/05/2021			6	3
12/05/2021	3	3		
14/05/2021				3
16/05/2021			3	
26/05/2021			3	3
13/06/2021			3	
14/06/2021		6		
18/06/2021		3		
20/06/2021				6
22/06/2021	6			
28/06/2021			3	
19/07/2021		3		
24/07/2021			6	3
25/07/2021	6			
02/08/2021				1
17/08/2021		3		
22/08/2021	3		3	3
27/08/2021	3	3		
28/08/2021			3	3
29/08/2021				2
Total	**36**	**36**	**36**	**36**

Non-breeding 2021-22				
Date	**VP1**	**VP2**	**VP3**	**VP4**
28/09/2021	3	3		
29/09/2021			3	3
03/10/2021		3		6
06/10/2021		3	6	
18/10/2021	6			
16/11/2021		6		
21/11/2021	6			
03/12/2021		6		
05/12/2021	6			
15/12/2021			3	
19/12/2021				6
21/01/2022				6
23/01/2022		6		
24/01/2022	6			
30/01/2022		3	3	
16/02/2022	3	3		
27/02/2022			6	3
09/03/2022				6
10/03/2022	6			
12/03/2022			6	
13/03/2022		3		
15/03/2022				6
18/03/2022			6	
Total	**36**	**36**	**33**	**36**

3.3 Breeding bird surveys

The purpose of the site walkovers or point counts, according to SNH guidelines, is to give a broad overview of bird activity within the Study Area (and 800 m Study Area for curlew) using a route which is representative of the important ornithological features/habitats present (SNH, 2017). Breeding bird surveys aim to provide information on the distribution of breeding birds throughout the Study Area, highlighting the locations of potentially sensitive species to be flagged as ecological constraints, *e.g.* breeding waders or raptors. Various methods are employed depending on the habitat type and the expected species. Survey requirements were determined by the desk-based study such as proximity to designated sites, habitat availability and associated avian assemblages.

Based on topography and habitat availability, the desk-based study determined that the Study Area had the potential to support upland breeding birds, including upland breeding waders such as golden plover, curlew and snipe. For the upland breeding bird surveys, a Brown & Shepherd survey technique was employed, as modified by SNH (2017) based on Calladine *et al.* (2009). This recommends an increase in the number of visits per season from two to four, and that all suitable habitat is searched to within 100 m. Due to access restrictions in the earlier breeding seasons, 2018 and 2019, only two visits were carried out. Subsequently, it was determined that, due to low observed usage of the Study Area by breeding waders, <4 visits were sufficient. Additionally, four seasons of breeding wader surveys were carried out as opposed to the minimum recommended two seasons by SNH (2017). According to SNH (2017), breeding bird surveys should be at least 7 days apart, covering the whole breeding season. A search radius covering suitable habitat within 800 m of the proposed turbine locations was used, for breeding curlew, which have been reported to be sensitive to wind farm infrastructure up to 800 m (Pearce-Higgins *et al.*, 2009; 2012). This is in line with recommendations from NIEA.

In addition to breeding waders, the Study Area was determined to be suitable for other upland breeding birds such as red grouse and merlin. The locations of calling/flushed red grouse were noted down during the transect surveys, including field signs such as droppings. Additionally, the forestry block in the south-west of the Study Area was judged to provide potential nesting habitat for merlin and this area was covered during the walkover surveys (see route 1a and SW buffer in **Figure A11.1.4.1** and route 4, 5 and 6 in **Figure A11.1.4.2**, **Appendix IV**), when surveyors took note of merlin signs, such as plucking posts. Targeted merlin surveys were also employed during the wider area breeding raptor surveys, as detailed in **Section 3.4**.

The results of the upland breeding bird surveys identified that there were breeding snipe within the Study Area. To inform mitigation measures, an additional season of targeted breeding snipe surveys was conducted over the 2022 breeding season. This involved surveyors targeting wetter areas of the Study Area (see core snipe breeding areas in **Figure A11.1.7.2**, **Appendix VII**) from dawn to three hours after or late afternoon to dusk, as detailed in O'Brien & Smith (1992), to increase the chances of detecting breeding behaviour, including chipping or drumming.

During the upland breeding bird surveys, all other bird species encountered were also noted, along with behaviour to provide an indication of breeding status. The dates of these surveys are shown in **Table A11.1.6** and **Table A11.1.7** (with additional weather data and survey effort in **Appendix V**) and survey transect routes are shown in **Appendix IV**. All breeding

bird surveys were conducted under optimal weather conditions for surveying, as can be seen in **Appendix V**.

Table A11.1.6: Breeding bird survey effort during summer 2018 and summer 2019

Breeding 2018		
Date	**Survey type** (Appendix IV)	**Survey or**
10/05/2018	Brown & Shepherd (route 1 & 2)	MT/HPD
17/05/2018	Brown & Shepherd (route 6 & 3)	MT/HPD
26/05/2018	Brown & Shepherd (route 4 & 5)	MT/HPD
22/06/2018	Brown & Shepherd (SW buffer)	HPD
26/06/2018	Brown & Shepherd (route 1, 2 & 3)	MT/HPD /KB
27/06/2018	Brown & Shepherd (route 4 & 5)	HPD/KB
28/06/2018	Brown & Shepherd (route 6)	HPD/KB

Breeding 2019		
Date	**Survey type** (Appendix IV)	**Survey or**
11/04/2019	Brown & Shepherd (route 5a, 5d, 6b, 2b and 2a, 1b, 1a)	HD
22/05/2019	Brown & Shepherd (route 6a & 5b)	HD
04/06/2019	Brown & Shepherd (route 3a, 3b, 3c & 3d)	HPD
19/06/2019	Brown & Shepherd (route 4a & 4b)	HD
25/06/2019	Brown & Shepherd (route 2, 1a, 1b, 5a, 6b, 5c & 5d)	HD/HPD
04/07/2019	Brown & Shepherd (SW buffer)	HD
16/07/2019	Brown & Shepherd (route 4a, 4b, 5b & 6a)	HD/HPD
25/07/2019	Brown & Shepherd (route 3c)	KW
30/07/2019	Brown & Shepherd (route 2a & 2b)	HD
31/07/2019	Brown & Shepherd (route 3a & 3b)	HD

Table A11.1.7: Breeding bird survey effort during summer 2021 and summer 2022

Breeding 2021		
Date	**Survey type** (Appendix IV)	**Surveyor**
18/03/2021	Brown & Shepherd (route 4 & 5)	JB
20/03/2021	Brown & Shepherd (route 3)	JB
30/03/2021	Brown & Shepherd (route 1a, 1b, 1c & 6)	RV
31/03/2021	Brown & Shepherd (route 2a & 2b)	RV
12/05/2021	Brown & Shepherd (route 4)	JB
14/05/2021	Brown & Shepherd (route 5)	JB
16/05/2021	Brown & Shepherd (route 3)	JB
30/05/2021	Brown & Shepherd (route 2a & 6)	RV
03/06/2021	Brown & Shepherd (route 1c, 1b, 1c & 2b)	RV
10/06/2021	Brown & Shepherd (route 5)	JB
13/06/2021	Brown & Shepherd (route 3)	JB
14/06/2021	Brown & Shepherd (route 4)	JB
18/06/2021	Brown & Shepherd (route 2a & 2b)	RV
29/06/2021	Brown & Shepherd (route 1a, 1b, 1c & 6)	RV

Breeding 2022		
Date	**Survey type**	**Surveyor**
01/05/2022	Dusk snipe survey	JB
11/05/2022	Dusk snipe survey	JB
21/06/2022	Dusk snipe survey	JB

3.4 Wider area breeding raptor surveys

SNH (2017) recommends surveying the wider area (hinterland) for up to 2 km from the proposed wind turbines for most breeding raptor species, including hen harrier and merlin. This can be extended if the 2 km Study Area lies within the potential zone of influence to Special Protection Areas – SPAs (SNH, 2016) or can be extended to 6 km for breeding eagles. In this instance, the 2 km Study Area was not near any SPAs designated for raptors (the closest being the Derryveagh and Glendowan Mountains SPA *c.* 42 km north-west). Additionally, the habitat availability (*e.g.* no availability of crags or suitable cliffs) precluded the need for wider area eagle surveys. Thus, the 2 km search radius was considered appropriate – see **Figure A11.1.3**.

A combination of 'mini-VPs', as well as driven and walked transects were used to search potential nesting habitat within the hinterland over the breeding seasons of 2018, 2019 and 2021. Survey methods for breeding raptors follow those outlined in Hardey *et al.* (2013).

The occurrence of merlin exhibiting territorial behaviour over the plantation adjacent to the southwest corner of the Study Area in May 2018 altered the focus the hinterland surveys and, following this, wider area breeding raptor surveys largely focused on monitoring the success of this pair within the Study Area. The confirmation of a nest in the forestry block in the south-west of the Study Area in summer 2021 resulted in an additional season of targeted merlin surveys in summer 2022 involving VP watches of the nest site.

The dates of the wider area raptor and targeted breeding merlin surveys carried out during the survey period are shown in **Table A11.1.8** and **Table A11.1.9**, with further detail on weather and survey effort provided in **Appendix V**.

Table A11.1.8: Wider area breeding raptor survey effort in summer 2018 and 2019

Breeding 2018		
Date	**Survey**	**Surveyor**
10/05/2018	Wider area breeding raptor	MT/HPD
22/06/2018	Wider area breeding raptor / breeding merlin	KB/HPD
29/06/2018	Wider area breeding raptor / breeding merlin	KB
26/07/2018	Breeding merlin VP watches	KB

Breeding 2019		
Date	**Survey**	**Surveyor**
04/06/2019	Wider area breeding raptor	HD/ HPD
18/06/2019	Wider area breeding raptor	HD/KW
26/06/2019	Breeding merlin	KW
03/07/2019	Breeding merlin	KW
04/07/2019	Breeding merlin	HD
18/07/2019	Breeding merlin	KW
25/07/2019	Wider area breeding raptor	KW
30/07/2019	Wider area breeding raptor	HD

Table A11.1.9: Wider area breeding raptor survey effort in summer 2021 and 2022

Breeding 2021		
Date	**Survey**	**Surveyor**
26/03/2021	Wider area breeding raptor	RV
07/04/2021	Wider area breeding raptor	JB
05/05/2021	Wider area breeding raptor	RV
26/05/2021	Wider area breeding raptor	RV
19/07/2021	Wider area breeding raptor	JB
25/07/2021	Wider area breeding raptor	JB

Breeding 2022		
Date	**Survey**	**Surveyor**
19/03/2022	Breeding merlin VP	JB
25/03/2022	Breeding merlin VP	JB
18/04/2022	Breeding merlin VP	JB
01/05/2022	Breeding merlin VP	JB
11/05/2022	Breeding merlin VP	JB
21/06/2022	Breeding merlin VP	JB

3.5 Winter site walkovers

Winter walkovers of the Study Area were undertaken during winter 2018-19, 2019-20 and 2021-22, during which surveyors walked the Study Area noting down all species encountered, ensuring to cover a sample of all habitats present. As such, winter walkovers provide useful information on the distribution of winter bird species within the Study Area and how they are utilising each habitat type. As mentioned in Section 2, walkovers are also a more suitable survey method for species which are difficult to detect during VP watches, such as wintering woodcock. The dates of the winter site walkovers carried out during winter 2019-20 and winter 2020-21 can be found in **Table A11.1.10** and **Table A11.1.11**, with further detail on weather and survey effort provided in **Appendix V**. All winter site walkovers were conducted under optimal weather conditions for surveying. The transect routes referred to are shown in **Appendix IV.**

Table A11.1.10: Non-breeding season site walkover survey effort in winter 2018-19 and 2019-20

Non-breeding 2018-19		
Date	**Survey** (Appendix IV)	**Surveyor**
08/11/2018	Winter site walkover (route 97000 & 97500)	MT
06/12/2018	Winter site walkover (route 96500-96000/ 95500-95000)	MT/HPD
24/01/2019	Winter site walkover (all routes)	MT/HPD
12/02/2019	Winter site walkover – route (96750, 96250, 95750, 95250 & 94750)	HD/HPD

Non-breeding 2019-20		
Date	**Survey** (Appendix IV)	**Surveyor**
20/02/2020	Winter site walkover (route 5 & 6)	JB
22/02/2020	Winter site walkover (route 1 & 2)	RV
08/03/2020	Winter site walkover (route 3, 5 & 6)	JB/RV
12/03/2020	Winter site walkover (route 1 & 2)	RV

Table A11.1.11: Non-breeding season site walkover survey effort in winter 2021-22

Non-breeding 2021-2022		
Date	**Survey** (Appendix IV)	**Surveyor**
31/10/2021	Winter site walkover (route 1, 2, 3, 5 & 6)	JB/RV
28/01/2022	Winter site walkover (route 1, 2, 3, 4 & 6)	JB/RV
10/03/2022	Winter site walkover (route 1, 2, 3, 4 & 6)	JB/RV

3.6 Wider area wintering waterbird surveys

The results of the desk study (see **Section 2.2**), limited habitat availability and the upland nature of the Study Area means it was considered unlikely the area would consistently support any significant numbers of wintering waterbirds. Consequently, only one season of wider area wintering waterbird surveys was carried out in winter 2021-22. The desk-based study identified that Moor Lough and Lough Ash, and their adjacent habitats, were the most likely area to support wintering waterbirds, including whooper swans and migratory grey geese. It should be noted that activity around Moor Lough was also viewable from VP3 (though it is beyond 2 km and therefore not shown within the viewshed map), and any swans in green fields would be particularly evident. Some of the airspace above Moor Lough was also visible from VP1.

In assessing the impact of the Development, it is important to provide contextual data on the numbers of waterbirds (target species) in the wider area relative to the usage of the Study Area by these species. SNH guidelines require monitoring of swan and geese foraging and roosting locations when occurring in the environs of the Study Area, and specifically where SPAs are designated for these species. Study areas of up to 500 m from the site (in this case, turbine locations) for foraging locations and up to 1 km from the site for roost locations are recommended, although this may be extended where high levels of activity are anticipated.

In Ireland and Northern Ireland, swan and goose distribution is often not well documented beyond designated sites. In addition, many wintering waterbirds occur outside of SPAs. As such, the number of surveys undertaken was subject to the results of the surveys and how much waterbird activity was noted within the Study Area. The surveys were based on the approach employed by WeBS (Wetland Bird Surveys) and the survey area was extended to just over 5 km from the turbines to cover both Lough Ash and Moor Lough – see **Figure A11.1.4**.

Eight wider area wintering waterbird surveys were conducted over winter 2021-22, see **Table A11.1.12**. During these surveys, counts were taken of waterbird species at all publicly accessible/viewable bogs, ponds, canals, rivers and other wetland habitats. Other species, notably raptors, present during the survey were also recorded.

Table A11.1.12: Wider area wintering waterbird survey effort in winter 2021-22

Non-breeding 2021-2022		
Date	**Survey**	**Surveyor**
28/09/2021	Wider area IWeBS	RV
31/10/2021	Wider area IWeBS	RV
09/12/2021	Wider area IWeBS	RV
24/01/2022	Wider area IWeBS	RV
28/01/2022	Wider area IWeBS	RV
30/01/2022	Wider area IWeBS	RV
16/02/2022	Wider area IWeBS	RV
10/03/2022	Wider area IWeBS	RV

3.7 Survey limitations

Survey limitations included:

- Upon commencing VP watches in summer 2018, due to access restrictions, an alternative VP4 (VP4b) had to be used in April. Access was restored in May 2018 and viewsheds were considered comparable for both VPs.
- Two VPs received <36 hours of watches during the survey period (VP4 in Breeding season 2019 and VP3 in non-breeding season 2021-22). However, as there were 6 seasons of surveys carried out as opposed to the recommended 4 seasons, and some VPs received in excess of 36 hours, it is considered that the flightline data collected is sufficient.
- Due to access restrictions, in summer 2018 and 2019, only two upland breeding bird surveys were carried out as opposed to the recommended four visits. Due to low observed usage of the Study Area by breeding waders, and four seasons of surveys carried out as opposed to the recommended two seasons, <4 visits were determined to be sufficient.
- Three upland breeding bird surveys were carried out in summer 2021, as opposed to the recommended four visits. This was considered appropriate as no breeding waders (apart from snipe) were recorded during the first two visits and the third visit covered the fledging period.

Despite these limitations and considering an additional three seasons of surveys which were undertaken to keep data current for any planning submission (two complete seasons and one season of targeted surveys) were carried out, it is considered that the survey period provides an extensive data set to sufficiently inform the ornithological baseline and undertake a robust ornithological impact assessment for the Development.

4 Survey Results

Table A11.1.6.1 in **Appendix VI** provides a complete list of bird species encountered during all ornithological survey work carried out within the Study Area and wider area, along with their conservation status (Gilbert *et al.*, 2021; Stanbury *et al.*, 2021) and an indication of their occurrence within the Study Area and wider area.

4.1 Vantage Point (VP) Watches

Flight times for target species recorded within the Study Area during the 6 seasons are provided in **Table A11.1.13** and for each season in **Table A11.1.14**, **Table A11.1.15**, **Table A11.1.16**, **Table A11.1.17**, **Table A11.1.18** and **Table A11.1.19**. Flight time is split into different altitudinal levels in order to better understand the extent to which target species fly within the CRZ. Including swift, which were only included as a target species in summer 2021, a total of 17 target species were recorded flying through the Study Area during the survey period. Flight lines have been digitised and maps are provided in **Appendix III**.

Table A11.1.13: All flight time recorded within the Study Area during the survey period 2018 to 2022, by species.

Target Species	**No. of obs. in the Study Area** Avg. no. of birds (range)	**A: 0-20 m** (seconds)	**B: 20-160 m (CRZ)** (seconds)	**C: >160 m** (seconds)
Black-tailed godwit	**1 observation** 4 birds	24		
Buzzard	**141 observations** 1.26 birds (1-5 birds)	805	**66,672**	1,182
Golden plover	**82 observations** 27.79 birds (1-160 birds)	1,449	**314,278**	4,120
Great black-backed gull	**3 observations** 1.67 birds (1-2 birds)	16	**556**	
Grey heron	**1 observation** 1 bird	98		
Hen harrier	**7 observations** 1 bird	616	**110**	
Herring gull	**1 observation** 4 birds		**760**	
Jack snipe	**1 observation** 1 bird	3		
Kestrel	**31 observations** 1 bird	1,045	**3,839**	
Lesser black-backed gull	**5 observations** 1.2 birds (1-2 bird)	129	**29**	
Mallard	**3 observations** 1 bird	36	**40**	
Merlin	**18 observations** 1 bird	898	**180**	
Peregrine	**17 observations** 1.18 birds (1-2 birds)	219	**654**	789
Red grouse	**4 observations** 1.75 birds (1-3 birds)	25		
Snipe	**10 observations** 1.1 birds (1-2 birds)	14	**181**	
Sparrowhawk	**10 observations** 1 bird	86	**511**	
Swift	**6 observations** 1.83 birds (1-5 birds)	140	**458**	

Table A11.1.14: Target species flight seconds recorded within the Study Area: Breeding season 2018

Target Species	A: 0-20 m	B: 20-160 m (CRZ)	C: >160 m
Buzzard	24	**1,341**	
Golden plover		**6,224**	
Kestrel		**265**	
Merlin	49	**19**	
Peregrine		**10**	113
Red grouse	11		
Snipe		**40**	
Sparrowhawk	6		

Table A11.1.15: Target species flight seconds recorded within the Study Area: Winter 2018-19

Target Species	A: 0-20 m	B: 20-160 m (CRZ)	C: >160 m
Black-tailed godwit	24		
Golden plover		**9,824**	2,074
Jack snipe	3		
Kestrel		**108**	
Merlin	389	**53**	
Peregrine		**101**	
Red grouse	12		
Snipe	14	**28**	

Table A11.1.16: Target species flight seconds recorded within the Study Area: Breeding season 2019

Target Species	A: 0-20 m	B: 20-160 m (CRZ)	C: >160 m
Buzzard	56	**11,324**	181
Golden plover		**1,930**	
Grey heron	98		
Hen harrier	412	**110**	
Kestrel	11	**2,606**	
Mallard	36	**40**	
Merlin	4	**27**	
Snipe	0	**86**	
Sparrowhawk		**130**	

Table A11.1.17: Target species flight seconds recorded within the Study Area: Winter 2019-20

Target Species	A: 0-20 m	B: 20-160 m (CRZ)	C: >160 m
Buzzard	7	**386**	
Golden plover	187	**239,124**	2,046
Hen harrier	10		
Kestrel	669		
Peregrine		**47**	
Sparrowhawk	16	**4**	

Table A11.1.18: Target species flight seconds recorded within the Study Area: Breeding season 2021

Target Species	A: 0-20 m	B: 20-160 m (CRZ)	C: >160 m
Buzzard	701	**53,611**	1,001
Golden plover	458	**18,108**	
Great black-backed gull		**556**	
Hen harrier	62		
Herring gull		**760**	
Kestrel	330	**860**	
Lesser black-backed gull	37		
Merlin	437	**81**	
Peregrine	219	**496**	676
Sparrowhawk		**368**	
Swift	140	**458**	

*Note that summer 2021 was the only season to include swift data in VP watches

Table A11.1.19: Target species flight seconds recorded within the Study Area: Winter 2021-22

Target Species	A: 0-20 m	B: 20-160 m (CRZ)	C: >160 m
Buzzard	17	**10**	
Golden plover	804	**39,068**	
Great black-backed gull	16		
Hen harrier	132		
Kestrel	35		
Lesser black-backed gull	92	**29**	
Merlin	19		
Red grouse	2		
Snipe		**27**	
Sparrowhawk	64	**9**	

4.2 Breeding bird surveys

Upland breeding bird surveys following a Brown & Shepherd methodology were undertaken in summer 2018, 2019 and 2021, with additional, targeted breeding snipe surveys carried out in summer 2022. **Table A11.1.20**, **Table A11.1.21**, **Table A11.1.22** and **Table A11.1.23** provide a list of all species recorded during each visit according to their BTO codes. Target species are underlined and birds that were noted to be exhibiting breeding/territorial behaviour are highlighted in **bold**. The codes and full names are provided in **Appendix I**.

A description of each species' occurrence within the Study Area is provided in **Appendix VI** and breeding red grouse, wader and raptor territories identified are shown in **Appendix VII**. During the targeted snipe surveys carried out in summer 2022, no drumming or chipping snipe were recorded, and no birds were flushed by surveyors.

Table A11.1.20: Summary of breeding bird walkover and dusk surveys carried out in summer 2018

Date	**Survey type** (Appendix IV)	**Species** (BTO code – see Appendix I)
10/05/2018	Upland breeding birds (route 1 & 2)	**BT**, BZ, **CH**, CK, CT, GC, HC, J, JD, **MP**, PH, R, RB, RG, **S**, SC, SG, SL, W, WR, **WW**
17/05/2018	Upland breeding birds (route 6 & 3)	BZ, **CH**, CK, GC, GL, HC, JD, K, **ML**, **MP**, PE, PH, **R**, RN, **S**, **SC**, **SG**, SK, SL, SM, W, **WR**, WW
26/05/2018	Upland breeding birds (route 4 & 5)	**B,** BT, BZ, **CH,** CK, **CT, GC, HC,** HM**, JD,** K, LI, **LR,** M**,** MG**, MP,** PE, PH, PW**, R, RB,** RN**, S, SC, SG,** SK, SL, SM, **ST, WH,** WP**, WR, WW**
22/06/2018	Upland breeding birds (SW buffer)	**BC**, BZ, **CH**, CR, GC, GL, JD, MG, **MP**, R, RN, RO, **S**, SI, **SK**, SL, WP, **WR**, **WW**
26/06/2018	Upland breeding birds (route 1, 2 & 3)	BZ, **CH**, CT, **GO**, HC, JD, **LR**, MG, **MP**, PH, **RB**, RG, RN, **S**, **SC**, SG, SI, SK, SL, **SW**, W, **WP**, **WR**, **WW**
27/06/2018	Upland breeding birds (route 4 & 5)	**B**, BT, BZ, **CC**, **CH**, CT, GC, GL, **GO**, HC, JD, LB, **LR**, **MP**, PH, **R**, **RB**, RG, RN, RO, **S**, **SC**, SG, SI, SL, **SW**, TC, **WP**, **WR**, **WW**
28/06/2018	Upland breeding birds (route 6)	BZ, **CH**, CT, GC, H, HC, JD, **LR**, **MP**, RN, **S**, **SC**, SG, SL, **WP**, **WR**, **WW**

Table A11.1.21: Summary of breeding bird walkover and dusk surveys carried out in summer 2019

Date	**Survey type** (Appendix IV)	**Species** (BTO code – see Appendix I)
11/04/2019	Upland breeding birds (route 5a, 5d, 6b, 2b and 2a, 1b, 1a)	**B**, **BZ**, **CH**, **GC**, GL, GP, HC, **JD**, K, MA, MG, **MP**, PH, **R**, RG, **RN**, **S**, SC, SG, SN, W, **WR**, **WW**
22/05/2019	Upland breeding birds (route 6a & 5b)	**BC**, BZ, **CH**, **CK**, CM, **GO**, HC, JD, LR, M, MG, **MP**, PH, **R**, RN, RO, **S**, SC, SK, SL, SM, **SN**, W, **WR**, **WW**
04/06/2019	Upland breeding birds (route 3a, 3b, 3c & 3d)	**CH**, **CK**, **CT**, GO, M, **MP**, **R**, RN, **S**, **SN**, **WR**, **WW**
19/06/2019	Upland breeding birds (route 4a & 4b)	**BT**, **CH**, **CT**, **GC**, **HC**, J, JD, LI, LR, MG, **MP**, **R**, **RB**, RN, **S**, SC, SG, **WP**, **WR**, **WW**
25/06/2019	Upland breeding birds (route 2, 1a, 1b, 5a, 6b, 5c & 5d)	**B**, **BF**, BT, BZ, **CH**, **CT**, **GC**, GL, GT, HC, J, JD, K, LB, LI, **LR**, M, MG, **MP**, PH, PW, **R**, **RB**, RG, RN, **S**, **SC**, **SG**, SI, SL, SM, **SN**, **ST**, **WP**, **WR**, **WW**

04/07/2019	Upland breeding birds (SW buffer)	**CH**, **CT**, **GC**, HC, J, LB, M, **MP**, **R**, RN, **S**, SG, SL, WP, **WR**, **WW**
16/07/2019	Upland breeding birds (route 4a, 4b, 5b & 6a)	BT, CH, GC, HC, LI, **LR**, M, MG, **MP**, **R**, **RB**, RN, **S**, **SC**, SG, SL, **WP**, **WR**, **WW**
25/07/2019	Upland breeding birds (route 3c)	**MP**, RG, RN, **S**, **SC**, **WR**
30/07/2019	Upland breeding birds (route 2a & 2b)	BT, CH, CT, GC, **GT**, HC, JD, LR, M, ML, **MP**, **R**, RB, RN, S, SG, SL, WP, **WR**, WW
31/07/2019	Upland breeding birds (route 3a & 3b)	BZ, **CT**, **GH**, HC, **MP**, RN, S, SG, SL, SN, **WP**, WR, WW

Table A11.1.22: Summary of breeding bird walkover and dusk surveys carried out in summer 2021

Date	**Survey type** (Appendix IV)	**Species** (BTO code – see Appendix I)
18/03/2021	Upland breeding birds (route 4 & 5)	BT, BZ, CH, GP, HC, JS, LR, **M**, **MP**, RE, RG, **S**, SN, **WR**
20/03/2021	Upland breeding birds (route 3)	CH, HC, JS, MG, **MP**, RG, **S**, SN, **WR**, WS
30/03/2021	Upland breeding birds (route 1a, 1b, 1c & 6)	**B**, BF, BZ, CA, **CH**, **CT**, D, FF, GB, **GC**, GO, **GT**, HC, JD, JS, K, LR, **M**, **MG**, **MP**, PH, **R**, **RB**, RE, **RN**, **S**, SC, SG, **SK**, SN, **ST**, WP, **WR**
31/03/2021	Upland breeding birds (route 2a & 2b)	**B**, **BT**, BZ, **CH**, D, FF, HC, HS, JD, JS, ML, **MP**, **R**, **RB**, RE, RG, RN, **S**, **SC**, **SG**, SN, **ST**, **WR**
12/05/2021	Upland breeding birds (route 4)	BZ, **CH**, **GC**, HC, J, **M**, **MP**, **R**, **S**, SG, **ST**, **WR**, **WW**
14/05/2021	Upland breeding birds (route 5)	**CH**, HC, **MP**, **R**, RG, RN, **S**, **SC**, **SG**, SK, SL, **SN**, **WR**
16/05/2021	Upland breeding birds (route 3)	HC, **MP**, **S**
30/05/2021	Upland breeding birds (route 2a & 6)	**B**, **BC**, BT, **CH**, **CK**, **CT**, D, **GC**, GT, HC, JD, LI, **MP**, PW, **R**, RB, RN, **S**, **SC**, **ST**, **SW**, WH, WP, **WR**, **WW**
03/06/2021	Upland breeding birds (route 1c, 1b, 1c & 2b)	**B**, **BC**, **BT**, **CH**, **CK**, **D**, FP, **GC**, GL, **GR**, **GT**, HC, JD, **LR**, M, MG, **MP**, PH, PW, **R**, **RB**, RN, **S**, **SC**, SG, SK, **SL**, SM, **ST**, **SW**, WP, **WR**, **WW**
10/06/2021	Upland breeding birds (route 5)	BZ, CK, GL, HC, M, MG, **MP**, RN, **S**, **SC**, SG, **WR**
13/06/2021	Upland breeding birds (route 3)	BZ, HC, **MP**, **S**, **SC**, SL, SN, **WR**, **WW**
14/06/2021	Upland breeding birds (route 4)	**CH**, HC, M, MG, **MP**, R, RB, **S**, **ST**, **WR**, **WW**
18/06/2021	Upland breeding birds (route 2a & 2b)	**B**, BF, **BT**, BZ, **CH**, **CK**, CT, GC, GL, GP, **GT**, HC, HS, JD, LI, LR, **M**, MG, **MP**, **R**, **RB**, RN, **S**, **SC**, SG, **SK**, SL, **SN**, **ST**, **WP**, **WR**, **WW**
29/06/2021	Upland breeding birds (route 1a, 1b, 1c & 6)	**B**, **BC**, BF, BT, **BZ**, **CH**, **CT**, **D**, **GC**, **GH**, GO, **GR**, HC, J, JD, LR, **M**, MA, MG, **MP**, **R**, RB, RN, **S**, **SC**, SG, **SK**, SL, **SN**, **ST**, **WP**, **WR**, **WW**

Table A11.1.23: Summary of breeding snipe dusk surveys carried out in summer 2022

Date	**Survey**	**Species** (BTO code – see Appendix I)

01/05/2022	Dusk snipe survey	No target species recorded
11/05/2022	Dusk snipe survey	No target species recorded
21/06/2022	Dusk snipe survey	No target species recorded

4.3 Wider area breeding raptor surveys

Table A11.1.24, **Table A11.1.25**, **Table A11.1.26** and **Table A11.1.27** show the number of target species recorded on each survey date during the wider area breeding raptor and targeted breeding merlin surveys carried out in the 2018, 2019, 2021 and 2022 breeding seasons, respectively. Breeding territories identified during the wider area surveys (supplemented by information from the VP and walkover surveys) are shown in **Figure A11.1.7.3** in **Appendix VII.**

Table A11.1.24: Counts of target species recorded in the wider area - summer 2018

Species	02 May 2018	22 Jun 2018	29 Jun 2018	26 Jul 2018
Buzzard	1	1		
Lesser black-backed gull	1			

Table A11.1.25: Counts of target species recorded in the wider area - summer 2019

Species	04 Jun 2019	18 Jun 2019	26 Jun 2019	03 Jul 2019	04 Jul 2019	18 Jul 2019	25 Jul 2019	30 Jul 2019
Buzzard				1				
Hen harrier								1
Merlin		1						

Table A11.1.26: Counts of target species recorded in the wider area - summer 2021

Species	26 March 2021	07 April 2021	05 May 2021	26 May 2021	19 July 2021	25 July 2021
Buzzard	3	11	1	1	3	4
Kestrel					2	
Merlin					3	
Peregrine		1				
Red-throated diver	1					
Sparrowhawk	3	1		1	2	

Table A11.1.27: Counts of target species recorded during targeted breeding merlin surveys in 2022

Species	19 Mar 2022	25 Mar 2022	18 Apr 2022	01 May 2022	11 May 2022	21 Jun 2022
Buzzard		5		4		
Kestrel			1	2		
Merlin	5		9	10	5	1
Sparrowhawk		1				

Raptor activity within the 2 km Study Area was relatively low, with some survey dates recording no target species. Buzzard and merlin were the most frequently recorded raptors during the wider area surveys.

The only raptor found to be breeding within or directly adjacent to the Study Area was merlin, confirmed to be nesting within the block of forestry in the south-west of the Study Area in summer 2021 and 2022. Within the 2 km Study Area, breeding/territorial behaviour was noted for the green listed species buzzard and sparrowhawk, and it is estimated that

there are two buzzard pairs and one sparrowhawk pair nesting within areas of woodland/forestry. Though no nest site was pinned down during the survey period, the use of the Study Area by kestrel (both male and female observed) means that there is also likely a pair of kestrel breeding in the wider area.

The surveys confirmed that, though peregrine hunt and commute occasionally through the 2 km Study Area, there are no suitable cliffs/ledges for breeding. Similarly, hen harriers were occasionally seen utilising the Study Area and environs for hunting, but were not recorded as breeding within the 2 km Study Area.

4.4 Winter site walkovers

Winter site walkovers were undertaken in winter 2018-19, 2019-20 and 2021-22. **Table A11.1.28**, **Table A11.1.29** and **Table A11.1.30** provide a list of target species recorded during each visit according to their BTO codes, with target species underlined. A description of each species' occurrence within the Study Area is provided in **Appendix VI** and the BTO codes and full names are provided in **Appendix I**.

Table A11.1.28: Summary of winter walkover surveys carried out in winter 2018-19

Date	**Species** (BTO code – see Appendix I)
08/11/2018	CT, D, HC, M, MG, MP, RN, SG, SN, WR
06/12/2018	BF, HC, JD, LR, ML, MP, PW, RG, RN, SN, ST, WK, WR
24/01/2019	BF, BT, GC, HC, JD, LR, MG, MP, PH, PW, R, RB, RG, RN, SC, SN, WR
12/02/2019	CT, GC, GP, MP, R, RG, RN, S, SN, WR

Table A11.1.29: Summary of winter walkover surveys carried out in winter 2019-20
Note: only target species (excluding target passerine sp.) were recorded during winter 2019-20 surveys

Date	**Species** (BTO code – see Appendix I)
20/02/2020	GB, SN
22/02/2020	GP, SN
08/03/2020	JS, SN
12/03/2020	SN

Table A11.1.30: Summary of winter walkover surveys carried out in winter 2019-20

Date	**Species** (BTO code – see Appendix I)
31/10/2021	B, BF, BT, BZ, CH, CR, CT, D, GC, GO, GP, GT, HC, J, JD, LI, LR, LT, MG, MP, R, RB, RE, RN, SC, SK, SN, WR
28/01/2022	B, BB, BF, BT, CH, CT, D, FF, GC, GP, GT, HC, JD, JS, LR, LT, M, MG, MP, PW, R, RB, RE, RN, RO, SC, SG, SK, SN, WK, WR
10/03/2022	B, BF, CH, CR, CT, GC, GP, GS, HC, JD, LR, M, MG, MP, R, RG, S, SC, SG, SN, ST, WK, WP, WR

4.5 Wider area wintering waterbird surveys

Wider area wintering waterbird surveys were carried out in winter 2021-22, largely focusing on counts at Moor Lough and Lough Ash. **Table A11.1.31** shows the number of wintering waterbirds recorded on each survey date and their location in relation to the survey area. Waterbird activity was very limited within the 5 km Study Area, with most of the activity recorded at Moor Lough and Lough Ash.

The only waterbird/riverine species recorded outside of Moor Lough and Lough Ash included:

- Two lesser black-backed gulls feeding within a field adjacent to a stream south of VP4;
- A grey wagtail recorded along the Donaldsglen Burn south-west of the 2 km turbine buffer; and
- A dipper recorded on two occasions at Jack's Bridge along the Burn Dennett 3 km north-east of the Study Area.

Other target species recorded during the wider area wintering waterbird surveys included an immature, male sparrowhawk, recorded on one occasion hunting along the margins of Moor Lough. This corresponds to a likely sparrowhawk territory identified in summer 2021 *c.* 200 m west of this location. A buzzard was also seen foraging for worms within a field in this area.

At Lough Ash, a pair of buzzards were seen displaying and circling high over the lake on 24 January 2022. Later in the season, on 10 March 2022, the pair were seen copulating in a tree adjacent to the lake, confirming a breeding territory in the area (outside of the 2 km Study Area for breeding raptors).

Table A11.1.31: Wintering waterbird numbers at Moor Lough and Lough Ash during winter 2021-22

Species	**28 Sep 2021**	**31 Oct 2021**	**09 Dec 2021**	**24 Jan 2022**	**28 Jan 2022**	**30 Jan 2022**	**16 Feb 2022**	**10 Mar 2022**
Moor Lough (*c.* 1.2 km north-east of the nearest proposed turbine location)								
Cormorant			1	1			5	1
Goosander							2	
Lapwing				48				
Little grebe	2	3	3			1	5	1
Mallard	8	15	9	6			5	9
Moorhen	1		2	1			2	
Species	**28 Sep 2021**	**31 Oct 2021**	**09 Dec 2021**	**24 Jan 2022**	**28 Jan 2022**	**30 Jan 2022**	**16 Feb 2022**	**10 Mar 2022**
Lough Ash (*c.* 5.1 km north-east of the nearest proposed turbine location)								
Cormorant				6		4	8	5
Goldeneye				2			3	3
Great black-backed gull						1		
Grey heron		1						
Little grebe		2		4			4	2
Mallard		2		9		4	4	3
Moorhen		3						2
Teal								13

Species	28 Sep 2021	31 Oct 2021	09 Dec 2021	24 Jan 2022	28 Jan 2022	30 Jan 2022	16 Feb 2022	10 Mar 2022
Whooper swan				1		1		
Wigeon				7		17	18	5

5 Discussion

5.1 Red grouse

Based on walkover data and birds heard calling during VP watches, there is potential for three to four pairs of red grouse to occur within the Study Area. The southern part of the Study Area had the highest levels of red grouse activity during the survey period, with birds regularly flushed, droppings found, and birds heard calling on multiple occasions from VP3 and on one occasion from VP4. The majority of records were in the vicinity of VP3 and the existing substation, which correlates with some of the denser areas of heather within the Study Area. It was noted in the early stages of the survey period (2018/2019) that low incidences of grouse in the area surrounding VP4 may be due to significant sections of the northern slopes of Owenreagh being burnt just prior to this period, adversely affecting the amount of cover for nesting grouse. In March 2021, droppings were also recorded north of the Glenmornan Road and a bird was recorded calling twice from this location in December 2021 from VP1. This correlates with a breeding territory identified in the north of the Study Area in 2009 and 2010 (BioSphere Environmental Services, 2014). Estimated breeding territories for red grouse are presented in **Figure A11.1.7.1** in **Appendix VII.**

Relatively low breeding densities are typical for the northwest of Ireland and the Study Area would not be expected to support more than three to four pairs in its current condition. It has also been reported that red grouse are actively hunted in parts of the Study Area, which may explain the relatively low levels of abundance recorded out of the breeding season.

Over the study period, only one flight was observed for red grouse (short flight at 1 m) and all other records during VP watches were of flushed or calling birds. No red grouse were observed within the CRZ (>20 m).

Due to their red-listed status (Gilbert *et al.*, 2021) and confirmed breeding territories within the Study Area, it is considered that there is **potential for significant effects** on red grouse in the absence of mitigation. As such, potential effects on red grouse and mitigation are discussed further within Chapter 11 – Ornithology of the ES.

5.2 Waterbirds

Wildfowl – swans, geese & ducks

Across all the surveys undertaken, there were no records of swans or geese within the Study Area. In respect to the wider area, during a watch at VP1 on 29 November 2019, two whooper swans were recorded flying in a north-westerly direction over Moor Lough *c.* 1 km north of the Study Area. Two whooper swans were also recorded flying close to Moor Lough in the north of the 2 km Study Area on 20 March 2021 and an individual whooper swan was recorded feeding on the edge of Lough Ash on two occasions in January 2022, *c.* 5 km north-east of the Study Area.

In terms of duck species, a population of mallard (up to 15 birds) was recorded at Moor Lough and wigeon (up to 18 birds), teal (up to 13 birds), mallard (up to 9 birds) and goldeneye (up to 3 birds) were recorded at Lough Ash during the wider area wintering waterbird surveys carried out in winter 2021-22. The only duck species observed within or in close proximity to the Study Area was one male mallard seen flying into the Legnahone Burn, and then back towards the direction of Moor Lough approximately an hour later, on 29 March 2019 from VP1 and one mallard flying north of the Study Area in April 2019.

The Study Area is not considered archetypal swan or goose foraging habitat and no foraging flocks were recorded in the area. Similarly, the first order, fast flowing upland eroding streams within the Study Area are not considered suitable habitat for duck species. As outlined in the desk-based study, most of the wildfowl activity recorded in the wider area is associated with Moor Lough and Lough Ash, with the nearest sensitive goose and swan habitat being the margins of the River Foyle and Lough Foyle.

Based on the low level of flights and limited foraging or roosting habitat in the area, the Development is assessed as highly unlikely to affect whooper swans, as well as other species of swans, geese and ducks occurring in the wider area and those with potential to be ecologically connected to Natura 2000 sites (here, this reference is including UK National Sites, European Sites and in NI under PPS 2, Ramsar Sites). Thus, there is **no potential for significant effects**.

Waders

Golden plover

Golden plover were recorded during all six survey, with the majority of records occurring in the southern part of the Study Area between VP3 and VP4 (see **Figure A11.1.3.2**-**Figure A11.1.3.7** in **Appendix III**). Golden plover were the most frequently recorded target species recorded during the VP watches with an aggregated flight time of 314,278 seconds within the CRZ. Most of the observations (n = 101) were wintering records, where flocks of up to 160 birds (mean flock size of 28 birds recorded within the Study Area) were recorded flying/circling within and adjacent to the Study Area. Flightlines regularly passed through the existing array of turbines and birds were also observed showing turbine avoidance behaviour. Based on flightline and walkover data capturing birds foraging/roosting on the ground, the operational wind turbines appear to overlap somewhat with core golden plover foraging areas. Flocks appeared to be attracted to the ridge of Owenreagh and Craignagapple, often concentrating in areas with bare peat and small bog hags.

Flights during the breeding seasons were mostly birds on passage in March and April, though there were two records of birds calling during the 2021 breeding season:

- On 18 June 2021 a bird was heard calling from the west of the Study Area, *c.* 300 m south of Napple Road, during a walkover survey; and
- On 24 July 2021 a bird was heard calling from VP4 on 5 occasions between 16:41 and17:57 on the southern slopes of Owenreagh Hill, north of VP4.

Golden plover is a species which aggressively defends nest sites and performs distinct display and distraction flights when breeding (Ratchliffe, 1976). Despite these two incidences of calling birds during the breeding season, no territorial or display behaviour was seen, and no breeding attempts were detected. As such, the two calling birds may have been breeding birds visiting the Study Area to forage, or failed breeding birds. The habitat quality beyond the existing array of turbines was considered of moderate to low quality for this species – being relatively rank or dense heather. There is some limited potential for this species to breed within the Study Area, though there are no historic breeding records (Sharrock, 1976).

Based on their high aggregated flight time within the CRZ (314,278 seconds) and red-listed status (Gilbert *et al.*, 2021), it is considered that there is **potential for significant effects** on wintering golden plover as a result of the Development, in the absence of mitigation. As such, potential effects were addressed further within Chapter 11 of the ES.

Curlew

On 19 April 2018, a curlew was heard calling south of the Study Area from the area where a displaying pair were recorded in 2017 (see **Figure A11.1.7.2** in **Appendix VII**). After this date, no curlews were recorded, and the breeding area was vacant during subsequent breeding seasons. The cause of the abandonment of the site by breeding curlew is likely as a result of the surrounding land being drained for agricultural purposes. Curlew are also particularly sensitive to wind farms (Pearce-Higgins *et al.*, 2009; 2012), though the existing wind farm has been in operation during previous successful breeding years.

