

Appendix 8.2 – Ornithology



Cruachan 2

Technical Appendix 8.2: Ornithology

Produced for Drax Generation Enterprise Ltd

By Applied Ecology Ltd

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1 Introduction

Background

- 1.1 The Cruachan Power Station is a pumped storage hydro-electric facility located to the west of the settlement of Dalmally on the northern shore of Loch Awe, in Argyll and Bute. Feasibility studies for an extension to the generating capacity of the power station began in 2016, when the Site was in ScottishPower ownership, and as part of those feasibility studies, a number of specialist investigations were commissioned, including a range of ecological and ornithological surveys.
- 1.2 In 2019, ownership of the power station transferred to Drax, and the potential for increasing the generation capacity of Cruachan was revisited. In February 2021, Applied Ecology Ltd (AEL) was commissioned to review the pre-existing ecological and ornithological information for the proposals to determine its spatial and temporal coverage in the context more detailed feasibility work for a second generating facility (“the Proposed Development”) at the Site (see **Figure 1.1**)¹. With regards to ornithology, the review of the 2016-2018 surveys undertaken by Arcus Ltd found that all pre-existing data for the Site was robust and likely to be accurate. It was noted that during that original survey period, consultation with Scottish Natural Heritage (SNH – as was²) had resulted in the removal of a number of survey elements from the ornithological survey suite, notably woodland point counts, and migratory and over-wintering birds, focussing the survey suite instead on the features and locations of greatest importance and most likely requiring full assessment in an EIAR.
- 1.3 Following that data review, AEL was therefore commissioned to provide full ecological and ornithological support for a S36 planning application and accompanying Environmental Impact Assessment Report (EIAR) for the Proposed Development, to be known as Cruachan 2. AEL consulted NatureScot regarding the survey suite required in 2021-2022, in order to ensure that robust and in-date data were available to inform a full Ecological Impact Assessment (EclA) within the Ecology chapter of the EIAR. Full details of this consultation can be found in Chapter 8 (Ecology) of the EIAR, but in summary the following approach was agreed:
 - reuse of the breeding bird data from 2016-2018, with no additional data collection required in 2021;
 - repeat of the three key vantage points identified as covering the Site in 2016-2018, namely VP1, VP3 and VP5, for 12 months between April 2021 and March 2022;
 - repeat of walkover surveys for nesting scarce diurnal raptors in the 2021 breeding season;
 - repeat of black grouse lekking surveys in the 2021 lekking period.

¹ **AEL (2021).** *Desk Study and Evaluation of Pre-Existing data.* Unpublished contract report for Stantec. March 2021.

² SNH became known as NatureScot in August 2020. Where correspondence or guidance was provided prior to their name change, the organisation is referred to as SNH. All correspondence and guidance produced post-August 2020 is referenced as being from NatureScot.



- 1.4 It was expected that these new data, when combined with the pre-existing data, would be sufficient to determine the likely ornithological constraints associated with the Proposed Development.

Purpose of this report

- 1.5 This report provides a summary of ornithological surveys undertaken on the Site between 2016 and 2018, as updated during the 2021-2022 survey season. It provides details of the methods used to collect primary and secondary data, a description of the survey results and an evaluation of the implications of these findings for the Proposed Development. No confidential data relating to the location of Schedule 1 birds is included in this report; all such details can be found in Confidential Technical Appendix 8.4. Non-avian ecology and fisheries are also covered in separate technical appendices.^{3,4}
- 1.6 These data will be used in the EclA presented in Chapter 8 (Ecology) of the Environmental Impact Assessment Report (EIAR) for the Proposed Development.

