2023

Mossmulloch Wind Farm

Appendix 7.1: Report on Ornithological Surveys, September 2022 to August 2023

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Contents

Introduction 1
Desk Study 1
Field Survey Methods 2
Flight Activity Survey 2
Scarce Breeding Raptors and Owls 4
Breeding Birds of Open Ground 5
Winter Transect Survey 7
Black Grouse 8
Field Survey Results 9
Wildfowl 9
Waders 10
Scarce Raptors and Owls 11
Black Grouse 13
Breeding Birds of Open Ground 13
Other Species 14
Tables 16-18 16
Appendix 1: Bird species to be recorded during surveys. 17

MOSSMULLOCH WIND FARM

ORNITHOLOGY TECHNICAL REPORT

Introduction

1. This report details the results of ornithological survey work undertaken by Natural Research (Projects) Ltd (NRP) on and around the site of the proposed Mossmulloch Wind Farm ("the Proposed Development") during the period September 2022 to August 2023.

2. The objectives of the study were to:

    - Map the distributions of breeding birds, including scarce species listed in Annex 1 of the EU Birds Directive (2009/147/EC) on the Conservation of Wild Birds (the Birds Directive) or Schedule 1 of the Wildlife and Countryside Act 1981 (WCA).

    - Quantify the level of bird flight activity by breeding, wintering and foraging birds of potential conservation importance.

    - Record the presence and abundance of other birds of conservation importance (those listed in Biodiversity Action Plans (BAP), on the Red List of Birds of Conservation Concern (BoCC) (Stanbury *et al*., 2021)[1] or the IUCN Red List of Threatened Species (IUCN, 2023)[2] throughout the study period.

Desk Study

3. The Proposed Development is located approximately 5.8 km from the Muirkirk & North Lowther Uplands Special Protection Area (SPA) and the Muirkirk Uplands Site of Special Scientific Interest (SSSI) (**Figure 1**). The SPA is classified for its breeding populations of hen harrier (*Circus cyaneus*), peregrine (*Falco peregrinus*), merlin (*Falco columbarius*), short-eared owl (*Asio flammeus*), golden plover (*Pluvialis apricaria),* and wintering population of hen harrier. All of these features, except short-eared owl, are described as being in Unfavourable Declining condition. The SSSI is

[1] Stanbury, A., Eaton, M., Aebischer, N., Balmer, D., Brown, A., Douse, A., Lindley, P., McCulloch, N., Noble, D., & Win I. (2021). The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. British Birds 114: 723-747.
[2] IUCN. (2023). IUCN Red List of Threatened Species (ver. 2022-2). Available at: http://www.iucnredlist.org. (Accessed: May 2023).

designated for breeding and wintering hen harrier, breeding short-eared owl and its breeding bird assemblage.

Field Survey Methods

4. The baseline surveys detailed here commenced in September 2022 and continued until end of August 2023. The Study Area was defined with reference to the Ornithology Study Area (OSA) and encompasses a series of buffers of up to 2 km radius; with buffer size dependent on the sensitivity of key species to potential effects associated with the Proposed Development (**Figure 2**). The various survey areas, which make up the Study Area, are defined as follows:

    - 'Site' refers to the area enclosed by the Proposed Development's red-line boundary. The Site is entirely enclosed by the OSA.
    - 'breeding bird survey area', 'winter transect survey area' or 'core survey area' refers to the OSA plus an additional 500 m wide strip around the site area.
    - 'black grouse survey area' refers to the OSA plus an additional 1.5 km wide strip, and
    - 'raptor survey area' refers to the OSA plus an additional 1-2 km wide strip depending on the focal species and presence of contiguous suitable habitat outside of the core survey area.
    - 'flight activity survey area' refers to a polygon around the outermost turbines plus an additional 500 m strip around that polygon.

5. Field surveyors were Bob Stakim (RAS), Rhodri Evetts (RE), Alex Ash (AA) and Neil Thurgate (NT). All field surveyors are trained ornithologists with extensive experience in surveying birds. Field surveyors received training prior to and during survey work to maintain professional standards.

Flight Activity Survey

6. Information on bird flight activity was collected during timed watches from strategic Generic Vantage Points (GVPs) using the methods described by Band *et al.* (2007)[3]. GVPs were selected through a mix of GIS analysis and field trials, with the aim of maximising ground visibility within the OSA using the minimum number of points. A total of two GVPs were used providing coverage

[3] Band, W., Madders, M. & Whitfield, D.P. (2007) Developing field and analytical methods to assess avian collision risk at wind farms. In de Lucas, M, Janss, G.F.E. and Ferrer, M. (Eds.) Birds and Wind Farms: Risk assessment and Mitigation, pp. 259 - 275. Quercus, Madrid.

of the OSA and associated 500 m buffer. Viewsheds from each GVP are derived using a 20 m vertical cut-off and truncated horizontally at 2 km (**Figure 3**).

7. Observers at GVPs positioned themselves to minimise their effects on bird behaviour. A viewing arc not exceeding 180 degrees was scanned. Watches were undertaken during daylight hours by a single observer in a wide range of weather conditions, mainly in conditions of good ground visibility (> 2km). Between September 2022 and August 2023, a total of 164 hours of Vantage Point watches were undertaken (**Table 1**).

Table 1. Summary of monthly GVP observations. Data are hours of observation.

GVP No.	2022				2023								Total
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	
GVP1	6.00	9.00	3.00	4.00	6.00	4.00	8.00	9.00	9.00	12.00	6.00	6.00	**82.00**
GVP2	6.00	9.00	2.00	5.00	6.00	4.00	8.00	9.00	9.00	12.00	6.00	6.00	**82.00**
Total	**12.00**	**18.00**	**5.00**	**9.00**	**12.00**	**8.00**	**16.00**	**18.00**	**18.00**	**24.00**	**12.00**	**12.00**	**164.00**

8. During each watch, hierarchical recording methods were used, as follows:

- Focal bird sampling - timed. The viewing arc was scanned constantly until a *Target A Species*[4] was detected in flight. Once detected, the bird was followed until it ceased flying or was lost to view. The time the bird was initially detected and the time it spent flying (to the nearest second) were recorded. The route followed by the bird was plotted in the field onto an enlarged 1:25,000 scale map, with the direction of flight indicated. The bird's flying elevation above the ground was estimated at the point of detection and at 15 second intervals thereafter, using a countdown timer with an audible alarm. Flying elevation was classified as <10 m, 10-30 m, 30-100 m, 100-200 m, 200-250 m or >250 m.

  In some circumstances, instead of mapping a flight line, a 'flight area' denoting the area in which a bout of flight activity occurred was plotted on the field map. Recording the spatial extent of a flight bout with a flight area was preferable in circumstance where;

  - simultaneous flight activity by a number of birds was observed.
  - an individual flight bout is observed over a long period of time.
  - an individual flight bout is too complicated, i.e. a display flight, or
  - any combination of the above.

[4] Target species were drawn from those listed in Annex 1 of the Birds Directive and Schedule 1 of the WCA. Other species considered important in a regional or local context may also be included. These are listed in Appendix 1.

- Focal bird sampling – untimed. The same scanning procedure as described above was used. However, flights of *Target B Species* were not timed, instead the flight path was mapped and flying elevation was recorded at the start and when it changed during the recorded bout. Where a flock was observed a central flight line representative of the route was estimated.

- Activity summaries. At the end of each 5-min period, flight activity within the survey area by species of lesser conservation importance (*Secondary Species)* was summarised. Each GVP watch was sub-divided into 5-minute periods and at the end of each 5-minute period the total number of individuals of each secondary target species seen flying in the study area was recorded. The height, direction and number of individuals involved in notable bird movements were recorded.