As curlew were not recorded during the survey period within the Study Area or wider area, it is considered that there is **no potential for significant effects** as a result of the Development.

Snipe

Aggregated flight time for snipe within the Study Area was relatively low (195 seconds, 181 of which were in the CRZ). However, as flight activity for this species is largely crepuscular and VP surveys are carried out during daylight hours, VP surveys are not always an effective method of estimating snipe flight activity. As such, flight time within the Study Area is likely underestimated. Flights were mostly concentrated within the core breeding areas (see **Figure A11.1.3.8** and **Figure A11.1.7.2**).

Snipe were the only wader species breeding within the Study Area and territorial birds (drumming and chipping) were recorded from wetter areas adjacent to VP1, VP3 and VP4 during the 2018, 2019 and 2021 breeding wader surveys, with the eastern part of the Study Area between the existing substation and Napple Road holding the highest densities (see **Figure A11.1.7.2**). Across the Study Area as a whole, breeding densities were relatively low (max 3-4 pairs in 2019), reflecting the predominately free draining nature of the Study Area resulting in a patchy breeding distribution for this species, which selects wetter breeding sites. In 2018, it was noted that drought conditions were experienced which may have caused snipe to abandon breeding attempts due to wetter areas drying out. Numbers of chipping/drumming birds increased in 2019 and 2021 but in summer 2022, no snipe were flushed or heard during the breeding season. It should be noted that this may have been as a result of a surge in avian influenza at this time. Alternatively, weather conditions may have resulted in a drier spring, reducing the overall suitability of the Study Area for breeding snipe. Snipe over winter within the Study Area in higher numbers and were regularly flushed on walkovers. Small numbers of jack snipe were also flushed during the winter walkovers.

Though breeding snipe were not recorded during the 2022 breeding season, their confirmed breeding status in previous years and their wintering usage of the Study Area, as well as their red-listed status (Gilbert *et al.*, 2021), means there are **potential significant effects** on snipe as a result of the Development, in the absence of mitigation. As such, potential effects on snipe were addressed within Chapter 11 of the ES.

Other waders

A small number of wintering woodcock were observed during the winter site walkovers carried out in winter 2018-19 and 2021-22, with two records of birds flushed from the area around the proposed T9 and one record of a bird feeding at the conifer plantation in the south-west. It is likely that small numbers of woodcock over winter within the forestry in the Study Area. Though the breeding population of woodcock in Ireland and the UK are currently red-listed, the wintering population is considered to be stable at present (Gilbert *et al.*, 2021;

Stanbury *et al.*, 2021). Based on low activity and no loss of woodcock habitat (mature forestry), there is **no potential for significant impacts** on this species as a result of the Development.

A flock of approximately 50 lapwing was recorded on 24 January 2022 along the margins of Moor Lough. This flock was picked up during the wider area wintering waterbird surveys and from VP1 on the same date. The flock were never observed to travel through the Study Area during the survey period and all activity was associated with Moor Lough *c.* 1.2 km north-east of the nearest proposed turbine location. As such, they are not considered to be at risk of collision with the proposed wind turbines or loss of any foraging habitat, and there considered to be **no potential for significant effects.**

The only other wader species recorded during the survey period within the Study Area or wider area was a single record of four black-tailed godwits recorded flying in a north-easterly direction from VP3 on 28 February 2019.

Gulls

Gull species recorded within the Study Area included lesser black-backed gull, herring gull and great black-backed gull, see **Figure A11.1.3.10** in **Appendix III**. The density of use by gull species was relatively low, including:

- One observation of herring gull, involving four birds flying in a northerly direction between the existing turbines, amounting to an aggregated flight time of 760 seconds within the CRZ.
- Three observations of great black-backed gulls, with only one or two birds recorded on each occasion commuting over the Study Area. Aggregated flight seconds within the CRZ amounted to 560 seconds.
- Five observations of lesser black-backed gulls, with one or two birds commuting through the Study Area. Aggregated flight seconds within the CRZ amounted to 23 seconds, with most flights being below collision risk height.

Low aggregate flight times within the CRZ, combined with the species' observed avoidance of the existing turbines, means that the Development is not considered likely to impact any gull species in terms of collision risk. Additionally, no birds were observed to be foraging within the Study Area and the Development will not result in the loss of any suitable gull habitat. As such, gull activity within the Study Area is likely limited to birds commuting between more suitable, lowland pastures. There is therefore considered to be **no potential for significant effects** on gull species a result of the Development.

Other waterbirds

Other waterbird species recorded at Moor Lough included cormorant (1-5 birds), moorhen (2 birds), little grebe (1-5 birds) and goosander (pair) and species recorded at Lough Ash included moorhen (2-3 birds), cormorant (4-8 birds), little grebe (2-4 birds) and grey heron (1 bird). The pair of goosanders are suspected to be breeding along the Mourne River, between Strabane and Newtownstewart.

None of these species were recorded within the Study Area, bar a single record of a grey heron flying below the existing turbine array in an easterly direction on 15 August 2019. Given the low-level of usage recorded, the Development is not considered important for these waterbird species in terms of foraging or commuting and will result in **no potential significant effects**.

5.3 Birds of prey

Merlin

Merlin observations within the CRZ during the VP watches were relatively low (180 seconds), though it is acknowledged that VP surveys are not considered to be an appropriate methodology for this species (Madders & Whitfield, 2006). This is due to the low detectability of merlin (size, plumage and behaviour) and their sensitivity to disturbance from observers. Though flight time within the CRZ was likely underestimated, it should also be noted that most of the flight time for merlin (898 seconds) was recorded at <20 m. This reflects their low flight behaviour. Merlin flightlines are shown in **Figure A11.1.3.11** in **Appendix III**.

There is a longstanding merlin territory within the conifer plantation in the south-west of the Study Area (see **Figure A11.1.7.3**, **Appendix VII**), which was picked up during the first survey season when a male merlin was seen exhibiting territorial behaviour over this area in May 2018. Following this, extra survey effort was allocated to monitoring and tracking the success of this pair. Though nest locations can vary between years (particularly for tree-nesting merlin, as they do not maintain nest sites), merlin are site faithful, and territories can be occupied from year to year. Territories can also be used by successive generations with some studies finding birds occupying territories for over 70 years (Newton *et al*., 1978).

Surveys carried out in 2019 also found merlin attempting to breed in this area, though a nest was not pinned down at this point. In 2021, breeding was confirmed in the south-western point of the forestry by the presence of two fledglings. Merlin were again confirmed to be breeding at this same location in 2022, though it was noted by a surveyor that the pair failed later in the breeding season, likely due to the nest being predated.

Due to the confirmed breeding status of this Annex I species within the 2 km Study Area, there are **potential for significant effects** as a result of the Development, in the absence of mitigation. As such, potential effects to merlin and mitigation are addressed further within Chapter 11 of the ES.

Hen harrier

Hen harrier are an important Annex I species to consider in relation to wind farm developments. No hen harriers were recorded breeding or roosting within the 2 km turbine buffer and, though the Study Area has some suitable habitat in the form of upland bog dominated by heather, this species has not historically bred here, see **Section 2.3**.

All observations of hen harrier within the Study Area during the VP watches (n=7) were of hunting birds, mainly flying low (between 5 and 10 m) below the CRZ, see **Figure A11.1.3.12** in **Appendix III**. On 05 June 2019, a bird was observed to be foraging around the existing turbines, showing a level of habituation to the existing structures. Hen harrier were not included in the CRM as aggregated flight seconds amounted to just 120 seconds within the CRZ, consisting of only one observation of a bird flying above 20 m, also on 05 June 2019. Overall, observations of hen harrier during the survey period represent a very low usage of the Study Area and 2 km Study Area, with only occasional hunting birds seen. The Development is therefore considered to have **no potential for significant effects** on hen harrier.

Peregrine falcon

No suitable breeding habitat (cliff faces/buildings) for peregrine was identified within the 2 km Study Area. Peregrines were recorded occasionally during most of the survey seasons, including VP watches (see **Figure A11.1.3.13**), walkovers and wider area breeding raptor surveys. Plumage notes associated with some of the peregrine observations recorded brown colouration, which would be suggestive of immature birds. On 22 June 2018, a pair of peregrines were also seen interacting with one another south of Silverhill Road, during a breeding merlin survey at the forestry plantation. This was not concluded to be breeding/display behaviour. Most observations were of hunting birds and, as such, records are likely to be non-breeding birds or immature birds, which can be wide ranging and occur away from breeding sites (Hardey *et al*., 2013). Depending on prey availability, breeding peregrine can also travel significant distances from nest sites (Enderson & Craig, 1997).

A low aggregate flight time within the CRZ (654 seconds), combined with a lack of suitable breeding habitat means that there is **no potential for significant effects** on this Annex I species. Additionally, peregrine is currently green-listed in both Ireland and the UK (Gilbert *et al.*, 2021; Stanbury *et al.*, 2021).

Kestrel

After buzzards, kestrels were the most regularly recorded raptor species within the Study Area with 3,839 flight seconds recorded within the CRZ over the study period. As shown in **Figure A11.1.3.14** in **Appendix III**, kestrels regularly foraged through the Study Area over both the winter and breeding seasons. A male kestrel may have been prospecting for a nest site in a shelter belt near VP1 in summer 2018 however, the site was not occupied. This was suspected to be as a result of a high number of corvid species in the area. On 17 May 2018, a kestrel was also seen mobbing a peregrine along the Ballykeery Rd, south-west of VP3. No other breeding/territorial behaviour was noted within the 2 km Study Area during the survey period and no nest sites were identified. However, based on the usage observed, it is likely that there is at least one pair of breeding kestrel in the wider area and that the core foraging range of this pair overlaps with the Study Area.

Based on a relatively high aggregate flight time (3,839 seconds) within the CRZ, and a recent upgrade to red-listed status (Gilbert *et al.*, 2021), there is **potential for significant effects** on kestrel as a result of the Development, in the absence of mitigation. Potential effects and mitigation are therefore considered further within Chapter 11 of the ES.

Sparrowhawk

A relatively small number of sparrowhawk flightlines (n=10) were recorded within the Study Area over the survey period – see **Figure A11.1.3.15** in **Appendix III**. These were largely of flying and hunting birds, and no breeding/territorial behaviour was identified within the Study Area. As is the case with merlin, relying on VP watch data and the resultant CRMs may not be an appropriate methodology for assessment of collision risk in a small, more elusive raptor species like sparrowhawk (Madder & Whitfield, 2006). Though flight times from VP watches have the potential to be underestimated, it should also be noted that the open nature of the Study Area and the limited occurrence of woodland habitats is likely to contribute to the low number of observations. This can be seen in **Figure A11.1.3.15**, which shows that flightlines were largely associated with areas of woodland/scrub and forestry.

In terms of the 2 km Study Area, in summer 2021, a pair was seen circling together on two occasions over a woodland area *c.* 350 m north of VP1. This behaviour was picked up once

on a wider area breeding raptor survey on 26 March 2021 and again from VP1 on 03 April 2021. Subsequently, in July 2021, two suspected juvenile sparrowhawks were seen hunting together and chasing one another on Owenreagh Hill adjacent to the existing wind turbine array. An immature male was also seen hunting directly adjacent to the suspected breeding territory on 28 January 2022 during the wider area wintering waterbird surveys. Consequently, it is considered that there is at least one sparrowhawk breeding territory within the 2 km buffer (see **Figure A11.1.7.3** in **Appendix VII**), and that parts of the Study Area are used occasionally by this pair for hunting and commuting.

As such, despite a low aggregate flight time recorded within the CRZ (511 seconds), based on the presence of a breeding pair within the 2 km Study Area, and suspected juvenile birds utilising the Study Area, there is some limited **potential for significant effects** on sparrowhawk. This is addressed further within Chapter 11 of the ES.

Buzzard

Buzzards were the most commonly recorded raptor, with 144 observations recorded within the Study Area during the VP watches (see **Figure A11.1.3.16**-**Figure A11.1.3.19** in **Appendix III**). Buzzard observations generated the highest number of raptor flight seconds within the CRZ (66,672 seconds) over the 6 seasons. No breeding sites were detected within the Study Area over the survey period and the availability of suitable nesting habitat (woodland) is limited to a small number of wooded areas and forestry blocks.

Due to the late start of the breeding season surveys in summer 2018, no nest sites were identified in the hinterland, however, it was suspected that two pairs were holding territories in the vicinity of the Study Area and, based on a relatively high frequency of visits by buzzards, a possible nest site was identified in a small plantation south of VP4. In summer 2019, a likely changeover was observed between a male and female buzzard in a small area of trees surrounding an old farmhouse off Napple Road, 200 m east of VP1, indicating a probable nest site here. This correlated with the highest number of buzzard flightlines, including a pair observed displaying, being from VP1 in summer 2019. In summer 2021, a family of buzzards (2 adults and 3 juveniles) was seen in August from VP1, which suggested that this nest site was occupied again.

A bird was also seen carrying prey (provisioning) at Glenmornan, north-east of the 2 km buffer on 26 March 2021 and it was noted by a surveyor that birds were regularly seen in this area in summer 2021. Another breeding territory was identified at Lough Ash during the wider area wintering waterbird surveys carried out in winter 2021-22, though this pair are outside of the zone of influence of the development (*c.* 5.1 km from the nearest proposed turbine location). Buzzard territories identified within the 2 km Study Area throughout the study period are shown in **Figure A11.1.7.3**.

Based on activity within the Study Area and environs, it is likely that up to two buzzard pairs hold territories within the 2 km turbine buffer. Though no breeding territories were identified within the Study Area during the survey period, there is potential for buzzard to utilise the small areas of mature trees south of T13 and east of T2 in subsequent years. These areas are being retained within the Development and, as such, the Development will not result in the loss of any potential buzzard breeding habitat.

A buzzard corpse was recovered near the hardstand of the existing T14 on 12 July 2020 during the bat carcass searches carried out (see Chapter 10 of the ES). Due to the decomposition, it was not determined whether this was an adult or juvenile bird.

Though buzzard are currently green-listed in the UK and Ireland, based on a high aggregate flight time within the Study Area (66,672 seconds), an observed occurrence of collision mortality, and the confirmed presence of breeding pairs within the 2 km Study Area, there is considered to be **potential significant effects** on buzzard as a result of the Development, in the absence of mitigation. As such, potential effects and mitigation are discussed further within Chapter 11 of the ES.

5.4 Other species of conservation concern

Riverine species

Grey wagtails were observed along both the Legnahone Burn (within the Study Area) and Owenreagh Burn (immediately adjacent to the Study Area) and were recorded during summer 2018, 2019 and 2021. Though no nest sites were identified during the walkover surveys, this red-listed passerine species is considered as possible breeding within the Study Area. Although red listed, grey wagtails are relatively widespread and common on waterways and other waterbodies across Ireland. Severe winters during the last Bird Atlas (Balmer *et al.*, 2013) were thought to contribute to the observed population decline in this species, which although still registering declines appears to be stabilising (Crowe *et al.*, 2014). In relation to development projects, grey wagtails regularly utilise holes/cervices in man-made nest sites, including bridges and rock armouring around culverts, but are sensitive to deterioration in water quality.

A foraging dipper was recorded within the Study Area at the road bridge over the Legnahone Burn, along the Napple Road, on 06 February 2019 during trail camera surveys carried out for otter, indicating that this river segment may form part of a breeding territory. Though a nest-site was not observed at this bridge during the survey period, bridges are often used by nesting dipper. Dipper were also recorded during the wider area wintering waterbird surveys carried out in winter 2021-22 on two occasions at Jack's Bridge along the Burn Dennett, 3.5 km north-east of the nearest proposed turbine. On one occasion, a bird was flushed by the surveyor from underneath the bridge. On the next occasion, a bird was recorded exhibiting territorial (singing) behaviour (Magoolagan & Sharp, 2018) along the banks of the river, indicating a breeding territory (typical home range 0.5-2.5 km (Tyler *et al*., 1990)). This pair occur upstream of the proposed works. Though currently green-listed dipper, like grey wagtail, are sensitive to changes in water quality (Sorace *et al.*, 2002).

Based on their presence (and possible breeding status) within the Study Area and sensitivity to water quality impacts, there are **potential for significant effects** on riverine species as a result of the Development, in the absence of mitigation. As such, potential effects and mitigation are discussed further within Chapter 11 of the ES.

Plate A11.1.1: The road bridge over the Legnahone Burn, along the Napple Road

Plate A11.1.2: A dipper recorded foraging on 06 February 2019 during trail camera surveys for otter

Swift

Swift, which have moved from amber to red listed in the most recently published BoCCI (Gilbert *et al.*, 2021), and are a NI Priority Species, are emerging as species susceptible to turbine mediated mortality (Rydell *et al.*, 2012). Therefore, in the second breeding season (2021) swifts were included as target species during VP surveys and flight line data was collected. However, as this was not implemented ubiquitously across the survey period, the flight times recorded are only indicative and do represent a full breeding season. The area does not hold any suitable nesting habitat for this species, and they are unlikely to breed within the Study Area. Birds are, however, known to travel considerable distances from breeding sites to forage (up to 20 km). The Study Area is within the foraging range of swifts nesting in buildings within larger urban centres like Strabane.

Swifts were observed foraging within the Study Area a number of times during walkover surveys and VP watches, though very small numbers were noted. For the most part, numbers of between 1 and 6 birds were observed with a max foraging party of 18. Flight lines (2021 breeding season only) are shown in **Figure A11.1.3.20** in **Appendix III**. Flocks were recorded foraging with an aggregated flight time in the CRZ amounting to 600 seconds; however, this is an underestimate as surveyors did not start including swift as a target species until June 2021. Swift activity during VP and walkover surveys was mostly associated with the southern slopes of Owenreagh Hill, between VP4 and the conifer plantation.

Based on the indicative levels of flight activity and small flock numbers recorded, as well as a lack of suitable breeding habitat within the Study Area, there is **no potential for significant effects** on swift as a result of the Development.

Red-listed and NI priority list passerines

A summary of all species and their occurrence within the Study Area is provided in **Table A11.1.6.1** in **Appendix VI**. Red-listed (BOCCI4/BOCC5) and NI priority passerine species recorded within the Study Area included meadow pipit, skylark, cuckoo, redwing, grey wagtail, lesser redpoll, house sparrow, fieldfare, linnet, mistle thrush, song thrush and starling.

The habitat availability within the Study Area is such that ground nesting, open habitat species will be most impacted by the Development due to direct habitat loss. This includes

the red-listed species meadow pipit and skylark. Cuckoo is also included as a ground-nesting species in the assessment as they are brood parasites and meadow pipit, which were recorded frequently throughout the Study Area, are one of the most commonly used host species. As such, there is **potential for significant effects** on these species and potential effects and mitigation are discussed further within Chapter 11 of the ES.

Other red-listed breeding species occurring within the Study Area included lesser redpoll, house sparrow, mistle thrush, song thrush, linnet and starling. Lesser redpoll are considered to be breeding within the conifer plantation habitats within the Study Area. Linnet were recorded on four occasions within the Study Area, and were mostly associated with the area north-west of the Study Area boundary, where they are most likely to be breeding within scrub and gorse. Though no breeding/territorial behaviour was noted within the Study Area, linnet were included on a precautionary basis as possible breeding. Mistle thrush and song thrush were recorded singing from areas of forestry plantation and treelines, including the trees around the derelict farm building in the north-east of the Study Area.

House sparrow were found to be breeding within a farm building off the Glenmornan Road in the north-west of the Study Area. Usage of the Study Area by house sparrow was limited to this farm building, as this species tends to favour areas associated with human occupation. Starlings were also recorded as nesting in this farm building, along with the derelict farm building in the north-east of the Study Area, and the operational Owenreagh I and II Wind Farms substation.

Habitat loss associated with the Development (see **Technical Appendix A10 - Ecological Impact Assessment**) largely includes loss of acid and improved grassland, degraded peatland, *c.* 100 m of hedgerow and scrub. The Abnormal Load Route Works will result in the loss of some trees and hedgerow sections at pinch points along the road edge, as described in **Tables A2.3.1** and **A2.3.2** of **Technical Appendix TA2.3 Delivery Route Works – EIA Scoping Review**). It should be noted that there is no removal of forestry plantation associated with the Development. This precludes any direct habitat loss to lesser redpoll. House sparrow was recorded breeding at a farm building off the Glenmornan Road, which will not be affected by the Development, and therefore there is not considered to be the potential for any direct impacts to this species. Starlings were recorded nesting within the existing substation, which is proposed to be demolished. This will result in the very limited loss of used nesting habitat for this species. Due to the exposed, gappy nature of the hedgerows/scrub habitats being removed, there is also limited potential for direct habitat loss to linnet, which prefer to nest in dense hedgerows, scrub and gorse. Habitat loss for mistle thrush and song thrush will also be limited to small areas of hedgerow/scrub removal largely associated with the Abnormal Load Route.

Though there is **limited potential for direct significant effects** on these species, all species are considered within Chapter 11 of the ES in relation to indirect effects resulting from inappropriate timing of vegetation removal.

Wintering species foraging throughout the Study Area such as fieldfare and redwing, though likely to be displaced in the short-term, were considered to have **no potential for significant effects**, due to limited time spent within the Study Area and ample alternative foraging and/roosting habitat within the wider area.

Replacement planting for habitat loss as a result of the footprint of the wind farm has been discussed in detail within the draft HMEP (see Technical Appendix A3.2).

6 Conclusions

This report provides the ornithological baseline information required to undertake a robust ornithological impact assessment for the Development. Ornithological surveys conducted between April 2018 and June 2022 comply fully with the SNH (2017) guidelines for informing impact assessment of onshore wind farms. The information contained in this report includes robust baseline data, which can be used to assess the likely significant effects of the Development on the avi-fauna in the area. No substantial limitations were identified in terms of scale, scope or context in the preparation of this report.

Wintering waterbird, including geese and swan species, activity through and around the Study Area was very low and the closest area of importance for wintering waterbirds is Moor Lough, *c.* 1.2 km north-east of the nearest proposed turbine location. Therefore, the Study Area is not considered to be important for waterbirds and it can be concluded the Development will not impact significantly on any waterbird populations, including SPAs designated for breeding or wintering waterbirds, which is discussed further within the HRA (Woodrow, 2023a).

Though no breeding records were found of golden plover within the Study Area, wintering and passage birds regularly were observed to be foraging and roosting, including around the existing wind turbine array. Golden plover were the most commonly recorded species within the Study Area, with the highest aggregate flight time within the CRZ. Other species which are considered to potentially be impacted by the Development are red grouse and snipe, due to their confirmed breeding status within the Study Area.

In terms of birds of prey, the only raptor species identified to be breeding within/adjacent to the Study Area was the Annex I species merlin. Other raptor species breeding within the 2 km Study Area were buzzard, sparrowhawk and kestrel. The Annex I species peregrine and hen harrier were not found to be breeding within the 2 km buffer, and only occasionally used the Study Area for hunting and commuting.

Given that there is potential for the Development to have adverse impacts upon local water quality (in the absence of mitigation) this is considered further in the ES Chapter 11 – Ornithology, particularly for riparian birds such as grey wagtail and dipper.

Overall, the Development is considered to have a low risk to the bird populations occurring in the environs of the Study Area. In the absence of mitigation, there is considered to be potential for significant impacts on **red grouse, golden plover, snipe, merlin**, **buzzard, kestrel, sparrowhawk, riverine species** and red-listed and NI priority list breeding passerines, in particular, red-listed ground-nesting, open habitat passerine species such as **skylark, cuckoo** and **meadow pipit**. These species are discussed further in Chapter 11 – Ornithology of the ES. For species which have potential to be significantly impacted, measures to limit or compensate for potential negative impacts can be implemented.

A draft Habitat Management Plan (HMEP) has also been designed for this proposal, see Technical Appendix A3.2 of the ES. This plan intends to maintain, restore and enhance areas for biodiversity, particularly in relation to the local bird population at the site.

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Appendix I - BTO Species Codes

BTO SPECIES CODES

AC	Arctic Skua	GA	Gadwall	LE	Long-eared Owl	SM	Sand Martin
AE	Arctic Tern	GX	Gannet	LT	Long-tailed Tit	SS	Sanderling
AV	Avocet	GW	Garden Warbler	MG	Magpie	TE	Sandwich Tern
BO	Barn Owl	GY	Garganey	MA	Mallard	VI	Savi's Warbler
BY	Barnacle Goose	GC	Goldcrest	MN	Mandarin Duck	SQ	Scarlet Rosefinch
BA	Bar-tailed Godwit	EA	Golden Eagle	MX	Manx Shearwater	SP	Scaup
BR	Bearded Tit	OL	Golden Oriole	MR	Marsh Harrier	CY	Scottish Crossbill
BS	Berwick's Swan	GF	Golden Pheasant	MT	Marsh Tit	SW	Sedge Warbler
BI	Bittern	GP	Golden Plover	MW	Marsh Warbler	NS	Serin
BK	Black Grouse	GN	Goldeneye	MP	Meadow Pipit	SA	Shag
TY	Black Guillemot	GO	Goldfinch	MU	Mediterranean Gull	SU	Shelduck
BX	Black Redstart	GD	Goosander	ML	Merlin	SX	Shorelark
BJ	Black Tern	GI	Goshawk	M.	Mistle Thrush	SE	Short-eared Owl
B.	Blackbird	GH	Grasshopper Warbler	MO	Montagu's Harrier	SV	Shoveler
BC	Blackcap	GB	Great Black-backed Gull	MH	Moorhen	SK	Siskin
BH	Black-headed Gull	GG	Great Crested Grebe	MS	Mute Swan	S.	Skylark
BN	Black-necked Grebe	ND	Great Northern Diver	N.	Nightingale	SZ	Slavonian Grebe
BW	Black-tailed Godwit	NX	Great Skua	NJ	Nightjar	SN	Snipe
BV	Black-throated Diver	GS	Great Spotted Woodpecker	NH	Nuthatch	SB	Snow Bunting
BT	Blue Tit	GT	Great Tit	OP	Osprey	ST	Song Thrush
BU	Bluethroat	GE	Green Sandpiper	OC	Oystercatcher	SH	Sparrowhawk
BL	Brambling	G.	Green Woodpecker	PX	Peafowl/Peacock	AK	Spotted Crake
BG	Brent Goose	GR	Greenfinch	PE	Peregrine	SF	Spotted Flycatcher
BF	Bullfinch	GK	Greenshank	PH	Pheasant	DR	Spotted Redshank
BZ	Buzzard	H.	Grey Heron	PF	Pied Flycatcher	SG	Starling
CG	Canada Goose	P.	Grey Partridge	PW	Pied Wagtail	SD	Stock Dove
CP	Capercaillie	GV	Grey Plover	PG	Pink-footed Goose	SC	Stonechat
C.	Carrion Crow	GL	Grey Wagtail	PT	Pintail	TN	Stone-curlew
CW	Cetti's Warbler	GJ	Greylag Goose	PO	Pochard	TM	Storm Petrel
CH	Chaffinch	GU	Guillemot	PM	Ptarmigan	SL	Swallow
CC	Chiffchaff	FW	Guineafowl (Helmeted)	PU	Puffin	SI	Swift
CF	Chough	HF	Hawfinch	PS	Purple Sandpiper	TO	Tawny Owl
CL	Cirl Bunting	HH	Hen Harrier	Q.	Quail	T.	Teal
CT	Coal Tit	HG	Herring Gull	RN	Raven	TK	Temminck's Stint
CD	Collared Dove	HY	Hobby	RA	Razorbill	TP	Tree Pipit
CM	Common Gull	HZ	Honey Buzzard	RG	Red Grouse	TS	Tree Sparrow
CS	Common Sandpiper	HC	Hooded Crow	KT	Red Kite	TC	Treecreeper
CX	Common Scoter	HP	Hoopoe	ED	Red-backed Shrike	TU	Tufted Duck
CN	Common Tern	HM	House Martin	RM	Red-breasted Merganser	TT	Turnstone
CO	Coot	HS	House Sparrow	RQ	Red-crested Pochard	TD	Turtle Dove
CA	Cormorant	JD	Jackdaw	FV	Red-footed Falcon	TW	Twite
CB	Corn Bunting	J.	Jay	RL	Red-legged Partridge	WA	Water Rail
CE	Corncrake	K.	Kestrel	NK	Red-necked Phalarope	W.	Wheatear
CI	Crested Tit	KF	Kingfisher	LR	Redpoll (Lesser)	WM	Whimbrel
CR	Crossbill (Common)	KI	Kittiwake	RK	Redshank	WC	Whinchat
CK	Cuckoo	KN	Knot	RT	Redstart	WG	White-fronted Goose
CU	Curlew	LM	Lady Amherst's Pheasant	RH	Red-throated Diver	WH	Whitethroat
DW	Dartford Warbler	LA	Lapland Bunting	RE	Redwing	WS	Whooper Swan
DI	Dipper	L.	Lapwing	RB	Reed Bunting	WN	Wigeon
DO	Dotterel	TL	Leach's Petrel	RW	Reed Warbler	WT	Willow Tit
DN	Dunlin	LB	Lesser Black-backed Gull	RZ	Ring Ouzel	WW	Willow Warbler
D.	Dunnock	LS	Lesser Spotted Woodpecker	RP	Ringed Plover	OD	Wood Sandpiper
EG	Egyptian Goose	LW	Lesser Whitethroat	RI	Ring-necked Parakeet	WO	Wood Warbler
E.	Eider	LI	Linnet	R.	Robin	WK	Woodcock
FP	Feral Pigeon	ET	Little Egret	DV	Rock Dove (not feral)	WL	Woodlark
ZL	Feral/hybrid goose	LG	Little Grebe	RC	Rock Pipit	WP	Woodpigeon
ZF	Feral/hybrid mallard type	LU	Little Gull	RO	Rook	WR	Wren
FF	Fieldfare	LO	Little Owl	RS	Roseate Tern	WY	Wryneck
FC	Firecrest	LP	Little Ringed Plover	RY	Ruddy Duck	YW	Yellow Wagtail
F.	Fulmar	AF	Little Tern	RU	Ruff	Y.	Yellowhammer

Appendix II – Viewshed Analysis

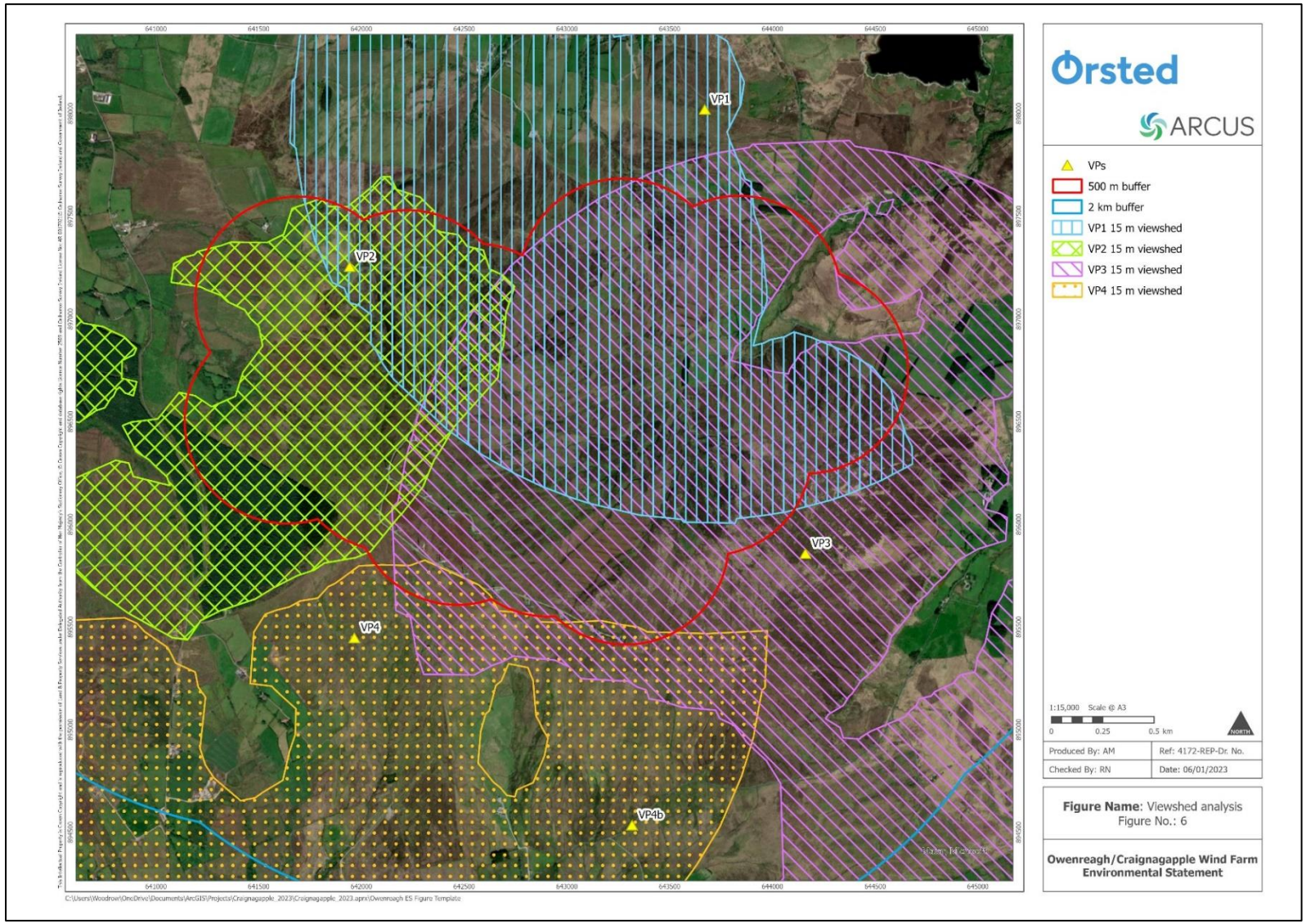

Figure A11.1.2.1: 15 m viewshed analysis for each of the four VPs

Appendix III – Flight line tables and maps for target species

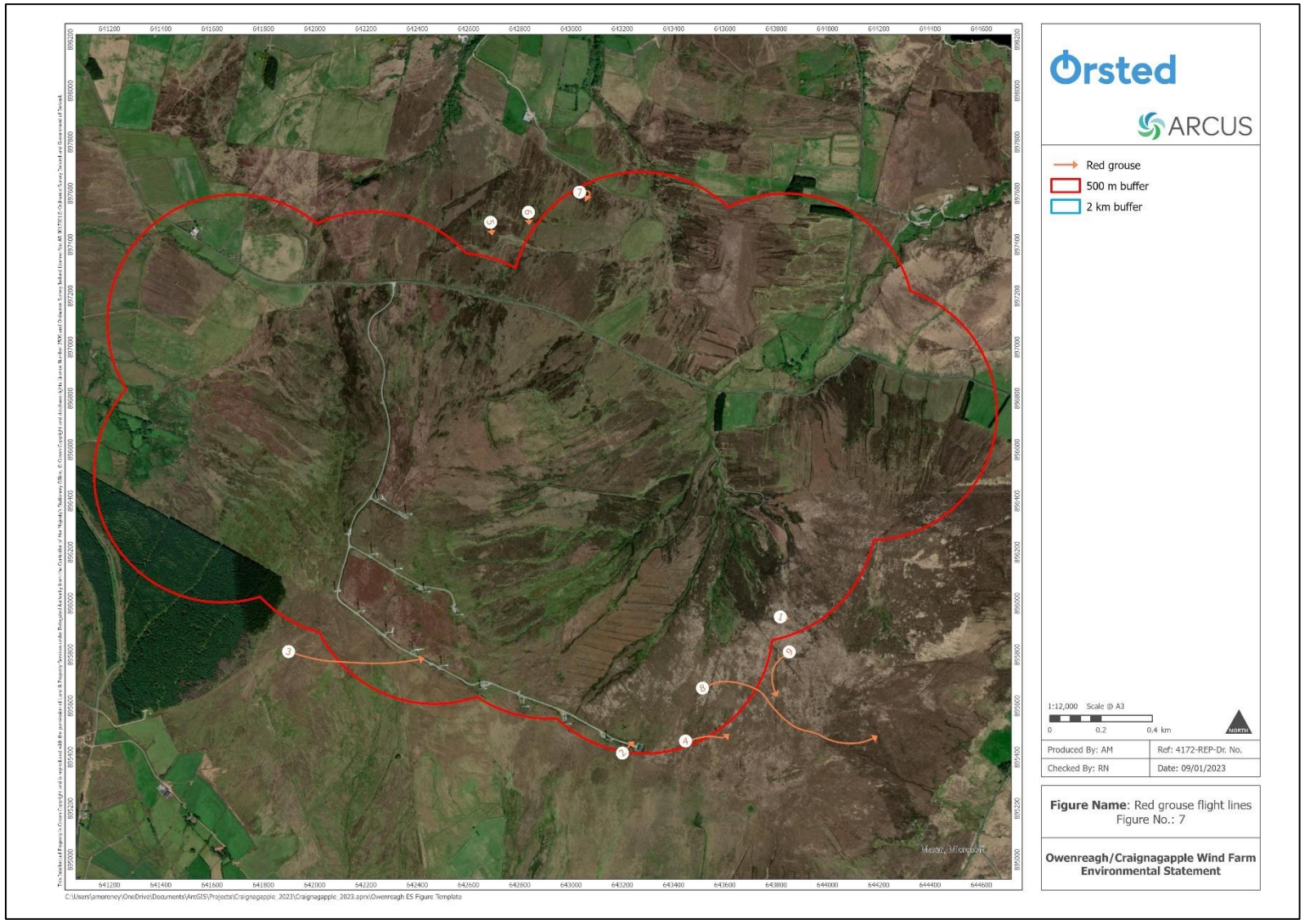

Figure A11.1.3.1: Red grouse flight lines

Table A11.1.3.1: Flight line data collected during VP watches for red grouse.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
1	Breeding season 2018	3	25/04/2018	RG	Red grouse	1	0					Calling	Calling from the ground near VP, again at 1785, 1744, 1805, 1829
2	Breeding season 2018	3	18/05/2018	RG	Red grouse	1	5	5	1-2			Flushed	flushed by van at sub-station flies at 1 to 5 m
3	Breeding season 2018	4	31/07/2018	RG	Red grouse	2	5	7	0-7			Flushed	flushed from heather on way to VP
4	Non-breeding season 2018-19	3	06/11/2018	RG	Red grouse	3	8	5	5			Flushed	Flushed
5	Non-breeding season 2019-20	1	22/12/2019	RG	Red grouse	1	0	0		F		Feeding	Feeding on ground.
6	Non-breeding season 2019-20	1	22/12/2019	RG	Red grouse	2	0	0		F		Feeding	On ground
7	Non-breeding season 2021-22	1	05/12/2021	RG	Red grouse	1	0					Perched	Not seen, heard calling twice and rough location indicated on the map.
8	Non-breeding season 2021-22	3	27/02/2022	RG	Red grouse	1	8	10	0-10	M	A	Flushed	Flushed on walk to VP
9	Non-breeding season 2021-22	3	12/03/2022	RG	Red grouse	1	10	1	1-2		A	Flying	Bird took a short flight before landing, grouse pellets found in area also