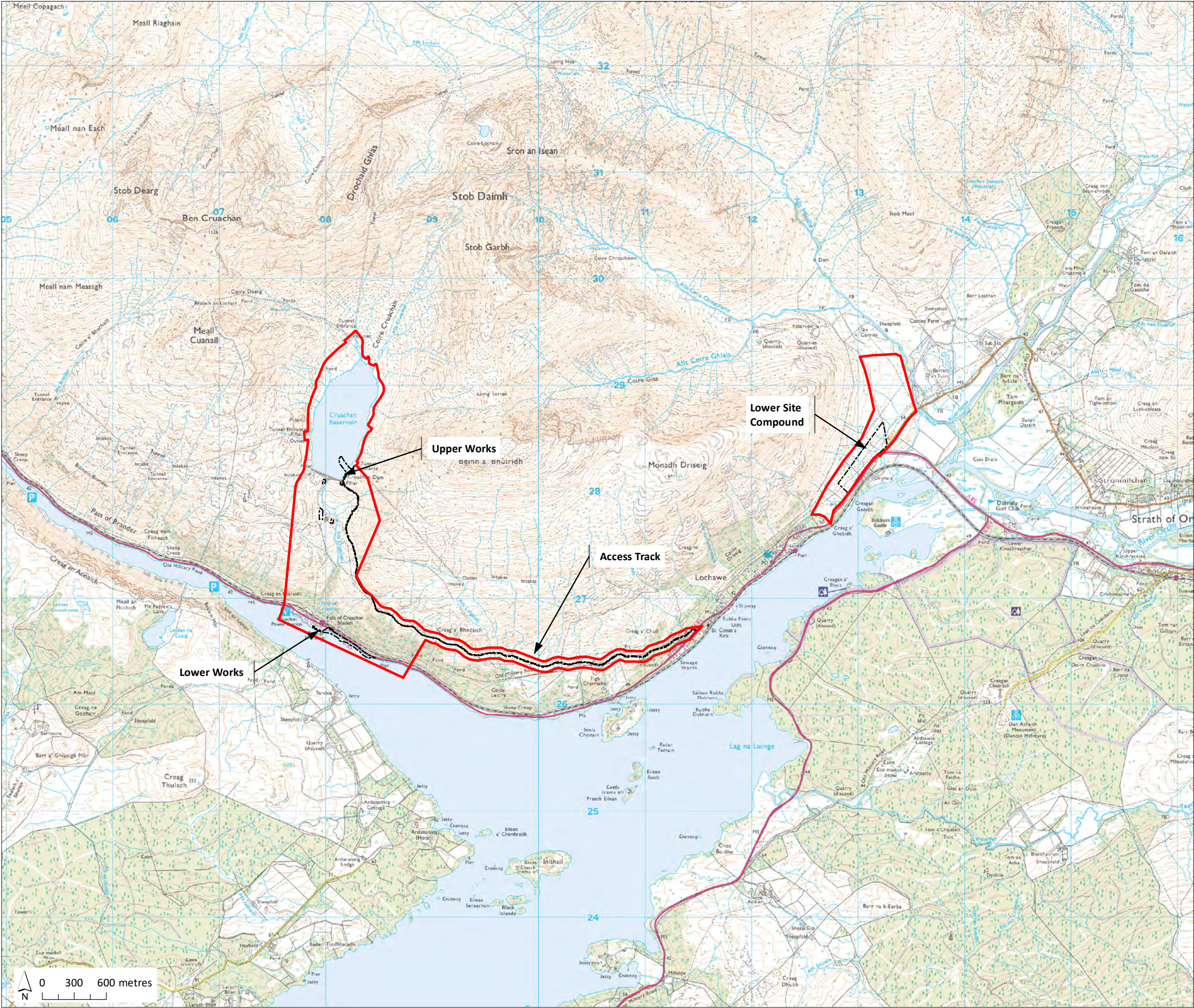
Report qualification

- 1.7 The surveys described here were undertaken in accordance with the best practice methodologies current at the time of commissioning. Site circumstances, scientific knowledge or methodological requirements can change during the course of a project, and these external factors may impact on the scope of subsequent work requirements.
- 1.8 All survey work and reporting was undertaken by experienced and qualified ecologists in accordance with the Code of Professional Conduct of the Chartered Institute of Ecology and Environmental Management (CIEEM) and BS 42020:2013 (Biodiversity).
- 1.9 All ecological surveys have an expected validity period, owing to the tendency of the natural environment to change over time. This validity period varies from feature to feature, and is also dependent on the degree of change in a site's management and overall landscape ecology. Where the potential for change is considered to be relevant to the Site, this is highlighted in the appropriate section.
- 1.10 This report does not purport to provide detailed, specialist legal advice. Where legislation is referenced, the reader should consult the original legal text, and/or the advice of a qualified environmental lawyer.