9. Data were entered in the field onto recording sheets and later transferred to Excel spreadsheets. Maps of flight activity by *Target Species* were compiled for each watch. Each flying bout was numbered consecutively and cross-referenced to the relevant flightpath on the map.

Scarce Breeding Raptors and Owls

10. Priority was given to detecting the species considered most likely to occur; goshawk (*Accipiter gentilis*), hen harrier and merlin. Due to the iterative nature of the study a watching brief was maintained to identify possible breeding within the study area by additional species during the course of fieldwork, including red kite (*Milvus milvus*) and honey buzzard (*Pernis apivorus*).

11. Surveys for scarce breeding raptors and owls focused on areas or sites suitable for nesting and foraging within the 2 km buffer of the OSA (**Figure 2**). Surveyors conducted 18 separate searches or watches during the survey period, totalling 70 hours, to search for scarce breeding species (**Table 2**). These visits complemented search effort accrued during VP watches. Methods used for individual species are summarised below.

    - Goshawk (GI). Survey methods based on Hardey *et al*. (2013)[5] were followed. Areas of potential habitat (particularly mature areas of woodland and forestry) were watched from suitable vantage points to observe adults displaying over the nest area and perched near the nest location. The calls of adults and juveniles were listened for, and searches carried out on foot where nesting was suspected to locate nests.

- Hen harrier (HH). Survey methods based on Hardey *et al.* (2013)[5] were followed. Emphasis was given to searching habitats considered potentially suitable for nesting, in this case limited to areas of heath/bog with stands > 0.4m tall and areas of re-stock plantation.

- Merlin (ML). Survey methods based on Hardey *et al*. (2013)[5] were followed. Within suitable habitats, old crow nests (which could be re-used by merlin), fenceposts, hummocks, bushes and trees were checked for signs of occupation (e.g. plucked prey, moulted feathers, pellets and faeces). Emphasis was given to heath bog habitats with stands of heather >0.4m tall and edges of closed canopy forestry plantations.

- Red kite (KT) and honey buzzard (HZ). Survey methods based on Hardey *et al.* (2013)[5] were followed.

Table 2. Details of Scarce Breeding Raptor and Owl surveys, 2023.

Date	Start time	End time	Duration (hrs)	Observer	Cloud (10^{ths})	Cloud base (m)	Wind direction	Wind force	Precip*	Visibility (km)	Target species
03/04/2023	0710	1210	5.00	AA	0	-	SE	2	nil	20	GI ML
20/04/2023	0935	1435	5.00	AA	2	1000	E	3	nil	20	GI ML HH
21/04/2023	0835	1235	4.00	AA	1	1000	E	4	nil	20	GI ML
09/05/2023	0800	1300	5.00	AA	5	1000	W	3	nil	20	ML GI
12/05/2023	1000	1600	6.00	AA	10	600		2	nil	20	ML GI
17/05/2023	1300	1500	2.00	AA	7	1000	W	4	nil	20	ML GI
19/05/2023	1010	1210	2.00	AA	10	1000	W	3	nil	20	GI
28/06/2023	0700	1100	4.00	RE	10	500	W	2	IHR	2	GI KT
28/06/2023	1110	1510	4.00	RE	10	300	W	2	CHR	1	GI KT
30/06/2023	0810	1610	8.00	RE	10	300	WSW	5	CHR	1	GI KT
04/07/2023	1355	1555	2.00	AA	10	1000	S	3	nil	20	GI KT
21/07/2023	1315	1715	4.00	RE	6	1000	WSW	3	nil	5	GI KT HZ
24/07/2023	1500	1700	2.00	RE	10	700	W	3	ILR	5	GI KT HZ
25/07/2023	1250	1350	1.00	RE	10	800	W	4	nil	5	HH ML GI KT
26/07/2023	0900	1300	4.00	RE	8	700	W	3	nil	5	HH ML GI KT HZ
01/08/2023	0845	1645	8.00	RAS	10	500	ENE	3	ILR	5	GI HH
02/08/2023	1150	1350	2.00	RAS	10	400	NE	4	nil	5	GI
03/08/2023	1145	1345	2.00	RAS	9	700	NW	3	nil	5	GI
Total			**70.00**								

*Precipitation codes: Continuous/Intermittent + Light/Heavy + Rain/Snow/Hail/Fog

Breeding Birds of Open Ground

12. Surveys were completed using a four-visit adapted Brown & Shepherd (1993)[6] method for upland waders. These visits were completed within the 500 m survey boundary (**Figure 2**) between April and July to allow for differences in detection rate between early and late breeding species for a total of over 68 hours. Selected bird species were surveyed, namely those included on Annex 1 of

[5] Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. and Thompson, D. (2013). Raptors, a field guide to survey and monitoring. The Stationery Office, Edinburgh.
[6] Brown, A.F. & Shepherd, K.B. (1993) A method for censusing upland breeding waders. Bird Study 40: 3 pp 189 -195.

the Birds Directive, Schedule 1 of the WCA, Red-listed BoCC and those listed on the UK and local BAPs together with selected other species.

13. Fieldwork was not undertaken in conditions considered likely to affect bird detection, for example, strong winds (greater than Beaufort Force 5), persistent precipitation, poor visibility (less than 500 m) or in unusually hot or cold temperatures (**Table 3**).

14. The survey aimed to cover the ground systematically with a constant search effort. All points within the survey areas were approached closely typically to within 100 m. Patches of scrub, isolated trees, rocky outcrops and streams were investigated closely and surveyors paused at regular intervals to scan and listen for calling and singing birds. Careful attention was given to recording behaviour indicative of breeding with care taken to avoid counting the same individual more than once.

15. The location and activity of birds were mapped onto enlarged 1:25000 scale OS maps using standard BTO codes (Marchant, 1983)[7]. The position of each bird was mapped at the point of first detection and flight lines recorded. At the end of each visit, a summary map was compiled showing the locations of each identified territory or breeding pair. The following evidence was considered diagnostic of breeding: song, courtship or territorial display; territorial dispute; nest building and hole excavation; agitated behaviour by adult bird(s) indicative of the presence of a nearby nest or young (e.g. repetitive alarm calling, distraction display); adult(s) carrying food; presence of newly fledged young; adult(s) removing faecal sac.

16. Where a number of breeding individuals were present and it was not possible to determine the exact number of breeding pairs, a method was devised to allow the number of discrete territories to be estimated. Registrations of individual birds were deemed to represent discrete breeding territories / pairs if the distance between them was more than 250 m (500 m for curlew, 200 m for small passerines). Whilst it is recognised that these distances are arbitrary and the territory size varies both inter- and intra- specifically, this approach produces a standardised index of abundance based on the distance that members of a breeding pair are likely to move during the survey period. In cases where two individuals were considered to constitute a pair of birds, the location of the pair was placed centrally by convention.

[7] Marchant, J.H. (1983). BTO Common Birds Census Instructions. British Trust for Ornithology, Thetford.

Table 3. Details of Breeding Birds of Open Ground surveys, 2022.

Visit No.	Date	Start time	End time	Duration (hrs)	Observer	Cloud (10^{ths})	Cloud base (m)	Wind direction	Wind force	Precip*	Visibility (km)
1	03/04/2023	1215	1515	3.00	AA	2	1000	SE	3	nil	20
	12/04/2023	0825	1625	8.00	NT	5	1500	S	3	nil	15
	14/04/2023	0740	1340	6.00	AA	5	1000	WSW	3	nil	20
	20/04/2023	0630	0930	3.00	AA	0	-	E	2	nil	20
2	12/05/2023	1030	1630	6.00	NT	10	1500	E	2	nil	15
	16/05/2023	0700	1300	6.00	AA	5	1000	W	3	nil	20
	17/05/2023	0700	1300	6.00	AA	4	1000	W	3	nil	20
	19/05/2023	0705	1005	3.00	AA	5	1000	W	2	nil	20
3	13/06/2023	0815	1315	5.00	RAS	4	900	NE	3	nil	5
	14/06/2023	0800	1230	4.50	RAS	3	1500	E	3	nil	5
4	04/07/2023	0745	1345	6.00	AA	10	1000	S	3	ILR	20
	22/07/2023	0755	1355	6.00	AA	10	1000	E	2	ILR	20
	24/07/2023	0845	1445	6.00	RE	10	700	WNW	3	nil	5
Total				**68.50**							

*Precipitation codes: Continuous/Intermittent + Light/Heavy + Rain/Snow/Hail/Fog

Winter Transect Survey

17. Walk-over surveys were undertaken between September 2022 and March 2023 and occurred within the 500 m buffer of the OSA (**Figure 2**).