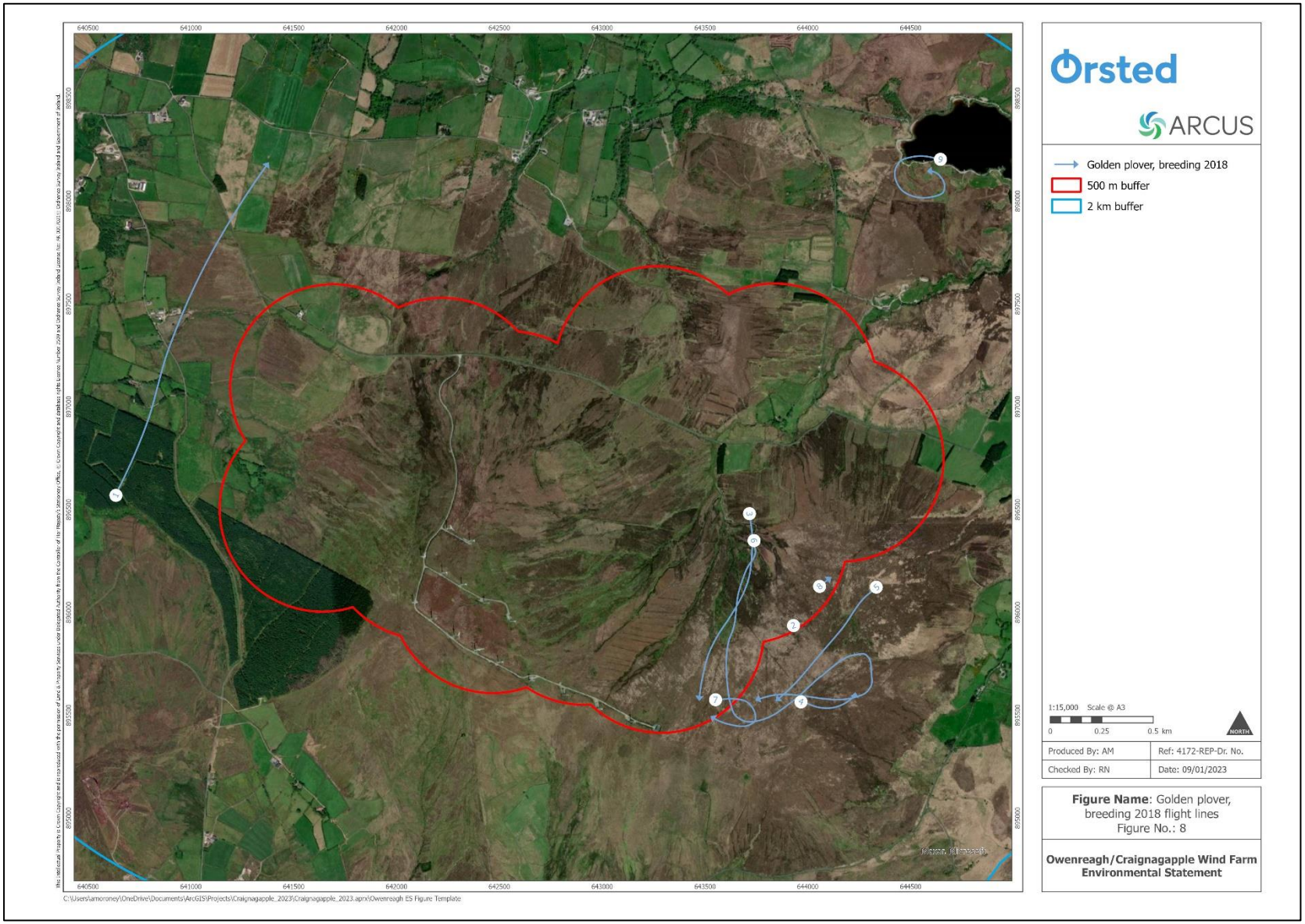

Figure A11.1.3.2: Golden plover, breeding 2018 flight lines

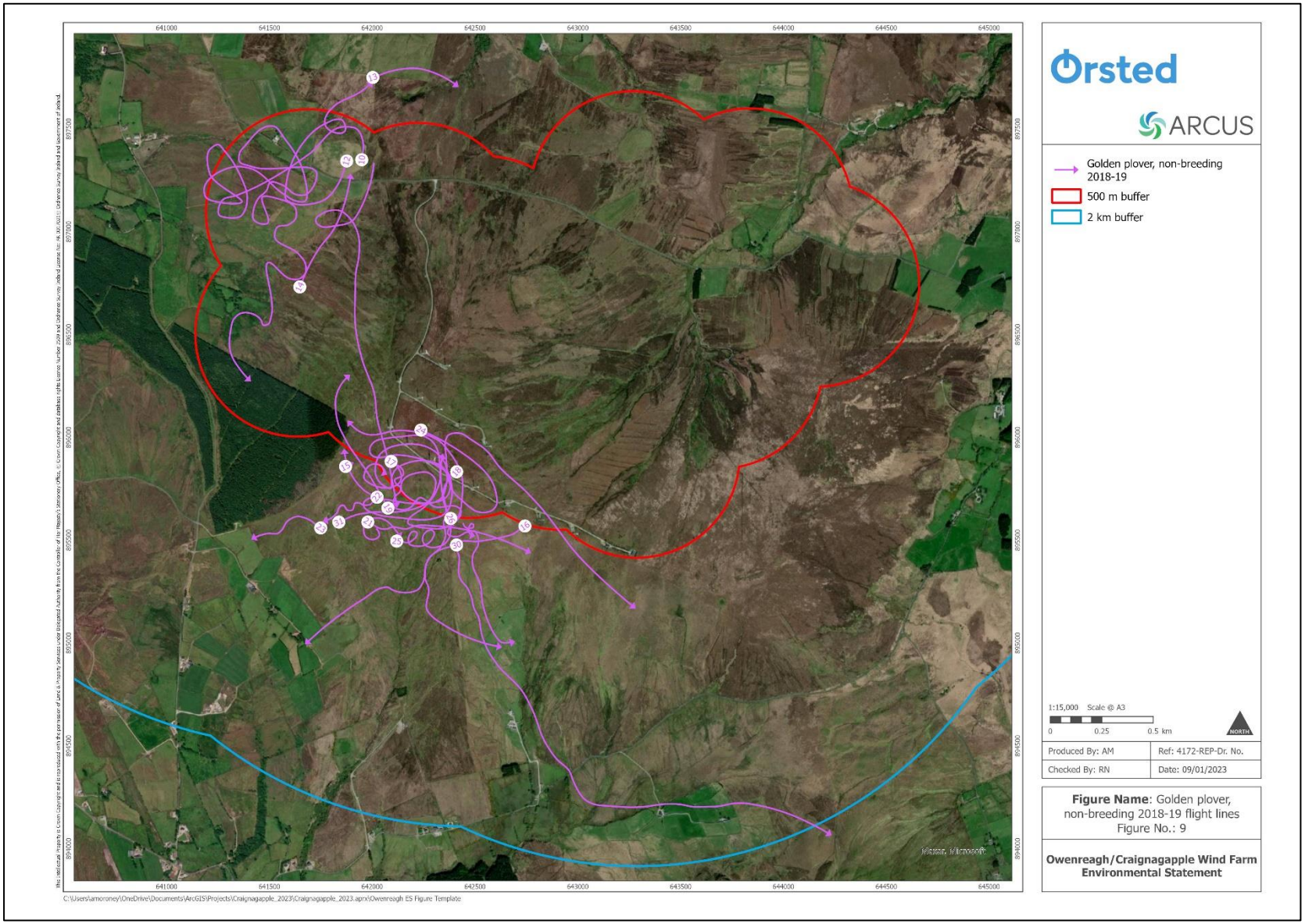

Figure A11.1.3.3: Golden plover, non-breeding 2018-19 flight lines

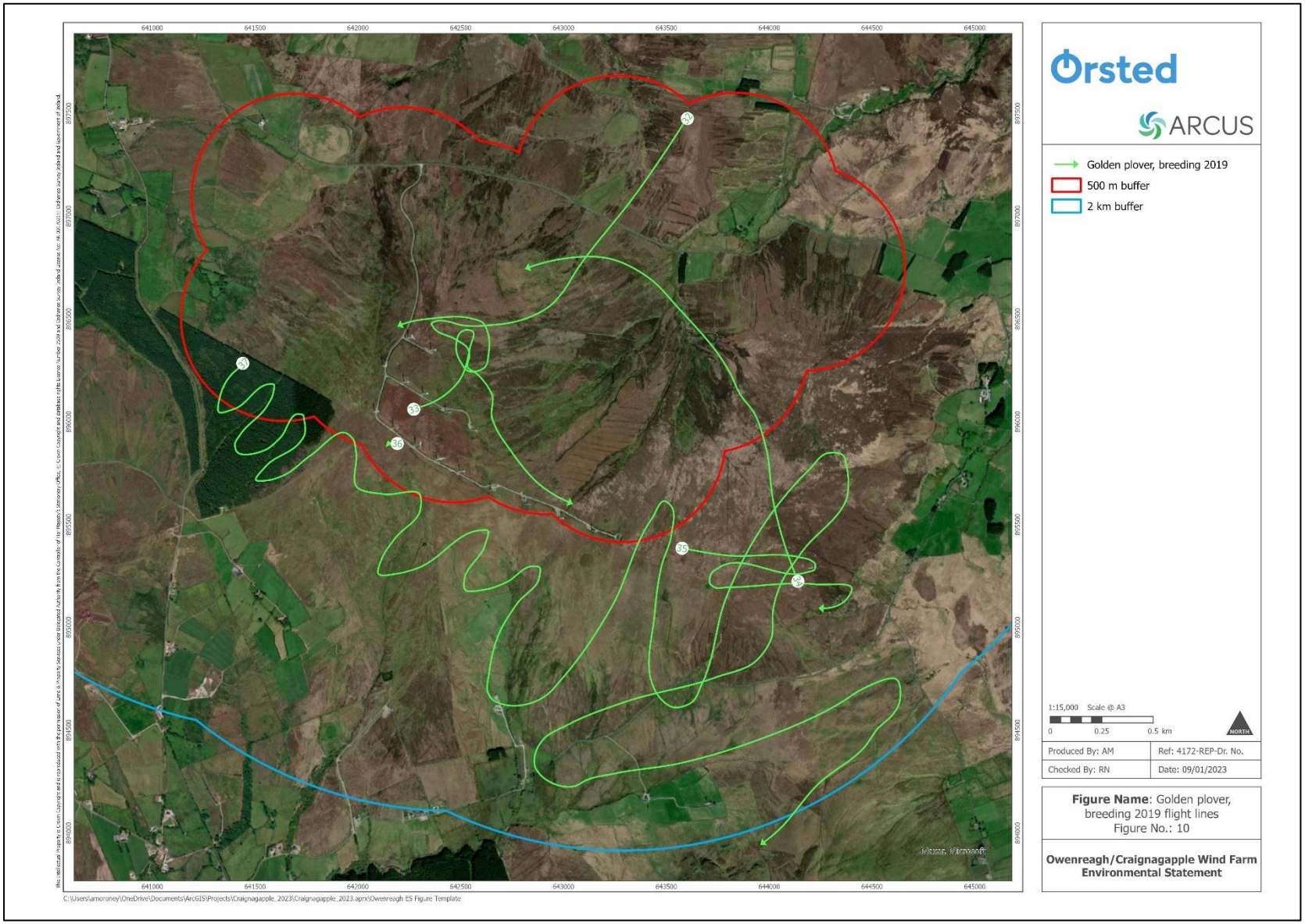

Figure A11.1.3.4: Golden plover, breeding 2019 flight lines

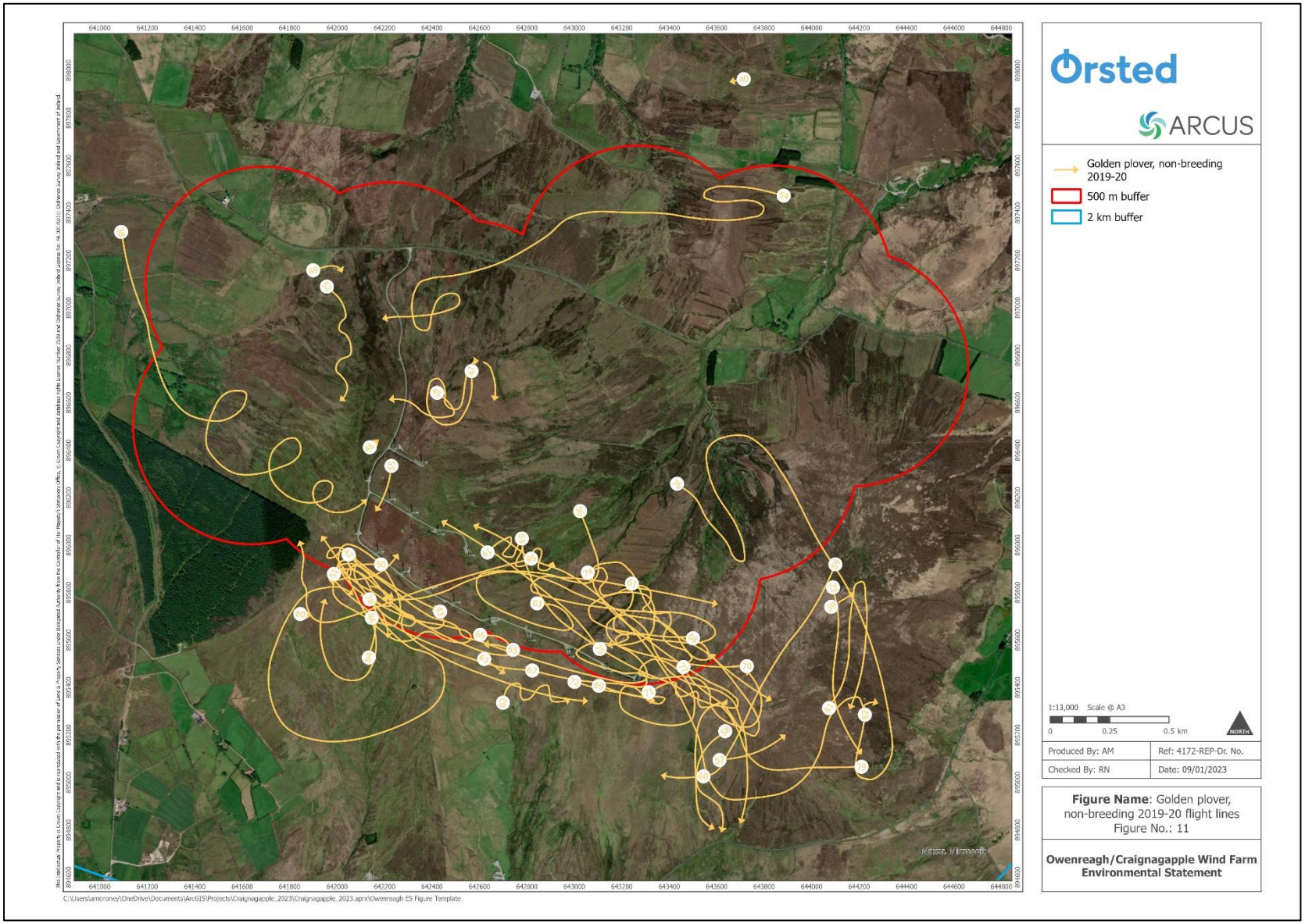

Figure A11.1.3.5: Golden plover, non-breeding 2019-20

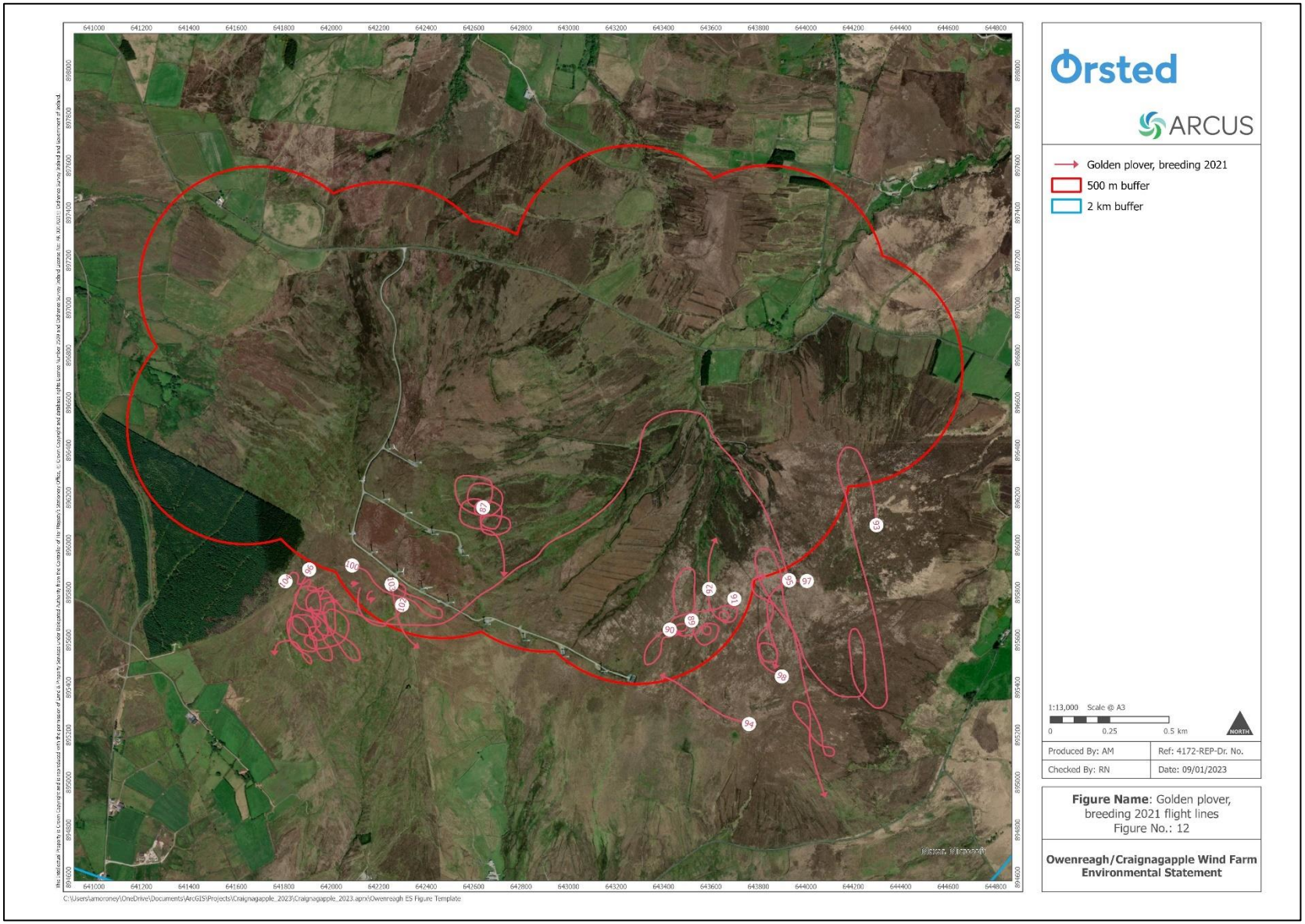

Figure A11.1.3.6: Golden plover, breeding 2021 flight lines

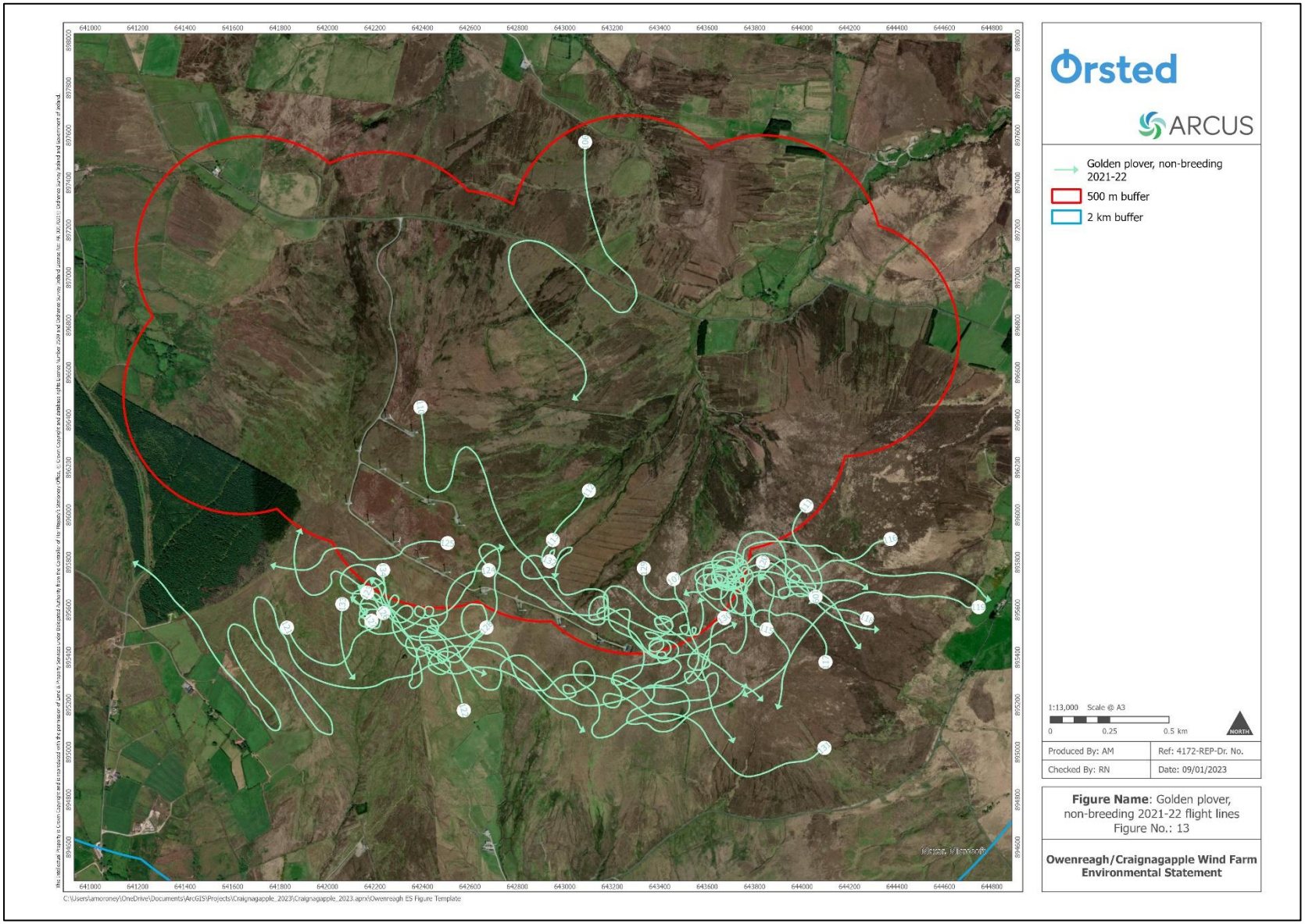

Figure A11.1.3.7: Golden plover, non-breeding 2021-22 flight lines

Table A11.1.3.2: Flight line data collected during VP watches for golden plover.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
1	Breeding season 2018	2	25/04/2018	GP	Golden plover	60	40	70	50-70			Commuting	Migrating flock heading north at edge of buffer - flying relatively high
2	Breeding season 2018	3	25/04/2018	GP	Golden plover		0					Calling	Circle over bog then land 5-30m between VP and substation
3	Breeding season 2018	3	27/04/2018	GP	Golden plover	27	154	20	10-30			Circling	Fly past VP, low and circle over bog between VP and substation 10-30m
4	Breeding season 2018	3	27/04/2018	GP	Golden plover	35	18	30	5-30			Circling	Circle over bog then land 5-30m between VP and substation
5	Breeding season 2018	3	27/04/2018	GP	Golden plover	8	7	30	30			Circling	Fly by VP and join flock circling, 35 birds circling
6	Breeding season 2018	3	27/04/2018	GP	Golden plover	42	12	50	30-50			Circling	Fly into site at 50-30m, circle over bog trying to land
7	Breeding season 2018	3	27/04/2018	GP	Golden plover	42	225	20	20			Circling	Circle low over bog trying to land, stop tracking as PE attacks
8	Breeding season 2018	3	27/04/2018	GP	Golden plover	1	8	20	20-30			Flying	PE singles out GP - chase over bog at 20-30m
9	Breeding season 2018	3	27/04/2018	GP	Golden plover	1	42	100	60-100			Flying	GP rises and drops 60-100m being chased by PE
10	Non-breeding season 2018-19	2	13/20/2019	GP	Golden plover	1	613	150				Flying	Disturbed flock from just behind VP when parking. Bird whirled east of VP for nearly 10min. Lost sight of rising high into cloud above plantation.
11	Non-breeding season 2018-19	2	06/01/2019	GP	Golden plover	110	47	120				Roosting	Roosting in field and passing through site close to turbines heading towards Craignagapple hill. Flock broke up into two flocks as birds went over crest of hill.
12	Non-breeding season 2018-19	2	09/01/2019	GP	Golden plover	34	75	175				Flying	Flew up out of field and circled, 10 birds left.
13	Non-breeding season 2018-19	2	09/01/2019	GP	Golden plover	24	1361	150				Circling	Continually circling the area for about 22min before eventually flying east (Birds were the same as flock above).
14	Non-breeding season 2018-19	2	09/01/2019	GP	Golden plover	11	38	40				Feeding	11 Plovers flew back to feed on green field.
15	Non-breeding season 2018-19	4	02/11/2018	GP	Golden plover	3	0					Calling	Heard over toward plantation, small number flying
16	Non-breeding season 2018-19	4	02/11/2018	GP	Golden plover	2	85	150	150-200			Flying	Fly at c.150m through site, rising to 200m

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
17	Non-breeding season 2018-19	4	02/11/2018	GP	Golden plover	3	200	100	40-100			Flying	Flies around turbines at c.40-100m, poss drops to ground
18	Non-breeding season 2018-19	4	02/11/2018	GP	Golden plover	1	28	100	0-100			Flying	Flies between turbine at c.100m, dropping to 40m, then to ground
19	Non-breeding season 2018-19	4	06/02/2019	GP	Golden plover		0					Feeding	GP seen feeding on the ground in buffer but not seen in flight over site
20	Non-breeding season 2018-19	4	06/03/2019	GP	Golden plover	27	22	30				Roosting	On route to VP4 flock of 27 CP seen roosting 200m S of Turbine 2 on bog, briefly flew round, landed in same area
21	Non-breeding season 2018-19	4	06/03/2019	GP	Golden plover	80	34	50				Flying	GP flock seen flying approx. Parallel with turbines, went into fog thereafter.
22	Non-breeding season 2018-19	4	06/11/2018	GP	Golden plover	1	10	40	5-40			Flying	Passing through site, birds picked up heading SW through site
23	Non-breeding season 2018-19	4	06/11/2018	GP	Golden plover	1	35	100	40-100			Flying	
24	Non-breeding season 2018-19	4	06/11/2018	GP	Golden plover	3	235	100	80-100			Flying	
25	Non-breeding season 2018-19	4	06/11/2018	GP	Golden plover	3	20	20	0-20			Flying	
26	Non-breeding season 2018-19	4	06/11/2018	GP	Golden plover	3	55	50	20-50			Flying	
27	Non-breeding season 2018-19	4	06/11/2018	GP	Golden plover	1	10	10	0-10			Flying	
28	Non-breeding season 2018-19	4	20/11/2018	GP	Golden plover	35	14	10	10			Flushed	Flying, flushed when walking to VP, circled observer and dropped behind the hill
29	Non-breeding season 2018-19	4	20/11/2018	GP	Golden plover	3	7	5	5			Flushed	Flying, flushed when returning from VP, flew North and dropped below the hill
30	Non-breeding season 2018-19	4	06/12/2018	GP	Golden plover	27	45	120	120			Commuting	Passing through site, birds picked up heading SW through site
31	Non-breeding season 2018-19	4	09/01/2019	GP	Golden plover	20	192	100				Flying	Flying around top of most turbines, and in between turbines (turbines were turned off - no wind)
32	Breeding season 2019	1	29/03/2019	GP	Golden plover	2	120	120				Flying	Flying SW over bog then W nearing turbines, then back E and out of sight in cloud
33	Breeding season 2019	1	09/05/2019	GP	Golden plover	20	34	30				Flying	Flying north from the turbines. Circled then flew South West behind turbines out of flight.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
34	Breeding season 2019	3	12/04/2019	GP	Golden plover	40	35	30				Flying	Flying NE over hillside between turbines and Glenmornan road, lost sight of in low cloud
35	Breeding season 2019	3	12/04/2019	GP	Golden plover	40	98	20				Flying	Flying south along ridge from 20m down to 5m over bog then whirled back north direction then south again and out of sight behind hill
36	Breeding season 2019	4	22/03/2019	GP	Golden plover	55	0						55GP were found on way back from VP roosting 300m in front of turbine No2. Birds settled back in same area after being disturbed.
37	Breeding season 2019	4	12/04/2019	GP	Golden plover	1	589	80				Flying	Flying north but zigzagged east-west after being disturbed from hill - south of Craignagapple - opposite side of Ballykeery road) by fire started by farmer
38	Non-breeding season 2019-20	1	02/10/2019	GP	Golden plover	40	268	40	5-40			Circling	Flying south, circled several times before appearing to land west of turbines
39	Non-breeding season 2019-20	1	07/02/2020	GP	Golden plover	9	15	4				Flying	Lost view behind VP3 hillock.
40	Non-breeding season 2019-20	1	07/02/2020	GP	Golden plover	12	0					Calling	Heard only. Calling from Ground, 100-200m S of VP1.
41	Non-breeding season 2019-20	1	11/03/2020	GP	Golden plover	11	255	100	40-100			Flying	Circling over near side of turbines. Appeared to stay a large distance from turbines.
42	Non-breeding season 2019-20	1	20/01/2020	GP	Golden plover	30	35	50				Flying	Tight flock spreading out, rising flight
43	Non-breeding season 2019-20	1	20/01/2020	GP	Golden plover	30	50	80				Flying	Spread out flock.
44	Non-breeding season 2019-20	1	20/01/2020	GP	Golden plover	30	20	50				Flying	Went below skyline.
45	Non-breeding season 2019-20	1	27/01/2020	GP	Golden plover	19	15	40				Flying	Low flight 5 sec rising to 40m 10 sec
46	Non-breeding season 2019-20	1	27/01/2020	GP	Golden plover	19	50	80	40-120			Flying	Flight at 40-50 m 35sec then rising to c.120 m lost in cloud
47	Non-breeding season 2019-20	2	27/01/2020	GP	Golden plover	24	118	70	40-80			Flying	Loose flock mostly at 70 m dipping to 40 m
48	Non-breeding season 2019-20	2	27/01/2020	GP	Golden plover	24	19	40	5-40			Flying	Gradual descend flight, went below skyline, landing?
49	Non-breeding season 2019-20	2	07/02/2020	GP	Golden plover	12	15	4	0-6			Flying	Flushed by RN. Quickly settled again.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
50	Non-breeding season 2019-20	2	22/02/2020	GP	Golden plover	30	27	50	15-50			Flying	Descending out of view behind skyline. Weave
51	Non-breeding season 2019-20	2	20/01/2020	GP	Golden plover	25	30	75	20-75			Circling	Loose flock, circling flight, looking to land, slow descent from75-20m dropped below skyline
52	Non-breeding season 2019-20	3	18/02/2020	GP	Golden plover	100	55	60	50-80			Flying	Strung out flock, descend below hill line
53	Non-breeding season 2019-20	3	08/03/2020	GP	Golden plover	7	1800		10-100			Flying	Flew back and forth along E side of turbines. Constantly changed direction & height, landed 1119 - 1129 flew low past substation + offsite at 1139, not seen again, F1200 P600
54	Non-breeding season 2019-20	3	10/01/2020	GP	Golden plover	24	278	100	0-150			Flying	Flying in flock, loose formation, landing
55	Non-breeding season 2019-20	3	10/01/2020	GP	Golden plover	20	28	40	0-40			Flying	Flying, landing
56	Non-breeding season 2019-20	3	10/01/2020	GP	Golden plover	8	88	50	3-100			Flying	Flying high then landing low through turbines
57	Non-breeding season 2019-20	3	25/01/2020	GP	Golden plover	80	15	15	10-15			Flying	2 bunched flocks, 10m apart c.40 birds, both flocks went below skyline
58	Non-breeding season 2019-20	3	25/01/2020	GP	Golden plover	21	48	60	10-60			Flying	Level flight 40sec then quick descend below skyline
59	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	20	34	1	1-2			Flying	Fast low flight
60	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	20	18	50	5-100			Flying	Ascending flight into clouds
61	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	100	540	70	50-100			Flying	Back and forth over area on map
62	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	100	48	80	50-180			Flying	Ascending into clouds
63	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	35	10	150	150-180			Flying	Ascending into clouds
64	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	35	88	80	50-150			Flying	Ascending into clouds
65	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	35	20	150	150-180			Flying	Ascending into clouds
66	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	42	200	150				Flying	Level flight 40sec then quick descend below skyline
67	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	42	190	20	15-150			Flying	Dipping low after substation as if to land

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
68	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	42	620	150	1-180			Flying	Direct flight to crown of hill. High drifting flight over hill
69	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	42	360	70	20-200			Flying	Back and forth changing height a lot
70	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	49	65	100	50-100			Flying	7 birds joined flock
71	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	49	120	75	5-100			Flying	Back and forth then landing. Descending below hill
72	Non-breeding season 2019-20	3	31/01/2020	GP	Golden plover	100	85	40	5-60			Flying	Flying in very loose flock, some as low as 5m, other as high as 60m
73	Non-breeding season 2019-20	4	20/02/2020	GP	Golden plover	12	118	90	2-90			Flying	Tight flock
74	Non-breeding season 2019-20	4	20/02/2020	GP	Golden plover	160	515	80	80-100			Flying	Back and forth
75	Non-breeding season 2019-20	4	20/02/2020	GP	Golden plover	160	75	80	50-100			Flying	Descending out of view at 50m
76	Non-breeding season 2019-20	4	20/02/2020	GP	Golden plover	38	570	100	100-300			Flying	Ascending from100-300m then out of view into clouds
77	Non-breeding season 2019-20	4	08/03/2020	GP	Golden plover	7	30	4	3-4			Flying	
78	Non-breeding season 2019-20	4	16/10/2019	GP	Golden plover	1	224	20	20-0			Flying	Disturbed 1 GP walking to VP-flew anti clockwise over hillside and landed back on bog just south of turbines-counted 18 other GP on bog as flying bird landed
79	Non-breeding season 2019-20	4	21/11/2019	GP	Golden plover	33	157	225	200-250			Flying	Flying in loose flock, high slow relaxed flight
80	Non-breeding season 2019-20	4	25/01/2020	GP	Golden plover	1	0					Calling	Heard only form crown of hill 200m N of VP4
81	Non-breeding season 2019-20	4	25/01/2020	GP	Golden plover	36	1260	120	100-180			Flying	Traversed area of map 16 times average height 120 m
82	Non-breeding season 2019-20	4	25/01/2020	GP	Golden plover	36	10		100-10			Flying	Rapid descent, landing? Below hill line
83	Non-breeding season 2019-20	4	31/01/2020	GP	Golden plover	26	390	150	70-200			Flying	Lost in cloud at 200m
84	Non-breeding season 2019-20	4	31/01/2020	GP	Golden plover	26	318	80	40-120			Flying	Descending over crown of hill
85	Non-breeding season 2019-20	4	31/01/2020	GP	Golden plover	31	115	160	40-120			Flying	Descending over crown of hill out of sight
86	Non-breeding season 2019-20	4	31/01/2020	GP	Golden plover	3	26	40	5-40			Flying	Looked to be landing crown of hill

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
87	Breeding season 2021	1	26/03/2021	GP	Golden plover	40	241	50	50-100			Flying	Circled over area east of turbines. Not seen changing direction or height drastically at any point.
88	Breeding season 2021	3	21/03/2021	GP	Golden plover	4	20	40	25-40			Flying	
89	Breeding season 2021	3	21/03/2021	GP	Golden plover	4	54	10	1-25			Flying	Looking to settle
90	Breeding season 2021	3	21/03/2021	GP	Golden plover	4	85	40	25-40			Flying	
91	Breeding season 2021	3	21/03/2021	GP	Golden plover	4	30	10	1-25			Flying	
92	Breeding season 2021	3	21/03/2021	GP	Golden plover	4	25	40	25-40			Flying	Lost sight against background
93	Breeding season 2021	3	21/03/2021	GP	Golden plover	28	430	30	30-50			Flying	
94	Breeding season 2021	3	21/03/2021	GP	Golden plover	4	5	3	0-3			Flying	Flushed by ML pair. Didnï¿½t observe flight as following ML
95	Breeding season 2021	3	21/03/2021	GP	Golden plover	28	360	40	30-50			Flying	OOV over back of hill
96	Breeding season 2021	3	21/03/2021	GP	Golden plover	24	1000		4-200			Flying	43 sec below 20m,690 sec 20-160m, 267 sec above 160m
97	Breeding season 2021	3	06/05/2021	GP	Golden plover	26	21	20	Oct-20		A	Flying	Flushed by another surveyor walking a transect across East side of site.
98	Breeding season 2021	3	06/05/2021	GP	Golden plover	26	18	10	Oct-20		A	Flying	Flushed again by another surveyor walking a transect across East side of site.
99	Breeding season 2021	4	21/03/2021	GP	Golden plover	1	0					Calling	Calling from N and E of VP
100	Breeding season 2021	4	21/03/2021	GP	Golden plover	5	44	40	May-40			Flying	Flew up circled and landed. 15 sec below 20m
101	Breeding season 2021	4	21/03/2021	GP	Golden plover	5	38	30	20-30			Flying	
102	Breeding season 2021	4	21/03/2021	GP	Golden plover	5	8	10	Oct-20			Flying	
103	Breeding season 2021	4	21/03/2021	GP	Golden plover	5	54	30	20-40			Flying	
104	Breeding season 2021	4	06/05/2021	GP	Golden plover		0					Calling	Heard as I walked to VP + then again as poor weather arrived at 08:50 to end of survey, not seen leaving site.
105	Breeding season 2021	4	24/07/2021	GP	Golden plover	1	0					Calling	Heard only. Called 5 times between 16:41 and17:57
106	Non-breeding season 2021-22	1	10/03/2022	GP	Golden plover	10	160	60	60-100			Flying	Birds flew into fog and I lost sight of them
107	Non-breeding season 2021-22	1	18/10/2021	GP	Golden plover	25	213	75	25-75			Circling	Distantly circling over open bog
108	Non-breeding season 2021-22	3	29/09/2021	GP	Golden plover	12	0					Roosting	C.12 birds roosting and feeding just south of VP.
109	Non-breeding season 2021-22	3	29/09/2021	GP	Golden plover	7	8	10	0-25			Flushed	7 birds flew a short distance when a raven flew low over the feeding

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
													flock, gradually walked back to original spot.
110	Non-breeding season 2021-22	3	12/03/2022	GP	Golden plover	18	80	120	120-150			Flying	Birds flying S/SE with avoidance behaviour at 2 turbines
111	Non-breeding season 2021-22	3	12/03/2022	GP	Golden plover	4	80	30	15 - 100			Flying	Birds flying overhead in a SW direction
112	Non-breeding season 2021-22	3	18/03/2022	GP	Golden plover	20	16	30	25-35			Flying	
113	Non-breeding season 2021-22	3	18/03/2022	GP	Golden plover	20	40	10	0-25			Flying	Landed
114	Non-breeding season 2021-22	3	06/10/2021	GP	Golden plover	1	20	15	Jan-25			Flying	Chased by merlin
115	Non-breeding season 2021-22	3	06/10/2021	GP	Golden plover	25	25	25	25-50			Flying	Circled and left area when merlin flew in
116	Non-breeding season 2021-22	3	06/10/2021	GP	Golden plover	1	28	50	50-100			Flying	Flew over calling
117	Non-breeding season 2021-22	3	06/10/2021	GP	Golden plover	1	36	50	50-100			Flying	Flew over calling
118	Non-breeding season 2021-22	3	06/10/2021	GP	Golden plover	3	29	50	25-75			Flying	Flew in low calling, circled higher and flew back east calling
119	Non-breeding season 2021-22	3	06/10/2021	GP	Golden plover	5	11	30	25-50			Flying	Flew across site calling
120	Non-breeding season 2021-22	3	30/01/2022	GP	Golden plover	16	6	5	0-10			Flushed	16 flushed on walk to VP, seen occasionally on ground during VP but seemed to be roosting not feeding.
121	Non-breeding season 2021-22	4	29/09/2021	GP	Golden plover	4	79	25	10-50			Flying	Flew in and circled area where birds were heard calling earlier in morning, then continued flying south out of view into sun.
122	Non-breeding season 2021-22	4	29/09/2021	GP	Golden plover	4	41	25	0-40			Flying	4 birds returned and landed behind VP roughly where birds had been heard earlier in VP.
123	Non-breeding season 2021-22	4	29/09/2021	GP	Golden plover	13	94	50	0-150			Flying	Circled up from behind VP and flew high over top between 2 turbines.
124	Non-breeding season 2021-22	4	29/09/2021	GP	Golden plover	13	76	40	25-50			Flying	Flew in from east between turbines, low below rotors.
125	Non-breeding season 2021-22	4	09/03/2022	GP	Golden plover	11	45	100	70-100			Flying	Birds observed flying through WF, weaving through turbines before flying West
126	Non-breeding season 2021-22	4	15/03/2022	GP	Golden plover	1	6	10	5-20			Flying	Descending flight to top of hill

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
127	Non-breeding season 2021-22	4	15/03/2022	GP	Golden plover	1	6	10	5-30			Flying	Descending flight rapid to vertical decent
128	Non-breeding season 2021-22	4	15/03/2022	GP	Golden plover	21	246	80	150-80-50			Flying	OOV over brow of hill
129	Non-breeding season 2021-22	4	03/10/2021	GP	Golden plover	75	245	50	25-75			Flying	Appeared reluctant to cross turbines, rough count
130	Non-breeding season 2021-22	4	03/10/2021	GP	Golden plover	75	194	50	25-75			Flying	Appeared reluctant to cross turbines, rough count
131	Non-breeding season 2021-22	4	03/10/2021	GP	Golden plover	75	207	100	100-150			Flying	Reluctantly flew along line of turbines, but then went through between within rotor height
132	Non-breeding season 2021-22	4	03/10/2021	GP	Golden plover	75	485	100	100-150			Flying	Flew high over turbines but level flight height, then circled along turbine line reluctant to cross.
133	Non-breeding season 2021-22	4	21/01/2022	GP	Golden plover	6	6	15	10-20			Flying	Heard before and after but lost in fog, a few calls throughout survey.
134	Non-breeding season 2021-22	4	09/03/2022	GP	Golden plover	4	10	5	5-10			Flying	Birds flushed as I walked to VP location

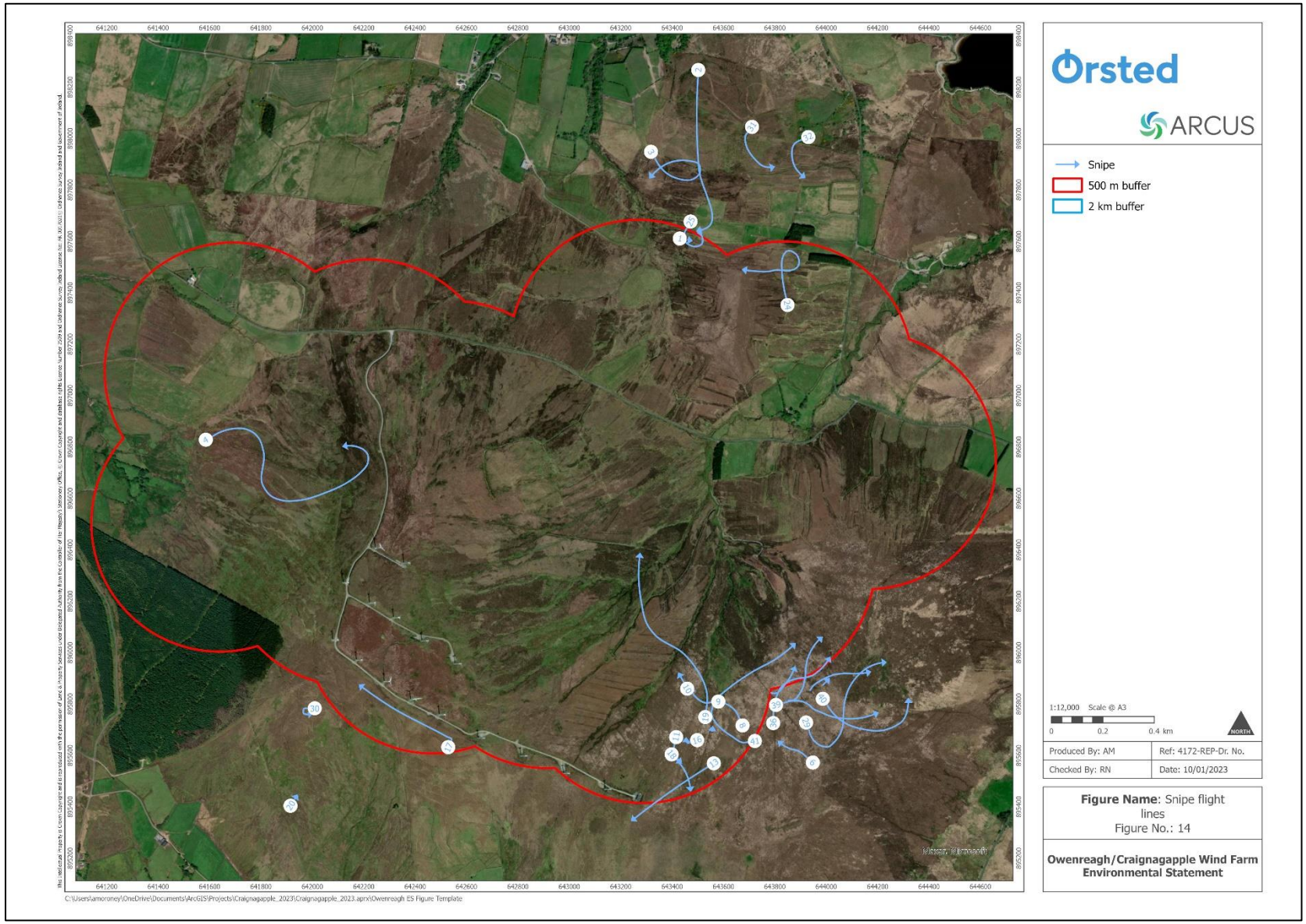

Figure A11.1.3.8: Snipe flight lines

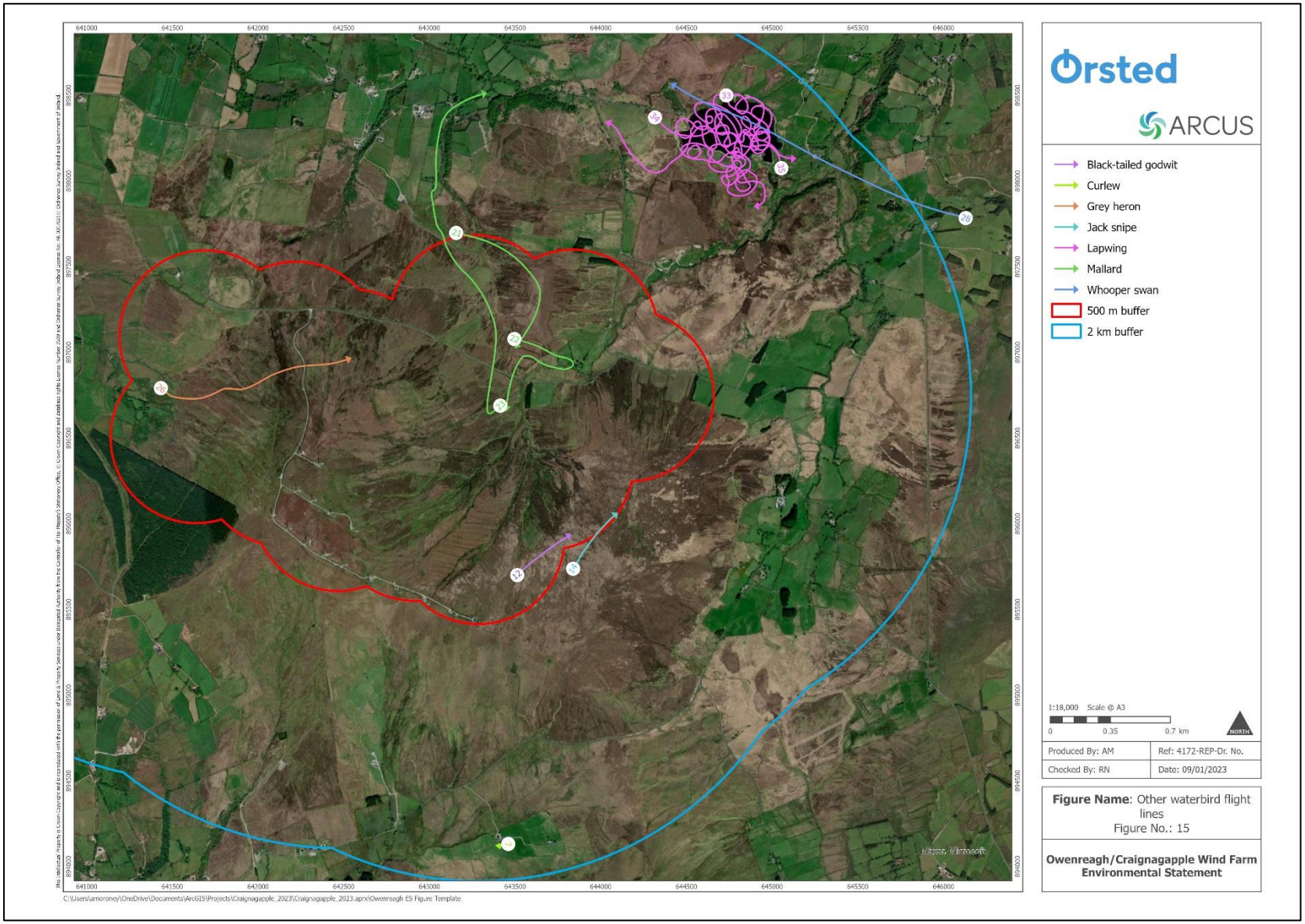

Figure A11.1.3.9: Other waterbird flight lines

Table A11.1.3.3: Flight line data collected during VP watches for snipe and other waterbirds

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
1	Breeding season 2018	1	19/04/2018	SN	Snipe	1	0					Chipping	SN chipping in front of VP, possibly 2 different birds
2	Breeding season 2018	1	18/06/2018	SN	Snipe	1	30	40	20-40			Flying	Undulating flight, dropped down into heather
3	Breeding season 2018	1	18/06/2018	SN	Snipe	1	4	20	0-20			Flying	Came up - interacted with first SN and dropped back down
4	Breeding season 2018	2	18/06/2018	SN	Snipe	1	40	40	0-40			Flying	Landed in heather
5	Breeding season 2018	3	27/04/2018	SN	Snipe	1	0					Chipping	Chipping around VP
6	Breeding season 2018	3	18/05/2018	SN	Snipe	1	0	30				Flushed	Flushed by observer
7	Breeding season 2018	4	19/04/2018	CU	Curlew	1	0					Calling	Calling - well south of site - same location as recorded during 2017 breeding season
8	Non-breeding season 2018-19	3	15/10/2018	SN	Snipe	1	18	40	0-40			Flushed	Flushed walking to VP
9	Non-breeding season 2018-19	3	15/10/2018	SN	Snipe	1	10	60	40-60			Flying	
10	Non-breeding season 2018-19	3	15/10/2018	SN	Snipe	1	0	40	10-40			Flying	
11	Non-breeding season 2018-19	3	28/02/2019	SN	Snipe	1	8	5				Flying	Flushed walking to VP
12	Non-breeding season 2018-19	3	28/02/2019	BW	Black-tailed godwit	4	6	2				Flying	Flew past up and uphill NE direction
13	Non-breeding season 2018-19	3	06/03/2019	SN	Snipe	1	9	15				Flying	Flushed walking to VP
14	Non-breeding season 2018-19	3	06/03/2019	JS	Jack snipe	1	6	2				Flying	Flushed walking to VP
15	Non-breeding season 2018-19	3	02/11/2018	SN	Snipe	1	0					Flushed	Flushed walking to VP
16	Non-breeding season 2018-19	3	02/11/2018	SN	Snipe	3	0					Flushed	Flushed leaving VP
17	Non-breeding season 2018-19	3	02/11/2018	SN	Snipe	14	0					Flushed	Flushed when leaving site - driving
18	Non-breeding season 2018-19	3	13/12/2018	SN	Snipe	1	0	9				Flushed	Flushed walking to VP
19	Non-breeding season 2018-19	3	13/12/2018	SN	Snipe	1	0	29				Flushed	Flushed walking to VP
20	Non-breeding season 2018-19	4	02/11/2018	SN	Snipe	1	0					Calling	Heard calling
21	Breeding season 2019	1	29/03/2019	MA	Mallard	1	20	10		M		Flying	Flying SE across bog then SW into stream
22	Breeding season 2019	1	29/03/2019	MA	Mallard	1	17	10				Flying	Flying loudly quacking for a period of 30 sec before being seen so may have been flying just out of sight
23	Breeding season 2019	1	29/03/2019	MA	Mallard	1	77	30				Flying	Flying N then NE rising to 30m before appearing to drop in direction of lake

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
24	Breeding season 2019	1	09/05/2019	SN	Snipe	1	53	25				Drumming	Drumming over bog in front of plantations, circled over bog then dived to the bog
25	Breeding season 2019	1	18/06/2019	SN	Snipe	1	41	25				Flying	Flying, flew up from bog to 15m then dived back to bog touching down for split second before flying in zig zag fashion to 25m, circled twice before diving back to bog, began chipping shortly after
26	Breeding season 2019	2	15/08/2019	H	Grey heron	1	98	10	02-10			Flying	Flying eastward across bog and lower slopes below turbines
27	Breeding season 2019	3	22/03/2019	SN	Snipe	1	0	5				Flying	Flying, disturbed walking to VP
28	Non-breeding season 2019-20	3	29/11/2019	WS	Whooper swan	2	90	40	30-50		A	Flying	Heard before seen
29	Breeding season 2021	3	06/05/2021	SN	Snipe	1	9	10	10-20			Flying	Flushed by another surveyor walking a transect across East side of site.
30	Breeding season 2021	4	28/08/2021	SN	Snipe	1	0					Calling	Heard only
31	Non-breeding season 2021-22	1	05/12/2021	SN	Snipe	1	8	20	0-25			Flushed	Flushed on walk up to VP
32	Non-breeding season 2021-22	1	24/01/2022	SN	Snipe	1	5	10	0-10			Flushed	Flushed on walk up to VP
33	Non-breeding season 2021-22	1	24/01/2022	L	Lapwing	55	220	50	20-75			Circling	Circled widely over lake area, usually high, swept low once out of view for 5 seconds. Counted from photograph.
34	Non-breeding season 2021-22	1	24/01/2022	L	Lapwing	55	55	20	15-50			Circling	Flew in high and then swept low over lake and appeared to land in sheep fields behind lake.
35	Non-breeding season 2021-22	1	24/01/2022	L	Lapwing	48	780	50	50-75			Circling	48 counted from photograph taken lakeside after VP, 30 counted from VP at 14:42, number increased to estimated 50 at 14:45.
36	Non-breeding season 2021-22	3	29/09/2021	SN	Snipe	1	8	20	0-25			Flushed	Flushed on walk to VP
37	Non-breeding season 2021-22	3	29/09/2021	SN	Snipe	1	6	20	0-25			Flushed	Flushed on walk to VP
38	Non-breeding season 2021-22	3	29/09/2021	SN	Snipe	1	8	20	0-25			Flushed	Flushed on walk to VP
39	Non-breeding season 2021-22	3	30/01/2022	SN	Snipe	1	7	10	0-25			Flushed	Flushed on walk to VP
40	Non-breeding season 2021-22	3	30/01/2022	SN	Snipe	1	7	10	0-25			Flushed	Flushed on walk to VP
41	Non-breeding season 2021-22	3	27/02/2022	SN	Snipe	2	10	20	0-20			Flushed	2 Snipe flushed on walk back to car.