³ **AEL (2022a)** *Cruachan 2 – Technical Appendix 8.1: Non-Avian Ecology*. Unpublished contract report produced for Drax Generation Enterprise Ltd, April 2022.

⁴ **Gavia Environmental Ltd (2022)** *Cruachan 2 – Technical Appendix 8.3: Freshwater Ecology*. Unpublished contract report produced for Drax Generation Enterprise Ltd, May 2022.





Cruachan 2

Site Location

 Site boundary

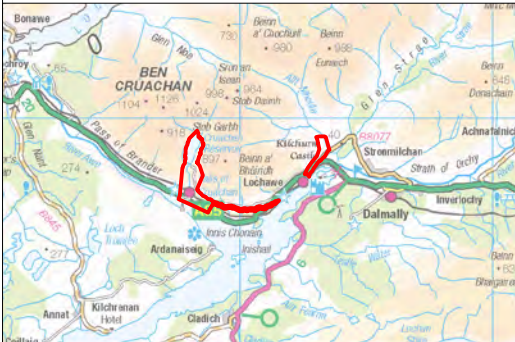


Figure 1.1

Map Scale @ A3: 1:35,000

Surveyed by: -
Survey date: -
Drawn by: RAH
Checked by: DS
Status: Final



2 Methodologies

Data review

Designated sites

- 2.1 Details of nearby statutory sites designated for ornithological aspects of nature conservation were obtained from the NatureScot Natural Spaces website⁵ and plotted in a Geographical Information System (GIS).

Pre-existing survey data

- 2.2 The 2017 and 2018 ornithological survey reports for the Site were reviewed, including the remapping of key spatial data in GIS⁶.
- 2.3 Pre-existing information regarding the presence of black grouse within 2 km of the Site was also extracted from a range of data sources within the National Biodiversity Network (NBN) Atlas⁷, where there were no copyright issues associated with doing so in a commercial context.

Vantage Points

- 2.4 Timed watches from the three selected vantage points (VPs) previously surveyed for the Site (see **Table 2.1**) were undertaken according to the methodology described by Band *et al.* (2007)⁸ and the relevant SNH (as was) guidance documents.
- 2.5 The objective of VP surveys is to accurately record the flight behaviour of target bird species within the Proposed Development envelope during the seasons when they are likely to be present. In the context of the Proposed Development, this would allow estimates to be made of the following:
- the time each species spends flying over the study area;
 - the relative use each species makes of different parts of the study area.
- 2.6 In addition, the vantage point data can be used to verify the findings of any modelling of use of the Site by raptor species of conservation interest.
- 2.7 As in previous years, Target Species were all divers, grebes, herons, swans, wild geese, ducks and raptors, and owls listed on Annex 1 or Schedule 1, black grouse, all waders and all terns. Secondary species included cormorant, all gulls, all other raptor and owl species, raven, and passerine species in noteworthy numbers.

⁵ <https://gateway.snh.gov.uk/natural-spaces/index.jsp> Accessed April 2022.

⁶ **ScottishPower Generation Ltd (2018)** *Cruachan Power Station Ornithology Annual Report Year 2: October 2017 – September 2018*. Unpublished contract report, dated December 2018.

⁷ <https://nbnatlas.org/> accessed March 2021.

⁸ **Band, W, Madders, M, & Whitfield, D.P. (2007)** Developing field and analytical methods to assess avian collision risk at wind farms. In: Janss, G, de Lucas, M & Ferrer, M (eds.) *Birds and Wind Farms*. Quercus, Madrid. 259-275