18. Walk routes meandered to closely examine as much ground as practical, in particular features of potential ornithological importance such as woodland edges, rocky outcrops, mires and streams. Where practicable, observers used a different route on each visit to maximise the eventual spatial coverage of the OSA. Observers frequently paused to scan for birds.

19. Twenty-three hours of winter transects were undertaken. A range of meteorological conditions were sampled, although wind speeds above Beaufort F5 were generally avoided to improve aural detection of species (**Table 4**).

20. The walked transects were effectively mobile VP watches. The procedure employed was as follows:

    - For *Target Species* the time each individual was first detected was recorded along with details of age, sex and behaviour. These details were cross-referenced to a 1:25,000 scale map where the location and flight route (if applicable) were plotted.

    - For all other species, the number of individuals was recorded and the location they were first detected was plotted on the map.

Table 4. Details of Winter Transect Surveys, 2022/23.

Date	Start time	End time	Duration (hrs)	Observer	Cloud (10^{ths})	Cloud base (m)	Wind direction	Wind force	Precip*	Visibility (km)
27/09/2022	1205	1405	2.00	RAS	6	800	NW	5	nil	5
28/09/2022	1210	1410	2.00	RAS	7	900	NW	3	nil	5
05/10/2022	1245	1445	2.00	RAS	10	500	WSW	4	CLR	3
06/10/2022	1150	1350	2.00	RAS	10	400	SW	5	CLR	2
31/10/2022	1150	1250	1.00	RE	10	300	S	5	IHR	1
31/10/2022	1600	1630	0.50	RE	10	400	S	4	ILR	1
01/11/2022	1005	1235	2.50	RAS	10	500	SW	5	ILR	4
01/12/2022	1405	1605	2.00	RAS	9	500	SW	3	nil	5
02/12/2022	1200	1300	1.00	RAS	10	800	nil	0	nil	5
27/02/2023	1105	1405	3.00	RAS	10	700	E	3	nil	5
28/02/2023	1100	1200	1.00	RAS	10	700	NE	3	nil	5
01/03/2023	0830	0930	1.00	RAS	7	700	ENE	3	nil	5
02/03/2023	0830	0930	1.00	RAS	10	400	NE	3	nil	4
03/03/2023	0850	1050	2.00	RAS	10	700	N	2	nil	5
Total			**23.00**							

*Precipitation codes: Continuous/Intermittent + Light/Heavy + Rain/Snow/Hail/Fog

Black Grouse

21. Searches for black grouse (*Tetrao tetrix*) were undertaken within suitable habitat in the 1.5 km survey buffer (**Figure 2**) during the peak period for display activity (lekking) by males between April and May. The methods employed were based on those described in Gilbert *et al.* (1998)[8]. Surveys were undertaken during the early morning in calm, dry weather with good visibility. Observers listened and scanned the areas considered suitable for lekking. In total, 18 hours was spent searching for black grouse (**Table 5**).

Table 5. Details of black grouse lek surveys, 2023.

Date	Start time	End time	Duration (hrs)	Observer	Cloud (10^{ths})	Cloud base (m)	Wind direction	Wind force	Precip*	Visibility (km)
10/04/2023	0500	0800	3.00	NT	7	2000	SSW	2	nil	15
11/04/2023	0510	0810	3.00	NT	6	1000	SW	3	ILR	10
21/04/2023	0530	0830	3.00	AA	8	1000	E	4	nil	20
09/05/2023	0455	0755	3.00	AA	4	1000	W	3	nil	20
10/05/2023	0500	0800	3.00	NT	10	200	S	2	ILR	2
11/05/2023	0500	0800	3.00	NT	10	1500	S	1	nil	10
Total			**18.00**							

*Precipitation codes: Continuous/Intermittent + Light/Heavy + Rain/Snow/Hail/Fog

[8] Gilbert, G., Gibbons, D.W. & Evans, J. (1998) Bird monitoring methods. RSPB Sandy, Bedfordshire.

Field Survey Results

22. Observed flight activity, timings and heights refer to all flights observed in the field from all GVPs. It should be noted that flight activity and timings will reduce, due to clipping flights to the 500 m flight activity survey area buffer and viewshed, from that recorded in the field when it comes to analysing these data in a Collision Risk Model (CRM).

Wildfowl

Occurrence and status

23. One species of conservation concern was recorded during the study period: **whooper swan** (*Cygnus cygnus*). Other wildfowl species recorded of lesser conservation concern included pink-footed goose (*Anser brachyrhynchus*), goosander (*Mergus merganser*), mallard (*Anas platyrhynchos*) and teal (*A. crecca*) (**Tables 6**-**8**, **15** & **17**; **Figures 4** & **5**).

24. Two flights by **whooper swan** (Annex 1 and Schedule 1) were recorded during the study period. One flight involving a total of nine individuals was recorded during a GVP watch and an additional flight involving two birds was observed during a winter transect (**Figures 4** & **5**).

25. Three flights involving a total of 99 pink-footed geese were recorded during the study period, all of which were recorded during flight activity surveys (**Figure 4**).

26. Three flights involving a total of 418 unidentified geese were recorded during the study period, all of which were recorded during flight activity surveys (**Figure 4**).

Flight activity recorded from GVPs

27. One flight by **whooper swan** was recorded involving nine individuals for a total duration of 91 seconds. The entire flight was less than 30 m above ground level (**Table 6**; **Figure 4**).

Table 6. Details of whooper swan flights recorded from GVPs.

Period	GVP No.	No. of flights	No. of birds	Total fly time (s)	Adjusted fly time (s)	Time in height class (s)					
						<10m	10-30m	30-100m	100-200m	200-250m	>250m
Sep-Mar	GVP2	1	9	91	819	135	684				
Total		**1**	**9**	**91**	**819**	**135**	**684**				

28. Three flights by pink-footed geese were recorded during GVP watches involving 99 individuals. Flights varied in height between 30-100 m and 200-250 m above ground level (**Table 7**; **Figure 4**).

Table 7. Details of pink-footed goose flights recorded from GVPs.									
Period	**GVP No.**	**No. of flights**	**No. of birds**	**Height class**					
				<10m	**10-30m**	**30-100m**	**100-200m**	**200-250m**	**>250m**
Sep-Mar	GVP1	1	16			*			
		1	33			*			
	GVP2	1	50					*	
Total		**3**	**99**			*		*	

29. Three flights by unidentified geese were recorded during GVP watches involving 418 individuals. Flights varied in height between 10m and 200 m above ground level (**Table 8**; **Figure 4**).

Table 8. Details of unidentified goose flights recorded from GVPs.									
Period	**GVP No.**	**No. of flights**	**No. of birds**	**Height class**					
				<10m	**10-30m**	**30-100m**	**100-200m**	**200-250m**	**>250m**
Sep-Mar	GVP1	1	300			*	*		
		1	110			*	*		
		1	8		*				
Total		**3**	**418**		*	*	*		

Waders

Occurrence and status

30. Three species of wader of conservation concern were recorded during the study period: **curlew** (*Numenius arquata*), **golden plover** and **lapwing** (*Vanellus vanellus*). Species of lesser conservation concern that were recorded included snipe (*Gallinago gallinago*) (**Tables 9** & **14**-**17**; **Figures 4**-**6**).