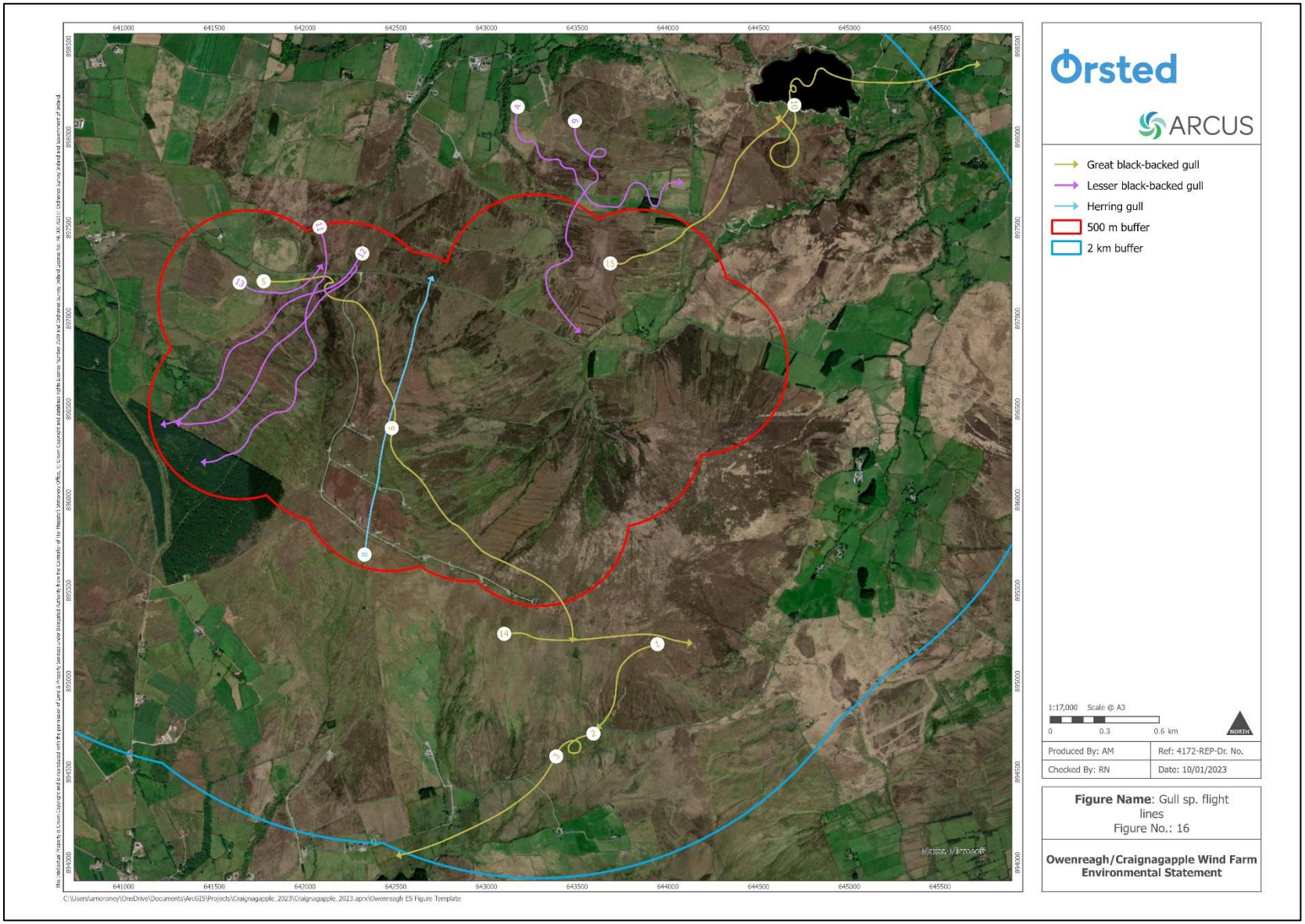

Figure A11.1.3.10: Gull species flight lines

Table A11.1.3.4: Flight line data collected during VP watches for gull species.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
1	Breeding season 2018	4	16/04/2018	GB	Great black-backed gull	2	21	20	20			Flying	Flying at c.20m over bog
2	Breeding season 2018	4	16/04/2018	GB	Great black-backed gull	2	12	40	20-40			Flying	Flying, rises to c.40m - one splits off
3	Breeding season 2018	4	16/04/2018	GB	Great black-backed gull	1	63	80	40-80			Flying	Fly 40-80 m only 1 bird tracked.
4	Breeding season 2019	1	18/06/2019	LB	Lesser black-backed gull	2	104	20				Flying	Flying/gliding on wind east over bog, soared over plantation and continued south
5	Breeding season 2021	1	03/04/2021	GB	Great black-backed gull	2	150	20	15-25		A	Flying	Travelling
6	Breeding season 2021	1	03/04/2021	GB	Great black-backed gull	2	150	50	25-70			Flying	Travelling
7	Breeding season 2021	2	04/04/2021	LB	Lesser black-backed gull	1	37	10	10-20		S	Flying	Flew across site
8	Breeding season 2021	3	16/05/2021	HG	Herring gull	4	190	50	50-120			Flying	Between turbines at hub height. Then continued level flight
9	Non-breeding season 2021-22	1	28/09/2021	LB	Lesser black-backed gull	1	53	20	10-25		A	Flying	Flew slowly across site into wind just as heavy sleet arrived.
10	Non-breeding season 2021-22	1	16/02/2022	GB	Great black-backed gull	1	15	40	20-50		I	Flying	Battling into wind, turned back north
11	Non-breeding season 2021-22	2	03/10/2021	LB	Lesser black-backed gull	1	28	10	0-20		A	Flying	Flew across site
12	Non-breeding season 2021-22	2	03/10/2021	LB	Lesser black-backed gull	2	25	10	0-20		A	Flying	2 adults flew across site
13	Non-breeding season 2021-22	2	06/10/2021	LB	Lesser black-backed gull	1	14	10	1-15		A	Flying	Flew low past VP
14	Non-breeding season 2021-22	3	18/03/2022	GB	Great black-backed gull	2	93	50	40-80			Flying	
15	Non-breeding season 2021-22	3	27/02/2022	GB	Great black-backed gull	1	93	15	10-20		A	Flying	Flew across site and looked to land on Moor Lough but continued toward Lough Ash

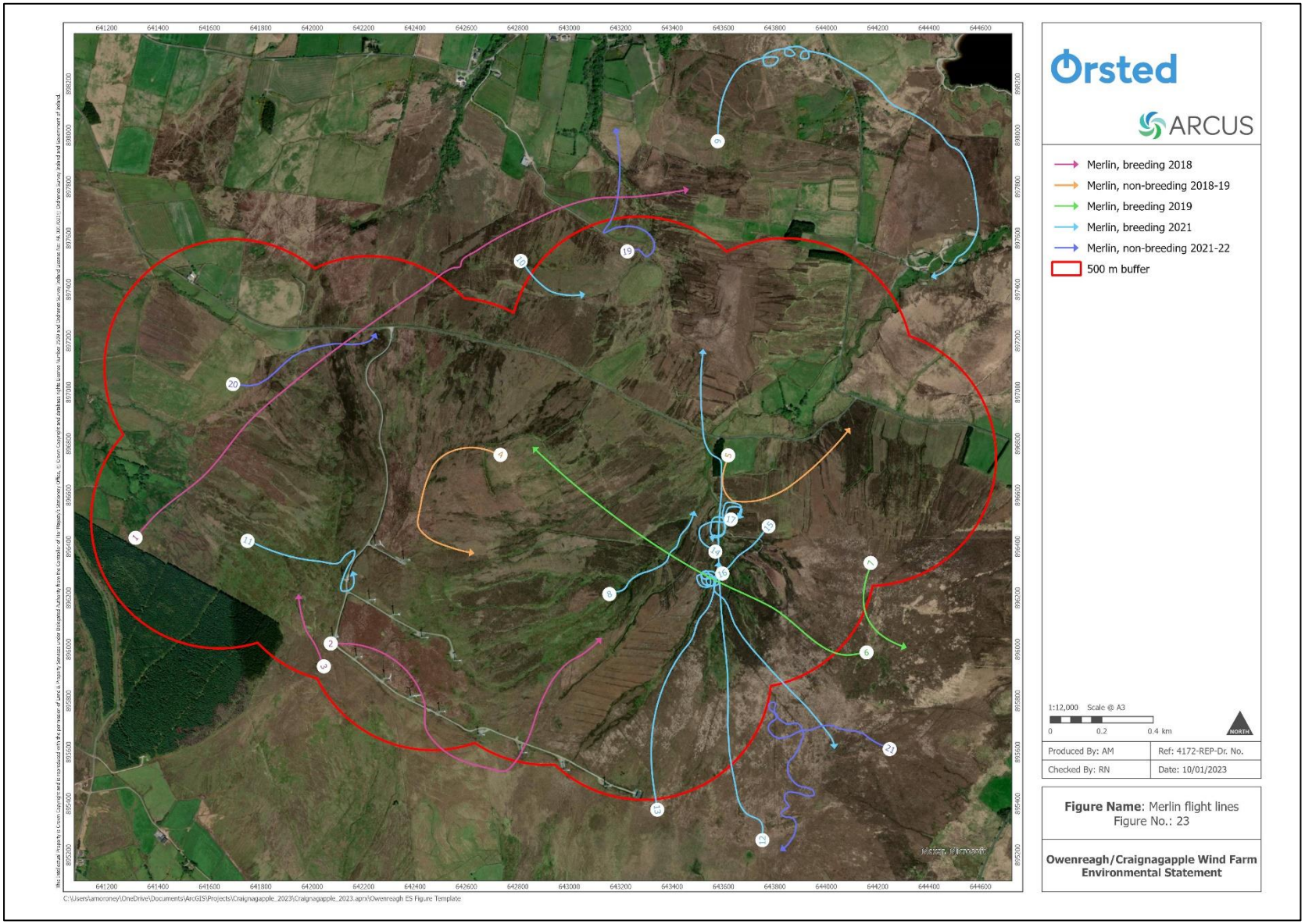

Figure A11.1.3.11: Merlin flight lines

Table A11.1.3.5: Flight line data collected during VP watches for merlin.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
1	Breeding season 2018	2	19/07/2018	ML	Merlin	1	15	60	60			Commuting	Travelling
2	Breeding season 2018	3	09/08/2018	ML	Merlin	1	61	10	5-10			Flying	Perched on truck - flew south and landed on post - flew NE downhill
3	Breeding season 2018	4	18/05/2018	ML	Merlin	1	10	20	20			Alarm call	Harassing BZ, chasing N seen for 10 sec picked up from VP on call, ML giving loud alarm call
4	Non-breeding season 2018-19	2	13/20/2019	ML	Merlin	1	53	40				Hunting	Glided in over hillside NE direction. Then veered SE towards turbines flying 2-5 above heather closer to turbines flapped vertically up to 40m before gliding away west.
5	Non-breeding season 2018-19	3	30/01/2019	ML	Merlin	1	389	15		M		Foraging	Foraging
6	Breeding season 2019	3	12/04/2019	ML	Merlin	1	29	20				Flying	Flying hard NE then long glide, lost sight of in low cloud
7	Breeding season 2019	3	18/06/2019	ML	Merlin	1	10	15				Foraging	Foraging flying south uphill 2 m above heather, lifted to 15m near top of hill veering east/south-east downhill after viewing me, continued under brow of hill out of sight
8	Breeding season 2021	1	23/03/2021	ML	Merlin	1	8	10	5-10	F		Flying	Flew low along gulley, probably a female.
9	Breeding season 2021	1	03/04/2021	ML	Merlin	1	180	10	1-30		A	Flying	Circled with BZ to 30m north of VP then hunted low over site 1 to 10m until OOV near shooting range.
10	Breeding season 2021	1	05/05/2021	ML	Merlin	1	5	10	0-10	M	A	Perched	
11	Breeding season 2021	2	14/06/2021	ML	Merlin	1	44	15	5-25			Hunting	Hunting pipits. OOV into track of road
12	Breeding season 2021	3	21/03/2021	ML	Merlin	1	150	3	1-4	M	A	Hunting	Male and Female flying together. Only able to observe the male bird. Flew over site to perch on fence post. Couldn't pick up the female again.
13	Breeding season 2021	3	22/08/2021	ML	Merlin	1	12	5	0-10	F		Flying	Flew low across site and ignored several pipits and skylark flushed.
14	Breeding season 2021	3	28/08/2021	ML	Merlin	1	60	4	2-4			Flying	Repeatedly playing chase with K. Back and forth over area, landing together then chasing again.
15	Breeding season 2021	3	28/08/2021	ML	Merlin	1	75	10	2-25			Flying	Gaining height
16	Breeding season 2021	3	28/08/2021	ML	Merlin	1	104	75	25-100			Flying	Gaining height. Then travelling
17	Breeding season 2021	3	28/08/2021	ML	Merlin	1	108	1	1-2			Flying	Repeatedly playing chase with K. Back and forth over area, landing together then chasing again.
18	Breeding season 2021	3	26/05/2021	ML	Merlin	1	25	45	40-50			Mobbing	Flew up and attacked BZ before dropping down and out of view.
19	Non-breeding season 2021-22	1	24/01/2022	ML	Merlin	1	10	5	0-10	M	A	Flying	On post, flew into ditch then up to another post and preened before flying north at 13:27
20	Non-breeding season 2021-22	2	03/12/2021	ML	Merlin	1	14	5	0-5	F	A	Flying	Spotted on a post and flew almost as soon as I saw it, flew low across in front of VP.
21	Non-breeding season 2021-22	3	06/10/2021	ML	Merlin	1	25	15	1-25	F		Flying	Flushed GP flock and chased a bird that separated from flock

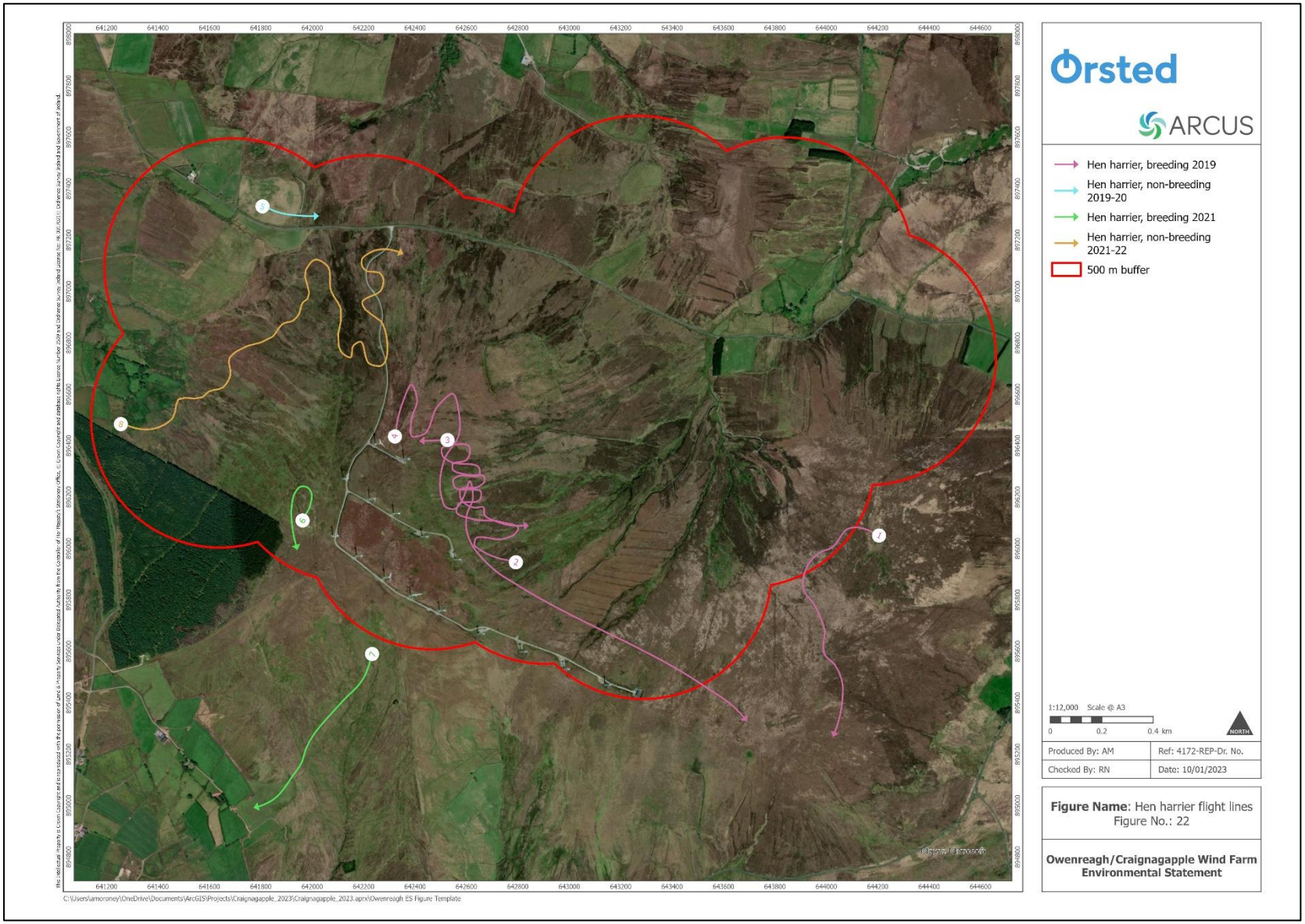

Figure A11.1.3.12: Hen harrier flight lines

Table A11.1.3.6: Flight line data collected during VP watches for hen harrier.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
1	Breeding season 2019	3	20/08/2019	HH	Hen harrier	1	170	5	1-2		Ringtail	Hunting	Hunting over bog- flying south at first 5m dropped to 1m over hill out of site
2	Breeding season 2019	3	05/06/2019	HH	Hen harrier	1	351	10				Foraging	Foraging in front of turbines, mobbed by HC, flew east west then back east dropping v low to the ground out of sight
3	Breeding season 2019	3	05/06/2019	HH	Hen harrier	1	15	5				Foraging	Foraging westwards just above track, quickly out of sight
4	Breeding season 2019	3	05/06/2019	HH	Hen harrier	1	120	50				Foraging	Foraging high above mountain side, mobbed by HC gliding north-south direction at first, circled back to glide south-north still continuously being mobbed by HC at 45-50m, circled again to glide north - south dropping to 20m after HC flew off, continued east parallel to turbines, steady flight past substation south along hillside then east over hill out of site
5	Non-breeding season 2019-20	2	22/12/2019	HH	Hen harrier	1	10	10	0-10	F	J	Hunting	Sub-Ad F HH seen behind VP2, flew v low to ground, not picked up by J. bliss at VP1
6	Breeding season 2021	2	19/07/2021	HH	Hen harrier	1	62	10	3-10	F		Hunting	Large ringtail, probably adult female
7	Breeding season 2021	4	28/08/2021	HH	Hen harrier	1	25	5	5-25			Flying	Travelling. OOV into low cloud
8	Non-breeding season 2021-22	2	03/12/2021	HH	Hen harrier	1	132	10	5-20	M	A	Hunting	Arrived from the west and hunted across the site.

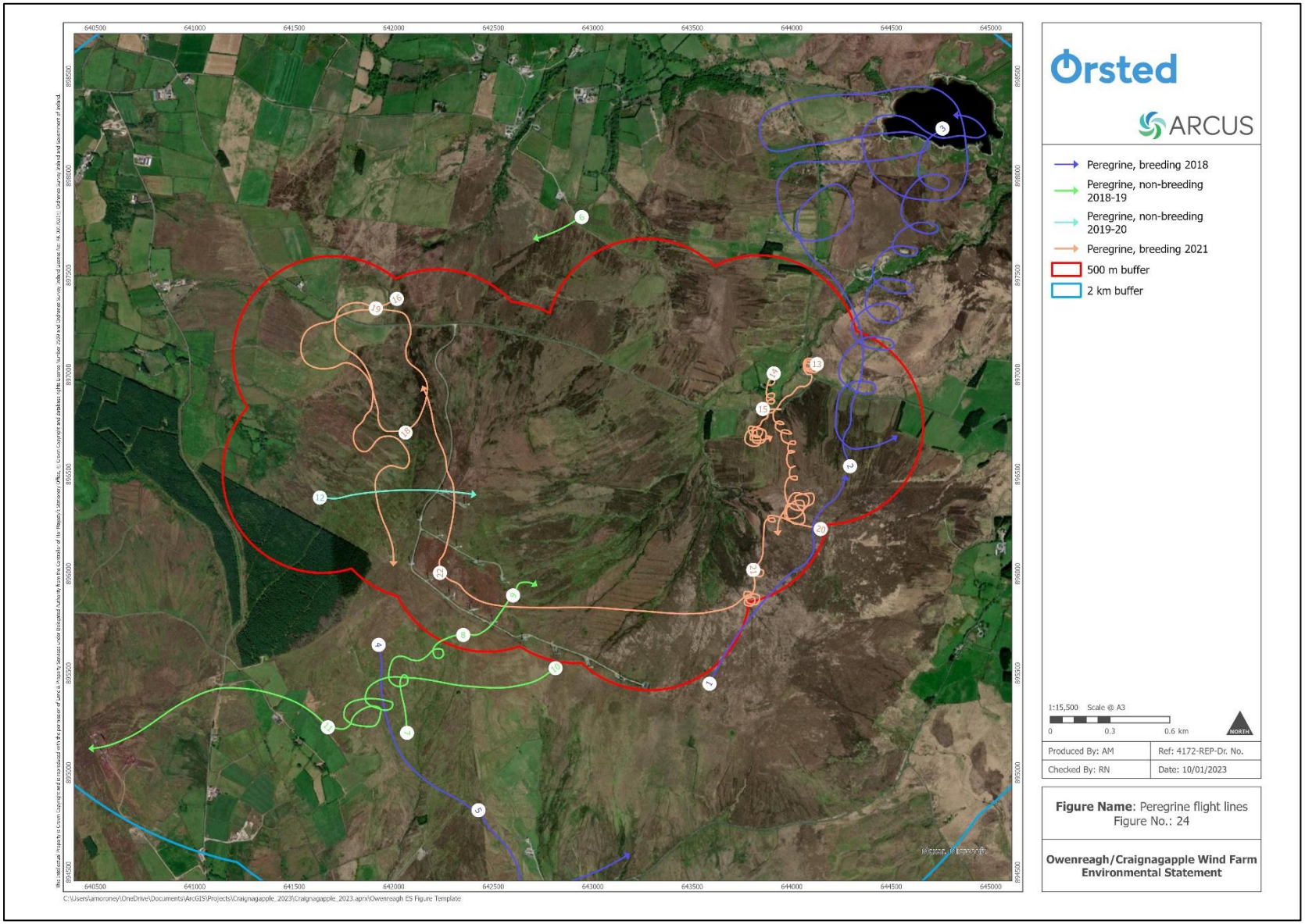

Figure A11.1.3.13: Peregrine flight lines

Table A11.1.3.7: Flight line data collected during VP watches for peregrine.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
1	Breeding season 2018	3	27/04/2018	PE	Peregrine	1	8	20	20-30		F	Hunting	Hunting PE, female flies through GP flock, splits off single GP
2	Breeding season 2018	3	27/04/2018	PE	Peregrine	1	42	100	60-100			Hunting	Follows GP 60-100m - gets to within 5m of GP over lough then drifts north dropping to c.200
3	Breeding season 2018	3	27/04/2018	PE	Peregrine	1	344	300	100-300			Circling	PE circles up rising to c.300m over lough, then drops to c.200m out of view N
4	Breeding season 2018	4	01/06/2018	PE	Peregrine	1	28	30	Oct-30		J?	Flying	Flew from direction of turbines, 10-30m. Possibly young PE - not grey – very brown looking
5	Breeding season 2018	4	01/06/2018	PE	Peregrine	1	146	120	30-120			Flying	Flies away from turbine envelope, large bird, prob female. Moulted-looked thin, rises 30-120 m - drifting east joining BZ
6	Non-breeding season 2018-19	1	12/12/2018	PE	Peregrine	1	15	15	15			Perched	Picked up perched on fence post - perched for 160 sec, then flies off
7	Non-breeding season 2018-19	4	06/11/2018	PE	Peregrine	1	220	100	60-100			Soaring	
8	Non-breeding season 2018-19	4	06/11/2018	PE	Peregrine	1	42	60	40-60			Soaring	
9	Non-breeding season 2018-19	4	06/11/2018	PE	Peregrine	1	35	40	30-40			Soaring	Soaring 30-40m, dropped below ridge, out of view
10	Non-breeding season 2018-19	4	06/11/2018	PE	Peregrine	1	40	40	20-40		A	Hunting	Soaring 20-40m, hunting, adult, bog
11	Non-breeding season 2018-19	4	06/11/2018	PE	Peregrine	1	75	80	40-80			Soaring	
12	Non-breeding season 2019-20	1	02/10/2019	PE	Peregrine	1	47	25	25			Gliding	Flew/glided east and landed on mast/aerial on hillside
13	Breeding season 2021	1	25/07/2021	PE	Peregrine	1	210	150	150			Hunting	Circled for 90 sec then short flight 15 sec then circled 105 sec. Lost sight while taking notes. Possibly had dived to ground.
14	Breeding season 2021	1	25/07/2021	PE	Peregrine	1	80	80	60-180			Flying	Circling gaining height
15	Breeding season 2021	1	25/07/2021	PE	Peregrine	1	260	250	180-400			Flying	Circling gaining height
16	Breeding season 2021	2	04/04/2021	PE	Peregrine	1	6	30	0-30		I	Flying	Caught and fed on magpie, flushed at 12:20 by buzzard.
17	Breeding season 2021	2	04/04/2021	PE	Peregrine	1	28	10	Oct-20		I	Flying	Flew to hillside.
18	Breeding season 2021	2	04/04/2021	PE	Peregrine	1	21	10	Oct-20		I	Flying	Returned to carcass and searched for scraps.
19	Breeding season 2021	2	04/04/2021	PE	Peregrine	1	60	20	Oct-40		I	Flying	Flew south towards VP4
20	Breeding season 2021	3	28/06/2021	PE	Peregrine	2	70	80	50-150			Flying	Circling, gaining height
21	Breeding season 2021	3	28/06/2021	PE	Peregrine	2	220	200	150-220			Flying	Long gliding flight.

22	Breeding season 2021	3	28/06/2021	PE	Peregrine	2	85	10	10-220			Flying	Fast dive to hunt low 10

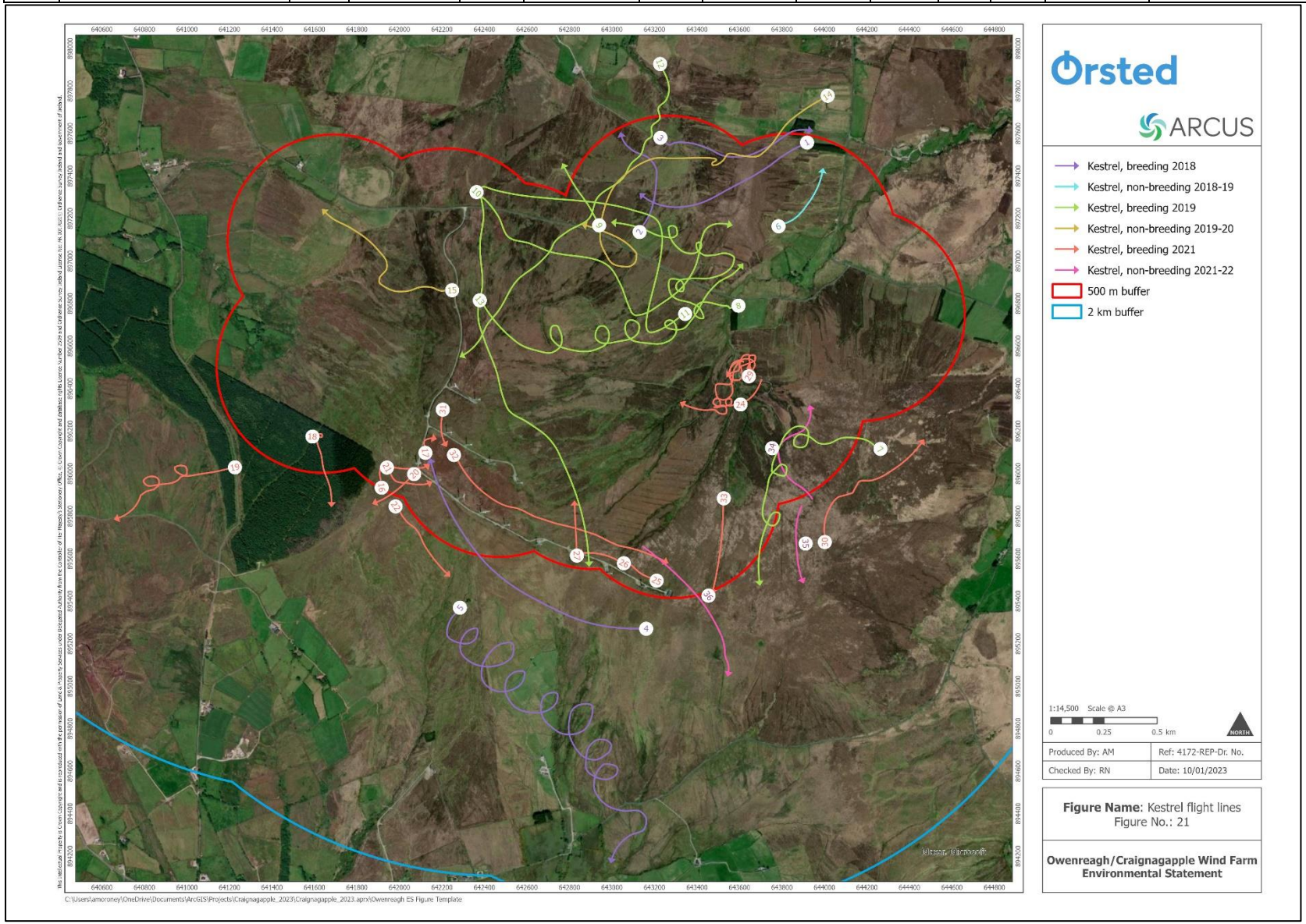

Figure A11.1.3.14: Kestrel flight lines

Table A11.1.3.8: Flight line data collected during VP watches for kestrel.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
1	Breeding season 2018	1	25/04/2018	K	Kestrel	1	22	20	5-20			Flying	Fly out of area of turbines - flew out of plantation at 20m - 5m, drops out of view, male
2	Breeding season 2018	1	25/04/2018	K	Kestrel	1	204	50	30-50	M		Hunting	Fly out of area of turbines into valley hunting at 30-50m, male
3	Breeding season 2018	1	25/04/2018	K	Kestrel	1	24	30	30	M		Circling	Fly out of area of turbines, circles up out of valley towards plantation, male
4	Breeding season 2018	3	22/08/2018	K	Kestrel	1	50	40	10-40	M		Hunting	Male, hunting
5	Breeding season 2018	4	27/04/2018	K	Kestrel	1	0					Flushed	Flushed before start, perched on telegraph pole
6	Non-breeding season 2018-19	1	22/11/2018	K	Kestrel	1	108	30	30			Flying	Flew in from south hovered and dived to the ground behind hill
7	Breeding season 2019	1	03/07/2019	K	Kestrel	1	341	80				Foraging	Foraging 20-80m, hunting above bog and hillside moving SW across bog, hovering at 80-40m as terrain below rises higher - flew south over hillside out of sight, 20m
8	Breeding season 2019	1	20/08/2019	K	Kestrel	1	506	30	10-30			Hunting	Hunting over bog on both sides of Glenmornan road- moving west circling up to and hovering at 30m dropping to 10m to hover at a couple of locations. Finally dived to ground and remained on ground for several minutes.
9	Breeding season 2019	1	20/08/2019	K	Kestrel	1	15	10	0-10			Flying	Flew up from bog where it had been for several minutes- flew over brow of hill out of sight west north-west direction
10	Breeding season 2019	1	09/05/2019	K	Kestrel	1	76	20				Hunting	Hillside from Glenmornan road. Hovered at 20m then glided south then north-east. Back across road briefly hovered 20m again before gliding east. Dropped out of sight.
11	Breeding season 2019	1	09/05/2019	K	Kestrel	1	1371	30				Foraging	Foraging hovering at 30m then gliding north across road hovering for several minutes before flying west and hovering again for several minutes followed by flying south and hovering at several spots on hillside, finally flew off south 20m between turbines
12	Breeding season 2019	1	05/06/2019	K	Kestrel	1	24	25				Flying	Flying north over hillside, veered west/north-west over hill and out of sight
13	Breeding season 2019	3	18/07/2019	K	Kestrel	1	351	35				Foraging	Foraging 35-20m hovering over hillside, circled eastwards and departed north eastwards, seen first at 35m - maintained height circling eastwards and hovering, dropped in height to 20m near small plantation before departing across the road and out of sight
14	Non-breeding season 2019-20	1	16/10/2019	K	Kestrel	1	617	15	5-15			Hunting	Hunting south west/west over bog, hovered numerous spots, flew down over glen across the road briefly back east before circling back west, landing on sitka tree beside road
15	Non-breeding season 2019-20	2	09/10/2019	K	Kestrel	1	131	15	2-15	M		Hunting	Hunting west over bog, hovered then flew north west over hill and out of sight
16	Breeding season 2021	2	27/08/2021	K	Kestrel	1	100	20	10-20			Hunting	OOV low into site
17	Breeding season 2021	2	27/08/2021	K	Kestrel	1	63	10	10-5			Hunting	OOV low into site
18	Breeding season 2021	2	27/08/2021	K	Kestrel	1	35	20	20-30			Flying	Circling over forestry with BZ
19	Breeding season 2021	2	27/08/2021	K	Kestrel	1	39	40	30-40			Hunting	Searching flight

20	Breeding season 2021	2	27/08/2021	K	Kestrel	1	105	20	20			Hunting	Hunting together, interacting, diving at each other
21	Breeding season 2021	2	27/08/2021	K	Kestrel	1	295	20	10-20			Hunting	Hunting together, interacting, diving at each other
22	Breeding season 2021	3	24/07/2021	K	Kestrel	1	235	30	0-30			Hunting	Dived OOV
23	Breeding season 2021	3	28/08/2021	K	Kestrel	1	75	10	2-25			Flying	Gaining height
24	Breeding season 2021	3	28/08/2021	K	Kestrel	1	195	100	25-180			Hunting	Gaining height. Then hunting, OOV in low cloud
25	Breeding season 2021	3	28/08/2021	K	Kestrel	1	50	20	1-20			Hunting	Dived for prey
26	Breeding season 2021	3	28/08/2021	K	Kestrel	1	30	25	4-30			Hunting	Land on tree top
27	Breeding season 2021	3	28/08/2021	K	Kestrel	1	12	5	5			Hunting	OOV against background
28	Breeding season 2021	3	28/08/2021	K	Kestrel	1	108	2	1-2			Flying	Repeatedly playing chase with ML back and forth over area, landing together then chasing again.
29	Breeding season 2021	3	28/08/2021	K	Kestrel	1	60	4	2-4			Flying	Repeatedly playing chase with ML, Back and forth over area, landing together then chasing again.
30	Breeding season 2021	3	16/05/2021	K	Kestrel	1	100	20	20-25	M	A	Flying	Slow gliding flight
31	Breeding season 2021	3	16/05/2021	K	Kestrel	1	12	10	10-4			Hunting	Hovered briefly the OOV against background
32	Breeding season 2021	3	16/05/2021	K	Kestrel	1	95	20	2-20			Flying	Long fast glide attacking flight. OOV against background when got low
33	Breeding season 2021	3	16/05/2021	K	Kestrel	1	22	30	2-30			Hunting	V. Fast attacking shallow dive. OOV against background when low
34	Non-breeding season 2021-22	3	12/03/2022	K	Kestrel	1	25	3	1-20	M	A	Hunting	Bird observed perching on fencepost before flying N and starting to hunt
35	Non-breeding season 2021-22	3	12/03/2022	K	Kestrel	1	15	2	2-3	M	A	Flying	Bird flying across HB to S
36	Non-breeding season 2021-22	3	12/03/2022	K	Kestrel	1	25	15	15-20			Commuting	Birds flying through site moving S

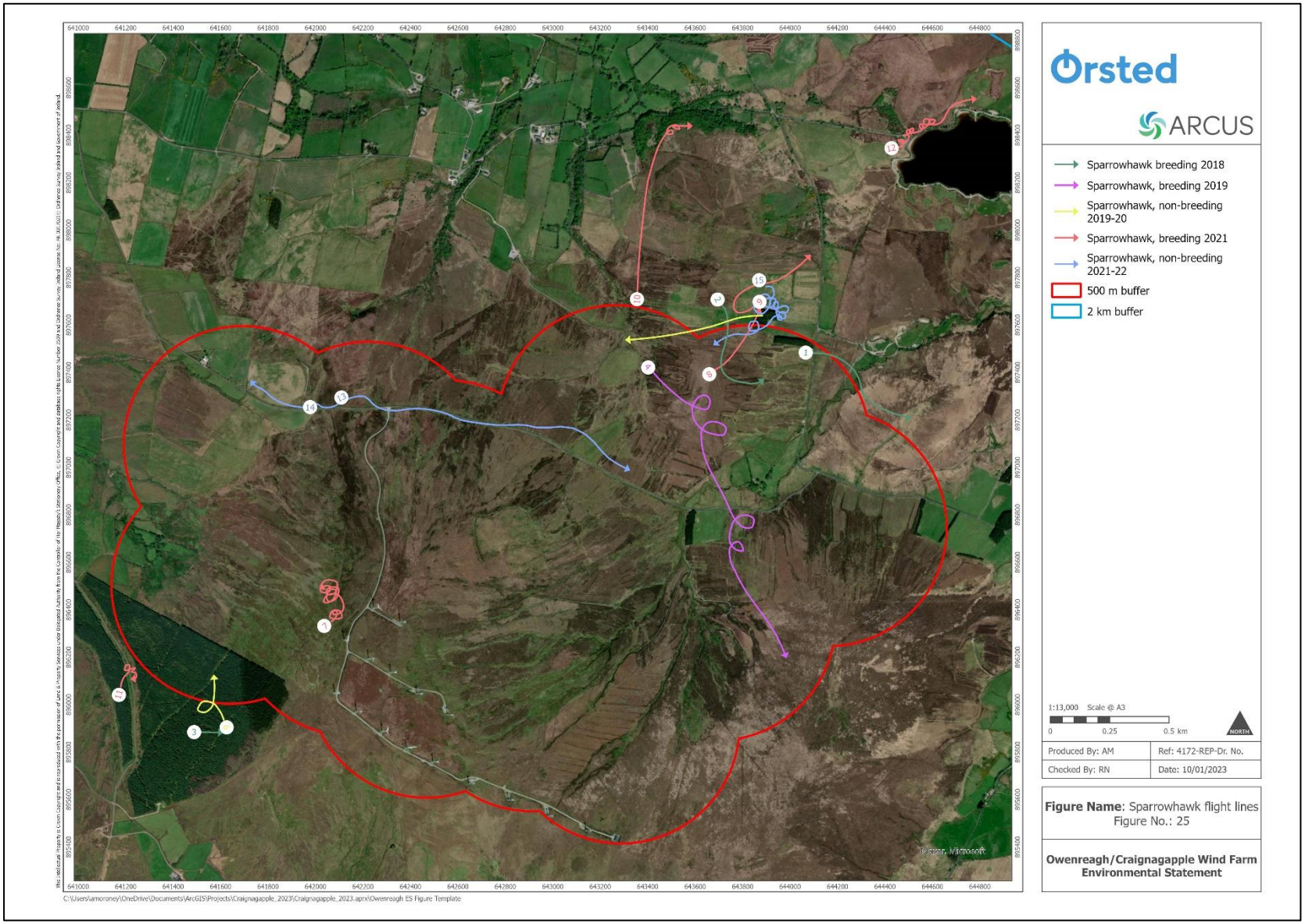

Figure A11.1.3.15: Sparrowhawk flight lines

Table A11.1.3.9: Flight line data collected during VP watches for sparrowhawk.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
1	Breeding season 2018	1	03/05/2018	SH	Sparrowhawk	1	4	5	5	M		Perched	Perched on fencepost approx. 100m from parking bay for VP1, flew off into bog habitat, male
2	Breeding season 2018	1	03/05/2018	SH	Sparrowhawk	1	6	5	4-5	M		Flying	Male SH flew from behind VP into view approx. 20m from VP and flew in direction of forestry
3	Breeding season 2018	2	16/04/2018	SH	Sparrowhawk	1	0	50	50			Flying	Flying, glimpse of SH behind BZ - not tracked, time not recorded
4	Breeding season 2019	1	23/05/2019	SH	Sparrowhawk	1	130	60				Foraging	E/SE over bog. Circled grassy meadows - plantation. N & S of road then flew on SE direction
5	Non-breeding season 2019-20	1	07/02/2020	SH	Sparrowhawk	1	35	18	2-18	M	A	Hunting	Low circling flight over forestry block then mobbed by HC, then descending flight out of view.
6	Non-breeding season 2019-20	2	29/11/2019	SH	Sparrowhawk	1	10	45	45-70	F		Flying	Over forestry, being mobbed by H.C. descended into forest
7	Breeding season 2021	1	22/08/2021	SH	Sparrowhawk	1	315	40	25-50	M		Circling	Male circling with 5 buzzards and 3 Ravens behind Turbines.
8	Breeding season 2021	1	27/08/2021	SH	Sparrowhawk	1	70	20	10-20			Flying	To land on edge of forestry
9	Breeding season 2021	1	27/08/2021	SH	Sparrowhawk	1	46	10	01-10			Hunting	Flew low OOV
10	Breeding season 2021	1	03/04/2021	SH	Sparrowhawk	1	120	30	20-40			Flying	Flew N behind VP, circled with 2nd SH
11	Breeding season 2021	2	18/06/2021	SH	Sparrowhawk	1	39	40	10-50	M	A	Mobbing	Circled up and mobbed Buzzard before gliding away.
12	Breeding season 2021	3	22/08/2021	SH	Sparrowhawk	1	82	30	20-40			Circling	Circled distantly behind lake before gliding away.
13	Non-breeding season 2021-22	1	05/12/2021	SH	Sparrowhawk	1	52	5	0-10	M		Flying	Mobbed by two HC and flew low close to road.
14	Non-breeding season 2021-22	2	03/10/2021	SH	Sparrowhawk	1	12	5	0-10	M	J	Flying	Low along road, brief attempt to catch flushed MP
15	Non-breeding season 2021-22	3	27/02/2022	SH	Sparrowhawk	1	40	25	0-25	M	A	Circling	Circled above plantation before diving steeply and flying west.