- 2.8 The VP work was undertaken by a single observer per VP in conditions of good visibility. Normally, each observation period lasted 3 hrs but, if necessary, they were suspended and later resumed to take account of changes in weather. The 180° area in view was scanned constantly until a Target Species was detected perched or in flight. Once detected, the bird was followed until it ceased flying or was lost from view. The time the bird was first detected, and the duration of the flying period was recorded onto standard proformas. The route followed by the bird was plotted in the field onto 1:25,000 scale maps. The bird's flight height was estimated at the point of detection and recorded at 15 sec intervals thereafter.
- 2.9 The VP watches are summarised in **Table 2.2**, with full details provided in **Appendix B**. All VPs were completed in the timeframes summarised in **Table 2.2**, with the exception of VP3, where the final survey visit for March 2022 was not completed until 02 April 2022 due to scheduling difficulties. It is not considered that this delay by 48 hours would have materially altered the results in the context of a year-long dataset.
- 2.10 For Target Species, the 180° area in view to the surveyor was scanned constantly with the naked eye and binoculars until a Target Species was detected perched or in flight. Once detected, the bird was watched until it ceased flying or was lost from view. The time the bird was first detected, and the duration of the flying period was recorded, and its route plotted in the field onto 1:25,000 scale maps. The bird's flight height was estimated at the point of detection and recorded at 15 sec intervals, thereafter, using an audible countdown timer. The behaviour of the bird(s) was recorded during each 1 min flight segment.
- 2.11 Activity of secondary species observed during searches for Target Species was noted within each relevant 5 min period within the vantage point survey session, giving information on numbers of birds involved, their flight heights and position in relation to the Site boundary.
- 2.12 All flight activity data were input into GIS.

Table 2.1: Coordinates of Vantage Point locations.

VP number	X coordinate	Y coordinate
VP1	208828	728387
VP3	208035	726106
VP5	212049	726397

Table 2.2: Hours of observation at each Vantage Point.

VP number	Breeding season hours	Non-breeding season hours
VP1	36 (Apr - Sept 2021)	36 (October 2021 – March 2022)
VP3	36 (Apr - Sept 2021)	36 (October 2021 – March 2022)
VP5	36 (Apr – Sept 2021)	36 (October 2021 – March 2022)



Diurnal raptor walkovers

- 2.13 Surveys for nesting Target Species raptors within the Study Area were undertaken between March and July 2021. Survey methods according to Hardey *et al.* (2009)⁹ were followed, by Schedule 1 licensed surveyors. These surveys specifically for breeding raptors were in addition to, and complemented, by the VP surveys (see earlier).

Black grouse

- 2.14 The survey methodology for black grouse was based on the survey principles described in Gilbert *et al.*¹⁰. Three visits were made to suitable areas within 1.5 km of the Site, to capture the lek sites found in previous surveys during 2018. The visits were carried out on 23 April 2021, 24 April 2021, 30 April 2021, and 15 May 2021.
- 2.15 Visits began an hour before dawn and continued for up to two hours after sunrise. The initial visit was carried out over two mornings but with better knowledge of the Site it was found to be possible to cover the required study area within one morning. Where possible, surveys were carried out in fine, dry weather with light breeze although weather varied according to date and altitude. Summary data for each visit are provided in **Table 2.3** below.

Table 2.3: Summary of 2021 black grouse surveys.

Survey date	Start time	Finish time	Wind direction	Wind speed	Cloud cover	Cloud base codes	Cloud base (m)	Visibility code	Visibility	Precipitation
23/04/2021	04:45	06:45	W	0 - 1	0 - 8	2	>500 m	2	>2 km	0
24/04/2021	04:45	06:45	SE	2	0 - 1	2	>500 m	2	>2 km	0
30/04/2021	04:35	07:35	W	0 - 1	1 - 2	2	>500 m	2	>2 km	0
15/05/2021	04:10	06:15	E	2 - 3	6 - 7	2	>500 m	2	>2 km	0

Wind speeds refer to the Beaufort Scale. Cloud cover estimated in Octads. Cloud base and visibility codes as indicated. Precipitation codes are: 0 : nil; 1 : mist or drizzle; 2 : light showers; 3 : heavy showers.

- 2.16 The Study Area was covered by vehicle and on foot. Different parts of the Study Area were concentrated on during each of the three visits, but as wide as possible coverage was made on each survey. Special effort was made on the historical lek sites, but all other suitable habitat in the lek areas was covered. Regular stops were made to listen for calling birds before and after dawn. After dawn, areas of suitable habitat were visually scanned within the 1.5 km study area extending beyond the Site boundary. Care was taken not to disturb any lekking birds, which were to be observed from a distance or by using a car as a hide.