31. **Curlew** (BoCC Red list, IUCN Red List of Threatened Species) were only recorded during the breeding season with up to four territories located within the study area (**Figures 4**-**6**).

32. **Golden plover** (Annex 1) was recorded once during the study period. In late April a flock of 55 were encountered in flight during a scarce breeding bird survey (**Figure 5**). No breeding activity was observed, and these spring birds were likely to be birds on migration to breeding sites further north.

33. **Lapwing** (Red list) was recorded infrequently during the study period with two confirmed breeding territories located within the study area (**Figure 6**).

Flight activity recorded from GVPs

34. Three flights by **curlew** were recorded from GVPs during the study period for a total duration of 161 seconds. Flight height varied between less than 10 m to 100 m in height (**Table 9**; **Figure 4**).

Table 9. Details of curlew flights recorded from GVPs.

Period	GVP No.	No of flights	No of birds	Total fly time (s)	Time in height class (s)					
					<10m	10-30m	30-100m	100-200m	200-250m	>250m
Apr-Aug	GVP1	1	1	71	53	18				
		1	1	32	32					
	GVP2	1	1	58		19	39			
Total		**3**	**3**	**161**	**85**	**37**	**39**			

Scarce Raptors and Owls

Occurrence and status

35. Six species of scarce raptor and owl were recorded during surveys: **red kite** (*Milvus milvus*), **goshawk**, **hen harrier**, **peregrine**, **merlin** and **barn owl** (*Tyto alba*). Other raptor species of lesser conservation concern were also recorded, including common buzzard (*Buteo buteo*), sparrowhawk (*Accipiter nisus*) and common kestrel (*Falco tinnunculus*) (**Tables 10**-**13** & **15**-**18**; **Figures 4** & **5**; **Confidential Figure 1**).

36. **Red kite** (Annex 1 and Schedule 1) was recorded once during the study period, with a lone adult seen foraging during the non-breeding season. No evidence of breeding by red kite was obtained despite extensive searches in potential breeding habitat within 2 km of the OSA (**Figure 5**).

37. **Goshawk** (Schedule 1) was recorded on twelve occasions during the study period with a confirmed nest location found within the study area fledging two young (**Figures 4** & **5**; **Confidential Figure 1**).

38. **Hen harrier** (Annex 1 and Schedule 1) was observed on four occasions during the study period with all observations being an adult male. There was no evidence of breeding despite extensive searches in potential breeding habitat within 2 km of the OSA (**Figures 4** & **5**).

39. **Peregrine** (Annex 1 and Schedule 1) was recorded once during the study period. No evidence of breeding by peregrine was obtained during baseline surveys, despite extensive searches in potential breeding habitat (**Figure 4**).

40. **Merlin** (Annex 1 and Schedule 1) was recorded once during the study period. A juvenile bird was recorded from a GVP in October 2022. There was no evidence of breeding despite extensive searches in potential breeding habitat within 2 km of the OSA (**Figure 4**).

41. **Barn owl** (Schedule 1) was recorded once during the study period with one bird observed roosting in a small conifer (**Confidential Figure 1**).

Flight activity recorded from GVPs

42. No flights by **red kite** were recorded from GVPs during the study period.

43. Three flights by **goshawk** were recorded from GVPs during the study period for a total duration of 475 seconds. Flights varied in height between less than 10 m and 200 m above ground level (**Table 10**; **Figure 4**).

Table 10. Details of goshawk flights recorded from GVPs.

Period	GVP No.	No of flights	No of birds	Total fly time (s)	Time in height class (s)					
					<10m	10-30m	30-100m	100-200m	200-250m	>250m
Sep-Mar	GVP1	1	1	144	32	80	32			
Apr-Aug	GVP2	1	1	99		17	82			
		1	1	232		46	155	31		
Total		**3**	**3**	**475**	**32**	**143**	**269**	**31**		

44. Three flights by **hen harrier** were recorded from GVPs during the study period for a total duration of 235 seconds. All flights were less than 30 m above ground level (**Table 11**; **Figure 4**).

Table 11. Details of hen harrier flights recorded from GVPs.

Period	GVP No.	No of flights	No of birds	Total fly time (s)	Time in height class (s)					
					<10m	10-30m	30-100m	100-200m	200-250m	>250m
Sep-Mar	GVP1	1	1	16		16				
		1	1	147	147					
Apr-Aug		1	1	72	36	36				
Total		**3**	**3**	**235**						

45. One flight by a **peregrine** was recorded from GVPs during the study period for a total duration of 24 seconds. The entire flight was less than 10 m above ground level (**Table 12**; **Figure 4**).

Table 12. Details of peregrine flights recorded from GVPs.

Period	GVP No.	No of flights	No of birds	Total fly time (s)	Time in height class (s)					
					<10m	10-30m	30-100m	100-200m	200-250m	>250m
Sep-Mar	GVP1	1	1	24	24					
Total		**1**	**1**	**24**	**24**					

46. One flight by a **merlin** was recorded from GVPs during the study period for a total duration of 28 seconds. The entire flight was less than 10 m above ground level (**Table 13**; **Figure 4**).

Table 13. Details of merlin flights recorded from GVPs.

Period	GVP No.	No of flights	No of birds	Total fly time (s)	Time in height class (s)					
					<10m	10-30m	30-100m	100-200m	200-250m	>250m
Sep-Mar	GVP1	1	1	28	28					
Total		**1**	**1**	**28**	**28**					

47. No **barn owl** flights were recorded.

Black Grouse

Occurrence and status

48. No **black grouse** or signs of black grouse were recorded during any survey during the study period.

Breeding Birds of Open Ground

Occurrence and Status

49. Confirmed breeding species of interest recorded within the 500 m buffer of the OSA include curlew, lapwing, skylark (*Alauda arvensis*), house martin (*Delichon urbica*) and grasshopper warbler (*Locustella naevia*). All are BoCC Red-listed and considered of conservation concern (**Table 14**; **Figure 6**).

50. Other species probably breeding within the 500 m of the OSA include cuckoo (*Cuculus canorus*), tree pipit (*Anthus trivialis*), lesser redpoll (*Acanthis cabaret*), linnet (*Linaria cannabina*) and whinchat (*Saxicola rubetra*). All are BoCC Red-listed and considered of conservation concern (**Table 14**; **Figure 6**).

Relative Abundance

51. Four curlew territories were identified, of which two were confirmed as breeding. Two lapwing territories were identified, both of which were confirmed as breeding, and included a record of an adult with chicks (**Figure 6**).

52. Skylark were observed across the OSA, in relatively low densities. Approximately 19 breeding territories were recorded in 2023, which equates to a breeding density of 2.9 pairs per km^2 (**Figure 6**).

53. Four grasshopper warbler territories were recorded and four sand martin colonies holding two, two, six and eight occupied sites respectively were located (**Figure 6**).

Table 14. Breeding bird territories, 2023.

Species	Confirmed	Probable
Common sandpiper	-	3
Cuckoo	-	3
Curlew	2	2
Dipper	1	-
Grasshopper warbler	4	-
Grey wagtail	-	1
House martin	Colony (4 occupied sites)	-
Lapwing	2	-
Lesser redpoll	-	3
Linnet	-	2
Mallard	1	-
Reed bunting	4	4
Sand martin	Colony (2, 2, 6 and 8 occupied sites)	-
Skylark	19	-
Snipe	6	1
Song thrush	-	5
Tree pipit	-	1
Whinchat	-	1

Other Species

54. Species with high rates of occurrence recorded during flight activity surveys included common buzzard, raven (*Corvus corax*), house martin (*Delichon urbicum*), common kestrel and stock dove (*Columba oenas*). All these species are common and distributed throughout Scotland. One flight by a single unidentified tern species was recorded in October 2022 (**Table 15**).