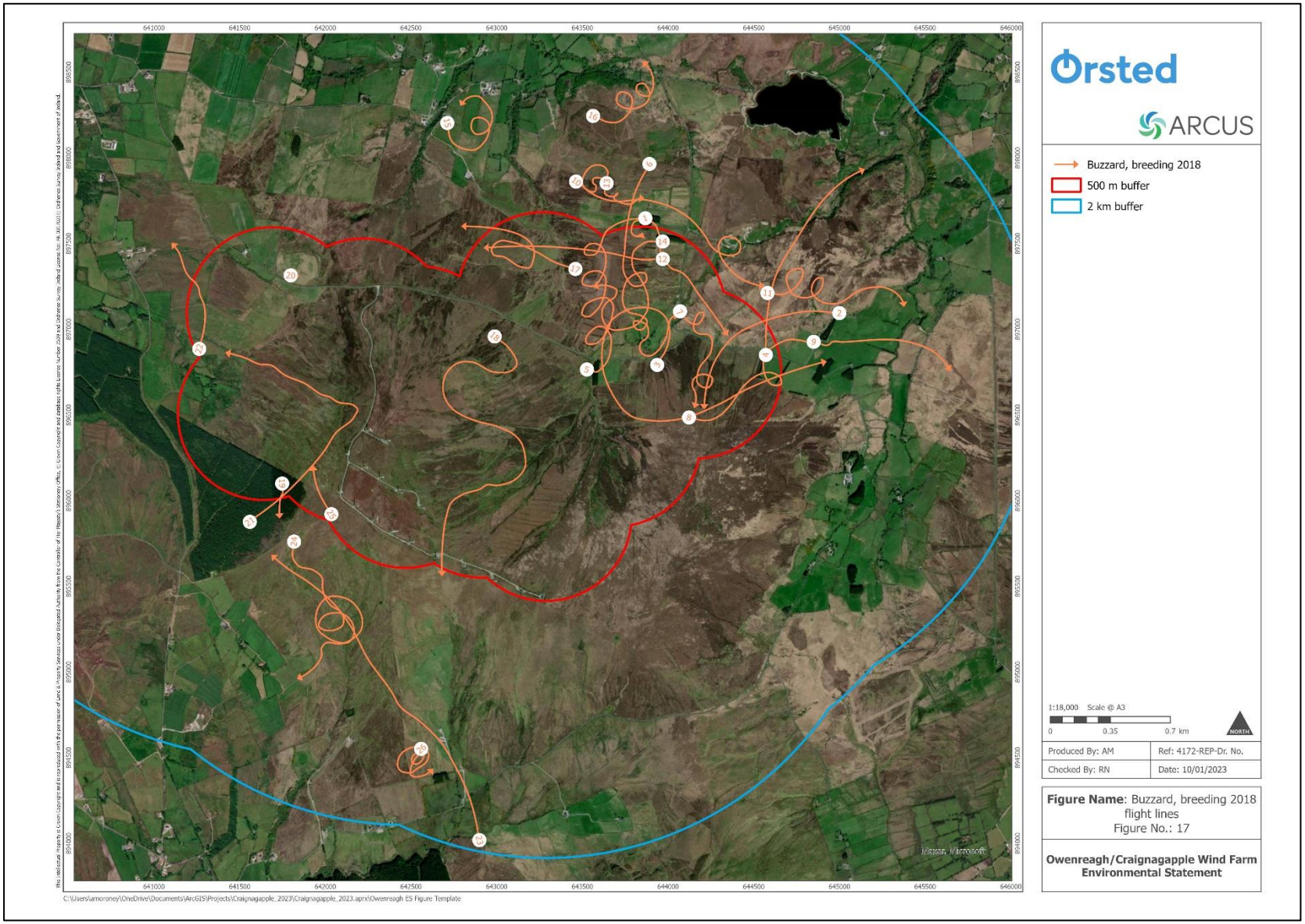

Figure A11.1.3.16: Buzzard, breeding 2018 flight lines

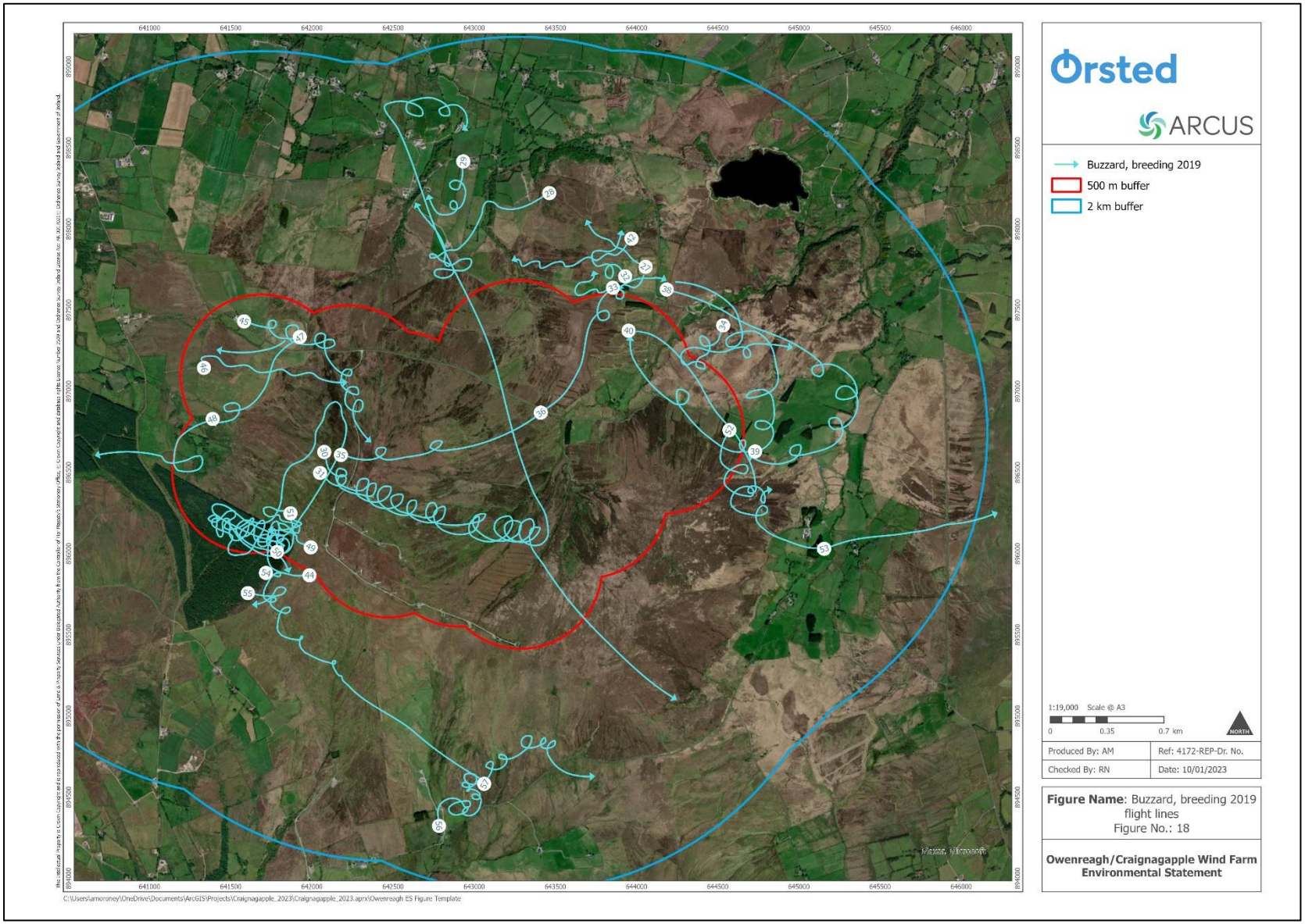

Figure A11.1.3.17: Buzzard, breeding 2019 flight lines

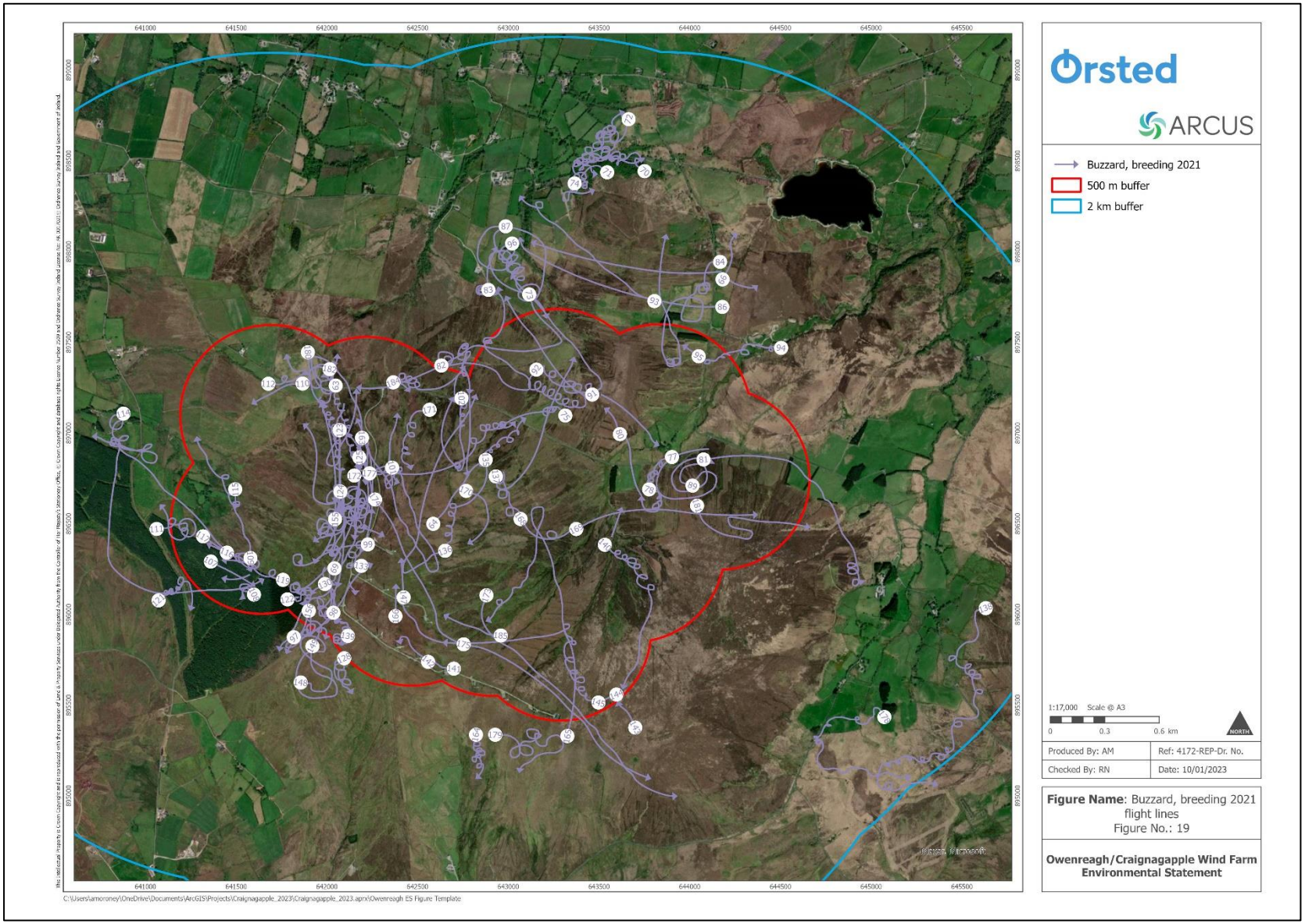

Figure A11.1.3.18: Buzzard, breeding 2021 flightlines

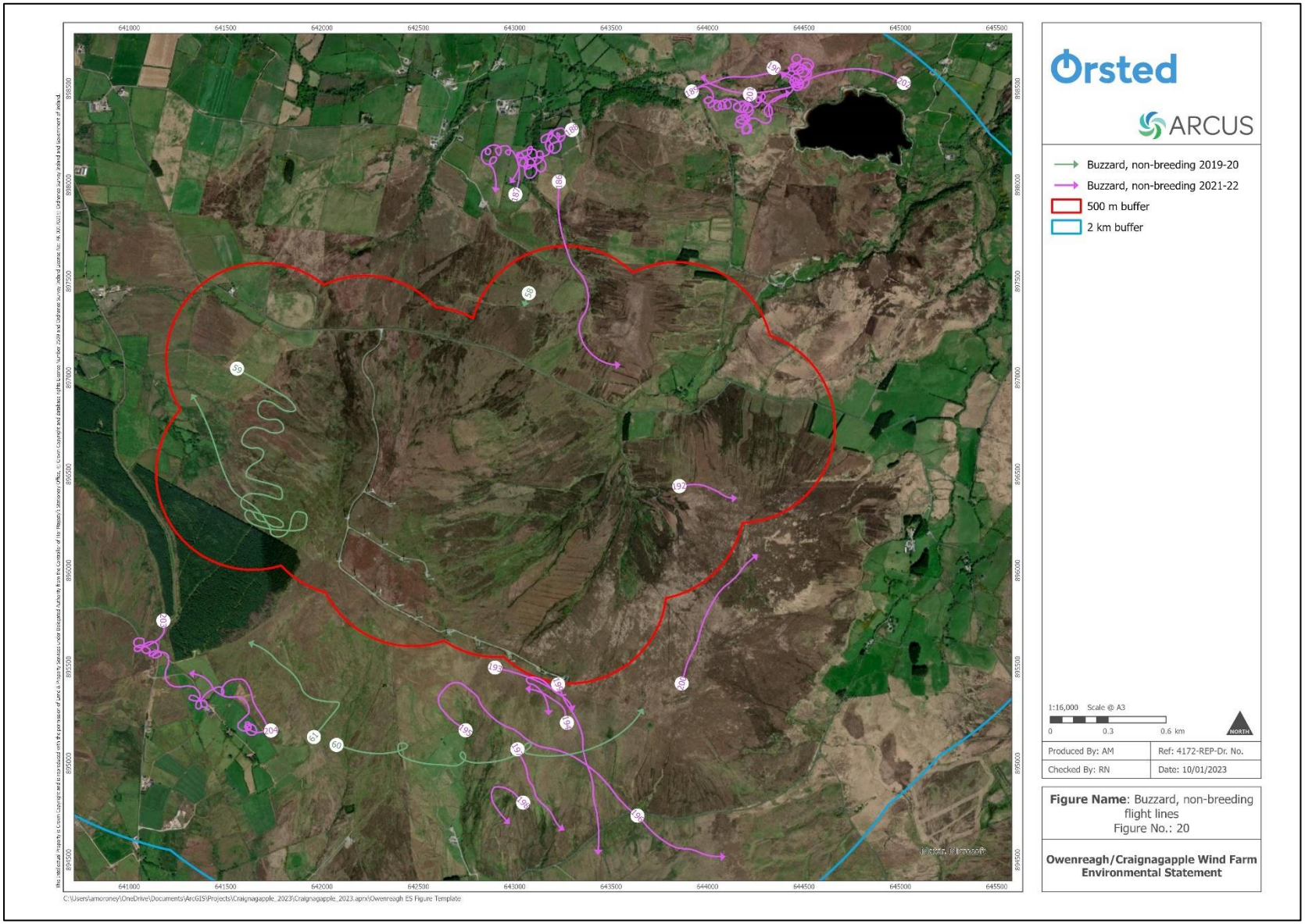

Figure A11.1.3.19: Buzzard, non-breeding flight lines

Table A11.1.3.10: Flight line data collected during VP watches for buzzard.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
1	Breeding season 2018	1	19/07/2018	BZ	Buzzard	1	20	20	Oct-20			Calling	Emerged from forestry patch calling and descending back down
2	Breeding season 2018	1	29/08/2018	BZ	Buzzard	1	30	40	40			Hunting	
3	Breeding season 2018	1	29/08/2018	BZ	Buzzard	2	50	40	40			Hunting	
4	Breeding season 2018	1	29/08/2018	BZ	Buzzard	3	25	40	20-40			Hunting	
5	Breeding season 2018	1	19/04/2018	BZ	Buzzard	1	157	100	80-100			Circling	BZ circles at 80-100m - lost from view suddenly
6	Breeding season 2018	1	25/04/2018	BZ	Buzzard	1	74	20	10-20		J	Flying	Out of turbine envelope. Immature BZ flying through site at 10-20m
7	Breeding season 2018	1	25/04/2018	BZ	Buzzard	1	62	50	30-50			Circling	Circles up 30-50
8	Breeding season 2018	1	25/04/2018	BZ	Buzzard	1	23	100	50-100			Flying	Rises to c.100m
9	Breeding season 2018	1	25/04/2018	BZ	Buzzard	1	110	150	100-150			Flying	Rises to c. 150m, flies away from site - lost from view against hill
10	Breeding season 2018	1	25/04/2018	BZ	Buzzard	1	18	20	20-60			Flying	Flies through site at 20m, immature BZ
11	Breeding season 2018	1	25/04/2018	BZ	Buzzard	1	43	60	60			Flying	Flies through buffer at c.60m, rising up, immature BZ
12	Breeding season 2018	1	27/04/2018	BZ	Buzzard	1	22	30	30			Commuting	Passing through going north
13	Breeding season 2018	1	27/04/2018	BZ	Buzzard	3	50	40	40			Circling	Tight group of BZ circling behind VP
14	Breeding season 2018	1	03/05/2018	BZ	Buzzard	1	35	30	30			Circling	BZ was circling at boundary of forestry then flew off
15	Breeding season 2018	1	25/06/2018	BZ	Buzzard	1	120	60	20-60			Soaring	Hunting, soaring, calling
16	Breeding season 2018	1	25/06/2018	BZ	Buzzard	2	160	120	120			Soaring	Soaring- display flight
17	Breeding season 2018	1	25/06/2018	BZ	Buzzard	2	120	20	20			Hunting	
18	Breeding season 2018	1	25/06/2018	BZ	Buzzard	2	240	60	60			Courtship	
19	Breeding season 2018	2	16/04/2018	BZ	Buzzard	1	45	40	40			Flying	Fly over plantation, drops out of view south of site
20	Breeding season 2018	2	19/04/2018	BZ	Buzzard	1	24	15	15			Mobbed	Harassed by HC, brief scurry then dropped below horizon
21	Breeding season 2018	2	02/05/2018	BZ	Buzzard	1	180	40	30-40			Circling	Circling on side of hill birds observed in same area last wek.
22	Breeding season 2018	2	02/05/2018	BZ	Buzzard	1	20	25	25			Breeding/ territorial	Breeding pair present in this area
23	Breeding season 2018	4	27/04/2018	BZ	Buzzard	1	289	300	150-300		J	Circling	Immature BZ circles at 150 m drifting SE, then circles up to c. 300 m and glides into wind (north) veering W dropping to 200 m
24	Breeding season 2018	4	02/05/2018	BZ	Buzzard	1	34	50	30-50			Hunting	Below turbine ridge, hunting at 30-50m, drops out of view
25	Breeding season 2018	4	18/05/2018	BZ	Buzzard	1	10	20	20			Mobbed	Mobbed by ML
26	Breeding season 2018	4	01/06/2018	BZ	Buzzard	1	95	120	120-150			Circling	Southern slope, away from turbines - BZ circling with PE (120-150m), stop tracking to follow PE
27	Breeding season 2019	1	29/03/2019	BZ	Buzzard	1	8	10				Flying	Flying, flew N from one plantation

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
28	Breeding season 2019	1	29/03/2019	BZ	Buzzard	1	407					Foraging	Foraging, flew out from back of plantation across bog, soared up from 2m to 10m, circled for 5 min then drifted over slope to NE
29	Breeding season 2019	1	29/03/2019	BZ	Buzzard	1	196	5				Foraging	Foraging up from behind hill, flapping slowly and gliding then briefly soaring at 5m, drifted NE over hill
30	Breeding season 2019	1	03/07/2019	BZ	Buzzard	1	699	150				Soaring	Soaring 120-150m, female BZ soaring easterly direction 150m above hillside diving and rising on breeze with male 2B before parting company and completed long glide NW, soared for couple of minutes again before diving to plantation below
31	Breeding season 2019	1	03/07/2019	BZ	Buzzard	1	506	150				Soaring	Soaring, foraging, 80-150m, soaring initially below female 100m before rising up to meet her at 150m, soared eastward over hillside before parting company and gliding south eastwards over hill east of turbines out of sight
32	Breeding season 2019	1	04/04/2019	BZ	Buzzard	1	157	40				Soaring	Soared N away from site
33	Breeding season 2019	1	04/04/2019	BZ	Buzzard	1	58	10				Soaring	Soaring out from behind the plantation, glided west then east and finally north away from site
34	Breeding season 2019	1	04/04/2019	BZ	Buzzard	1	373	100				Soaring	Soaring east of VP, soaring at 100m, glided further east dropping to 50m, mobbed by HC and continued flying and long glide east out of sight
35	Breeding season 2019	1	02/05/2019	BZ	Buzzard	3	470	150				Soaring	1 bird 120-150m, bird number 2 100-120m, bird number 3 80 - 100m. Then flying towards forestry block near VP, descending in height gradually
36	Breeding season 2019	1	02/05/2019	BZ	Buzzard	3	75	40				Soaring	Curved low over forestry. 30-40m
37	Breeding season 2019	1	02/05/2019	BZ	Buzzard	2	743	60				Soaring	Farmland
38	Breeding season 2019	1	02/05/2019	BZ	Buzzard	1	743	120				Soaring	High over farmland
39	Breeding season 2019	1	02/05/2019	BZ	Buzzard	3	409	60				Soaring	All 3 birds re-join behind forestry. Smaller bird flies north out of view. 2 other birds not in view after.
40	Breeding season 2019	1	02/05/2019	BZ	Buzzard	1	20	60				Soaring	
41	Breeding season 2019	1	23/05/2019	BZ	Buzzard	1	94	25				Soaring	Soaring on thermals and diving towards plantation with wings folded then climbing again, finally dived into plantation
42	Breeding season 2019	1	23/05/2019	BZ	Buzzard	1	501	70				Soaring	Soaring westwards then drifting back east, hovering several times before long dive, dropping behind hill and valley below
43	Breeding season 2019	2	29/03/2019	BZ	Buzzard	1	7	8		M		Flying	Flying, sitting on telegraph pole, flew downhill NW
44	Breeding season 2019	2	15/08/2019	BZ	Buzzard	1	2487	80	10-80			Flying	Rollercoasting on wind with second juvenile BZ and RN. Remained to the west above plantation for period of observation before departing south behind turbines.
45	Breeding season 2019	2	04/04/2019	BZ	Buzzard	1	433	25				Foraging	Foraging, flew behind (North of) VP. Being mobbed by RN flying east, soaring up from 5m to 25m SE in over entrance to Owenreagh, continued soaring and drifted away SE

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
46	Breeding season 2019	2	04/04/2019	BZ	Buzzard	1	49	5				Flying	Flying east 1-2m above ground, mobbed by 2 HC continued east over hill rising to 5m, evading crows
47	Breeding season 2019	2	02/05/2019	BZ	Buzzard	1	132	60				Soaring	Passing through then started soaring high
48	Breeding season 2019	2	02/05/2019	BZ	Buzzard	1	334	250				Soaring	Same bird soaring high. Drifted west out of site
49	Breeding season 2019	2	02/05/2019	BZ	Buzzard	1	659	75				Hunting	Hunting at edge of plantation
50	Breeding season 2019	2	02/05/2019	BZ	Buzzard	1	20	50				Breeding/ territorial	Interacting with another buzzard. Bird flew up from plantation and briefly interacted with above BZ. Landed back into plantation
51	Breeding season 2019	2	02/05/2019	BZ	Buzzard	3	1441	100				Breeding/ territorial	3 BZ interacting with each other, 24 mins, at heights of 50-120m, in area shaded, occasionally landing on plantation. Possibly breeding in area?
52	Breeding season 2019	3	02/05/2019	BZ	Buzzard	1	107	100				Soaring	Soaring 80-100m. Mainly 100m and all gliding. Mobbed by HC.
53	Breeding season 2019	3	02/05/2019	BZ	Buzzard	1	35	80				Soaring	Soaring and descending at 50-100m. Only some flapping. Lost from view over hill as it gradually descended.
54	Breeding season 2019	4	15/08/2019	BZ	Buzzard	1	287	50	02-50			Soaring	Soared up from plantation briefly soared south before drifting east rising to 50m circling several times before gliding further east eventually out of sight over bridge
55	Breeding season 2019	4	15/08/2019	BZ	Buzzard	1	18	15	2-15			Soaring	Briefly soared above plantation before dropping back down
56	Breeding season 2019	4	23/05/2019	BZ	Buzzard	1	140	120				Soaring	Soaring, gaining height, BZ soaring at 120m
57	Breeding season 2019	4	23/05/2019	BZ	Buzzard	1	4	225				Soaring	Soaring, now at c.225m and commuting over off site
58	Non-breeding season 2019-20	1	22/12/2019	BZ	Buzzard	1	7	1	1-2			Flying	Perched on post, flew to another post. Stayed on that post till end of watch.
59	Non-breeding season 2019-20	2	09/10/2019	BZ	Buzzard	1	386	20	5-20		J	Flying	Flying south, mobbed by two HC, soared up to 20m just north of plantation, circled for several minutes before gliding west dropping in height behind hill out of sight
60	Non-breeding season 2019-20	4	08/03/2020	BZ	Buzzard	1	150	150	90-200			Hunting	Lost view against sky as rain shower came in
61	Non-breeding season 2019-20	4	25/01/2020	BZ	Buzzard	1	70	30	20-30			Hunting	Fly, hover, fly, hover, fly. Mobbed by HC went below skyline towards plantation.
62	Breeding season 2021	1	25/07/2021	BZ	Buzzard	1	330	50	40-70			Flying	With BZ flight id3
63	Breeding season 2021	1	25/07/2021	BZ	Buzzard	1	220	60	60-180			Flying	With BZ Flight ID2 then flew to 2nd BZ to circle high together. Lost sight trying to watch 3rd BZ
64	Breeding season 2021	1	25/07/2021	BZ	Buzzard	1	70	100	100-180			Flying	Swoops and dives then met with Flight ID3 to circle high together. Lost sight trying to watch 3rd BZ
65	Breeding season 2021	1	25/07/2021	BZ	Buzzard	1	50	50	30-50			Hunting	Hanging in air. OOV against background
66	Breeding season 2021	1	22/08/2021	BZ	Buzzard	2	45	10	0-25		1A 1J	Flying	Adult and juvenile flushed as I got out of car, juvenile calling persistently and heard all the way up to VP.
67	Breeding season 2021	1	22/08/2021	BZ	Buzzard	1	82	40	25-50		A	Circling	Lone bird circling over east slope, no reaction to turbines observed during survey, birds circled over regular area behind them.

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
68	Breeding season 2021	1	22/08/2021	BZ	Buzzard	1	15	10	0-25		J	Flying	Juvenile flushed from same area as earlier as I returned to the car.
69	Breeding season 2021	1	22/08/2021	BZ	Buzzard	5	7740	50	25-75		2A 3J	Circling	2 ad and 3 juv circling and interacting almost constantly in view. 5 from 14:15-15:37, 2 until 15:41, 4 until 15:56 and 5 again until 16:20.
70	Breeding season 2021	1	22/08/2021	BZ	Buzzard	2	420	40	25-75		1A 1J	Circling	Adult and juvenile circling and interacting, constantly calling.
71	Breeding season 2021	1	22/08/2021	BZ	Buzzard	4	295	40	25-75		2A 2J	Circling	2 ad and 2 juv circling and calling persistently behind VP.
72	Breeding season 2021	1	22/08/2021	BZ	Buzzard	3	1420	40	20-75		1A 2J	Circling	Ad circling with 2 juveniles, persistent calling and interaction.
73	Breeding season 2021	1	22/08/2021	BZ	Buzzard	1	36	10	0-10		A	Flying	Adult perched in tree from 15:35-15:52, then to gate and on to pole at 15:55 briefly. Total perched time 1240.
74	Breeding season 2021	1	22/08/2021	BZ	Buzzard	2	372	40	25-75		1A 1J	Circling	Adult and juvenile circling and interacting, constantly calling.
75	Breeding season 2021	1	27/08/2021	BZ	Buzzard	1	125	50	5-60			Hunting	Landed on tree top. 15 sec below 25m
76	Breeding season 2021	1	27/08/2021	BZ	Buzzard	1	36	8	8			Flying	OOV against background
77	Breeding season 2021	1	27/08/2021	BZ	Buzzard	1	112	100	40-180			Flying	Circling gaining Ht.
78	Breeding season 2021	1	27/08/2021	BZ	Buzzard	1	159	200	180-220			Flying	Circling
79	Breeding season 2021	1	27/08/2021	BZ	Buzzard	1	135	100	25-180			Flying	Descending
80	Breeding season 2021	1	27/08/2021	BZ	Buzzard	1	10	1	1-25			Flying	To land tree top. Perching until end of survey
81	Breeding season 2021	1	03/04/2021	BZ	Buzzard	1	257	180	140-300			Displaying	Diving then travelling offsite to circle with 2 other BZ
82	Breeding season 2021	1	03/04/2021	BZ	Buzzard	1	648	50	30-60			Hunting	Circling, mobbed by RN
83	Breeding season 2021	1	03/04/2021	BZ	Buzzard	1	420	40	40-80			Circling	Joined 1st BZ went N
84	Breeding season 2021	1	03/04/2021	BZ	Buzzard	1	235	40	40-60			Hunting	Mobbed by RN
85	Breeding season 2021	1	03/04/2021	BZ	Buzzard	1	73	20	20			Flying	Mobbed by RN
86	Breeding season 2021	1	03/04/2021	BZ	Buzzard	1	80	25	25			Flying	Followed Mobbed bird (5)
87	Breeding season 2021	1	03/04/2021	BZ	Buzzard	2	55	20	10-20			Displaying	Chasing
88	Breeding season 2021	1	03/04/2021	BZ	Buzzard	2	45	20	20			Displaying	Chasing
89	Breeding season 2021	1	03/04/2021	BZ	Buzzard	2	255	70	20-140			Displaying	Chasing, soaring. One bird went high OOV
90	Breeding season 2021	1	03/04/2021	BZ	Buzzard	2	198	160	160-200			Soaring	
91	Breeding season 2021	1	03/04/2021	BZ	Buzzard	2	42	100	160-100			Displaying	Swoops, dives, chases
92	Breeding season 2021	1	03/04/2021	BZ	Buzzard	1	245	160	160-200			Soaring	With BZ (1.1/1.2) but stayed above them. 3 more BZ North of VP
93	Breeding season 2021	1	22/06/2021	BZ	Buzzard	1	27	10	08-10			Flying	Calling then swoops and dives behind VP

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
94	Breeding season 2021	1	25/07/2021	BZ	Buzzard	1	155	40	25-60			Hunting	
95	Breeding season 2021	1	25/07/2021	BZ	Buzzard	1	10	20	20-25			Flying	Travelling OOV behind trees
96	Breeding season 2021	1	25/07/2021	BZ	Buzzard	1	135	100	70-100			Flying	Circling then fast descending glide OOV against background
97	Breeding season 2021	2	19/07/2021	BZ	Buzzard	1	70	50	25-50			Hunting	
98	Breeding season 2021	2	19/07/2021	BZ	Buzzard	1	18	20	10-25			Hunting	
99	Breeding season 2021	2	19/07/2021	BZ	Buzzard	1	30	5	3-5			Hunting	OOV against background, may of landed
100	Breeding season 2021	2	19/07/2021	BZ	Buzzard	1	43	30	20-40			Hunting	Circling descending
101	Breeding season 2021	2	19/07/2021	BZ	Buzzard	1	63	20	5-20			Hunting	Low OOV
102	Breeding season 2021	2	19/07/2021	BZ	Buzzard	1	230	150	50-200			Flying	Circling with some swoops and dives
103	Breeding season 2021	2	19/07/2021	BZ	Buzzard	1	185	80	50-120			Hunting	
104	Breeding season 2021	2	19/07/2021	BZ	Buzzard	1	65	60	30-120			Flying	Drifting level flight into site. OOV below higher ground
105	Breeding season 2021	2	19/07/2021	BZ	Buzzard	1	0					Perched	Perching on telegraph pole, marked with X on map
106	Breeding season 2021	2	19/07/2021	BZ	Buzzard	1	15	5	1-5			Flying	Flew between telegraph poles, remained perching until end of VP
107	Breeding season 2021	2	27/08/2021	BZ	Buzzard	1	19	15	10-15			Flying	Landed in forestry
108	Breeding season 2021	2	27/08/2021	BZ	Buzzard	1	25	20	10-20			Flying	Circling over forestry with K
109	Breeding season 2021	2	27/08/2021	BZ	Buzzard	1	105	50	40-60			Hunting	Searching flight
110	Breeding season 2021	2	04/04/2021	BZ	Buzzard	1	14	10	0-10		A	Flying	Sat on pole from my arrival to flying off at 07:32
111	Breeding season 2021	2	04/04/2021	BZ	Buzzard	1	135	40	20-75		A	Circling	Circled over edge of plantation
112	Breeding season 2021	2	04/04/2021	BZ	Buzzard	1	19	30	30-40		A	Circling	Circled over PE and stooped down to take the carcass, fed for 115s before flying off.
113	Breeding season 2021	2	04/04/2021	BZ	Buzzard	1	11	10	0-10		A	Flying	Carried prey remains away.
114	Breeding season 2021	2	12/05/2021	BZ	Buzzard	1	330	100	70-200			Flying	Circling, gaining height then travelling W for 1.5 km then NW
115	Breeding season 2021	2	12/05/2021	BZ	Buzzard	1	2	2	2			Flying	Being mobbed by HC. OOV into dip
116	Breeding season 2021	2	12/05/2021	BZ	Buzzard	1	8	10	10			Flying	Along edge of forestry, perching
117	Breeding season 2021	2	12/05/2021	BZ	Buzzard	1	15	10	10			Flying	Along edge of forestry, perching
118	Breeding season 2021	2	12/05/2021	BZ	Buzzard	1	35	20	20-25			Flying	Through forest canopy then perching
119	Breeding season 2021	2	12/05/2021	BZ	Buzzard	1	438	100	5-150			Hunting	Low drifting hunting flight. When it got back to forestry did vertical dive to another BZ perching on edge of forestry, both flew into edge of forestry OOV. Second bird only in flight 2 sec.
120	Breeding season 2021	2	12/05/2021	BZ	Buzzard	1	15	3	3			Flying	Flew into forestry ride then OOV into forestry from ride. Second BZ seen briefly following first into forestry 2 sec.
121	Breeding season 2021	2	18/06/2021	BZ	Buzzard	1	194	50	10-50			Circling	
122	Breeding season 2021	2	18/06/2021	BZ	Buzzard	1	420	50	50-75		A	Circling	Circling and Hunting, still present as I left at end of VP

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
123	Breeding season 2021	3	21/03/2021	BZ	Buzzard	2	95	40	40-120			Flying	Flying together
124	Breeding season 2021	3	21/03/2021	BZ	Buzzard	2	160	120	120-160			Flying	Circled high OOV
125	Breeding season 2021	3	21/03/2021	BZ	Buzzard	2	150	40	40-120			Flying	Flying together
126	Breeding season 2021	3	21/03/2021	BZ	Buzzard	2	175	120	120-160			Circling	Circled high OOV
127	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	8	4	3-5			Hunting	
128	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	95	140	140-200			Circling	
129	Breeding season 2021	3	21/03/2021	BZ	Buzzard	2	25	25	15-35			Displaying	Mock attacks, diving, 50% below 20m
130	Breeding season 2021	3	21/03/2021	BZ	Buzzard	2	45	25	16-35			Displaying	Mock attacks, diving, 50% below 20m. 2 pairs of BZ in same area at the same time doing the same thing.
131	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	60	30	30-120			Hunting	
132	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	180	120	120-160			Flying	Gaining height, went high OOV
133	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	150	30	30-120			Hunting	
134	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	125	120	120-160			Flying	Gaining height, drifted North
135	Breeding season 2021	3	24/07/2021	BZ	Buzzard	1	68	35	35-180			Flying	Circling, gaining height.
136	Breeding season 2021	3	24/07/2021	BZ	Buzzard	1	127	180	180-300			Flying	Travelling
137	Breeding season 2021	3	24/07/2021	BZ	Buzzard	1	55	150	150-180			Flying	Swoops and dives then travelling
138	Breeding season 2021	3	22/08/2021	BZ	Buzzard	1	845	50	40-60		A	Hunting	Hunting, hanging and hovering east of site.
139	Breeding season 2021	3	22/08/2021	BZ	Buzzard	2	840	20	20-60		A	Circling	2 birds circling and interacting together, remained behind turbines. 5, 2 ad and 3 juvenile in similar area as i was leaving site.
140	Breeding season 2021	3	28/08/2021	BZ	Buzzard	1	166	50	40-70		A	Flying	Circling gaining Ht. Then travel to land on fence post. 10sec below 20m.
141	Breeding season 2021	3	28/08/2021	BZ	Buzzard	1	15	6	3-6			Hunting	Low hunting, land on tree
142	Breeding season 2021	3	28/08/2021	BZ	Buzzard	1	50	3	2-3			Hunting	Low hunting, land on tree
143	Breeding season 2021	3	28/08/2021	BZ	Buzzard	1	10	4	01-Apr			Flying	2nd BZ flew in low to land near 1st BZ
144	Breeding season 2021	3	28/08/2021	BZ	Buzzard	2	72	15	Jan-20			Hunting	2 BZ flying together
145	Breeding season 2021	3	28/08/2021	BZ	Buzzard	2	323	50	20-180			Hunting	One of BZ went OOV into low cloud base
146	Breeding season 2021	3	28/08/2021	BZ	Buzzard	1	81	40	20-50			Hunting	2nd BZ continued hunting
147	Breeding season 2021	3	28/08/2021	BZ	Buzzard	1	25	20	5-20			Hunting	

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
148	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	140	60	50-70			Flying	Circling near GP
149	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	50	100	100			Flying	
150	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	40	100	100-200			Flying	Went high OOV
151	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	120	40	30-50			Flying	
152	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	35	40	25-50			Flying	
153	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	22	15	8-25			Flying	
154	Breeding season 2021	3	21/03/2021	BZ	Buzzard	2	240	40	30-50			Soaring	Soaring together, swoops and dives
155	Breeding season 2021	3	21/03/2021	BZ	Buzzard	2	60	30	30			Flying	
156	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	32	20	15-20			Hunting	
157	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	15	15	10-15			Hunting	
158	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	56	15	5-15			Flying	
159	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	22	35	20-35			Flying	
160	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	105	15	15-20			Flying	
161	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	20	25	15-25			Flying	
162	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	93	20	20			Flying	Flying together with Flight ID no.7
163	Breeding season 2021	3	21/03/2021	BZ	Buzzard	1	90	30	30-70			Flying	
164	Breeding season 2021	3	06/05/2021	BZ	Buzzard	1	76	50	50-75			Circling	Circled over far side of site behind substation.
165	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	470	80	30-120			Hunting	Swoops and dives when second BZ approached. OOV against back ground when it went low.
166	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	20	50	40-50			Hunting	OOV against background.
167	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	465	30	30-40			Hunting	Hanging in air
168	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	90	15	0-30			Hunting	Hovering, swooped to ground
169	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	60	30	30-35			Flying	Travelling
170	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	45	100	100			Flying	Didnï¿½t see where this bird went as I was watching other BZ (13)
171	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	180	20	Feb-20			Hunting	OOV when it went low
172	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	510	50	30-60			Hunting	OOV against background.
173	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	158	30	30			Flying	Travelling, probably map id 1 bird coming back into view
174	Breeding season 2021	3	16/05/2021	BZ	Buzzard	2	300	70	60-80			Flying	2BZ together, some chasing each other and hunting
175	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	100	50	30-70			Flying	Travelling, didn't see where 2nd bird went
176	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	40	40	30-40			Hunting	OOV behind ridge
177	Breeding season 2021	3	16/05/2021	BZ	Buzzard	1	45	30	20-30			Hunting	OOV against background.
178	Breeding season 2021	3	26/05/2021	BZ	Buzzard	1	736	555	40-75		A	Hunting	
179	Breeding season 2021	3	26/05/2021	BZ	Buzzard	1	536	50	50-75			Circling	Circling and hunting behind substation.
180	Breeding season 2021	3	28/06/2021	BZ	Buzzard	1	510	140	50-100			Hunting	OOV against background. Only briefly above 180m

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
181	Breeding season 2021	3	28/06/2021	BZ	Buzzard	1	106	30	25-30			Flying	Mobbed away by HC
182	Breeding season 2021	3	28/06/2021	BZ	Buzzard	4	480	100	100-400			Flying	Circling, on and off site, gaining Ht. 50sec at collision Ht.
183	Breeding season 2021	3	28/06/2021	BZ	Buzzard	1	400	50	50			Hunting	OOV against background
184	Breeding season 2021	3	28/06/2021	BZ	Buzzard	1	255	30	0-30			Hunting	Dived to ground then flew NE as if had caught prey
185	Breeding season 2021	4	24/07/2021	BZ	Buzzard	1	18	75	50-75			Flying	Glided low OOV below foreground
186	Non-breeding season 2021-22	1	05/12/2021	BZ	Buzzard	1	23	15	5-25			Flying	Flew in and landed in tree, flew low out of view at 10:47.
187	Non-breeding season 2021-22	1	24/01/2022	BZ	Buzzard	1	35	20	0-30		A	Feeding	Called from trees at 08:53, flew to field at 09:18, circled briefly and flew to another field at 09:56 and remained to end of VP.
188	Non-breeding season 2021-22	1	24/01/2022	BZ	Buzzard	1	190	75	50-75		A	Circling	Circled in from north then landed in trees where it was this morning, remained to end of survey.
189	Non-breeding season 2021-22	3	29/09/2021	BZ	Buzzard	1	252	75	10-100			Circling	Circled gaining height before diving steeply out of view behind lake.
190	Non-breeding season 2021-22	3	29/09/2021	BZ	Buzzard	2	260	75	25-100			Circling	2 birds circled together along edge of buffer and slowly moved west.
191	Non-breeding season 2021-22	3	12/03/2022	BZ	Buzzard	2	25	70	50-80			Circling	Birds observed circling and soaring before flying out of sight
192	Non-breeding season 2021-22	3	12/03/2022	BZ	Buzzard	1	10	25	20-50		A	Flying	Bird flying over HB to SE
193	Non-breeding season 2021-22	3	18/03/2022	BZ	Buzzard	1	110	30	25-30			Hunting	Hanging in air, drifted S OOV
194	Non-breeding season 2021-22	3	18/03/2022	BZ	Buzzard	1	90	30	25-30			Hunting	
195	Non-breeding season 2021-22	3	18/03/2022	BZ	Buzzard	1	330	80	50-120			Hunting	
196	Non-breeding season 2021-22	3	18/03/2022	BZ	Buzzard	1	100	60	120-140			Hunting	
197	Non-breeding season 2021-22	3	18/03/2022	BZ	Buzzard	1	100	80	50-80			Hunting	
198	Non-breeding season 2021-22	3	18/03/2022	BZ	Buzzard	1	60	80	80			Hunting	
199	Non-breeding season 2021-22	3	18/03/2022	BZ	Buzzard	1	129	30	25-40			Hunting	129 sec within 500m of site boundary
200	Non-breeding season 2021-22	3	18/03/2022	BZ	Buzzard	1	35	10	10-15			Flying	
201	Non-breeding season 2021-22	3	27/02/2022	BZ	Buzzard	1	35	20	10-30			Circling	Circled up from lake but buffered by wind and dropped quickly
202	Non-breeding season 2021-22	3	27/02/2022	BZ	Buzzard	1	18	20	10-30			Flying	Flew from behind lake to behind VP1
203	Non-breeding season 2021-22	4	03/10/2021	BZ	Buzzard	1	75	25	25-50			Circling	Circled but failed to gain height, landed on post

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
204	Non-breeding season 2021-22	4	03/10/2021	BZ	Buzzard	1	55	25	0-50			Flying	Circled but again failed to gain height, flew out of view.