⁹ Hardey, J.; Crick, H.; Wernham, C.; Riley, H.; Etheridge, B. and Thompson, D. (2013). Raptors: A Field Guide for Surveying and Monitoring. TSO

¹⁰ Gilbert, G., Gibbons, D.W. & Evans, J. (1998). *Bird Monitoring Methods: A Manual of Techniques for Key UK Species*. RSPB, Sandy, Beds.



- 2.17 Any black grouse calls, sightings, or signs such as droppings were recorded on survey maps for subsequent digitising within GIS. Other bird species of interest were also noted.

Potential limitations of the black grouse surveys

- 2.18 The weather conditions were extremely good on all four mornings on which surveying took place. There were no issues regarding access, and it was possible to use extensive quad-bike tracks that ran through the key survey area allowing good coverage on foot. There were therefore no methodological limitations to the survey.

GET model

- 2.19 The GET model has been developed to provide a simple model of landscape use for golden eagle (see Fielding *et al.* 2019)¹¹. It is based on the understanding that large soaring bird species such as golden eagle preferentially use terrestrial habitats that provide them with vertical energetic lift from orographic and anabatic winds. Accordingly, these large raptor species commonly use ridges and/or rugged topography, as demonstrated by the model which was developed and tested using thousands of GPS telemetry records from 92 tagged juvenile eagles between 2007 and 2016 for locations across upland Scotland. The model found that young golden eagles preferred, or used according to availability, slopes greater than 10°, at altitudes of ≥ 300 m, and within 300 m of a ridge.
- 2.20 The GET model therefore involves the integration of three datasets in grid format at 50 m resolution, namely:
- altitude (m);
 - slope (degrees);
 - distance to ridge (m).
- 2.21 Each 50 m grid pixel is assigned a Standardised Preference Index (SPI) value for all three of the above data sets. The SPI values are then summed and a final predicted use value is assigned to each pixel, ranging from 1 to 10, whereby 1 is the lowest predicted use value by golden eagle and 10 is the highest predicted use value. Habitat with a GET score of ≥ 6 is a good indicator of potential golden eagle activity; habitat with a score of ≤ 5 is used infrequently. The model has been subsequently tested with data from > 50 range holding birds and 99 dispersing golden eagle.
- 2.22 The appropriate baseline for an assessment of habitat loss arising from the construction of the Proposed Development is the current area of open GET habitat with a value of 6 or more. **Open habitat** is defined as land (lochs and reservoirs are excluded) with no closed canopy forest cover and not within 500 m of an existing or consented wind turbine (due to the avoidance behaviour that these structures cause). All subsequent measures of good golden eagle habitat refer to open country habitat with a GET score of 6+. **Closed golden eagle habitat** is defined here as being all land with an extensive tree cover or within 500 m of a consented or constructed turbine tower. In these analyses current tree cover was assessed using an August 25th 2021 Sentinel 2 image (tile 30UUG). A false colour composite image was constructed from the 10 m resolution bands 2, 3 and 4 while

¹¹ Fielding, A.H., Haworth, P.F., Anderson, D., Benn, S., Dennis, R., Weston, E. and Whitfield, D.P. (2019). A simple topographical model to predict Golden Eagle *Aquila chrysaetos* space use during dispersal. *International Journal of Avian Science*.