Table 15. The percentage of five-minute recording periods in which each species was encountered during watches from all GVPs during the study period.

Species	No. of 5-minute periods recorded	Occurrence (%)*
Common buzzard	140	7.114
Raven	108	5.488
House martin	80	4.065
Common kestrel	44	2.236
Stock dove	18	0.915
Grey heron	12	0.610
Sparrowhawk	11	0.559
Fieldfare	9	0.457
Swift	8	0.407
Woodpigeon	8	0.407
Starling	7	0.356
Great black-backed gull	6	0.305
Cormorant	5	0.254
Mallard	4	0.203
Goshawk	4	0.203
Herring gull	3	0.152
Pink-footed goose	3	0.152
Unidentified goose species	3	0.152
Curlew	3	0.152
Hen harrier	3	0.152
Cuckoo	2	0.102
Crossbill	1	0.051
Lesser black-backed gull	1	0.051
Snipe	1	0.051
Unidentified tern species	1	0.051
Merlin	1	0.051
Peregrine	1	0.051
Whooper swan	1	0.051

Birds listed in Annex 1 of the Birds Directive or Schedule 1 of the WCA are shown in bold.
* Total number of 5-minute recording intervals was 1,968.

Tables 16-18

Table 16. Results of Scarce Breeding Raptor and Owl surveys.

Date	Time	Species	Number	Sex	Age	Behaviour	Signs	Comments
21/04/2023	1105	Golden plover	55			Flying		
09/05/2023	0855	Goshawk	2	MF	Ad	Vocalise	Nest, used this year	GI nest, only signs under nest one bone and some splash & down in tree. Adults present and calling frequently
12/05/2023	1055	Goshawk	1	F		Flying		
19/05/2023	1030	See comments	0				Kill/prey	Fresh remains of blackbird, song thrush and rabbit/hare. Maybe GI?
30/06/2023	1210	Goshawk	0				Nest with young	In quite small tree with 1 downy young in nest
30/06/2023	1211	Goshawk	1	F		Agitated/alarm		Alarming near nest bird, possibly immature?
30/06/2023	1406	Buzzard	0				Nest with young	At least 2 young in nest
26/07/2023	1153	Goshawk	1	F		Flying		
02/08/2023	1310	Goshawk	2		2JUV	Vocalise/agitated/alarm	Recent fledglings, Used nest (this yr)	Minimum 2 juvs fledged. Tree species: sitka spruce

Table 17. Results of winter transects, 2022/23.

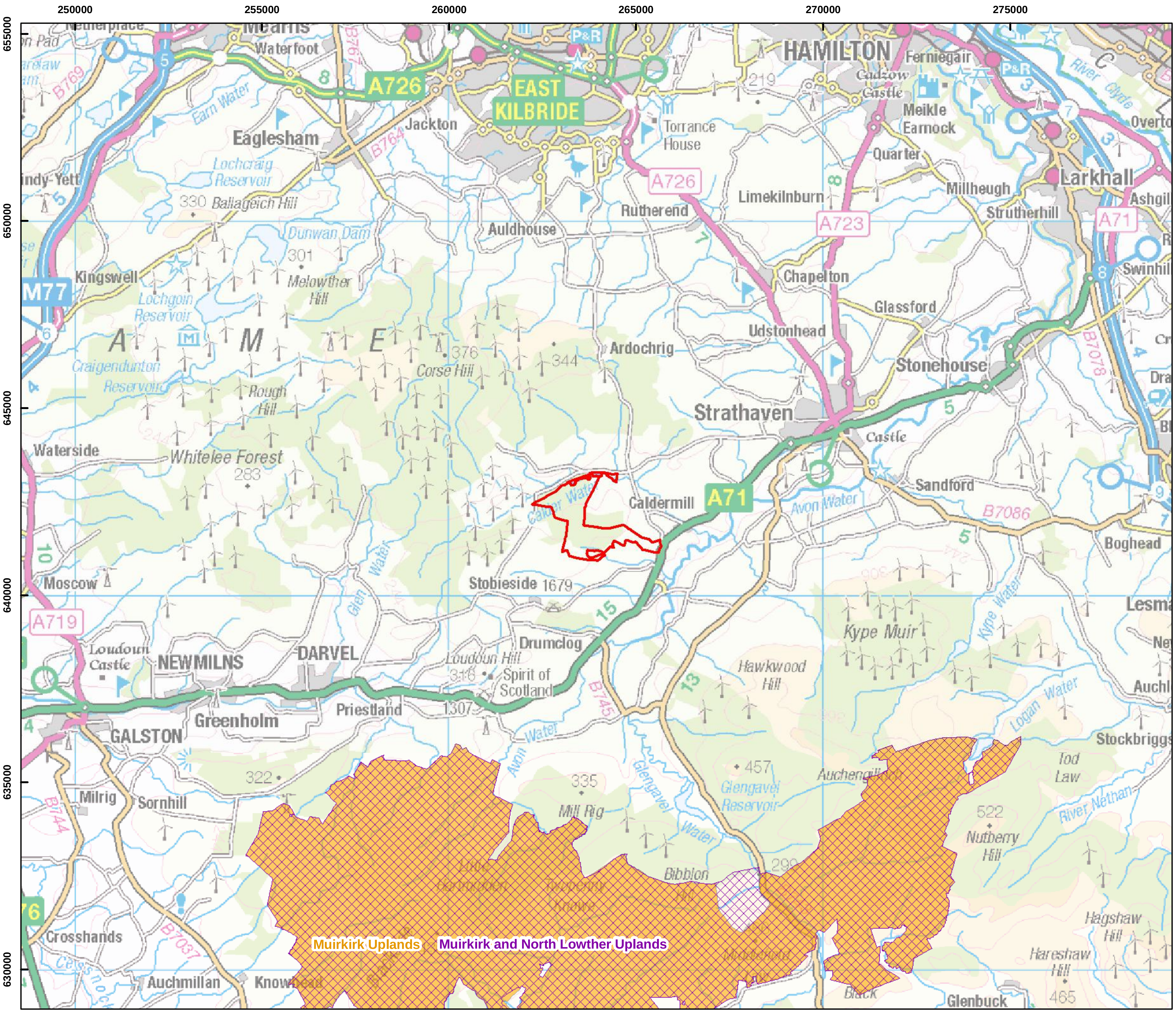
Species	Sep-22	Oct-22	Nov-22	Dec-22	Feb-23	Mar-23	Grand Total
Bullfinch		4					**4**
Buzzard		2		1	3	3	**9**
Crossbill	5				1		**6**
Dipper					2		**2**
Fieldfare					50		**50**
Goosander					3		**3**
Goshawk						3	**3**
Jay	1						**1**
Kestrel						3	**3**
Mallard				24	2		**26**
Mistle thrush	5			5	1		**11**
Raven					1		**1**
Red kite					1		**1**
Snipe	6		3	2	1		**12**
Sparrowhawk		signs					**0**
Teal				1			**1**
Whooper swan				2			**2**
Grand Total	**17**	**6**	**3**	**35**	**65**	**9**	**135**

Table 18. Incidental records.

Date	Time	Species	Number	Sex	Age	Behaviour	Signs	Comments
22/07/2023	1153	Barn owl	1		Ad	Roosting		Roosting in small conifer
24/07/2023	1014	Hen harrier	1	M	Ad	Hunting		Mobbed by gulls

Appendix 1: Bird species to be recorded during surveys.