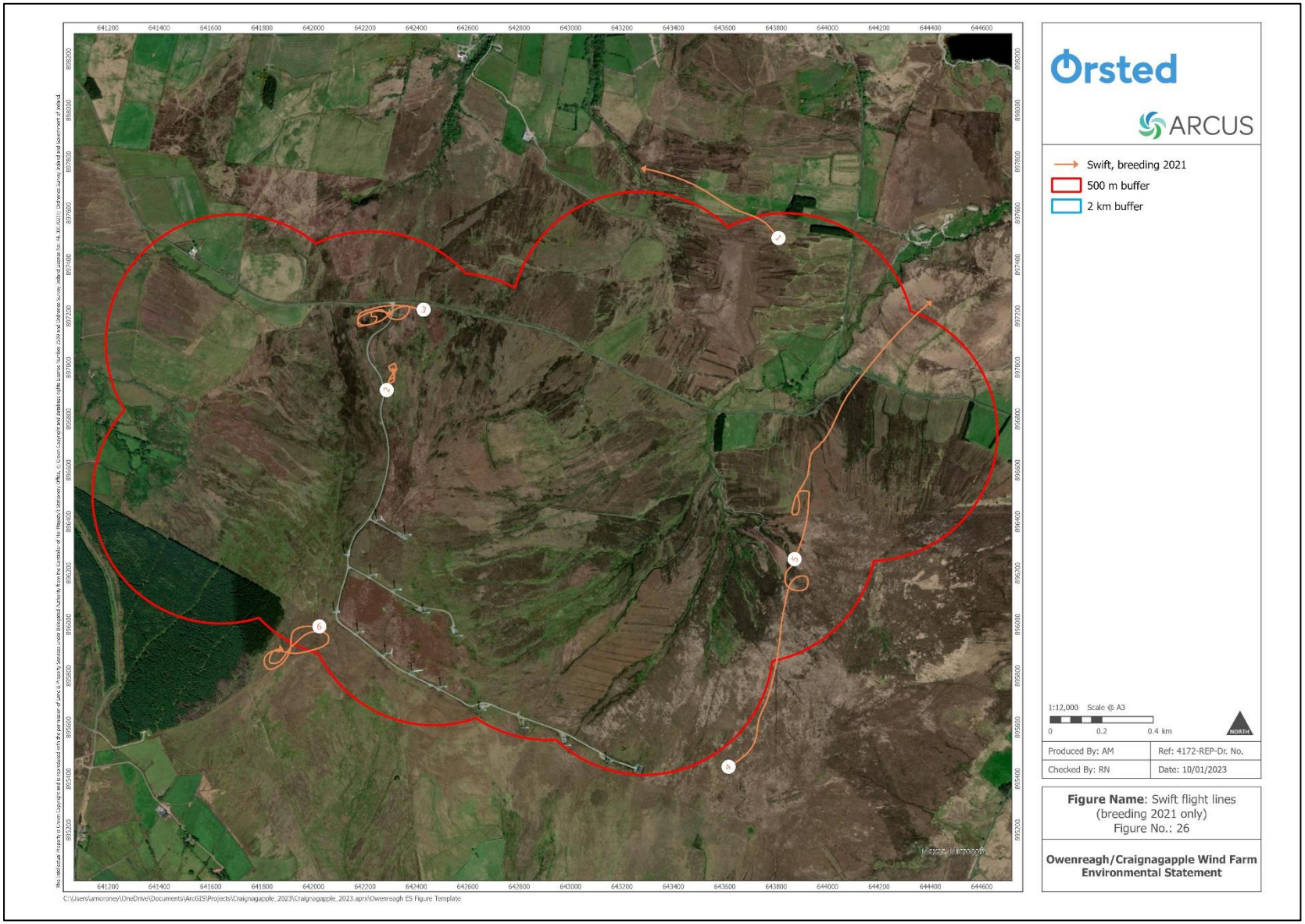

Figure A11.1.3.20: Swift flight lines (breeding 2021 only)

Table A11.1.3.11: Flight line data collected during VP watches for swift (breeding 2021 only)

Map ID	Season	VP No	Date	BTO Code	Sp. Name	No. of birds	Total seconds recorded	Height (m)	Flight range	Sex	Age	Behaviour	Comments
1	Breeding season 2021	1	22/06/2021	SI	Swift	1	63	8	06-9			Foraging	
2	Breeding season 2021	2	19/07/2021	SI	Swift	2	50	30	30			Foraging	Back and forth in area marked
3	Breeding season 2021	2	14/06/2021	SI	Swift	1	130	15	5-15			Foraging	In area marked
4	Breeding season 2021	3	13/06/2021	SI	Swift	1	45	80	50-150			Foraging	
5	Breeding season 2021	3	13/06/2021	SI	Swift	1	66	150	150-180			Foraging	
6	Breeding season 2021	4	24/07/2021	SI	Swift	5	140	50	30-80			Foraging	

Appendix IV – Walkover transect routes.

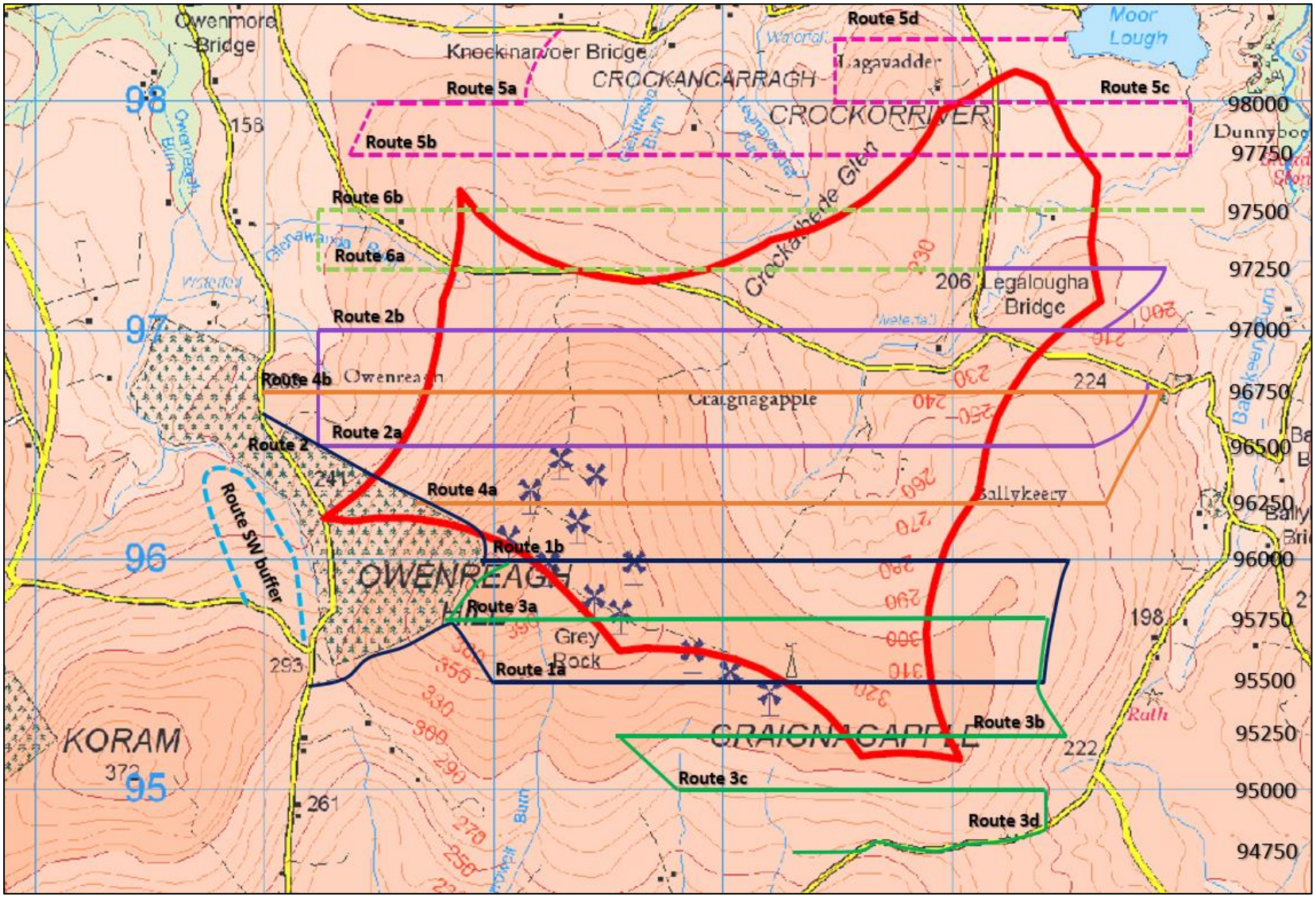

Figure A11.1.4.1: Transect routes for walkover surveys in summer 2018, winter 2018-2019 and summer 2019

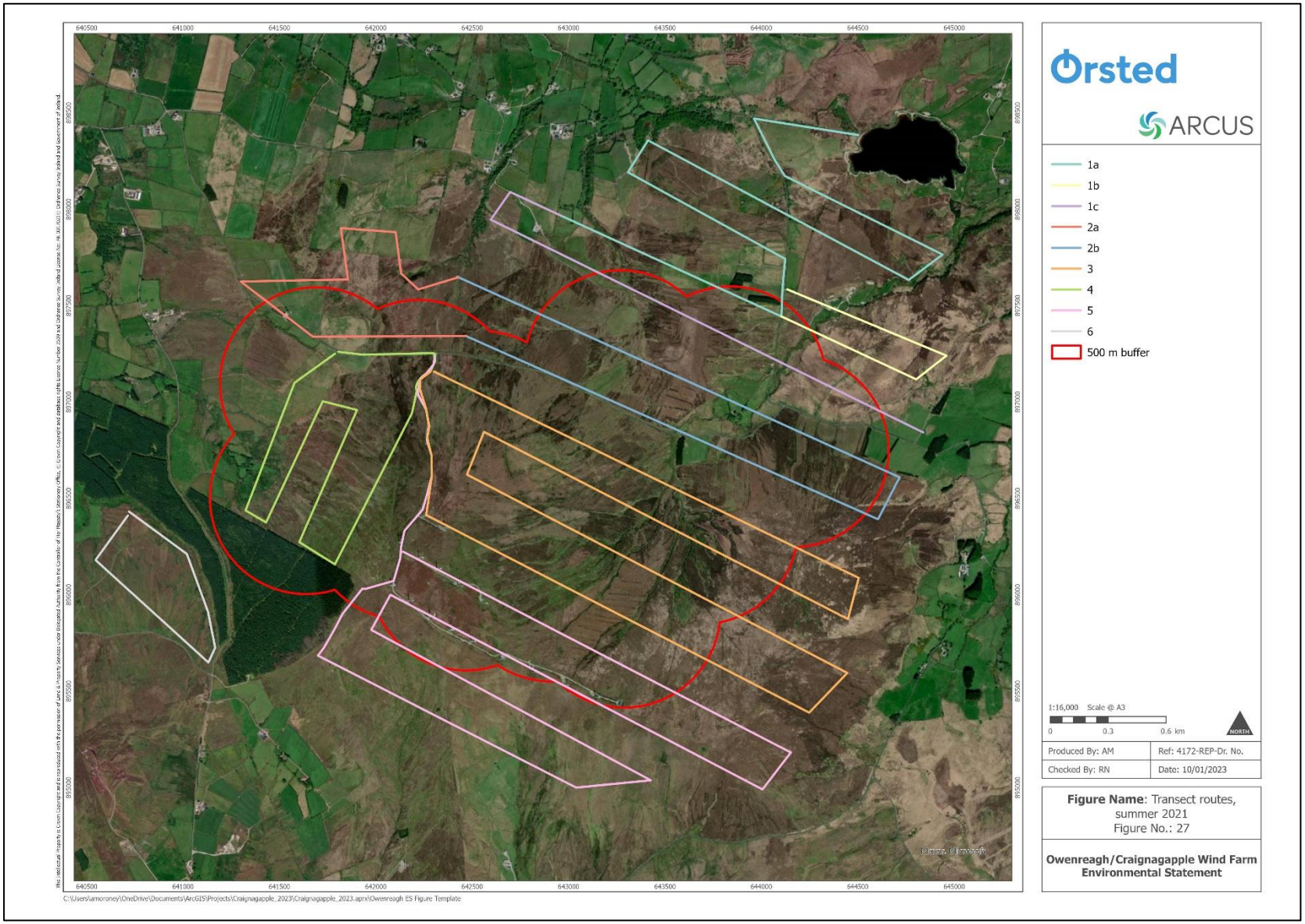

Figure A11.1.4.2: Transect routes for walkover surveys in summer 2021

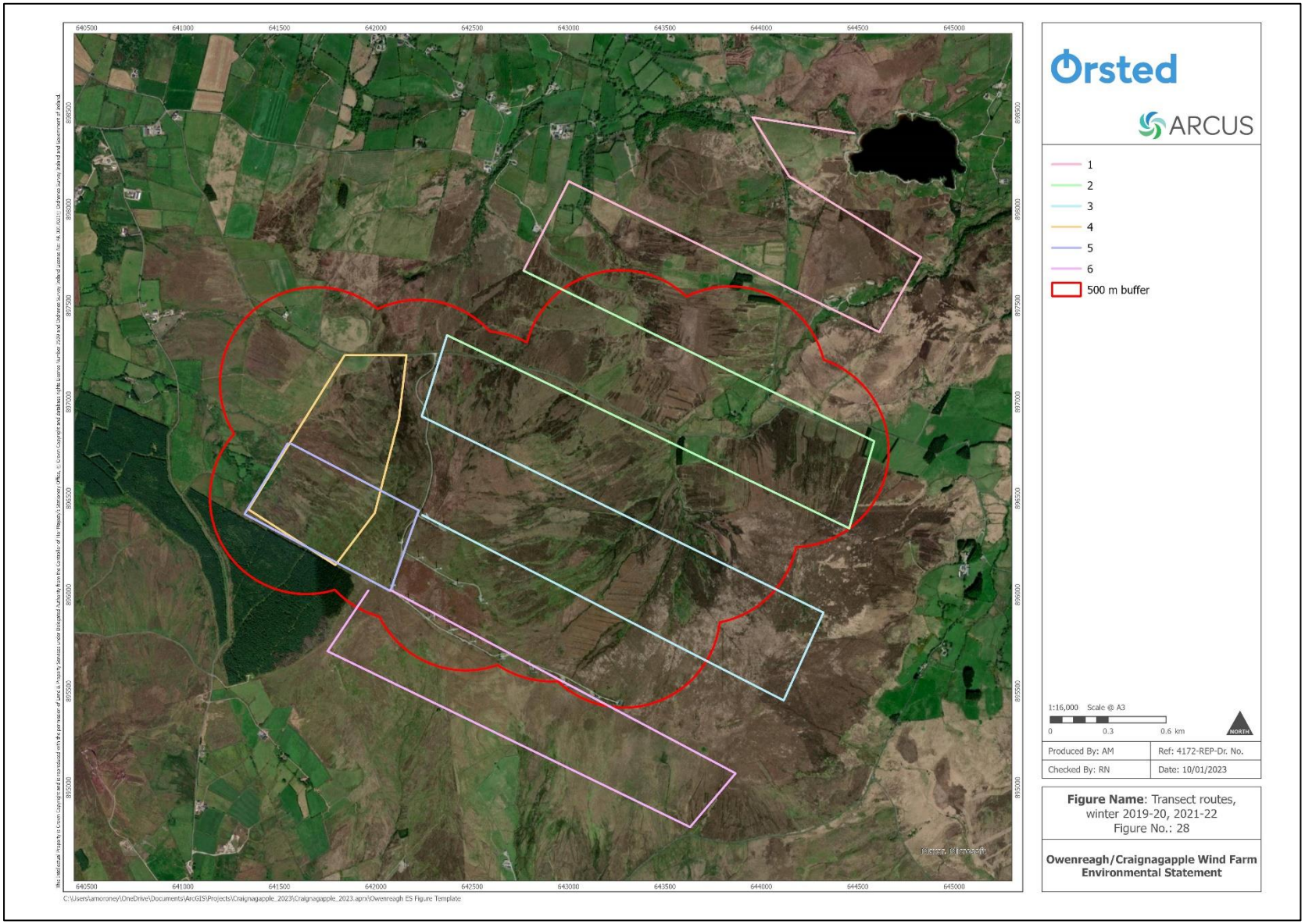

Figure A11.1.4.3: Transect routes for walkover surveys in winter 2019-20 and 2021-22

Appendix V – Survey effort tables showing weather conditions.

Table A11.1.5.1: Survey effort for VP watches showing weather conditions 2018-2022

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding 2018	16/04/2018	1	1	2.00	1445	None	MT	5	S-SSE	Good	8	11	damp	mostly dry, occ. light shower	sheep feeding	None
Breeding 2018	19/04/2018	1	2	3.00	1145	BZ, SN(chip)	MT	4-3	SW	Good	6-8	13-15	damp	mostly dry, v occ. spot	shots fired from sheds east of VP, firing range	mild glare at times
Breeding 2018	25/04/2018	1	3	3.00	1145	K, BZ	MT	4-5	S-W	Good-Mod	5-8	9	damp	passing showers, some heavy - wintery with hail	construction works visit	None
Breeding 2018	27/04/2018	1	4	3.00	1245	BZ, RN	HPD	2-3	N	Good	5	9	dry	dry	None	None
Breeding 2018	03/05/2018	1	5	3.00	1030	SH, BZ	PQ	2	S	Mod-Poor	8	10		showers	None	low cloud base, fog/mist
Breeding 2018	01/06/2018	1	6	3.00	1130	None	KB	3	S		6	21	dry	dry	None	glare to S
Breeding 2018	18/06/2018	1	7	3.00	1230	SN	KB	4	SW	Good	7	16	damp	showers	None	None
Breeding 2018	25/06/2018	1	8	4.00	1130	BZ	KB	2	NW	Good	4	20	dry	dry	None	None
Breeding 2018	12/07/2018	1	9	3.00	815	None	KB	3	N		8	15	damp	dry	None	None
Breeding 2018	19/07/2018	1	10	3.00	1500	BZ	KB	3	SW	Good	5	17	dry	dry	None	None
Breeding 2018	02/08/2018	1	11	3.00	1115	None	KB	3	SW		8	16	wet	rain showers	None	None
Breeding 2018	29/08/2018	1	12	3.00	1445	BZ	KB	2	W		8	14.5	damp	dry	None	None
Breeding 2018	16/04/2018	2	1	2.00	715	SH, BZ	MT	4	S	Good	2-6	6-7	damp	dry	None	some glare to east
Breeding 2018	19/04/2018	2	2	3.00	1515	GP, BZ	BMc	4	SSW	Good	5-7	16	damp	dry	None	None
Breeding 2018	25/04/2018	2	3	3.00	1545	None	HPD	5-6	W	Good-Mod	5		dry	occasional showers	None	visibility poor in showers
Breeding 2018	27/04/2018	2	4	3.00	845	BZ	HPD	1	N	Good	4	6	dry	none	None	None
Breeding 2018	01/05/2018	2	5	3.00	1045	None	PQ	2	S	Mod	8	9		light showers turned heavy	None	low cloud base
Breeding 2018	02/05/2018	2	6	3.00	1015	RN, BZ	HPD	3-5	W	Good	5	9-10	dry	several showers only	None	showers

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding 2018	15/06/2018	2	7	3.00	700	None	KB	4	SW		8	11	damp/wet	dry with some light showers	None	low cloud base, fog/mist
Breeding 2018	18/06/2018	2	8	4.00	1545	SN	KB	4	SW	Good	5-8	15	damp	dry	None	None
Breeding 2018	25/06/2018	2	9	3.00	1545	None	KB	1	NW	Good	7	2	dry	dry	None	None
Breeding 2018	29/06/2018	2	10	3.00	1200	None	KB	1	S	Good	0	28	dry	dry	None	None
Breeding 2018	10/07/2018	2	11	3.00	1030	None	KB	2	NE		8	17	dry	dry	None	None
Breeding 2018	19/07/2018	2	12	3.00	1815	ML	KB	3	SW	Good	8	15	dry	dry	None	None
Breeding 2018	01/08/2018	2	13	3.00	1045	None	KB	4	SW	Poor	8	16	wet	heavy rain	None	None
Breeding 2018	22/08/2018	2	14	3.00	1045	None	KB	3	W		7	15	wet	dry	None	None
Breeding 2018	16/04/2018	3	1	2.00	1200	None	MT	5	S	Good		12	damp	v occ spots	other surveyors behind VP	none, slightly strong wind
Breeding 2018	19/04/2018	3	2	3.00	1530	GP	MT	4-3	SW	Good	6-3	16-14	damp	dry	None	None
Breeding 2018	25/04/2018	3	3	3.00	1615	GP, RO	MT	5-4	W	Good-Mod	6-8	9	damp	occ wintry shower	none -works on site stopped	occ shower, periodic glare in last half hour
Breeding 2018	27/04/2018	3	4	3.00	915	GP, PE, BZ, SN	MT	1-2	N-NE	Good	1-3-5	4-10	damp	dry	minimal construction works in site/operational windfarm	ground level heat haze throughout site
Breeding 2018	18/05/2018	3	5	2.00	1030	RG, SN	HD	3	NW	Good-Mod	7	Not rec	dry		None	None
Breeding 2018	01/06/2018	3	6	2.00	1600	None	KB	3	SE	Good	7	18	dry	dry	thunder	None
Breeding 2018	14/06/2018	3	7	3.00	1245	None	KB	4	W	Good	6	13	dry	dry with some showers	None	None
Breeding 2018	14/06/2018	3	8	3.00	1545	None	KB	4	W	Good	6	14	dry	dry with some showers	None	None
Breeding 2018	28/06/2018	3	9	3.00	1200	None	HPD	3	N	Good	1	28	dry	none	None	None
Breeding 2018	12/07/2018	3	10	3.00	1145	None	KB	3	N		8	17	damp	dry	None	None
Breeding 2018	31/07/2018	3	11	3.00	1100	None	KB	4	S		8	15	wet	dry	None	None
Breeding 2018	09/08/2018	3	12	3.00	1515	ML	KB	4	W		6	15	wet	dry with light showers	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding 2018	22/08/2018	3	13	3.00	1400	K	KB	3	W		7	15	wet	dry	None	None
Breeding 2018	16/04/2018	4	1	2.00	945	GB	MT	4-5	S	Good	6-7	8-11	damp	dry	farmers feeding sheep	None
Breeding 2018	19/04/2018	4	2	3.00	1200	CU	BMc	4	SSW	Good	6-7	17	damp	mostly dry, occ v brief light passing shower	None	None
Breeding 2018	25/04/2018	4	3	3.00	1130	None	HPD	5-6	W	Good	5-7	9	dry	occ brief light shower	None	None
Breeding 2018	27/04/2018	4	4	3.00	1245	K, BZ	MT	3	N		5-7	10	damp	dry	operational windfarm - old turbines off, minimal construction activities	heat haze
Breeding 2018	02/05/2018	4	5	3.00	1015	BZ, SN	MT	4	W	Good	5-7	7-8	damp	mostly dry	None	None
Breeding 2018	18/05/2018	4	6	2.00	1030	ML, BZ	HPD	3	W	Good	6	12	dry	none	None	None
Breeding 2018	01/06/2018	4	7	3.00	1130	PE, BZ	HPD	3	S	Good	3	20	dry	dry	None	slightly misty, haze
Breeding 2018	19/06/2018	4	8	3.00	1300	None	KB	2	S	Good	8	11	wet	showers	None	None
Breeding 2018	19/06/2018	4	9	2.00	1000	None	KB	2	S	Good	8	11	wet	dry	None	None
Breeding 2018	10/07/2018	4	10	3.00	1400	None	KB	2	NE		8	17	damp	dry	None	None
Breeding 2018	31/07/2018	4	11	3.00	1430	RG	KB	4	S		8	16	wet	rain showers	None	None
Breeding 2018	02/08/2018	4	12	3.00	745	None	KB	3	SW		8	19	wet	dry	None	low cloud base covering the turbines for first half of survey
Breeding 2018	29/08/2018	4	13	3.00	1115	None	KB	2	W		8	4	damp	dry	None	None
Non-breeding 2018-19	30/10/2018	1	1	3.00	1045	None	HD	2-4	SSE	Good	6	6	dry	none	maintenance work in wind farm	low cloud base
Non-breeding 2018-19	02/11/2018	1	2	2.00	745	None	MT	3-2	S	Good	1-6	3-4	wet, light ground frost	dry	active windfarm	glare to east
Non-breeding 2018-19	08/11/2018	1	3	3.00	845	None	MT	4-5	S	Good	1-2	6	damp/wet	dry	operational windfarm,	glare

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
															shooting on range from 11	
Non-breeding 2018-19	22/11/2018	1	4	4.00	1200	K	KW	1	SE		1-6	4-6	wet		None	glare from S/SW
Non-breeding 2018-19	12/12/2018	1	5	3.00	945	None	HPD	4	SE	Mod	7-8	8	damp	dry	None	Fog/low cloud on upper slope, with good vis on lower slopes
Non-breeding 2018-19	12/12/2018	1	6	3.00	1245	PE	HPD	4	SE	Mod	7-8	6	damp	dry	None	Fog/low cloud on upper slope, with good vis on lower slopes
Non-breeding 2018-19	09/01/2019	1	7	3.00	1330	None	KW	1-2	S	Mod-Poor	8	7	wet	mist	None	low cloud base
Non-breeding 2018-19	22/01/2019	1	8	3.00	1300	None	KW	1-2	W	Mod-good	3-8	1-2	Frozen (snow)	snow	None	glare, shower, Low cloud
Non-breeding 2018-19	06/02/2019	1	9	3.00	1415	None	KW	4	SW	Mod-good	3-7	5-8	dry	none	None	glare to SW
Non-breeding 2018-19	13/02/2019	1	10	3.00	1315	None	KW	4-5	SW		5-8	9-10	wet	none	None	None
Non-breeding 2018-19	21/02/2019	1	11	3.00	945	None	KW	4-5	S	Good	5-8		Wet	none	None	glare 12pm
Non-breeding 2018-19	06/03/2019	1	12	3.00	1130	None	KW	4-5	NW	Poor	8	4-7	wet (bog)	mist	None	Fog, mist, low cloud
Non-breeding 2018-19	10/10/2018	2	1	2.50	1330	None	HD	4	SE	Mod	2	17	damp	none	None	glare from south
Non-breeding 2018-19	15/10/2018	2	2	0.50	1730	None	HD	3	SSE	Good	3	13	dry	none	None	minor glare from west
Non-breeding 2018-19	30/10/2018	2	3	3.00	1400	None	HD	3	SSE-SE	Good-Mod	8-6	7-6	dry	at times	maintenance work in wind farm, 6 turbines switched off , working on turbines with no blades	None
Non-breeding 2018-19	08/11/2018	2	4	3.00	845	None	KW	4	SE	Mod	2	5	dry	none	None	glare to SE
Non-breeding 2018-19	22/11/2018	2	5	3.00	830	None	KW	2-4	E-SE	Good	1-4	3	wet	none	None	slight glare to SE
Non-breeding 2018-19	12/12/2018	2	6	3.00	1000	None	KW	3-4	SE	Mod-Poor	8	6-7	wet	none	not rec	fog over hilltop - vis better on lower slopes

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding 2018-19	12/12/2018	2	7	3.00	1300	None	KW	3-4	SE	Mod	8	6-7	wet	none	not rec	fog over hilltop, clearing at times - vis better on lower slopes
Non-breeding 2018-19	06/01/2019	2	8	3.00	1000	GP	KW	5	SW	Good	5-7	7	damp, no frost/ice	light showers	None	none, good visibility
Non-breeding 2018-19	09/01/2019	2	9	3.00	1300	GP	HD	2	W		8	10	dry	light showers after 1540	None	low cloud, fog high on hill, showers clear to 1515 then heavy mist
Non-breeding 2018-19	22/01/2019	2	10	3.00	930	None	KW	1-2	W	Good	2-7	0-1	frozen (snow)	none	None	slight glare to S
Non-breeding 2018-19	13/02/2019	2	11	3.00	1000	GP, ML	KW	5	SW	Good	7-8	7-10	Wet	none	None	Slight glare over turbines
Non-breeding 2018-19	21/02/2019	2	12	3.00	930	None	HD	4-5	S	Good	6-8	9	dry	none	None	none, good visibility at top
Non-breeding 2018-19	06/03/2019	2	13	3.00	1115	None	HD	4-5	NW	Poor	8	5	damp	light misty	None	heavy fog and mist
Non-breeding 2018-19	15/10/2018	3	1	3.00	1300	SN	HD	2-3	SW	Good	3	12-13	damp-dry	none	work ongoing on turbines, some turbines turned off	None
Non-breeding 2018-19	02/11/2018	3	2	1.50	1500	SN	MT	4-5	S-SE	Good-Mod	8			persistent light drizzle	None	misty drizzle
Non-breeding 2018-19	06/11/2018	3	3	4.50	1300	RG	HD	4-5	SE	Good-Mod	8	10-11	wet	light	None	low cloud base, mist
Non-breeding 2018-19	06/12/2018	3	4	3.00	1245	RG heard	MT	4-3	SW	Good	6-7	9-7	wet	dry	None	low cloud, mist
Non-breeding 2018-19	13/12/2018	3	5	3.00	930	SN	KW	5	SE	Good	8	7	wet	dry	not rec	None
Non-breeding 2018-19	13/12/2018	3	6	3.00	1230	None	KW	5	SE	Good-Mod	8	6	wet	dry, then mist drizzle/light showers in last hour	not rec	misty drizzle/low cloud - in last hour
Non-breeding 2018-19	09/01/2019	3	7	3.00	945	None	KW	2	S	Mod	8	5		none	None	low cloud base
Non-breeding 2018-19	30/01/2019	3	8	3.00	1015	ML	KW	1-3	W	Mod-good	1-6	0-2	snow	none	None	None
Non-breeding 2018-19	06/02/2019	3	9	3.00	1030	None	KW	4	SW	Good	3-8	3-5	wet bog	none	None	low cloud at 12.15
Non-breeding 2018-19	21/02/2019	3	10	3.00	1330	None	KW	4-5	SW	Good	6-8		wet	none	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding 2018-19	28/02/2019	3	11	3.00	1045	SN, BW	KW	1	W	Poor	8	6	Wet bog	none	None	heavy fog
Non-breeding 2018-19	06/03/2019	3	12	3.00	1500	SN, JS	KW	4-5	NW	mod-good	8	5-6	Wet bog	mist	None	fog, low cloud
Non-breeding 2018-19	02/11/2018	4	1	4.00	1030	SN, GP	MT	3-4	S-SE	Good	6-8	4-5	wet	dry	active windfarm	None
Non-breeding 2018-19	06/11/2018	4	2	2.00	1015	GP, PE	HD	4	SE	Good-Poor	8	12-11	wet	at times	maintenance workers on site	low cloud base, mist
Non-breeding 2018-19	08/11/2018	4	3	3.00	1230	None	KW	5	SE	Mod	4	7	damp bog	none	None	glare to south/SW
Non-breeding 2018-19	20/11/2018	4	4	3.00	1315	GP	KW	3-5	NE	Good	4-8	6	wet bog	shower	None	None
Non-breeding 2018-19	06/12/2018	4	5	2.25	1345	GP	HD	3-4	W	Mod	8	9-10	damp	none	None	light mist, overcast
Non-breeding 2018-19	13/12/2018	4	6	3.00	930	None	HD	6	SE	Good	8	7	damp	mostly dry - occ light rain	None	occ misty drizzle
Non-breeding 2018-19	13/12/2018	4	7	3.00	1230	None	HD	6	SE	Good-Mod	8	6	damp	dry, then mist drizzle/light showers in last hour	None	misty drizzle/low cloud - in last hour
Non-breeding 2018-19	09/01/2019	4	8	3.00	945	GP	HD	0-1	W	Good-Poor	8	9	dry	mist	None	dense fog moved in from W at C.1045, vis then about 150m
Non-breeding 2018-19	30/01/2019	4	9	3.00	1345	None	KW	2	W		1-4	3-5	snow		None	None
Non-breeding 2018-19	06/02/2019	4	10	3.00	1330	None	HD	3-4	SW	Good	5-7	9	dry	none	None	None
Non-breeding 2018-19	21/02/2019	4	11	3.75	1300	None	HD	5	S	Good	7-8	10	dry	none	None	none, good visibility
Non-breeding 2018-19	28/02/2019	4	12	1.00	1415	None	KW	0		Poor	8	6	wet	none	crane and works on site	heavy fog
Non-breeding 2018-19	03/03/2019	4	13	5.00	1330	None	KW	5	N	Poor-Mod	8	3-4	wet	prolonged showers	hiker with sacks walked down hillside just before VP was started	None
Non-breeding 2018-19	06/03/2019	4	14	3.00	1445	JD, GP	HD	4-5	NW	Poor	8	10	damp	light	None	poor visibility early on, then improved to good later. Some light rain
Breeding 2019	22/03/2019	1	1	3.00	1315	None	KW	4-5	W	Good	6-8	10	wet	light shower	None	glare, minimal

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding 2019	29/03/2019	1	2	3.00	1030	MA, BZ, GP	KW	3	SW	Good	8	11-12	wet	none	None	None
Breeding 2019	04/04/2019	1	3	3.00	1000	BZ	KW	3	NE		5-8	6-7	wet	none	None	None
Breeding 2019	02/05/2019	1	4	3.00	1015	BZ	HD	2	W	Good	6-8		Damp	none	None	low cloud base
Breeding 2019	09/05/2019	1	5	2.00	1300	GP, K, SN	KW	4	SE	Good	8	10-11	wet	light showers	None	None
Breeding 2019	23/05/2019	1	6	2.00	1300	BZ	KW	2-3	WNW	Good	7	15-17	dry	none	None	None
Breeding 2019	23/05/2019	1	7	2.00	1815	BZ	KW	2-3	WNW	Good	2-6	13-15	dry	none	None	None
Breeding 2019	05/06/2019	1	8	3.00	1730	K	KW	1-2	N	mod-good	8	9-11	wet	showers	None	None
Breeding 2019	18/06/2019	1	9	3.00	1130	SN, LB	KW	3	SW	Good	6-8	13-14	wet	showers	None	None
Breeding 2019	03/07/2019	1	10	3.00	900	K, BZ	KW	1-3	NW	Good	1-7	13-17	dry	none	works and crane on site replacing gearbox on turbine	None
Breeding 2019	18/07/2019	1	11	3.00	745	None	KW	2-3	SW	Good	5-8	10-14	wet	showers	None	None
Breeding 2019	07/08/2019	1	12	3.00	1445	None	KW	2	NW	Mod-Good	7-8	16-18	wet	heavy showers	None	None
Breeding 2019	20/08/2019	1	13	3.00	1300	K	KW	3	S	Good	6-8	16-17	Wet	v. light showers	None	None
Breeding 2019	22/03/2019	2	1	3.00	900	None	MT	4-5	SW	Mod-Poor	8	10	damp	showery, sometimes heavy	None	fog/mist on top of site, rain
Breeding 2019	29/03/2019	2	2	3.00	645	BZ	KW	3-4	SW	Good	8	5-6	wet	none	None	None
Breeding 2019	04/04/2019	2	3	3.00	1330	BZ	KW	3	NE	Good	5-8	7-8	wet	showers	None	None
Breeding 2019	02/05/2019	2	4	3.00	945	BZ	HPD	2	NW	Good	7-8	12	Dry	none	None	None
Breeding 2019	09/05/2019	2	5	2.00	815	None	KW	1-2	SE	Good	8	5-6	wet	v. light showers	None	None
Breeding 2019	23/05/2019	2	6	2.00	1315	None	KW	2-3	WNW	Good	7-8	17	dry	none	None	slight haze, otherwise good.
Breeding 2019	23/05/2019	2	7	2.00	1600	None	KW	2-3	WNW	Good	7	17-18	dry	none	None	None
Breeding 2019	04/06/2019	2	8	3.00	1200	None	HD	3	NE	Good-Poor	8	11-12	wet	light to mod showers. Turned heavy	None	low cloud base, fog/mist