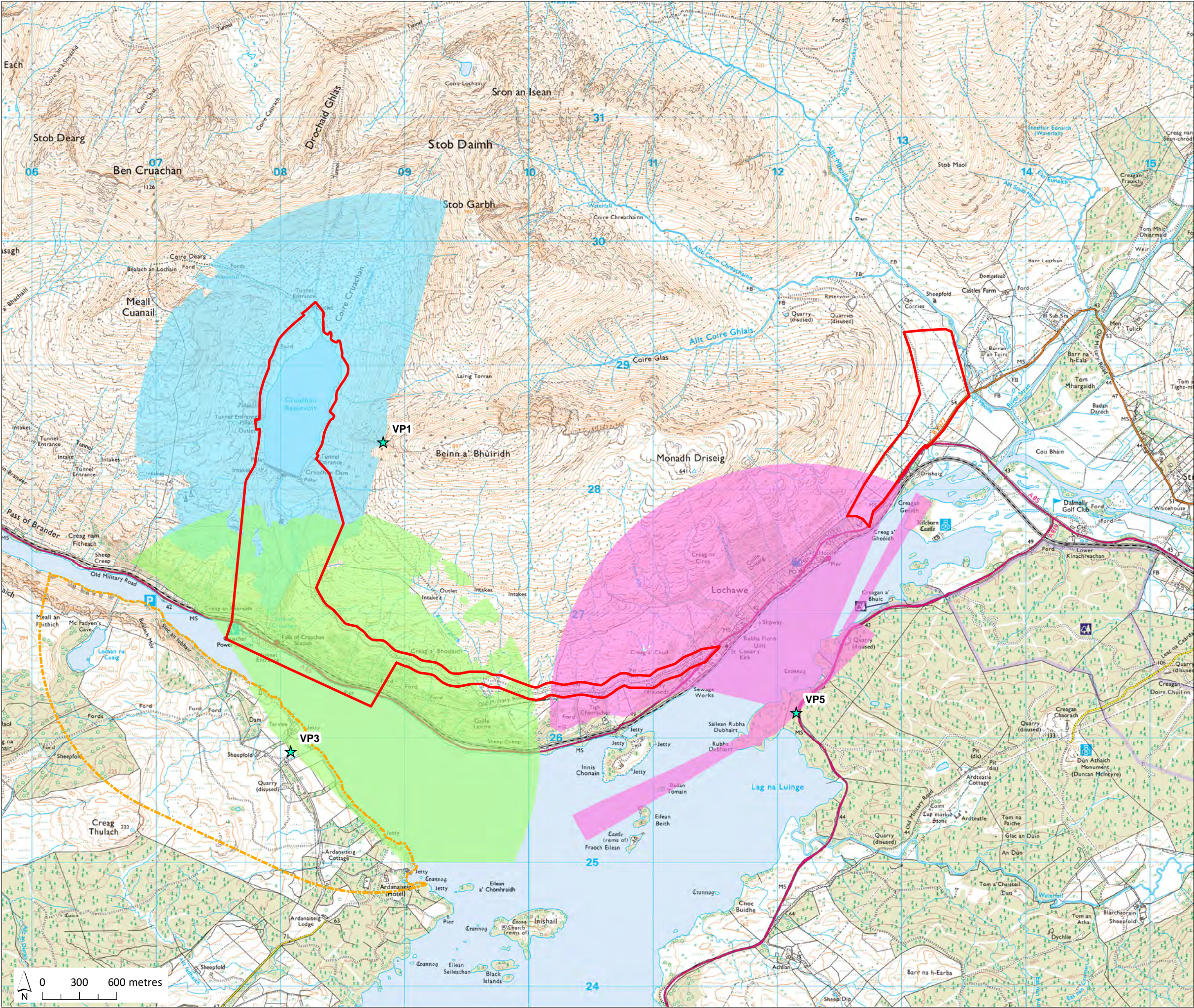


combining the 20 m resolution bands 2, 6 and 12 enhanced tree cover (Ottosen *et al.*, 2020)¹². Turbine locations were taken from a database regularly maintained by the authors of the GET model report.

2.23 The GET model used in this report was prepared by Alan Fielding.

¹² Ottosen, T.B., Petch, G., Hanson, M. and Skjøth, C.A. (2020). Tree cover mapping based on Sentinel-2 images demonstrate high thematic accuracy in Europe. *International Journal of Applied Earth Observation and Geoinformation*, **84**, p.101947.