SPECIES RECORDED FOR ASSESSMENT OF FLIGHT ACTIVITY			Additional species (e.g. breeding and/or wintering
Target A species	**Target B species**	**Secondary species**	
Diver species	Greylag goose	Cormorant	Tree pipit
Whooper swan	Barnacle goose	Grey heron	Dunnock
Common Scoter	White-fronted goose	Kestrel	Song thrush
White-tailed eagle	Pink-footed goose	Buzzard	Skylark
Golden eagle	Brent goose	Sparrowhawk	Grasshopper warbler
Hen harrier	Bean goose	Red grouse	Wood warbler
Goshawk	Tern species	Grey partridge	Spotted flycatcher
Red kite	Arctic skua	Lapwing	Marsh tit
Osprey	Great skua	Redshank	Willow tit
Merlin	Woodcock	Common sandpiper	Crested tit
Peregrine		Oystercatcher	Starling
Hobby		Snipe	Tree sparrow
Barn owl		Herring gull	Linnet
Short-eared owl		Cuckoo	Twite
Golden plover		Ring ouzel	Lesser redpoll
Dunlin		Raven	Crossbill species
Greenshank		(Any flocks >30)	Bullfinch
Whimbrel			Hawfinch
Curlew			Yellowhammer
Wood sandpiper			Reed bunting
Black grouse			Corn bunting
Capercaillie			Mute swan
Nightjar			Mallard
Chough			Goosander
(Other rare raptors)			Teal



nrp NATURAL RESEARCH PROJECTS LIMITED

Key

- Application boundary
- SPA
- SSSI

Date produced: 12/11/2024

Source: NRP LTD

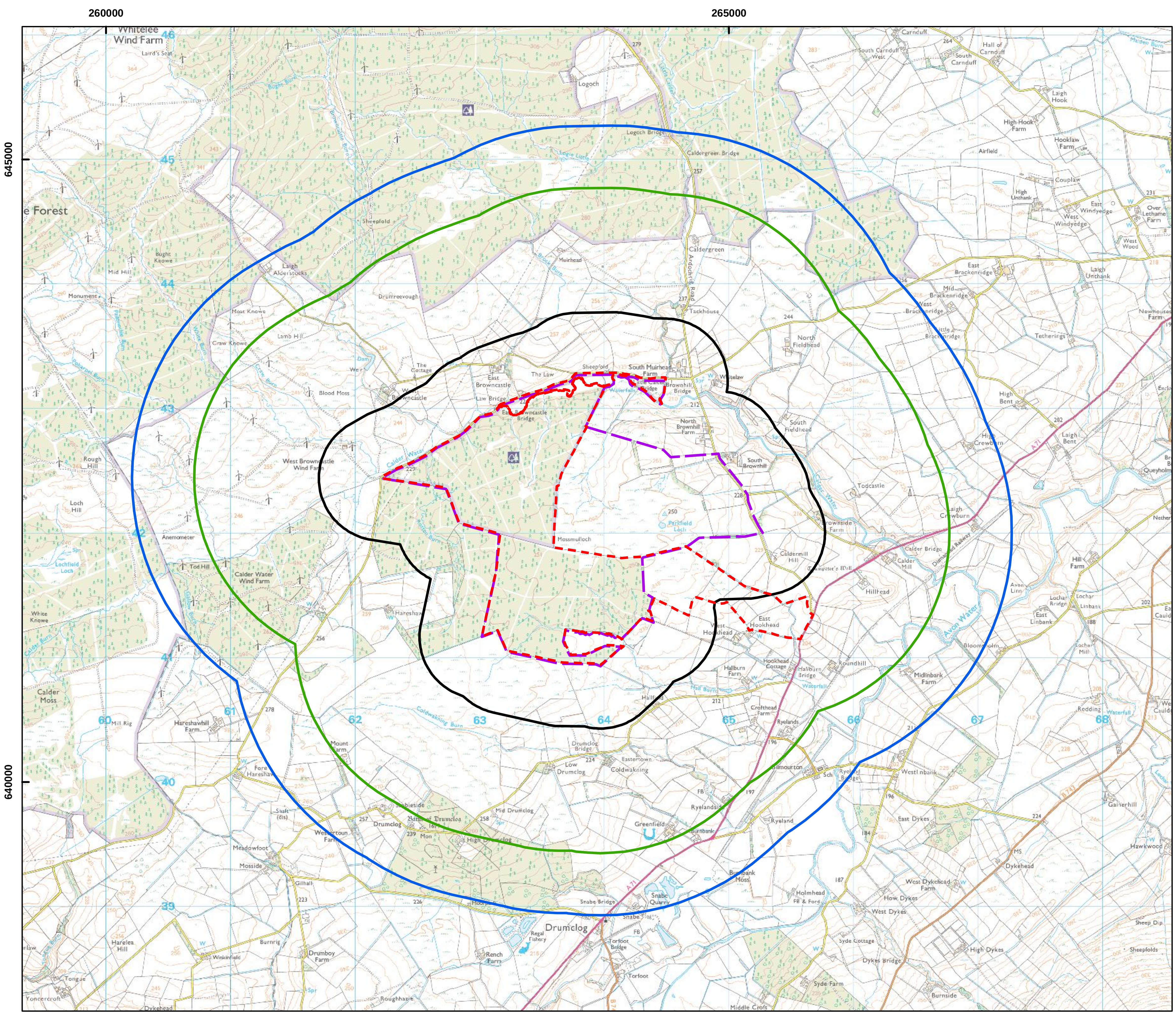
N

0 1 2 4 km

Figure 1.

Designated sites within 20km

Mossmulloch



Key

- Application boundary
- Ornithological survey area (OSA)
- 500m buffer of OSA
- 1.5km buffer of OSA
- 2km buffer of OSA