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding 2019	26/06/2019	2	9	3.00	1030	None	KW	2	N	Good	7-8	15	dry	none	None	low cloud over top of Craignagapple
Breeding 2019	10/07/2019	2	10	3.00	1000	None	KW	2-3	SW	Good	8	17-18	wet	shower	None	None
Breeding 2019	25/07/2019	2	11	3.00	900	None	KW	3-5	SE	Good	7-8	20	dry	none	None	None
Breeding 2019	15/08/2019	2	12	3.00	845	H, BZ	KW	3-4	WNW-W	Good	2-4	10-13	dry	none	None	None
Breeding 2019	30/08/2019	2	13	3.00	730	None	KW	4	SW	Poor-Mod	8	10-12	wet	persistent showers, mist to rain	None	None
Breeding 2019	22/03/2019	3	1	3.00	915	SN	MT	4-5	WSW	Good-Poor	8	10	wet	heavy shower to mist/light rain	None	None
Breeding 2019	03/04/2019	3	2	3.00	1015	None	KW	4	NW	mod-good	4-8	5-6	wet	showers	None	None
Breeding 2019	12/04/2019	3	3	3.00	800	GP, ML	KW	3	SE	mod-good	1-8	6	wet	none	None	None
Breeding 2019	02/05/2019	3	4	3.00	1345	BZ	HD	2-3	NW	Good-Mod	7-8	13-10	Dry and burnt	very light	None	low cloud base
Breeding 2019	09/03/2019	3	5	2.00	1515	None	KW	3-4	SE	Good	8	7-8	wet	light showers. Some persistent	None	None
Breeding 2019	23/05/2019	3	6	4.00	845	None	KW	2-4	WNW/W	Good	4-7	10-15	dry	none	None	None
Breeding 2019	05/06/2019	3	7	3.00	1045	HH	KW	1-2	N	mod-good	8	12	wet	showers	None	None
Breeding 2019	18/06/2019	3	8	3.00	1500	ML	KW	4	SW	mod-good	7-8	13-14	wet	showers	None	None
Breeding 2019	03/07/2019	3	9	3.00	1300	None	KW	1-2	NW	Good	8	18-19	dry	none	works on site near gearbox for turbine 1	None
Breeding 2019	18/07/2019	3	10	3.00	1115	K	KW	2	SW	Good-Poor	5-8	16-18	wet	showers	None	None
Breeding 2019	07/08/2019	3	11	3.00	930	None	KW	2	W	Good	5-8	17-19	wet	heavy showers	None	None
Breeding 2019	20/08/2019	3	12	3.00	845	HH	KW	2-3	SW	Good	2-6	15-17	wet	none	None	None
Breeding 2019	22/03/2019	4	1	3.00	1215	None	HPD	5-6	SW	Good	5-8	11	damp	shower, mostly dry	None	light mist, otherwise good
Breeding 2019	12/04/2019	4	3	3.00	1130	GP	KW	5-6	SE	Good	6-8	7-8	wet	none	None	None
Breeding 2019	02/05/2019	4	4	3.00	1330	None	HPD	2	NW	Good	7-8	12	Dry	none	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding 2019	09/05/2019	4	5	1.00	1045	None	KW	4-5	SE	Good	7-8	9-10	wet	none	None	None
Breeding 2019	23/05/2019	4	6	4.00	900	BZ	KW	1-2	W	Good	6-7	14	dry	none	None	None
Breeding 2019	05/06/2019	4	8	3.00	1415	None	KW	3	N	Good-Poor	8	10-11			None	None
Breeding 2019	26/06/2019	4	9	3.00	1400	None	KW	4	N	Good	1-7	15	dry	none	None	None
Breeding 2019	10/07/2019	4	10	3.00	1330	None	KW	2-3	SW	Good	6-8	15-16	wet	shower	None	None
Breeding 2019	25/07/2019	4	11	3.00	1215	None	KW	5	SE	Good	7-8	22	wet (bog)	none	None	None
Breeding 2019	15/08/2019	4	12	3.00	1230	BZ	KW	4	W-WSW	Good	4-8	17-18	wet (bog)	none	None	None
Breeding 2019	04/09/2019	4	13	3.00	900	None	KW	4-6	WSW-W	mod-good	8	9-10	wet	showers	None	None
Non-breeding 2019-20	02/10/2019	1	1	3.00	745	GP, PE	KW	1	NW	Good	4-7	6	wet	v. light shower	None	None
Non-breeding 2019-20	16/10/2019	1	2	3.00	1530	K	KW	3-5	SW	Good	2-3	Not rec	wet	none	None	None
Non-breeding 2019-20	29/11/2019	1	3	3.00	1300	None	RV	2	E	Good	0	4-6	reasonable	none	continuous gun shots around valley	glare of setting sun
Non-breeding 2019-20	06/12/2019	1	4	3.00	1200	None	RV	3	W	Poor-Mod	1-3	8	wet	showers, heavy at times	None	None
Non-breeding 2019-20	22/12/2019	1	5	3.00	800	RG, BZ	JB	2	SW	Good	5-8	3	wet	none	shooting NE of VP	None
Non-breeding 2019-20	29/12/2019	1	6	3.00	1200	None	RV	4-5	S	Good	1-4	8	damp	dry	constant gun fire until 12.45, then on and off from 13.20	None
Non-breeding 2019-20	08/01/2020	1	7	3.00	900	None	JB	2-3	w	Good	2-6	5	wet	none	None	25% glare at times
Non-breeding 2019-20	20/01/2020	1	8	3.00	1245	gp	JB	2-3	sw	Good	7-8	8	damp	none	1300-1415 3 hunters with 5 dogs 750m-1250m n of substation	None
Non-breeding 2019-20	27/01/2020	1	9	3.00	1200	gp	JB	4-5	s	Good	5-8	3	damp	none	None	None
Non-breeding 2019-20	07/02/2020	1	10	3.00	1230	GP, SH	JB	5-6	SSE-SE	Good-Mod	8	6	Damp	A little light rain	None	Some low cloud, some haze
Non-breeding 2019-20	11/03/2020	1	11	3.00	745	GP	RV	5	W	Poor-Mod	8	6	Wet	Showers	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding 2019-20	11/03/2020	1	12	3.00	1445	None	RV	4		Good	8	6	Wet	Dry	None	None
Non-breeding 2019-20	09/10/2019	2	1	3.00	745	BZ, K	KW	4	SW	Good	5-8	8	wet	showers	None	None
Non-breeding 2019-20	31/10/2019	2	2	3.00	1130	None	KW	4	SE	Mod-Poor	8	7-9	wet	none	None	None
Non-breeding 2019-20	29/11/2019	2	3	2.00	1300	SH	JB	2	SE	Good	1	6	dry, firm	none	None	Glare, low sun
Non-breeding 2019-20	06/12/2019	2	4	3.00	830	None	RV	3	W-SW	Mod-Poor	1	1-7	wet	showers	Van along road among turbines at 0855 + 1156, no birds flushed	None
Non-breeding 2019-20	22/12/2019	2	5	3.00	845	HH	RV	2-3	WSW-SW	Mod	2-8	4	damp	none	None	None
Non-breeding 2019-20	29/12/2019	2	6	3.00	830	None	RV	6	S	Good	1-4	8	damp	none	None	None
Non-breeding 2019-20	08/01/2020	2	7	3.00	1230	None	JB	3	w	Good	7-8	5	wet	occ rain showers	None	rain, sleet, hail, 40%glare at times
Non-breeding 2019-20	20/01/2020	2	8	3.00	915	gp	JB	4	SSW-SW	Good	6-8	6	damp	none	None	None
Non-breeding 2019-20	27/01/2020	2	9	3.00	830	gp	JB	4-5	s	Good	3-8	-1, 1	frost, light snow	v. light snow shower	None	Occasional low cloud very top of site
Non-breeding 2019-20	07/02/2020	2	10	3.00	900	GP	JB	5	SSE	Good	5-8	7	Damp	None	None	None
Non-breeding 2019-20	22/02/2020	2	11	3.00	915	GP	JB	5-6	W	Good-Mod	7-8	3	Wet	Hail/ sleet shower	None	Short hail/sleet shower
Non-breeding 2019-20	11/03/2020	2	12	3.00	1115	None	RV	4-5	W	Poor-Mod	8	6	Wet	Showers	None	None
Non-breeding 2019-20	09/10/2019	3	1	3.00	1130	None	KW	2-4	SW	Mod-Good	6-8	11-12	wet	showers	None	None
Non-breeding 2019-20	31/10/2019	3	2	3.00	800	None	KW	4	SE	Mod	7-8	7-8	wet	none	None	None
Non-breeding 2019-20	21/11/2019	3	3	3.00	945	None	JB	4	SE	Mod	8	2	dry, firm	none	None	Haze
Non-breeding 2019-20	29/11/2019	3	4	3.00	800	WS	RV	1-2	E	Good	3-1	2-3	damp	none	None	None
Non-breeding 2019-20	15/12/2019	3	5	3.00	1230	None	RV	2	W	Good	1-7	-2	frozen	none	jogger along road at 1255-1320	None
Non-breeding 2019-20	22/12/2019	3	6	3.00	1230	None	RV	2	SW	Good-Poor	1-4	5	damp	none	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding 2019-20	10/01/2020	3	7	3.00	900	gp	JB	2-5	sw	Good	3-6	0	frost, frozen	none	None	None
Non-breeding 2019-20	25/01/2020	3	8	3.00	900	gp	JB	4-5	s	mod-good	7-8	6	wet	none	None	some low cloud top of site
Non-breeding 2019-20	31/01/2020	3	9	3.00	915	gp	JB	4-5	s	Good-Mod	4-8	10	wet	none	None	some low cloud drifting through site at start
Non-breeding 2019-20	18/02/2020	3	10	3.00	1015	GP	JB	3-5	W	Good	7-8	4	Wet	Occ rain showers.	None	Some low cloud top of site.
Non-breeding 2019-20	18/02/2020	3	11	3.00	1345	None	JB	5-6	W	Good	6-8	4	Wet	a little very light snow	None	None
Non-breeding 2019-20	08/03/2020	3	12	3.00	1030	GP	RV	4-5	W	Good	4	5	Wet	Showers	Walkers along main road on site	None
Non-breeding 2019-20	02/10/2019	4	1	3.00	1115	None	KW	1	NW	Good	6-8	8-10	wet	none	None	None
Non-breeding 2019-20	16/10/2019	4	2	3.00	1200	GP	KW	4-5	SW	Good	3-5	10	wet	none	None	None
Non-breeding 2019-20	21/11/2019	4	3	3.00	1315	GP	JB	4	SE	Good	8	4	dry, firm	none	None	haze
Non-breeding 2019-20	29/11/2019	4	4	3.00	900	SN	JB	1	E	Good	2	3	dry, firm	none	None	None
Non-breeding 2019-20	15/12/2019	4	5	3.00	900	None	RV	2	W	Poor-Mod	1-4	-2	frozen	none	None	None
Non-breeding 2019-20	22/12/2019	4	6	2.00	1230	None	JB	2	SW	Mod-Poor	6-8	4	wet	none	some shooting to west of VP.	None
Non-breeding 2019-20	10/01/2020	4	7	3.00	1245	None	JB	5-6	s-se	Good-Poor	6-8	3	wet	mod rain at times	None	bad wind and rain last half hour
Non-breeding 2019-20	25/01/2020	4	8	3.00	1230	GP, BZ	JB	3-4	s	Good	7-8	7	wet	none	None	None
Non-breeding 2019-20	31/01/2020	4	9	3.00	1245	GP	JB	4-5	S-SW	Good	7-8	10	wet	none	None	None
Non-breeding 2019-20	20/02/2020	4	10	3.00	915	GP	JB	2-3	W	Good-Mod	5-8	3	Wet/light snow	Occ snow shower	None	A little low cloud drifting through site.
Non-breeding 2019-20	22/02/2020	4	11	3.00	915	None	RV	6	NW	Good	4	4	Wet	Snow/Sleet flurries	None	None
Non-breeding 2019-20	08/03/2020	4	12	3.00	1015	None	JB	3	SW	Good	6-8	4	wet	occ rain showers	walkers at substation going E	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding 2021	23/03/2021	1	1	3.00	1000	ML	RV	5	S	Good	8	9	Damp	Dry, some brief light drizzle	None	None
Breeding 2021	26/03/2021	1	2	3.00	640	GP	RV	4	W-SW	Good	8	1	Wet	Some snow and sleet	None	None
Breeding 2021	03/04/2021	1	3	3.00	1000	GB, BZ, SH, ML	JB	2	N-NNW	Good	1	7-12	Damp	None	None	None
Breeding 2021	03/04/2021	1	4	3.00	1330	BZ	JB	2	NNW-NW	Good	1	12	Damp	None	None	Some haze
Breeding 2021	05/05/2021	1	5	3.00	1015	ML	RV	4	N	Good	4	4	Wet	Snow/ Sleet Flurries	None	Snow and Sleet flurries
Breeding 2021	12/05/2021	1	6	3.00	930	BZ	JB	1	N	Good	7-8	10	Damp	None	None	None
Breeding 2021	22/06/2021	1	7	3.00	1130	BZ,SI	JB	2-3	NW-W		7/8	10-12	Dry	None	None	None
Breeding 2021	22/06/2021	1	8	3.00	1500	None	JB	3	W		8	12	Dry	None	None	None
Breeding 2021	25/07/2021	1	9	3.00	815	BZ	JB	1-2	NE-N	Good	0	18-22	Dry	None	Regular shooting from shooting range	None
Breeding 2021	25/07/2021	1	10	3.00	1145	BZ, PE	JB	2-2	N-NNW	Good	1	24-26	Dry	None	Regular shooting from shooting range	None
Breeding 2021	22/08/2021	1	11	3.00	1415	BZ, SH	RV	2	N	Good	4	15	Wet	Dry	None	looking into the sun, glare and haze at times.
Breeding 2021	27/08/2021	1	12	3.00	1415	BZ,SH	JB	1	s	Good	1	20	Damp	None	None	Some haze, glare
Breeding 2021	23/03/2021	2	1	3.00	630	None	RV	5	S	Good	7/8	7	Dry	Dry	None	None
Breeding 2021	23/03/2021	2	2	3.00	1330	None	RV	5	S	Good	8	10	Dry	Showers, some heavy	None	None
Breeding 2021	04/04/2021	2	3	3.00	715	BZ	RV	3	W	Mod	8	4	Dry	Dry	None	Fog, low cloud covering hill top
Breeding 2021	04/04/2021	2	4	3.00	1045	LB, PE, BZ	RV	4	W	Good	8	6	Dry	Dry	None	None
Breeding 2021	05/05/2021	2	5	3.00	645	None	RV	4	N	Mod	8	1	Snow	Snow flurries	None	Snow and Sleet flurries
Breeding 2021	12/05/2021	2	6	3.00	1300	BZ	JB	1-2	N-W	Good	7/8	10	Damp	None	None	None
Breeding 2021	14/06/2021	2	7	3.00	1030	ML	JB	4-3	W	Good	8	10	Damp	None	None	None
Breeding 2021	14/06/2021	2	8	3.00	1530	SI	JB	3	W		8	10	Damp	1 light rain shower	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding 2021	18/06/2021	2	9	3.00	530	BZ, SH	RV	1	W-NW	Good	0	10	Dry	Dry	None	None
Breeding 2021	19/07/2021	2	10	3.00	930	BZ, HH, SI	JB	1-2	NW	Good	4-5	17-20	Dry	None	None	None
Breeding 2021	17/08/2021	2	11	3.00	630	None	RV	4	W-NW	Poor	8	13	Wet	Drizzle	None	Low cloud over hill through out
Breeding 2021	27/08/2021	2	12	3.00	1045	K, BZ,	JB	2-3	S	Good	1	18-20	Damp	None	None	None
Breeding 2021	21/03/2021	3	1	3.00	900	GP, ML,BZ	JB	3	NW	Good	8	7-10	Damp	None	None	None
Breeding 2021	21/03/2021	3	2	3.00	1230	GP, BZ	JB	3	WNW	Good	8	10-8	Damp	None	None	None
Breeding 2021	06/05/2021	3	3	3.00	1015	GP, SN	RV	4	N	Good	4	3	Wet	Dry	Another surveyor crossing site on transect	None
Breeding 2021	06/05/2021	3	4	3.00	1345	BZ	RV	4	N-NW	Good	4	5	Wet	Dry	None	None
Breeding 2021	16/05/2021	3	5	3.00	1115	BZ,K,HG	JB	3	NE-N	Good	6/8	10-12	Damp	None	None	None
Breeding 2021	26/05/2021	3	6	3.00	1645	BZ,ML	RV	3	N-NW	Good	0	15	Dry	Dry	None	Smoke drifted over site 16:55-17:00
Breeding 2021	13/06/2021	3	7	3.00	1000	SI,SN	JB	3	SW	Good	1-4	18-20	Damp	None	None	None
Breeding 2021	28/06/2021	3	8	3.00	1130	BZ,PE	JB	3	NNW		8-6	14-17	Damp	None	None	None
Breeding 2021	24/07/2021	3	9	3.00	830	None	JB	2-2	S-SE	Good	1-3	18-21	Dry	None	None	None
Breeding 2021	24/07/2021	3	10	3.00	1200	K, BZ	JB	3-2	SE-NE	Good	3-2	21-27	Dry	None	None	None
Breeding 2021	22/08/2021	3	11	3.00	1000	SH, ML, BZ	RV	3	N	Good	8	14	Wet	Dry	None	Low cloud at start, cleared quickly
Breeding 2021	28/08/2021	3	12	3.00	1315	BZ,K,ML	JB	3	NW-W	Mod-Good	7-8	18	Damp	None	None	Some low cloud, Murky at times
Breeding 2021	20/03/2021	4	1	3.00	1315	BZ	JB	3	NW-N	Good	7/8	10-8	Damp	None	None	None
Breeding 2021	21/03/2021	4	2	3.00	1600	GP, BZ	JB	2	W-SW	Good	8	8	Damp	None	None	None
Breeding 2021	08/04/2021	4	3	3.00	715	None	RV	5	NW	Mod-Poor	8	5	Wet	Constant	None	Constant rain, low fog/cloud
Breeding 2021	06/05/2021	4	4	3.00	630	None	RV	4	N	Good	1	0	Frost	Dry, 1 20 min snow flurry	None	low sun and snow flurry

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Breeding 2021	14/05/2021	4	5	3.00	1200	None	JB	3	SE	Good	7-8	12	Damp	None	None	None
Breeding 2021	26/05/2021	4	6	3.00	1315	None	RV	3	W-NW	Good	4	15	Damp	Dry	None	None
Breeding 2021	20/06/2021	4	7	3.00	1245	None	RV	3	N	Mod	8	15	Dry	Drizzle	None	fog from 13:50
Breeding 2021	20/06/2021	4	8	3.00	1615	None	RV	4	N	Poor-Mod	8	14	Wet	Drizzle and rain spells	None	fog and drizzle during survey, cleared as I left site.
Breeding 2021	24/07/2021	4	9	3.00	1530	GP,BZ, SI	JB	2	NE	Good	2-1	27-24	Dry	None	None	None
Breeding 2021	02/08/2021	4	10	1.00	1000	None	JB	2	S	Mod-Poor	8-9	16	damp	None	None	low cloud
Breeding 2021	22/08/2021	4	11	3.00	645	None	RV	3	W-NW	Poor	8	14	Wet	Drizzle	None	Low fog over hill top, clearing slowly through out
Breeding 2021	28/08/2021	4	12	3.00	1700	HH	JB	3	NW	Mod-Good	8-9	15	Damp	None	None	Some low cloud, Murky at times
Breeding 2021	29/08/2021	4	13	2.00	1000	None	JB	3	NW	Mod-Poor	8-9	12	Damp	None	None	Low cloud drifting through site, Murky
Non-breeding 2021-22	28/09/2021	1	1	3.00	1430	LB	RV	4	S-SW	Good	4	11	Wet	Dry	None	Low fog over hill top at times, some brief heavy sleet
Non-breeding 2021-22	18/10/2021	1	2	3.00	815	None	RV	5	S	Mod	8	11	Wet	Showers	None	Some heavy showers
Non-breeding 2021-22	18/10/2021	1	3	3.00	1145	GP	RV	4	S-SW	Good	7	13	Wet	Showers	None	None
Non-breeding 2021-22	21/11/2021	1	4	3.00	815	None	RV	5	N	Good	2	4	Damp	Dry	None	Low sun, then low cloud over turbines
Non-breeding 2021-22	21/11/2021	1	5	3.00	1145	None	RV	4	N	Good	4	5	Damp	Dry	None	Low cloud over turbines and low sun at times
Non-breeding 2021-22	05/12/2021	1	6	3.00	815	SN, RG, BZ	RV	3	SW	Good	2	2	Wet	Dry	Shooting audible from range	Low sun early on

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding 2021-22	05/12/2021	1	7	3.00	1145	SH	RV	3	S-SW	Good	2	4	Wet	Dry	Shooting audible from range	Low sun to south
Non-breeding 2021-22	24/01/2022	1	8	3.00	830	SN, BZ	RV	4	S	Good	8	5	Damp	Dry	None	Low cloud over turbines
Non-breeding 2021-22	24/01/2022	1	9	3.00	1200	L,ML,BZ,	RV	4	S	Good	8	6	Damp	Dry	None	Glare at times, Low cloud over turbines
Non-breeding 2021-22	16/02/2022	1	10	3.00	800	GB	RV	5	W/SW	Mod	8	4	Wet	Rain showers	None	Mist, low cloud over turbines from 8:15
Non-breeding 2021-22	10/03/2022	1	11	3.00	800	RN, GP	RL	2-4	S	Poor	8-6	4	Frozen-Damp	Fog	None	Fog
Non-breeding 2021-22	10/03/2022	1	12	3.00	1130	RN	RL	5	S	Good	6-5	5	Dry	No	None	None
Non-breeding 2021-22	28/09/2021	2	1	3.00	715	None	RV	5	S-SW	Good	4	7	Wet	Dry	None	Low cloud over hill at times
Non-breeding 2021-22	03/10/2021	2	2	3.00	730	SH, LB	RV	5	W-NW	Good	7	8	Wet	Drizzle	None	Low cloud and misty spells
Non-breeding 2021-22	06/10/2021	2	3	3.00	1430	LB	RV	5	S	Mod	8	10	Wet	Constant	None	Low cloud and rain
Non-breeding 2021-22	16/11/2021	2	4	3.00	930	None	RV	5	S-SW	Mod	8	9	Wet	Rain showers	None	Low cloud, strong wind with drizzle
Non-breeding 2021-22	16/11/2021	2	5	3.00	1300	None	RV	5	W	Mod	8	9	Wet	Rain showers	None	Low cloud, low sun at times
Non-breeding 2021-22	03/12/2021	2	6	3.00	830	HH, ML	RV	3	W	Good	8	7	Wet	Dry	None	None
Non-breeding 2021-22	03/12/2021	2	7	3.00	1200	None	RV	4	W/SW	Good	8	7	Wet	Dry	None	Fog covering turbines gradually from 13:30
Non-breeding 2021-22	23/01/2022	2	8	3.00	830	None	RV	4	S	Good	8	5	Damp	Dry	None	None
Non-breeding 2021-22	23/01/2022	2	9	3.00	1200	None	RV	4	S	Good	8	5	Damp	Dry	None	None
Non-breeding 2021-22	30/01/2022	2	10	3.00	1145	None	RV	4	S-SW	Good	8	4	Damp	Showers	None	Very strong wind and increasing low cloud
Non-breeding 2021-22	16/02/2022	2	11	3.00	1215	None	RV	6	W	Good	1-2	10	Wet	Dry	None	Sun glare from 13:00

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding 2021-22	13/03/2022	2	12	3.00	645	None	RV	4	E-SE	Good	8	6	Wet	Rain showers	None	Showers
Non-breeding 2021-22	29/09/2021	3	1	3.00	1115	SN, GP, BZ	RV	4	W-NW	Good	5	7	Wet	Drizzly spells	work continuing on turbine	drizzle causing very slight issues at times.
Non-breeding 2021-22	06/10/2021	3	2	3.00	730	ML, GP	RV	3	S	Good	5	7	Damp	Dry	None	None
Non-breeding 2021-22	06/10/2021	3	3	3.00	1100	GP	RV	4	S-SW	Good	8	9	Damp	Constant Rain	None	Low cloud and rain
Non-breeding 2021-22	15/12/2021	3	5	3.00	845	None	RV	5	S	Poor	8	7	Wet	Drizzle	None	Fog, low cloud, drizzle
Non-breeding 2021-22	30/01/2022	3	6	3.00	815	GP,SN	RV	4	S	Good	8	3	Damp	Brief showers	None	Very strong buffering wind
Non-breeding 2021-22	27/02/2022	3	7	3.00	1100	RG, BZ, SH	RV	5	S	Good	8	7	Damp	Drizzly spells	None	None
Non-breeding 2021-22	27/02/2022	3	8	3.00	1430	BZ, GB, SN	RV	5	S	Good	7	5	Damp	Dry	None	Glare at times
Non-breeding 2021-22	12/03/2022	3	9	3.00	800	K, RG, RN	RL	2	SW	Poor	8	5	Damp	Fog - Showers	None	Fog
Non-breeding 2021-22	12/03/2022	3	10	3.00	1130	GP, BZ, K,	RL	2	S	Good	7-4	5	Damp	Dry	None	None
Non-breeding 2021-22	18/03/2022	3	11	3.00	1015	BZ, GP	JB	3-4	S	Good	2	8-10	Damp	None	None	None
Non-breeding 2021-22	18/03/2022	3	12	3.00	1345	BZ, GB	JB	4-3	S	Good	1	12	Damp	None	None	None
Non-breeding 2021-22	29/09/2021	4	1	3.00	745	GP	RV	4	W-NW	Good	3	5	Wet	Dry	Workers on Turbine from 9am	low sun and glare early on.
Non-breeding 2021-22	03/10/2021	4	2	3.00	1100	GP	RV	5	W-NW	Good	6	13	Wet	Brief drizzly spells	None	brief drizzle and misty spells
Non-breeding 2021-22	03/10/2021	4	3	3.00	1430	GP,BZ	RV	4	W-NW	Good	6	13	Wet	Drizzly spells	None	some drizzly spells
Non-breeding 2021-22	19/12/2021	4	4	3.00	830	None	RV	3	W	Poor	8	3	Wet	Drizzle	None	Low cloud, fog
Non-breeding 2021-22	19/12/2021	4	5	3.00	1200	None	RV	3	E	Poor	8	3	Damp	Drizzle	None	Low cloud, fog
Non-breeding 2021-22	21/01/2022	4	6	3.00	830	GP	RV	3	SW	Mod	8	4	Damp	Dry	None	Started clear, misty fog developed
Non-breeding 2021-22	21/01/2022	4	7	3.00	1200	None	RV	3	SW	Poor	8	5	Damp	Drizzly mist	None	Low cloud/ fog
Non-breeding 2021-22	27/02/2022	4	8	3.00	715	None	RV	4	S	Good	8	5	Wet	Dry	None	None

Season	Date	VP	Visit no.	Duration (hr)	Start Time	Target Sp.	Surveyor	Wind Force	Wind Dir.	Vis.	Cloud (oktas)	Temp ()	Ground Cond.	Rain	Disturbance	Factors affecting visibility
Non-breeding 2021-22	09/03/2022	4	9	3.00	1100	GP	RL	1	W-SE	Mod	8	4	Damp	Constant with sleet	Engineers working on WF	Low cloud
Non-breeding 2021-22	09/03/2022	4	10	3.00	1430	GP	RL	1	NE	Mod	8	5	Damp	Drizzle with dry spells	None	Low cloud
Non-breeding 2021-22	15/03/2022	4	11	3.00	730	GP	JB	4	S	Good	8	5	Damp	None	None	None
Non-breeding 2021-22	15/03/2022	4	12	3.00	1100	None	JB	4	S	Good	8	6-8	Damp	None	None	None

Table A11.1.5.2: Survey effort for site walkovers showing weather conditions 2018-2022

Season	Date	Start time	End time	Surveyor	Wind Force	Wind Dir	Cloud (oktas)	Temp. (C)	Rain
Breeding season 2018	10/05/2018	1300	1900	MT/HPD	4	SW	5	11-12	None
Breeding season 2018	17/05/2018	1030	1630	MT/HPD	3-4	S	1	13	None
Breeding season 2018	26/05/2018	915	1515	MT/HPD	4-5	NR	2	15	None
Breeding season 2018	22/06/2018	1130	1430	HPD	not rec	not rec	not rec	not rec	not rec
Breeding season 2018	26/06/2018	1100	1730	MT/HPD/KB	3-4	SE	2	21	None
Breeding season 2018	27/06/2018	845	1345	KB/HPD	3	S	1	24	None
Breeding season 2018	28/06/2018	900	1130	KB/HPD	3	N	1	24	None
Non breeding season 2018-19	08/11/2018	1300	1600	MT	4-5	S-SE	3	8-9	None
Non breeding season 2018-19	06/12/2018	900	1700	MT/HPD	4-5	SW	6-7	8-9	None
Non breeding season 2018-19	24/01/2019	1000	1700	MT/HPD	3	SW	8	6	Light Misty rain much of day.
Non breeding season 2018-19	12/02/2019	945	1415	HD/HPD	3	S	8	10	Misty rain from start of survey to 12
Breeding season 2019	11/04/2019	1245	1715	HD/HPD	2-3	S	8	11-12	None
Breeding season 2019	22/05/2019	1040	1540	HD	1-2	NE-S	3-4	11-12	None
Breeding season 2019	04/06/2019	1100	1600	HPD	3	N	8	13	Light rain becoming heavy later.
Breeding season 2019	19/06/2019	830	1630	HD	2-3	SW	7-8	13-14	Was dry at start but now spots of rain in air and low cloud around site
Breeding season 2019	25/06/2019	840	1640	HD/HPD	2-3	NE	8	18	Dry at start, light Precipitation later
Breeding season 2019	04/07/2019	830	1030	HD	3	N/A	7	17	Dry with some drizzle towards end
Breeding season 2019	16/07/2019	1120	1820	HD/HPD	2-3	SW	3-4	19	None
Breeding season 2019	25/07/2019	not rec	not rec	KW	4	SE	7-8	21	Dry
Breeding season 2019	30/07/2019	1030	1630	HD	2	NW	6-8	19	Rained towards end of survey (last half hour) with visibility reducing
Breeding season 2019	31/07/2019	830	1500	HD	2-3	NW	3-8	19	Some low cloud . Brightened up over the day. Very sunny.
Non breeding season 2019-20	20/02/2020	1255	1515	JB	3-5	W	7	3-4	Snow showers

Season	Date	Start time	End time	Surveyor	Wind Force	Wind Dir	Cloud (oktas)	Temp. (C)	Rain
Non breeding season 2019-20	22/02/2020	1315	1600	RV	4-5	NW	7	not rec	Sleet and snow
Non breeding season 2019-20	08/03/2020	1330	1630	JB/RV	not rec	not rec	not rec	not rec	not rec
Non breeding season 2019-20	12/03/2020	1245	1545	RV	4	not rec	not rec	not rec	Dry until a little sleet and drizzle for last 15 min
Breeding season 2021	18/03/2021	1100	1730	JB	3	not rec	8	7-10	Light drizzle
Breeding season 2021	20/03/2021	800	1400	JB	3	NW	8	7-10	None
Breeding season 2021	30/03/2021	1000	1700	RV	not rec	not rec	not rec	not rec	not rec
Breeding season 2021	31/03/2021	1100	1400	RV	not rec	not rec	not rec	not rec	not rec
Breeding season 2021	12/05/2021	1600	1800	JB	2	W	8	10	None
Breeding season 2021	14/05/2021	700	1200	JB	1	E	8	7-12	None
Breeding season 2021	16/05/2021	935	1758	JB	3-4	N	5	15	None
Breeding season 2021	30/05/2021	1700	1900	RV	not rec	not rec	not rec	not rec	not rec
Breeding season 2021	03/06/2021	630	1230	RV	not rec	not rec	not rec	not rec	not rec
Breeding season 2021	10/06/2021	1100	1600	JB	4-5	S	6	17-20	Light showers
Breeding season 2021	13/06/2021	830	1630	JB	2	SW	4	18-22	None
Breeding season 2021	14/06/2021	1330	1530	JB	3	W	8	10-11	Light drizzle
Breeding season 2021	18/06/2021	900	1230	RV	not rec	not rec	not rec	not rec	not rec
Breeding season 2021	29/06/2021	1600	2100	RV	not rec	not rec	not rec	not rec	not rec
Non-Breeding 2021-22	31/10/2021	1105	1635	JB	3	S/W	6	8	None
Non-Breeding 2021-22	31/10/2021	1110	1510	RV	3	S	7	7	Drizzly spells
Non-Breeding 2021-22	28/01/2022	900	1425	JB	4	SW	8	7	None
Non-Breeding 2021-22	28/01/2022	900	1330	RV	5	W	9	9	Rain showers
Non-Breeding 2021-22	10/03/2022	815	1345	JB	4	S	3	7	None
Non-Breeding 2021-22	10/03/2022	830	1315	RV	5	S	4	5	None
Breeding season 2022	01/05/2022	1730	2030	JB	1	E	8	10	None
Breeding season 2022	11/05/2022	1800	2130	JB	3	SW	7	10	None
Breeding season 2022	21/06/2022	1915	2215	JB	2	NW	8	15	None
Breeding season 2022	28/06/2022	1000	1500	PP	Not rec	Not rec	Not rec	Not rec	Not rec

Table A11.1.5.3: Survey effort for breeding raptor surveys showing weather 2028-22

Season	Date	Start time	End time	Surveyor	Wind Force	Wind Dir	Cloud (oktas)	Temp. (C)	Rain
Breeding season 2018	02/05/2018	1330	1700	MT/HPD	not rec	not rec	not rec	not rec	not rec
Breeding season 2018	22/06/2018	1445	1745	KB	2	NW	4	17	None
Breeding season 2018	29/06/2018	1100	1500	KB	1	S	0	21	None

Season	Date	Start time	End time	Surveyor	Wind Force	Wind Dir	Cloud (oktas)	Temp. (C)	Rain
Breeding season 2018	26/07/2018	1000	1600	KB	1	S	7	24	None
Breeding season 2019	04/06/2019	not rec	not rec	HD/ HPD	not rec	not rec	not rec	not rec	Persistent rain
Breeding season 2019	18/06/2019	1300	1600	HD	2	SW	7	14	Light passing drizzle
Breeding season 2019	18/06/2019	1900	2100	KW	2-3	W	6-8	11-13	not rec
Breeding season 2019	26/06/2019	1715	2015	KW	2	W	n/a	16-17	None
Breeding season 2019	03/07/2019	1615	1915	KW	2	NW	8	16-18	None
Breeding season 2019	04/07/2019	not rec	not rec	HD	3	n/a	7	17	not rec
Breeding season 2019	18/07/2019	not rec	not rec	KW	not rec	not rec	not rec	not rec	not rec
Breeding season 2019	25/07/2019	not rec	not rec	KW	4-5	SE	5-7	20	None
Breeding season 2019	30/07/2019	not rec	not rec	HD	not rec	not rec	not rec	not rec	not rec
Breeding season 2021	26/03/2021	1010	1640	RV	4	W	2-5	3	Sleet showers
Breeding season 2021	07/04/2021	1000	1400	JB	2	N	8	5-7	Light shower
Breeding season 2021	05/05/2021	1345	1645	RV	4	N	1-2	5	Brief sleet showers
Breeding season 2021	26/05/2021	645	945	RV	3	N-NW	7	10	None
Breeding season 2021	19/07/2021	1200	1600	JB	2	N	5	20-27	None
Breeding season 2021	25/07/2021	1500	1800	JB	3	NW	1	24-27	None
Breeding season 2022	19/03/2022	830	1430	JB	4	SE	1	14	None
Breeding season 2022	25/03/2022	830	1430	JB	2	SW	5	12	None
Breeding season 2022	18/04/2022	1145	1745	JB	4	SW	7	10	One brief shower
Breeding season 2022	01/05/2022	1230	1830	JB	2	NW	8	12	None
Breeding season 2022	11/05/2022	1600	1900	JB	3-4	W	7	11	None
Breeding season 2022	21/06/2022	1815	2015	JB	2	NW	8	15	None

Table A11.1.5.4: Survey effort for wider area waterbird surveys showing weather, winter 2021-22

Season	Date	Surveyor	Wind Force	Wind Dir	Cloud (oktas)	Temp. (C)	Rain
Non breeding season 2021-22	28/09/2021	RV	5	S/SW	4	9	None
Non breeding season 2021-22	31/10/2021	RV	3	S	7	8	Rain showers
Non breeding season 2021-22	09/12/2021	RV	4	SW	9	5	None
Non breeding season 2021-22	24/01/2022	RV	2	S	4	7	None
Non breeding season 2021-22	28/01/2022	RV	5	W	9	9	Rain showers
Non breeding season 2021-22	30/01/2022	RV	5	NW	9	7	Rain showers
Non breeding season 2021-22	16/02/2022	RV	5	SW	9	8	Rain showers
Non breeding season 2021-22	10/03/2022	RV	4	S		8	None

Appendix VI – Species list

Table A11.1.6.1: List of all bird species recorded during surveys within the Study Area and wider area between 2018 and 2022

The column giving the BTO code also indicates species listed on Annex I of the EU Birds Directive with * and the BoCCI4 column refers to whether conservation concern status applies to wintering (Win) or breeding (Br) populations. Species that are likely to be breeding within the 500 m turbine buffer are highlighted in grey.

				Occurrence within the Study Area							
BTO Code	**Common Name**	**BoCCI 4 RoI**	**BoCC 5 UK**	**Summer 2018**	**Winter 2018-19**	**Summer 2019**	**Winter 2019-20**	**Summer 2021**	**Winter 2021-22**	**Wider Area**	**Notes on occurrence within the Study Area**
BW	Black-tailed godwit	Red Win	Red		✓						No. Rare and sporadic breeder in Ireland. One winter record within the Study Area.
CK	Cuckoo	Green	Red	✓		✓		✓			**Yes** – breeding within bog and grassland habitats – host species like meadow pipit and willow warbler are relatively common.
CU	Curlew	Red Br & Win	Red							✓	No. Not recorded within the Study Area during the survey period. Has bred in previous years in the wider area (see **Appendix VI**).
FF	Fieldfare	Green	Red					✓	✓	✓	No – winter visitor to Ireland (breeding season records are from March). Red listed in the UK due classification as a rare, declining breeding species.
GH	Grasshopper warbler	Green	Red							✓	No – not recorded within the Study Area.
GN	Goldeneye	Red Win	Red							✓	No -no suitable breeding habitat within the Study Area. Closest winter record at Lough Ash. Rare breeder in Ireland.
GP*	Golden plover	Red Br & Win	Green	✓	✓	✓	✓	✓	✓	✓	No – two occurrences of calling males within the Study Area during summer 2021 but no breeding/territorial males seen.
GR	Greenfinch	Amber Br	Red							✓	Not recorded within the Study Area. Breeding records in the wider area in summer 2021.
HH*	Hen harrier	Amber Br	Red			✓	✓	✓	✓	✓	No – no breeding records within the 500 m buffer or wider area during the survey period.
HG	Herring gull	Amber Br & Win	Red					✓			No – no suitable breeding habitat within the Study Area.
HM	House martin	Amber Br	Red							✓	No – only one record in the wider area throughout the survey period.
HS	House sparrow	Amber Br	Red						✓		**Yes** - likely nest site at farm building off the Glenmornan Road in the north-west of the Study Area.
K	Kestrel	Red Br	Amber	✓	✓	✓	✓	✓	✓	✓	No – no nest sites identified within the Study Area. Likely one pair breeding within the 2 km buffer.
L	Lapwing	Red Br & Win	Red							✓	No – flock of *c.* 50 birds recorded on 24 January 2022 at Moor Lough. No records within the Study Area.

				Occurrence within the Study Area							
BTO Code	**Common Name**	**BoCCI 4 RoI**	**BoCC 5 UK**	**Summer 2018**	**Winter 2018-19**	**Summer 2019**	**Winter 2019-20**	**Summer 2021**	**Winter 2021-22**	**Wider Area**	**Notes on occurrence within the Study Area**
LI	Linnet	Amber Br	Red			✓		✓		✓	**Yes** - possible breeding within the Study Area and wider area.
LR	Lesser redpoll	Green	Red	✓	✓	✓		✓	✓	✓	**Yes** – breeding within conifer plantations in the Study Area. Relatively common and widespread species in Ireland
M	Mistle thrush	Green	Red	✓	✓	✓		✓	✓	✓	**Yes** - breeding within forestry, woodland and treeline habitats. Relatively common and widespread species in Ireland
MP	Meadow pipit	Red Br	Amber	✓	✓	✓	✓	✓	✓	✓	**Yes** – confirmed breeding within the Study Area. The most commonly recorded breeding species
ML*	Merlin	Amber Br	Red	✓	✓	✓		✓	✓	✓	**Yes** – confirmed breeding within the forestry plantation in the south-west of the Study Area.
RG	Red grouse	Red Br	Green	✓	✓	✓	✓	✓	✓	✓	**Yes** – confirmed breeding within the Study Area (estimated min. 2 territories).
S	Skylark	Amber Br	Red	✓	✓	✓		✓	✓	✓	**Yes** – breeding throughout the Study Area.
SG	Starling	Amber Br	Red	✓	✓	✓		✓	✓	✓	**Yes –** likely nest sites at abandoned farmhouse in north-east, farmhouse in north-west along the Glenmornan Road, and at existing substation. Nest site also identified at farmhouse adjacent to VP1. Relatively common and widespread species in Ireland
SI	Swift	Red Br	Red	✓				✓		✓	No – no nest sites identified within the 500 m buffer. Foraging mainly associated with area around VP4.
WK	Woodcock	Red Br	Red		✓				✓		No – only wintering records within the Study Area.
BF	Bullfinch	Green	Amber		✓	✓		✓	✓	✓	**Yes** – Possible breeding in woodland and hedgerows.
CM	Common gull	Amber Br & Win	Amber							✓	No – no suitable breeding habitat within the Study Area. Potential breeding noted at Moor Lough.
DI	Dipper	Green	Amber		✓					✓	Possible breeding along the Legnahone Burn – captured during trail camera surveys in 2019, though no nest sites identified. Also breeding in the wider area along the Burn Dennett *c.* 3 km north-east.
D	Dunnock	Green	Amber						✓	✓	**Yes** – Possible breeding within the Study Area and wider area.
GB	Great black-backed gull	Green	Amber				✓	✓	✓	✓	No – no suitable breeding habitat.
GL	Grey wagtail	Red Br	Amber	✓		✓		✓		✓	**Yes** – recorded on a number of occasions along the Legnahone Burn and Owenreagh Burn during the breeding seasons.

				Occurrence within the Study Area							
BTO Code	**Common Name**	**BoCCI 4 RoI**	**BoCC 5 UK**	**Summer 2018**	**Winter 2018-19**	**Summer 2019**	**Winter 2019-20**	**Summer 2021**	**Winter 2021-22**	**Wider Area**	**Notes on occurrence within the Study Area**
LB	Lesser black-backed gull	Amber Br & Win	Amber					✓	✓	✓	No – no suitable breeding habitat. Small number of records of birds commuting through the Study Area.
MA	Mallard	Amber Br & Win	Amber			✓				✓	No – closest breeding population at Moor Lough.
MH	Moorhen	Green	Amber							✓	No – closest records at Moor Lough.
RB	Reed bunting	Green	Amber	✓		✓		✓	✓	✓	**Yes** – a number of pairs breeding within the Study Area.
RE	Redwing	Red Win	Amber					✓	✓	✓	No – winter visitor to Ireland (breeding season records are from March). Listed as NI Priority Species as previous Red listed in the UK due classification as a rare, declining breeding species
RO	Rook	Green	Amber							✓	No – not recorded within the Study Area.
SN	Snipe	Red Br & Win	Amber	✓	✓	✓			✓	✓	**Yes** – confirmed breeding in summer 2018 and 2019. No breeding records in summer 2021.
ST	Song thrush	Green	Amber	✓				✓	✓	✓	**Yes** - breeding within forestry, woodland and treeline habitats.
SW	Sedge warbler	Green	Amber	✓						✓	**Yes** - recorded breeding in summer 2018, but only breeding in the wider area in subsequent years.
SH	Sparrowhawk	Green	Amber	✓		✓	✓	✓	✓	✓	No – no nest sites identified within the Study Area during the survey period. Pair breeding within the 2 km buffer.
T	Teal	Amber Br & Win	Amber							✓	No – closest records at Moor Lough (wintering).
W	Wheatear	Amber Br	Amber	✓		✓					**Yes** - breeding in summer 2018, 2019. No records in summer 2021.
WH	Whitethroat	Green	Amber					✓		✓	**Yes** – only two records throughout survey period. Possible breeding in hedgerow along agricultural fields in the north-west of the Study Area in summer 2021.
WN	Wigeon	Amber Br & Win	Amber							✓	No – closest records at Moor Lough (wintering).
WP	Woodpigeon	Green	Amber	✓		✓		✓	✓	✓	**Yes** - breeding within forestry, woodland and treeline habitats.
WR	Wren	Green	Amber	✓	✓	✓		✓	✓	✓	**Yes** - confirmed breeding within the Study Area.
WS*	Whooper swan	Amber Br & Win	Amber							✓	No – no records within the Study Area. Small number of commuting/feeding birds in the wider area.
WW	Willow warbler	Green	Amber	✓		✓		✓		✓	**Yes** - breeding within forestry, woodland and treeline habitats.
B	Blackbird	Green	Green	✓		✓		✓	✓	✓	**Yes** - breeding within forestry, woodland and treeline habitats.

				Occurrence within the Study Area							
BTO Code	**Common Name**	**BoCCI 4 RoI**	**BoCC 5 UK**	**Summer 2018**	**Winter 2018-19**	**Summer 2019**	**Winter 2019-20**	**Summer 2021**	**Winter 2021-22**	**Wider Area**	**Notes on occurrence within the Study Area**
BC	Blackcap	Green	Green					✓		✓	**Yes** – breeding within treelines associated with agricultural fields in the north-west of the Study Area.
BT	Blue tit	Green	Green	✓	✓	✓		✓	✓	✓	**Yes** - breeding within forestry, woodland and treeline habitats.
BZ	Buzzard	Green	Green	✓		✓	✓	✓	✓	✓	No – no nest sites identified within the Study Area. Breeding within the 2 km buffer.
CA	Cormorant	Amber Br & Win	Green							✓	No – no nest sites identified within the Study Area.
CC	Chiffchaff	Green	Green							✓	No breeding/territorial behaviour noted within the Study Area.
CH	Chaffinch	Green	Green	✓		✓		✓	✓	✓	**Yes** - breeding within forestry, woodland and treeline habitats.
CR	Common crossbill	Green	Green	✓					✓		**Yes** – Possible breeding within the forestry plantation in the south-west of the Study Area.
CT	Coal tit	Green	Green	✓	✓	✓		✓	✓	✓	**Yes** - breeding within forestry, woodland and treeline habitats.
FP	Feral pigeon	Green	Green							✓	Not recorded within the Study Area.
GC	Goldcrest	Amber Br	Green	✓	✓	✓		✓	✓	✓	**Yes** -breeding within forestry plantation and woodland/treelines.
GD	Goosander	Amber Br	Green							✓	No – Two birds recorded swimming at Moor Lough in February 2022 on one occasion. Possible breeding along the Mourne River between Strabane and Newtownstewart.
GO	Goldfinch	Green	Green	✓						✓	**Yes** – associated with farmland habitats within the Study Area. Only recorded in the wider area in summer 2019 and 2021.
GS	Great spotted woodpecker	Green	Green						✓		**Yes** – drumming heard within the forestry plantation in the south-west of the Study Area early in the 2022 breeding season.
Gt	Great tit	Green	Green			✓		✓		✓	**Yes** - breeding within forestry, woodland and treeline habitats.
H	Grey heron	Green	Green			✓				✓	No – no nest sites identified within the Study Area.
HC	Hooded (grey) crow	Green	Green	✓	✓	✓		✓	✓	✓	**Yes** - confirmed nesting within a small block of forestry in the east of the Study Area, off the Glenmornan Road and within an area of scrub/woodland in the west of the Study Area.
J	Jay	Green	Green			✓		✓	✓	✓	**Yes** - breeding within the conifer plantation in the south-west of the Study Area.

				Occurrence within the Study Area							
BTO Code	**Common Name**	**BoCCI 4 RoI**	**BoCC 5 UK**	**Summer 2018**	**Winter 2018-19**	**Summer 2019**	**Winter 2019-20**	**Summer 2021**	**Winter 2021-22**	**Wider Area**	**Notes on occurrence within the Study Area**
JD	Jackdaw	Green	Green	✓		✓		✓	✓	✓	No nests identified within the Study Area. Nesting in buildings/ruins in the wider area.
JS	Jack snipe	Green	Green		✓		✓	✓	✓	✓	No – winter visitor to Ireland (breeding season records are from March likely to be birds on passage).
LG	Little grebe	Green	Green							✓	No – closest records at Moor Lough (wintering).
LT	Long-tailed tit	Green	Green							✓	Not recorded within the Study Area. Breeding in the wider area.
MG	Magpie	Green	Green	✓	✓	✓		✓	✓	✓	**Yes** – Possible breeding within plantation/trees in the Study Area.
PE*	Peregrine	Green	Green	✓	✓		✓	✓			No – no nest sites identified within the Study Area. limited suitable habitat within the 2km buffer, birds recorded occasionally foraging through the Study Area
PH	Pheasant	Green	Green	✓		✓				✓	**Yes** – Possible breeding within the Study Area
PW	Pied wagtail	Green	Green						✓	✓	Not recorded within the Study Area during the breeding seasons, breeding in the wider area.
R	Robin	Green	Green	✓	✓	✓		✓	✓	✓	**Yes** - confirmed breeding within the Study Area.
RN	Raven	Green	Green	✓	✓	✓		✓	✓	✓	**Yes** - no nest sites pinned down, but pairs seen displaying and mobbing other birds within Study Area. Probable breeding in the south-western plantation
SC	Stonechat	Green	Green	✓	✓	✓		✓	✓	✓	**Yes** - a number of pairs breeding within the Study Area.
SK	Siskin	Green	Green	✓		✓		✓	✓	✓	**Yes** – breeding within conifer plantations.
SL	Swallow	Amber Br	Green	✓		✓			✓	✓	**Yes** – recorded foraging during all breeding seasons with potential nest site at the abandoned farm house in the north-east of the Study Area.
SM	Sand martin	Amber Br	Green							✓	Not recorded within the Study Area. Possible nest holes at bank at Donneybow Gun Club. Recorded here on all breeding seasons.
TC	Treecreeper	Green	Green	✓							**Yes** - recorded calling from forestry plantation in south-west of the Study Area. Possible breeding.

Appendix VII – Indicative target species breeding territories within the 2 km turbine buffer

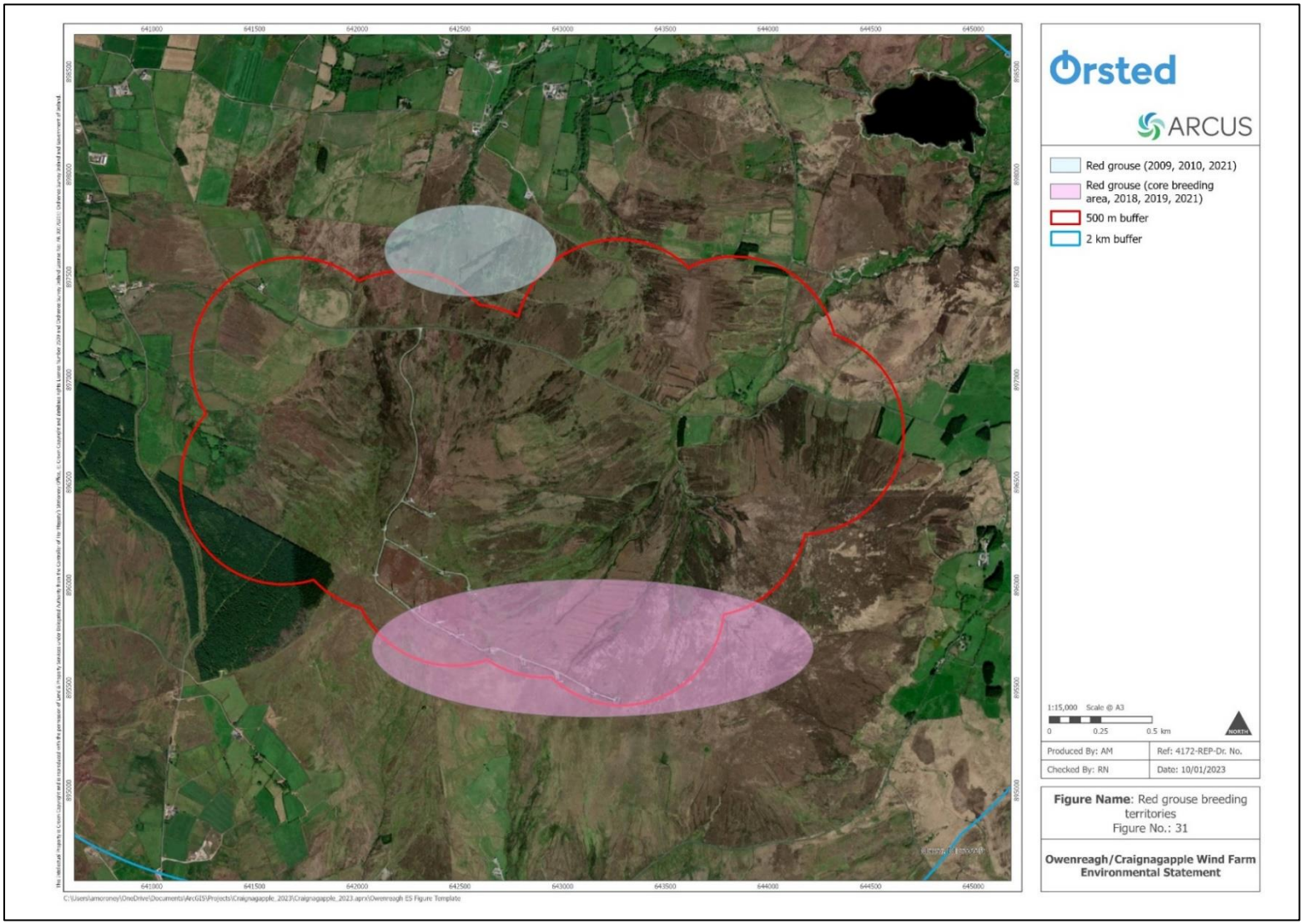

Figure A11.1.7.1: Indicative breeding red grouse territories

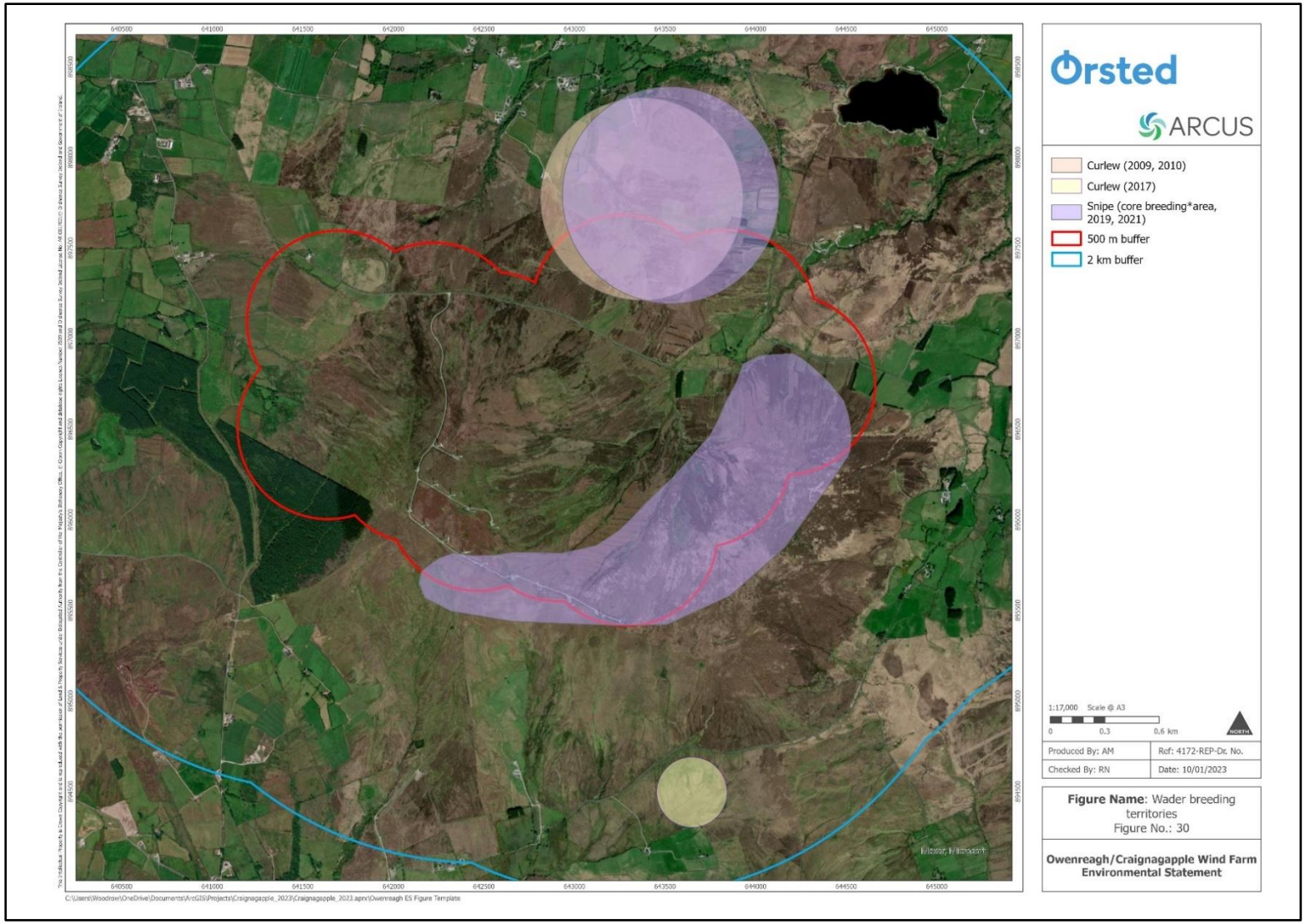

Figure A11.1.7.2: Indicative breeding wader territories

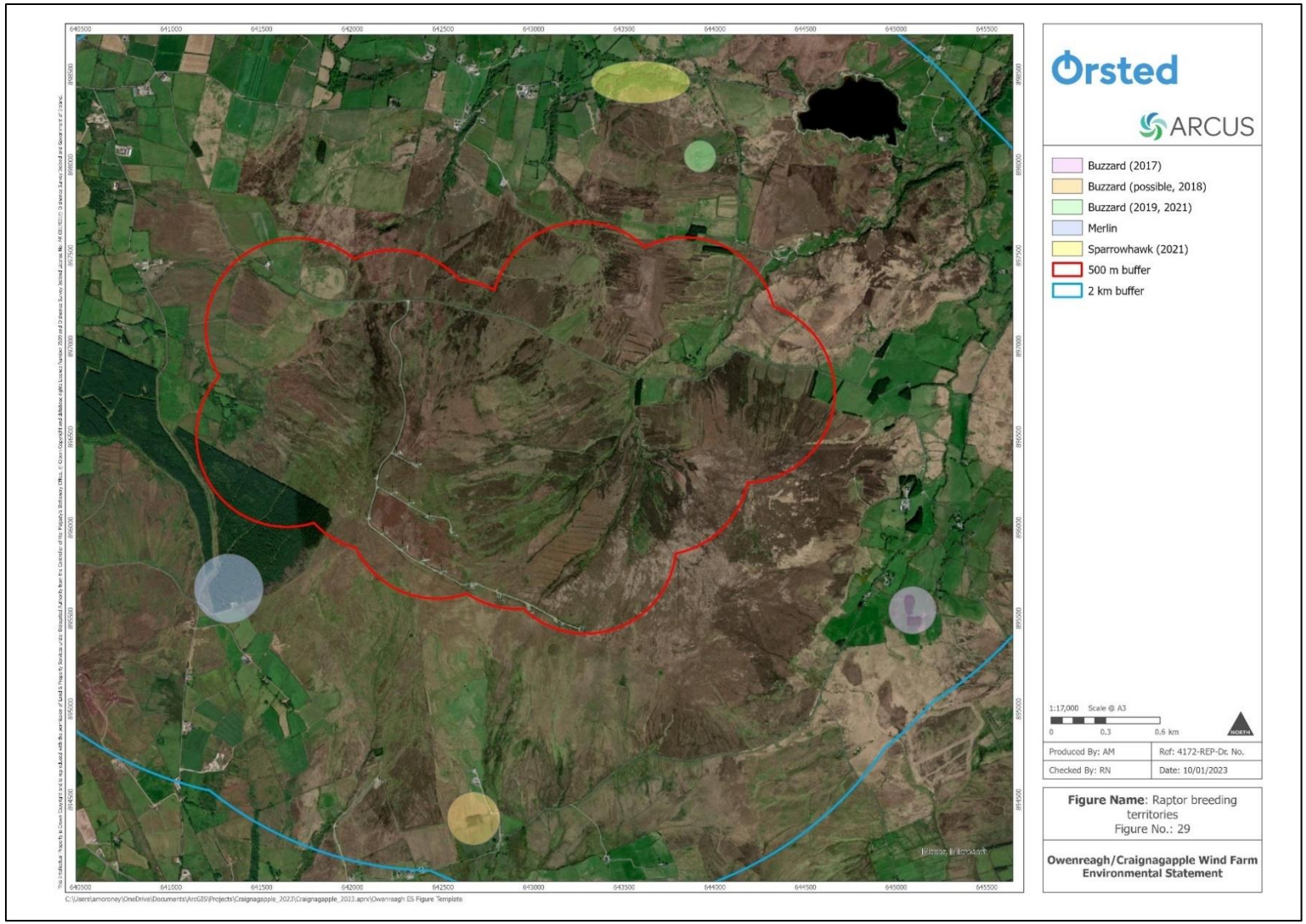

Figure A11.1.7.3: Indicative breeding raptor territories within the 2 km Study Area

Technical Appendix 11.2 – Collision Risk Modelling (CRM) Report

Avian Collision Risk Modelling (CRM) Report

Owenreagh/Craignagapple Wind Farm

Co. Tyrone

Report prepared by Woodrow APEM Group on behalf of Ørsted Onshore Ireland Midco Limited

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July 2023

Statement of Authority

This report has been written by Aoife Moroney. Aoife is an Ecologist – Ornithologist with Woodrow APEM Group. She has completed a B.Sc. in Engineering at University College Dublin and M.Sc. in Environmental Engineering (specialising in Environmental Management) at the Technical University of Denmark and the Royal Institute of Technology, Sweden. She has also recently completed a Post-graduate Certificate in Ecological Survey Techniques at the University of Oxford, achieving a distinction. In addition to being a skilled bird surveyor, Aoife is highly proficient in data analysis and management as well as mapping using ArcGIS and QGIS. Aoife regularly carries out ornithological surveys and compiles ornithological reports, including carrying out Collision Risk Modelling (CRM) to inform wind farm planning submissions. She volunteers as a surveyor with Birdwatch Ireland for the Irish Wetland Bird Survey (IWeBS) and the Countryside Bird Survey (CBS), in addition to the Irish Hen Harrier Survey (coordinated by BWI along with Golden Eagle Trust Ltd., and the Irish Raptor Study Group).

This report has been checked and approved by Mike Trewby. Mike is the company's Lead Ornithologist and Field Work Manager. Mike worked for Birdwatch Ireland from 2003 to 2010 conducting research on red-billed chough, red grouse and breeding seabirds. Prior to joining Woodrow in 2016, Mike worked as an independent ornithological consultant, and he has over 20 years fieldwork and research experience in the field of ecology. Mike regularly undertakes impact assessments for large scale developments and is a full member of CIEEM (MCIEEM).

QUALIFICATIONS:

Aoife Moroney:
B.Sc. – Engineering, University College Dublin, 2015
M.Sc. – Environmental Engineering (specialising in Environmental Management), Technical University of Denmark/Royal Institute of Technology Sweden, 2018
PGCert – Ecological Survey Techniques, University of Oxford, 2022

Mike Trewby:
B.Sc.- Zoology & Botany, University of Namibia, 1997
PGDip - Environmental Studies, University of Strathclyde, 2002
Ornithological survey experience: 20 years

Table of Contents

List of Tables

1 Overview

Woodrow APEM Group was commissioned by Ørsted Onshore Ireland Midco Limited to undertake ornithological survey work for the proposed Owenreagh/Craignagapple Wind Farm ("the Development") between 2018 and 2022. The operational Owenreagh I and II Wind Farms site access point is located at National Grid Reference: H 42364 97232, approximately 5 km east of Strabane, Co. Tyrone. The Development will involve decommissioning the existing 15 turbines (9x Z-40 and 6x V52) and replacing them with 14 new turbines.

The CRM employed is known as a 'Basic' Band Model (Band *et al.*, 2007; Madsen *et al.*, 2016), which assumes a uniform distribution of birds across the rotor swept area of the turbine. The proportion of birds at risk height is derived from site surveys. The CRM was run for both the operational wind farm (baseline) and proposed wind farm (Development), to provide a comparison between the two scenarios. In terms of the Development, the CRM was run for two potential turbines (the Vestas V136 and the Nordex N133) being considered. Note that the model does not account for habituation to the existing turbine array.

The intention of this report is to display modelled data, based on observed bird usage of the area, to provide an indication of the likely collision risk imposed by the Development on potentially sensitive avian populations. The report uses bird usage data derived from vantage point (VP) watches conducted by appropriately experienced ornithological surveyors.

Flight line data for selected target species was collected from four VPs. The survey period covered three breeding bird seasons and three winter seasons of VP watches. This amounted to a total of 869 hours of VP watch data. This is more than the SNH (2017) requirement of two breeding and two winter seasons. As such, the additional sampling effort is considered to increase the robustness of the model, and to account for inter-seasonal variation in bird activity. Further information on VP locations and survey effort can be found in Chapter 11 – Ornithology of the ES and Technical Appendix 11.1 – Ornithology Report, which provide details of timings for VP watches.

It should be noted that the operational Owenreagh I & II Wind Farms consist of an original array (Zond Z-40) and an extension (Vestas V52). To address both turbine types, the baseline model was run twice, once with the Z-40 dimensions and once with the V52 dimensions. As such, a collision risk range is provided for the baseline.

The flight risk volume applied in this analysis is based on a buffer extending 500 m from the turbines (the Study Area), which equates to area of 573.44 ha for the Development and an area of 247.47 ha for the baseline. Flight time within the Study Area was calculated in QGIS by clipping the mapped flightlines and then multiplying the total flight time by the ratio of the clipped flight line length to the total flightline length. The Collision Risk Zone (CRZ) height band was defined as 20-160 m for the Development, based on the Vestas V136 and the Nordex N133 turbines. In terms of the baseline models, the CRZ for the Z-40 was defined as 20-60 m and the V52 was defined as 14-66 m. These are precautionary ranges based on the minimum and maximum swept height of each of the turbine models.

The conducting of VP watches simultaneously by two or more surveyors was limited to avoid any duplicate records. Where two surveyors were on site at one time, surveyors would communicate with one another if a bird was seen to potentially enter/come from another viewshed. To limit observer fatigue, surveyors did not typically undertake VP watches of more

than 3-hours in duration without a break, unless inclement periods of weather meant watches were paused for short durations until conditions improved.

CRM was undertaken for those target species with >1000 flight seconds occurring with the potential CRZ over the survey period (*i.e.,* at collision risk height and within the 500 m turbine buffer). CRMs were run for three species, including:

- Buzzard;
- Golden plover; and
- Kestrel.

Though recorded within the Study Area, CRM was not undertaken for great black-backed gull, hen harrier, herring gull, lesser black-backed gull, mallard, merlin, peregrine, snipe and sparrowhawk, as flight times of these species within the CRZ were too low to draw any significant conclusions. Based on low recorded activity within the CRZ, there is not considered to be potential for significant effects due to collision mortality on great-black backed gull, hen harrier, herring gull, lesser black-backed gull, mallard and peregrine populations. For snipe, merlin and sparrowhawk, it is considered that VP watches may not be an effective method of recording flight activity for these species, and the that the CRM would not provide an accurate picture of predicted collisions per annum. This is explained further and taken into account when addressing these species within Chapter 11 – Ornithology of the ES.

Swift, which have moved from amber to red listed in the most recently published BoCCI (Gilbert *et al*., 2021), are emerging as species susceptible to turbine mediated mortality. Therefore, in the third breeding season (2021) swifts were included as target species during VP surveys and flight line data was collected. However, as this was not implemented ubiquitously across the season, the flight times recorded are only indicative and do not represent a full breeding season. As such, a CRM was not run for this species. Potential collision risk for this species is considered within Technical Appendix A11.1 – Ornithology Report.

Further information on the species recorded within the Study Area along with the number of observations per species can be found in Chapter 11 – Ornithology and Technical Appendix A11.1 – Ornithology Report.

2 Methodology

The collision risk analysis was undertaken using the Scottish Natural Heritage (SNH) model and guidelines, based on Band *et al.* (2007). The SNH model uses two approaches for different situations (SNH, 2000). The first approach is for birds that take regular flights through a wind farm area (*e.g.* wintering geese to roost sites) and the second is for birds that may occupy an area, including a wind farm, as a regular territory (*e.g.* raptors). The model approach used in this case is the second approach, relating to birds occupying a given area.

2.1 Stage 1 - Number of birds flying through rotors

This stage involved a number of sequential steps:

1. Identify a 'flight risk volume' V_w which is the area of the 500 m turbine buffer multiplied by the height of the rotors, as shown in Equation 1.

$$V_w = Area_{windfarm} * rotor\ diameter \quad (1)$$

2. Calculate the combined volume swept out by the windfarm rotors using Equation 2:

$$V_r = X\pi R^2(d + l) \quad (2)$$

where X is the number of wind turbines, R is the radius of the turbine, d is the depth of the rotor back to front, and l is the length of the bird.

3. Estimate the bird occupancy n within the flight risk volume. This is the number of birds present, multiplied by the time spent flying in the flight risk volume, within the period (usually one year) for which the collision estimate is being made.

4. The bird occupancy, in bird-seconds, of the volume swept by the rotors b is then calculated using Equation 3.

$$b = n\left(\frac{V_r}{V_w}\right) \quad (3)$$

5. Calculate the time taken for a bird to make a transit through the rotor and completely clear the rotors t, see Equation 4:

$$t = \frac{d + l}{v} \quad (4)$$

where v m/sec is the speed of the bird through the rotor.

6. To calculate the number of bird transits through the rotors N, divide the total occupancy of the volume swept by the rotors in bird-secs by the transit time t, as shown in Equation 5:

$$N = \frac{n\left(\frac{V_r}{V_w}\right)}{t} \quad (5)$$

Note in this calculation that the factor $(d + l)$ actually cancels itself out, so only assumed values need be used - it is used above to help visualise the calculation.

Within this stage, a weighting system can be applied to the value for bird occupancy n, which is intended to take account of the fact that the observations arise from different vantage points (VPs), that different vantage points cover varying area extents (in terms of total hectarage), and that the combination of the areas seen from all VPs may not always incorporate the entire site

being assessed. The weighting factor for each VP is worked out by the percentage cover of the viewshed of each VP (see viewshed maps in Technical Appendix 11.1), as well as the combined percentage cover of all the VPs. This report includes calculations for both unweighted and weighted occupancy values.

2.2 Stage 2 - Probability of bird being hit when flying through the rotors

This stage uses data relating to bird and rotor characteristics to compute the likelihood of a bird being hit when flying through the rotor (collision probability). The turbine and operational model inputs are shown in **Table A11.2.1,** and **Table A11.2.2** provides the model input for dimensions/attributes of target species. This, together with the output from Stage 1, allows for a model output of the likely number of collisions per annum. The probability of a bird being hit when flying through the rotor is derived from a spreadsheet available from NatureScot (formerly Scottish Natural Heritage)[1]. The outputs from this spreadsheet are provided for each target species in **Table A11.2.3**.

Following the above steps, the number of bird transits per year through the rotors can be combined with the probability of a bird being hit when flying through the rotors to give the likely collisions per annum (assuming no avoidance). To attain the likely collisions per annum with avoidance, avoidance rates given in SNH (2018) and Furness (2019) are applied. This stage also considers the proportion of time that turbines are likely to be operational. As the application is for a 40-year consent period, the collision risk over the 40-year life span of the Development was also assessed.

[1] Available at: https://www.nature.scot/wind-farm-impacts-birds-calculating-probability-collision (Accessed: December 2022)

Table A11.2.1: Turbine and operational inputs

Turbine parameter	Unit	Baseline		Proposed	
		Z-40 Original	**V52** Extension	**V136**	**N133**
Number of blades		3	3	3	3
Hub height	m	40	40	105	90
Rotor diameter	m	40	52	136	133
Minimum swept height	m	20	14	20.5	23.5
Maximum swept height	m	60	66	156.5	156.5
Maximum rotor depth d	m	1.5	1.5	4.1	3.94
Maximum rotor chord	m	1.5	1.5	4.1	3.94
Blade pitch*	°	10	10	10	10
Dynamic operating range	rpm	29.5 (max)	14-31.5	5.6-14.0	7.3-12.2
Average rotation period	s	3**	2.64	6.12	6.15
Turbine operation time***	%	0.85	0.85	0.85	0.85

*Note: Pitch varies between -5° and 90° depending on windspeed. This value can be difficult to obtain and is often derived from Band (2012) which states a mean pitch of 25° to 30° for large offshore turbines. However, this is not considered representative for onshore conditions and, as such, a more conservative value of 10° was employed in this model.
**A minimum operating speed could not be found for the Z-40 and therefore an average value could not be calculated for the rotation period. As such, the value was estimated based on turbines of a similar size.
***This operational period of 85% is referenced from a report by the British Wind Energy Association (BWEA) (2007) which identifies the standard operational period of the wind turbines in the UK to be 70-85%. 85% is therefore used on a precautionary basis.

Table A11.2.2: Avian biometrics and flight speeds inputs used in models
Sources: bird biometrics from Snow *et al*. (1998) and flight speeds from Alerstam *et al*. (2007), Bruderer & Bolt (2001) and Provan & Whitfield (2006)

Species	Length		Wingspan		Flight Speed (m/s)
	Range (cm)	**Average** (cm)	**Range** (cm)	**Average** (cm)	
Buzzard	51-57	**54**	113-128	**121**	**11.6**
Golden plover	26-29	**28**	67-76	**72**	**17.9**
Kestrel	32-35	**34**	71-80	**76**	**10.1**

Table A11.2.3: Average collision probability and avoidance rates
Source: Avoidance rates from SNH (2018)

Turbine parameter	Avoidance rate	Baseline		Proposed	
		Z-40 Original	**V52** Extension	**V136**	**N133**
Buzzard	0.98	10.61%	9.46%	7.24%	7.07%
Golden plover	0.98	7.74%	6.10%	4.75%	4.66%
Kestrel	0.95	8.63%	7.67%	6.98%	6.78%

2.3 Viewshed spatial coverage

As discussed in Technical Appendix 11.1 – Ornithology Report, upon commencing VP watches in April 2018 there were restrictions on accessing the operational Owenreagh I & II Wind Farms and surveyors had to conduct watches from an alternative VP4 (see VP4b in **Figure A11.1.1**), from which 15 hours of VP watches were conducted. Access to the optimally located VP4 was restored from May onwards and the airspace covered by both VP4 was considered comparable, especially for the core area of interest along the southern slopes of the operational

Owenreagh I Wind Farm. Aside from this short period of time, the VP locations used were the same during all survey periods.

Viewshed spatial coverages for each VP were calculated using ArcGIS Pro. The lowest minimum swept height of the turbine models is 14 m. The viewshed analysis was performed using a surface offset of 15 m and this mapped what airspace is visible to surveyors (height 1.75m) above 15 m. This was considered a precautionary estimate of the visible area based on the presence of mature forestry and woodland within the site, while ensuring a full view of the CRZ. Spatial coverage of these VPs, both in relation to the spatial area of the viewshed within the Study Area and proportion of the Study Area, is given in **Table A11.2.4**. The locations of the VPs and their viewsheds are mapped in Technical Appendix 11.1 (see **Figure A11.1.3.1**).

Table A11.2.4: Spatial and temporal coverage of the 500 m buffer

VP	Baseline		Proposed		VP survey effort non-breeding (hrs)	VP survey effort breeding (hrs)	Total VP survey effort (hrs)
	Visible area (ha)*	**% Coverage**	**Visible area** (ha)*	**% Coverage**			
VP1	28.88	11.67%	299.34	52.20%	108	108	216
VP2	73.31	29.62%	181.64	31.68%	108	114	222
VP3	148.37	59.95%	361.71	63.08%	105	108	213
VP4	77.31	31.24%	10.28	1.79%	114	104	218

*Note: Visible area refers to the area of the 500 m buffer which is visible from each VP

2.4 Recorded flight activity

VP surveys were undertaken for six seasons between April 2018 and March 2022. Flight times within the 500 m turbine buffer and 'at-risk' height are provided in **Table A11.2.5** for the 3 target species included in the model**.**

Table A11.2.5: Flight seconds in the CRZ for target species recorded from each VP

Turbine		Species	Observable period	VP1	VP2	VP3	VP4	Total (Flight seconds)
Baseline	**Z-40** Original	Buzzard	Year-round	38,939	1,036	5,729	93	**45,797**
		Golden plover	Winter + passage	16,959	1,187	28,325	37,884	**84,356**
		Kestrel	Year-round	586	535	572	0	**1,693**
	V52 Extension	Buzzard	Year-round	39,216	1,037	6,202	107	**46,562**
		Golden plover	Winter + passage	16,959	1,187	31,425	37,904	**87,475**
		Kestrel	Year-round	586	565	594		**1,745**
Proposed	**V136/ N133**	Buzzard	Year-round	45,769	9,573	11,302	28	**66,672**
		Golden plover	Winter + passage	32,740	10,543	118,052	152,943	**314,278**
		Kestrel	Year-round	2,609	469	761	0	**3,839**

3 Collision risk assessment

As detailed above, the collision risk assessment is undertaken in two stages, with Stage 1 being to ascertain the number of bird flights through the rotors and Stage 2 being to ascertain the probability of a bird being hit by the rotors as it passes through.

The model inputs for both turbine and bird parameters, as well as the basis of weighting for observational effort are provided in **Table A11.2.1**-**Table A11.2.4**.

3.1 Stage 1 - Number of birds flying through rotors

The first part of Stage 1 is defining the 'flight risk volume' V_w. This is derived from the area of the 500 m turbine buffer (5,734,413 m^2 for the Development and 2,474,695 m^2 for the baseline) multiplied by the rotor diameter (rotor swept area). The values for each turbine model are shown in **Table A11.2.6** and calculated using Equation 1. The 'rotor swept volume' V_r is then worked out based on the rotor swept area multiplied by the number of turbines, the depth of the rotor and the length of the bird. This is shown for the specified turbine models in **Table A11.2.7** and calculated using Equation 2.

Table A11.2.6: Flight risk volume V_w for each turbine model

Turbine	V_w (m^3)
Z-40	$= 2474695(40) = 98987800$
V52	$= 2474695(52) = 128684140$
V136	$= 5734413(136) = 779880179$
N133	$= 5734413(133) = 762676940$

Table A11.2.7: Risk Volume V_r and rotor transit time t for each species and turbine model

Species	Baseline				Proposed			
	Z-40 Original		V52 Extension		V136		N133	
	V_r (m^3)	t (s)	V_r (m^3)	t (s)	V_r (m^3)	t (s)	V_r (m^3)	t (s)
Buzzard	38453.0941	0.1759	64985.7290	0.1759	943656.0190	0.4000	871363.1968	0.3862
Golden plover	33552.2095	0.0994	56703.2341	0.0994	890778.7421	0.2447	820793.0113	0.2358
Kestrel	34683.1829	0.1822	58614.5791	0.1822	902981.191	0.4396	832463.0541	0.4238

The next stage of the calculations is to determine the bird occupancy n within the flight risk volume. This is worked out individually for each VP and then averaged to find the mean occupancy across the site. The observation effort (see Equation 6) of each VP (in hectare hours) is first calculated by multiplying the area viewed from the VP (see **Table A11.2.4**) by the number of VP hours undertaken. Occupancy n is then calculated, using Equation 7, by dividing the flight time at risk height (in hours) by the observation effort and then multiplying that value by the Study Area and the total hours the target species are active across the site.

The time the birds are active is defined as the product of the number of days in the season/year and the mean day length. This is assumed to be an average of 12 hours daylight for 365 days in the year for species that were present throughout the year (*i.e.,* 4,380 hours). For golden plover, a species which is present during the winter season and on passage, 2,127 hours were applied. The figures calculated for occupancy, in bird-seconds, are shown in **Table A11.2.8**.

$$Observation\ effort = Area_{viewshed} * Survey\ effort \quad (6)$$

$$n = \frac{Flight\ time\ at\ risk\ height\ (hrs)}{Observation\ effort} * Area_{500m\ turbine\ buffer} * Daylight\ hours \quad (7)$$

Table A11.2.8: Occupancy n (bird-secs) values calculated for each vantage point

Turbine		Species	VP1	VP2	VP3	VP4
Baseline	Z-40 Original	Buzzard	1879.4536	19.1625	54.5810	1.6664
		Golden plover	613.2985	16.2190	205.2450	551.1414
		Kestrel	28.2868	9.8976	5.4525	0.0000
	V52 Extension	Buzzard	1892.8040	19.1847	59.0880	1.9115
		Golden plover	613.2841	16.2152	227.7073	551.4329
		Kestrel	28.2839	10.4526	5.6592	0.0000
Proposed	V136/ N133	Buzzard	493.8710	165.6320	102.3472	8.7170
		Golden plover	264.6914	134.6957	813.0699	38774.5799
		Kestrel	28.15245	8.11463	6.89136	0.0000

As previously described, a weighting factor was also used to account for the varying extents of cover for each VP as well as the combined cover of each VP not accounting for the entire Study Area. Weighted values for n were calculated using the values for percentage cover described in **Table A11.2.4**.

In terms of the Development, the combined VPs do not cover the entirety of the Study Area and the total cover is 0.9349. The following weighting was therefore employed:

$$n_{weighted} = \frac{n_{VP1}(0.52) + n_{VP2}(0.32) + n_{VP3}(0.63) + n_{VP4}(0.02)}{0.9349}$$

For the baseline, the combined VPs also do not cover the entirety of the Study Area and the total cover is 0.9657. The following weighting was therefore employed:

$$n_{weighted} = \frac{n_{VP1}(0.12) + n_{VP2}(0.30) + n_{VP3}(0.60) + n_{VP4}(0.31)}{0.9657}$$

Once a value for n and $n_{weighted}$ has been calculated for each VP, this is then used to generate the mean activity for the site as a percentage of time (*i.e.,* percentage occupancy) within the risk zone, n_{avg}. This is calculated by adding the values for n calculated for each VP then dividing by the number of VPs. In this case, both weighted and unweighted values for n_{avg} were obtained, as shown in **Table A11.2.9**.

Table A11.2.9: Values obtained for n_{avg} and $n_{weightedavg}$ (bird-secs)

Species	Baseline				Proposed	
	Z-40 Original		V52 Extension		V136/N133	
	n_{avg}	$n_{weightedavg}$	n_{avg}	$n_{weightedavg}$	n_{avg}	$n_{weightedavg}$
Buzzard	488.7159	66.8547	493.2471	67.9791	192.6418	100.2755
Golden plover	346.4760	96.1986	352.1599	99.7077	9996.7592	371.3853
Kestrel	10.9093	2.4598	11.0989	2.5344	10.7896	5.7796

The bird occupancy of the rotor swept volume b is then worked out using Equation 3 by multiplying n_{avg} by $\frac{V_r}{V_w}$.

The bird occupancy of the swept volume b is used to ascertain the number of bird transits through the rotors N by dividing b by the rotor transit time t, see Equation 4-5. The number of transits through the rotors N is then adjusted by a factor of 0.85[2] to obtain Tn, which considers likely wind turbine down time. Calculations for the number of transits through the rotors are shown in **Table A11.2.10**.

Table A11.2.10: Values obtained for number of transits through the rotors T_n

Turbine		Species	Unweighted			Weighted		
			b	N	T_n	b	N	T_n
Baseline	Z-40 Original	Buzzard	683.4529	3886.3008	3303.3557	93.4941	531.6332	451.8882
		Golden plover	422.7806	4251.5581	3613.8244	117.3845	1180.4396	1003.3737
		Kestrel	13.7605	75.5333	64.2033	3.1028	17.0314	14.4767
	V52 Extension	Buzzard	896.7265	5099.0328	4334.1779	123.5864	702.7463	597.3344
		Golden plover	558.6312	5617.6954	4775.0411	158.1663	1590.5492	1351.9668
		Kestrel	18.1997	99.9006	84.9155	4.1558	22.8118	19.3901
Proposed	V136	Buzzard	839.1485	2097.8713	1783.1906	436.8004	1092.0011	928.2009
		Golden plover	41105.8559	167989.6849	142791.2322	1527.1058	6240.9117	5304.7750
		Kestrel	44.9738	102.3052	86.9594	24.0908	54.8012	46.5810
	N133	Buzzard	792.3400	2051.5947	1743.8555	412.4353	1067.9128	907.7259
		Golden plover	38730.6484	164284.0301	139641.4256	1438.8655	6103.2446	5187.7579
		Kestrel	42.3968	100.0484	85.0412	22.7104	53.5924	45.5535

3.2 Stage 2 - Probability of bird being hit when flying through the rotors

Table A11.2.3 provides the collision probability of the selected target species passing through the rotors, as calculated using the spreadsheet provided by NatureScot[3]. The average collision probability is applied within the CRM to account for birds travelling both upwind and downwind. All collision probability calculations were undertaken using the setting for birds flapping, as opposed to the setting for gliding birds. This is appropriate for birds like golden plover and snipe that predominately employ a flapping mode of flight. The flapping setting generates higher values for collision probability in species that incorporate gliding in their flight behaviour, in particular larger raptors, like buzzards. The higher (flapping) value has been retained for these species and will generate a more precautionary estimate for collision risk.

[2] This operational period of 85% is referenced from a report by the British Wind Energy Association (BWEA) (2007) which identifies the standard operational period of the wind turbines in the UK to be 70-85%. 85% is therefore used on a precautionary basis.
[3] Available at: https://www.nature.scot/wind-farm-impacts-birds-calculating-probability-collision (Accessed: December 2022)

Table A11.2.11: Collision risk model results

Turbine		Species	*Unweighted*					*Weighted*				
			Collisions/year		Stats			Collisions/year		Stats		
			No avoidance	With avoidance	Per 10 years	Per 40 years	Equivalent to 1 bird every	No avoidance	With avoidance	Per 10 years	Per 40 years	Equivalent to 1 bird every
Baseline	Z-40 Original	Buzzard	350.63	7.01	70.13	280.50	0.14 years	47.96	0.96	9.59	38.37	1.04 years
		Golden plover	279.58	5.59	55.92	223.66	0.18 years	77.62	1.55	15.52	62.10	0.64 years
		Kestrel	5.54	0.28	2.77	11.09	3.61 years	1.25	0.06	0.62	2.50	16.00 years
	V52 Extension	Buzzard	410.2185	8.20	82.04	328.17	0.12 years	56.5361	1.13	11.31	45.23	0.88 years
		Golden plover	291.1468	5.82	58.23	232.92	0.17	82.4330	1.65	16.49	65.95	0.61 years
		Kestrel	6.5125	0.33	3.26	13.02	3.07	1.4871	0.07	0.74	2.97	13.45 years
Proposed	V136	Buzzard	129.04	2.58	25.81	103.23	0.39 years	67.17	1.34	13.43	53.74	0.74 years
		Golden plover	6779.27	135.59	1355.85	5423.41	0.01 years	251.85	5.04	50.37	201.48	0.20 years
		Kestrel	6.07	0.30	3.04	12.14	3.29 years	3.25	0.16	1.63	6.50	6.15 years
	N133	Buzzard	123.30	2.47	24.66	98.64	0.41 years	64.18	1.28	12.84	51.35	0.78 years
		Golden plover	6502.65	130.05	1300.53	5202.12	0.01 years	241.58	4.83	48.32	193.26	0.21 years
		Kestrel	5.77	0.29	2.88	11.54	3.47 years	3.09	0.15	1.55	6.18	6.47 years

4 Results and discussion

The output figures from stage 1 (bird transits through the rotors per year) and stage 2 (probability of a bird being hit while passing through the rotors) are multiplied to get an estimated collision/mortality rate per year in the absence of any avoidance. An avoidance rate is then applied to this value – see **Table A11.2.3**. Unweighted and weighted results are detailed in **Table A11.2.11**. For clarity, **Table A11.2.12** shows the weighted results for the CRM only (with avoidance). As discussed in Section 1, the operational Owenreagh I & II Wind Farms (baseline) consist of an original array (9x Z-40) and an extension (6x V52). The baseline model was therefore run twice, once with the Z-40 dimensions and once with the V52 dimensions, and the predicted collisions/annum are presented as a range in **Table A11.2.12**.

Table A11.2.12: Weighted results (with avoidance) for baseline and proposed CRMs

Model		Species	Collisions/ year	Per 40 years (WF lifespan)	Equivalent to 1 bird every
Baseline		Buzzard	0.96-1.13	38.37- 45.23	0.87-0.88 years
		Golden plover	1.55-1.65	62.10- 65.95	0.20 -0.61 years
		Kestrel	0.04-0.07	2.50- 2.97	16.00-13.45 years
Proposed	V136	Buzzard	1.34	53.74	0.74 years
		Golden plover	5.04	201.48	0.20 years
		Kestrel	0.16	6.50	6.15 years
	N133	Buzzard	1.28	51.35	0.78 years
		Golden plover	4.83	193.26	0.21 years
		Kestrel	0.15	6.18	6.47 years

The results generated by the CRM are considered to represent relatively high levels of theoretical collision risk posed to the target species recorded within the turbine envelope, based on the flight data collected from April 2018 to March 2022, due to the parameters entered being notably precautionary (*e.g.* rotational period and selecting flapping flight behaviour for each species). It is also important to note that, as is always the case with a modelled approach, the CRM outputs are only considered to be indicative of the level of risk of fatalities resulting from the Development and should be considered in conjunction with other discussions within Chapter 11 – Ornithology of the ES. For instance, the outputs from the model do not take account of potential displacement of birds from the wind farm envelope, which for species breeding within or directly adjacent (*e.g.* buzzard and kestrel) to the site may be more of a cause for concern. In terms of the baseline CRM, the habituation of birds to the existing array is also not considered within the model.

The CRMs found that the Development generated the highest predicted collision risk for all three species, and that the N133 had a marginally higher predicted collision risk than the V136. Overall, golden plover presented the highest predicted collisions per annum of all three species. This is consistent with the high number of golden plover flightlines observed, in particular in the southern part of the Study Area and within the operational Owenreagh I & II Wind Farms. Though there are notably higher levels of activity within the operational wind farm, the proposed turbines have a larger collision risk height range (20-160 m) which results in more golden plover being placed within the CRZ.

It should be noted that a species-specific avoidance rate is not provided for golden plover and therefore the default 98% rate was applied (see **Table A11.2.3**), as per the SNH (2018) guidelines. It has been suggested that the default rate may be appropriate for breeding populations, however, may not be applicable to wintering populations due to differences in behaviour and ecology. Post-construction monitoring studies from the UK indicate that higher avoidance rates could be applied for non-breeding golden plovers and rates of 99.8% may generate more realistic modelled outputs, which are in line with avoidance rates applied for wintering geese (SNH, 2018). This would result in a predicted 0.5 (V136) and 0.48 (N133) collisions/annum for the Development and 0.16 predicted collisions per annum for the baseline. Collision risk for wader species, including golden plovers, is generally considered to be low due to manoeuvrability in flight (McGuinness *et al.*, 2015).

Reflective of high levels of flight time in the CRZ, predicted collision risk for buzzard was relatively high with 1.34 (worst-case scenario) predicted collisions per annum for the Development (baseline: 0.96-1.13 collisions/annum). This indicates that the Development will result in a slightly higher collision risk for buzzard, likely due to a larger rotor swept area resulting in more buzzards entering the CRZ. Kestrel, being the second most commonly recorded raptor within the Study Area, generated relatively low predicted collision risk, with 0.16 collisions per annum (baseline: 0.04-0.07 collisions/annum). As such, the Development will result in a marginally higher collision risk for kestrel.

These levels of predicted collision risk warrant further investigation in terms of effects on buzzard, golden plover and kestrel on populations, which are discussed in Chapter 11 – Ornithology of the ES. The population-level consequences of predicted collision risks are assessed by considering the additional mortality that would be caused (assuming that the collision risk is non-additive) relative to background mortality rates in the population, with a threshold level of a 1% increase in annual mortality used to determine whether the impact will be significant (Percival, 2003).

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