Date produced: 12/11/2024

Source: NRP LTD

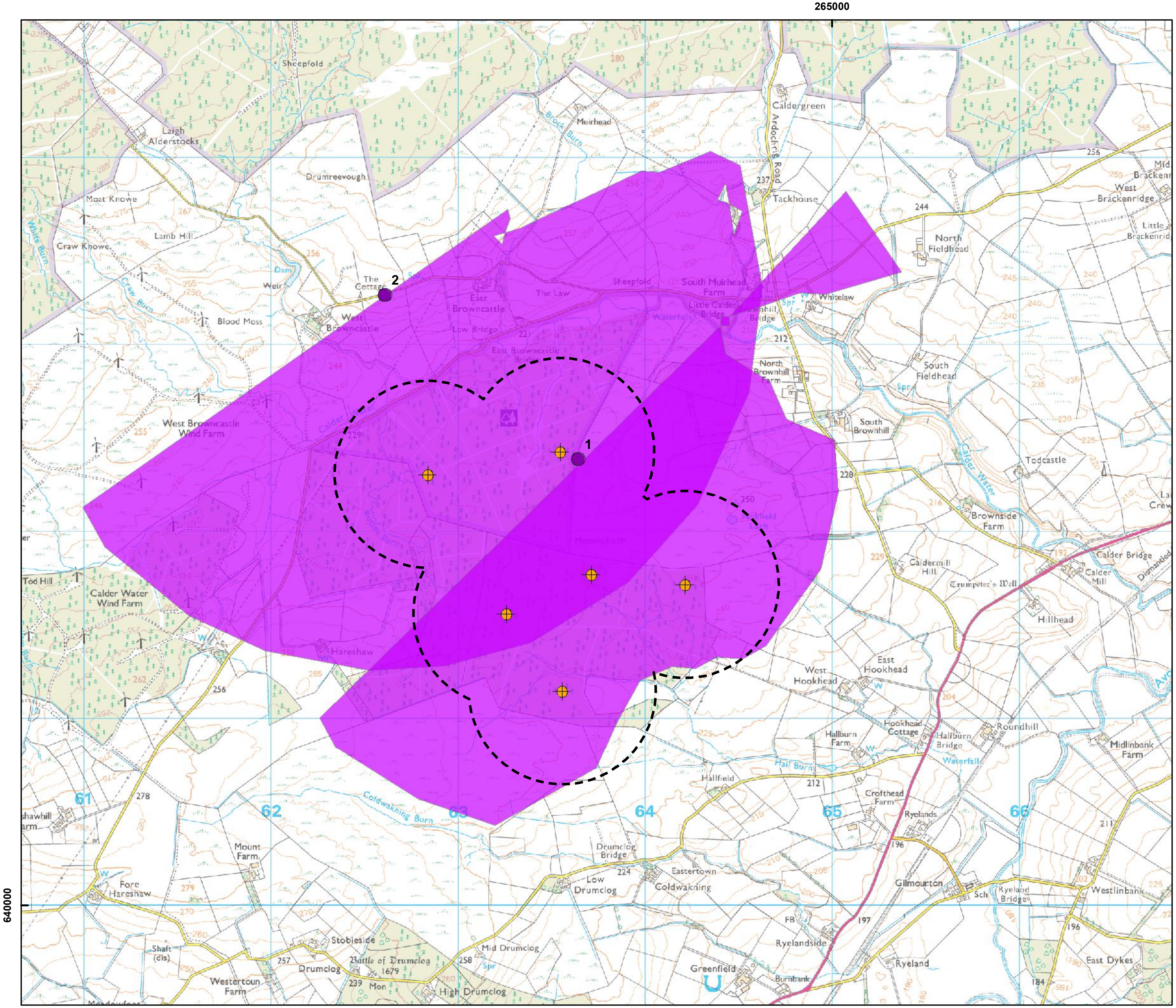
N

0 0.25 0.5 1 km

Figure 2.

Survey buffers

Mossmulloch



NATURAL RESEARCH PROJECTS LIMITED

Key

- Flight activity survey area
- Proposed turbine locations
- Vantage Points
- Viewsheds

Date produced: 22/11/2023
Source: NRP LTD

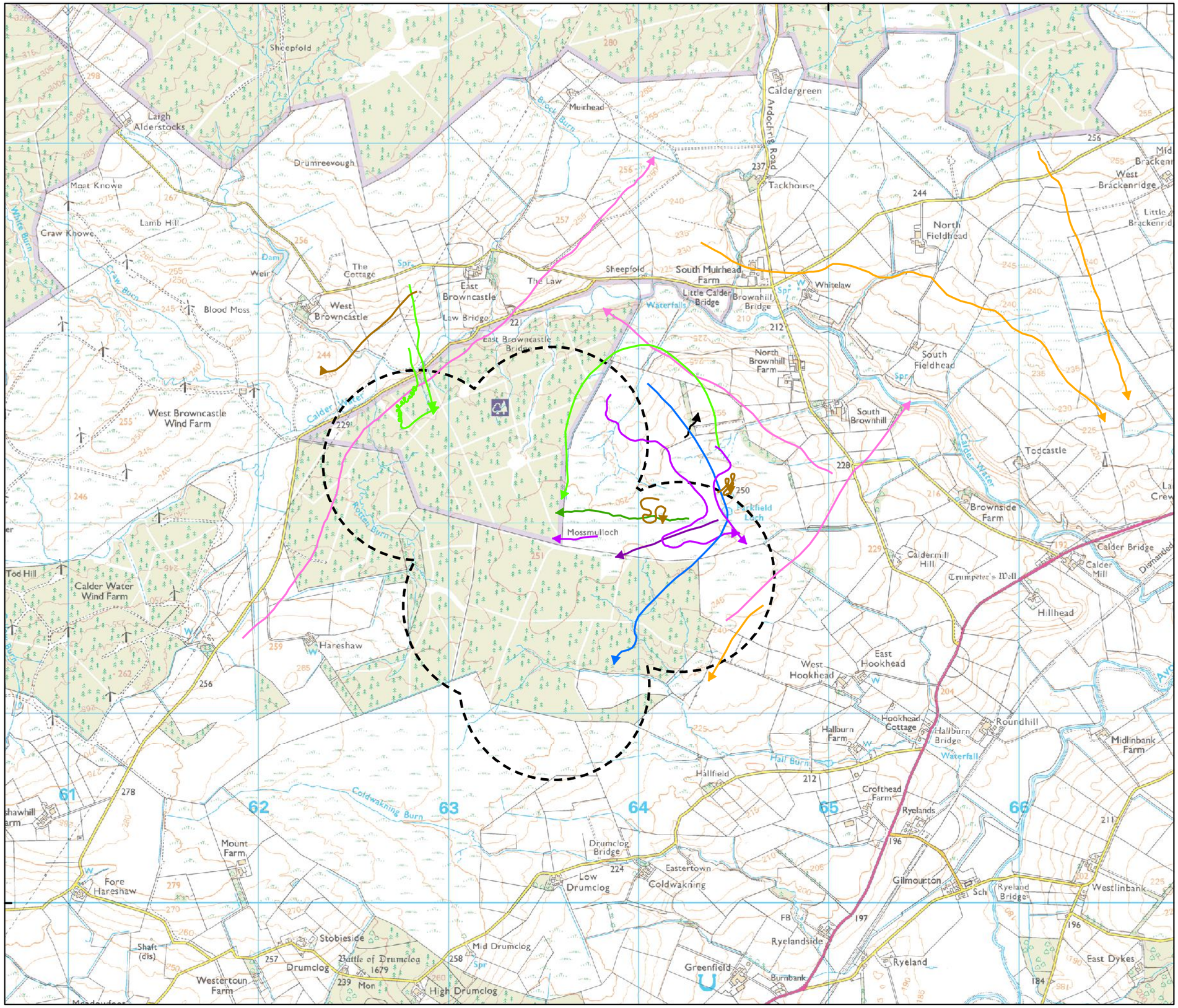
Figure 3.

Vantage Points and Viewsheds

Mossmulloch

265000

640000



nrp NATURAL RESEARCH PROJECTS LIMITED

Key

- Flight activity survey area

Flight lines

- Curlew
- Goose sp.
- Goshawk
- Hen harrier
- Merlin
- Peregrine
- Pink-footed goose
- Tern sp.
- Whooper swan

Date produced: 22/11/2023

Source: NRP LTD

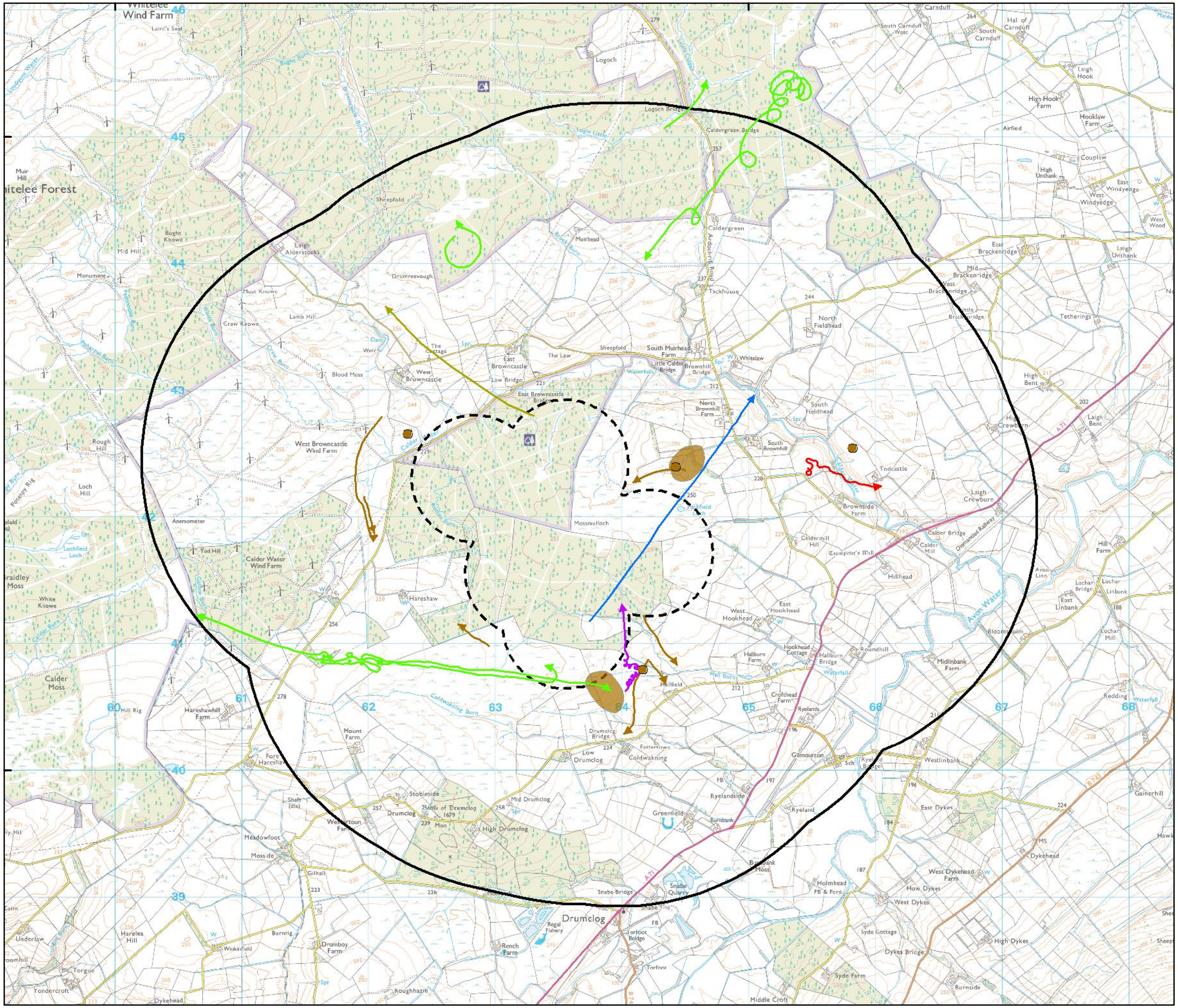
N

0 0.25 0.5 1 km

Figure 4.

Flights recorded from Generic Vantage Points

Mossmulloch



Key

Flight activity survey area

2km buffer of OSA

Flight lines

Curlew

Golden plover

Goshawk

Hen harrier

Red kite

Whooper swan

Flight areas

Curlew

Point records

Curlew

Date produced: 22/11/2023

Source: NRP LTD

N

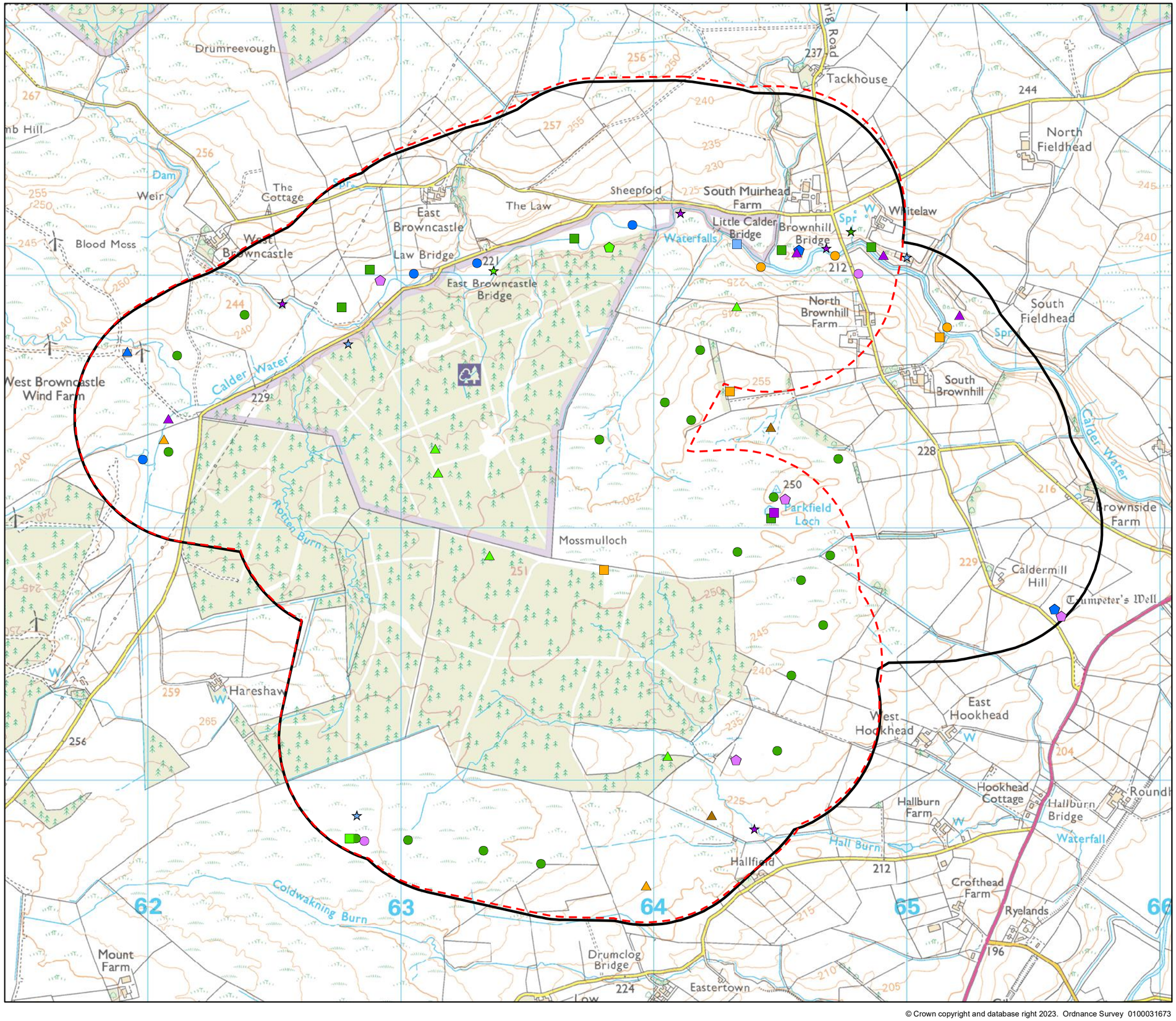
0 0.25 0.5 1 km

Figure 5.

Bird records made during other surveys

Mossmulloch

265000



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Key

- 500m buffer of the Site
- 500m buffer of OSA
- Common sandpiper, Probable
- Cuckoo, Probable
- Curlew, Confirmed
- Curlew, Probable
- Dipper, Confirmed
- Grasshopper warbler, Confirmed
- Grey wagtail, Probable
- House martin colony, Confirmed
- Lapwing, Confirmed
- Lesser redpoll, Probable
- Linnet, Probable
- Mallard, Confirmed
- Reed bunting, Confirmed
- Reed bunting, Probable
- Sand martin colony, Confirmed
- Skylark, Confirmed
- Snipe, Confirmed
- Snipe, Probable
- Song thrush, Probable
- Tree pipit, Probable
- Whinchat, Probable

Date produced: 23/11/2023
Source: NRP LTD

N

0 0.2 0.4 0.8 km

Figure 6.

Moorland Breeding Bird Territories

Mossmulloch