Cruachan 2

Ornithological Survey Approach in 2021-2022

- Site boundary
- VP
- VP1
- VP3
- VP5
- 1.5 km from Site boundary (black)

Figure 2.1

Map Scale @ A3: 1:30,000

Surveyed by: SS/KD
Survey date: April '21 - March '22
Drawn by: RAH
Checked by: DS
Status: Final



3 Results

Data review

Designated sites

- 3.1 The locations of statutory sites within 2 km of the Proposed Development and designated for ornithological purposes are shown in **Figure 3.1**. All other designated sites are covered in the non-avian ecology Technical Appendix 8.1¹³.
- 3.2 The **Glen Etive and Glen Fyne Special Protection Area (SPA)** encircles Cruachan Reservoir, and part of the Site boundary falls within it. The SPA was designated because it regularly supports a population of European importance of golden eagle. In 2003, it contained 19 active golden eagle territories, representing more than 4.2 % of the GB population of that species.

Breeding bird surveys

- 3.3 During the breeding bird surveys, a total of 50 species were recorded, including 16 species listed as being Birds of Conservation Concern (BoCC¹⁴) and/or Scottish Biodiversity List (SBL) that were considered to be breeding or holding territory within the Study Area; these are summarised in **Appendix C**, and in **Figure 3.2**. Only non-Schedule 1 species are shown in **Figure 3.2**, and all confidential nest records are included in **Map 2** of Confidential Technical Appendix 8.4. The species recorded during the BBS visits were considered to be typical of the habitats present and geographic location of the Site.
- 3.4 Territories were concentrated in the woodland habitats in the lower elevation areas of the BBS Study Area. Relatively few birds species listed on the BoCC and/or SBL were recorded breeding or holding territories within the actual Site.

Vantage point surveys

- 3.5 Within the 2016-2017 and 2017-2018 vantage point data, a total of 368 flights by 18 target species were observed. A summary of these flights is provided in **Table 3.1** below, and shown in **Figure 3.3**, for the non-confidential records. Flights lines for Schedule 1 raptors within this time period are provided in **Map 3** of Confidential Technical Appendix 8.4.
- 3.6 Overall, flight activity was greatest over and around Loch Awe, reflecting the predominance of waterbirds (wildfowl, heron, razorbill, etc.) among the species observed. Grey heron was the most frequently recorded species during the vantage point surveys, with many observations associated with the fish farm opposite the Cruachan Visitor Centre.
- 3.7 Within the Site Survey Area itself, relatively few flights were observed, although those that were recorded, tended to be more sensitive species (e.g. Schedule 1 raptor species). In

¹³ **AEL (2022)** *Cruachan 2 – Technical Appendix 8.1: Non-Avian Ecology*. Unpublished contract report produced for Drax Generation Enterprise Ltd, April 2021.

¹⁴ **Stanbury, A., Eaton, M., Aebischer, N., Balmer, D., Brown, A., Douse, A., Lindley, P., McCulloch, N., Noble, D., and Win I. (2021)**. The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. *British Birds* 114: 723-747.



addition to golden eagle and white-tailed eagle, peregrine and osprey were also recorded. There were also three observations of hen harrier during the 2017-2018 surveys, although none of the individuals recorded exhibited any type of breeding or territorial behaviour.

- 3.8 Detailed mapping for all Annex I/Schedule 1 raptor species confirmed as nesting within the Breeding Raptor Study Area are provided in Confidential Technical Appendix 8.4.

Table 3.1: Summary of flights recorded over the Site and a 2 km buffer in 2016-17 and 2017-18.

Species	Number of flights: 2016-2017		Number of flights: 2017-2018	
	Over Site	Over Site + 2 km	Over Site	Over Site + 2 km
Barnacle Goose	0	1	0	0
Canada Goose	0	50	2	24
Common Sandpiper	0	1	0	0
Golden Eagle	1	9	3	16
Goldeneye	0	7	2	9
Goosander	2	13	1	9
Grey Heron	40	58	27	33
Greylag Goose	0	5	1	4
Hen Harrier	0	0	1	6
Herring Gull	0	0	0	1
Mallard	1	8	0	16
Osprey	4	14	0	9
Oystercatcher	2	8	0	8
Peregrine Falcon	7	20	5	22
Pink-footed Goose	0	0	1	1
Razorbill	0	1	0	2
Red-breasted Merganser	0	2	0	0
White-tailed Eagle	3	7	3	4
Totals	60	204	46	164

Diurnal raptor walkovers

- 3.9 Both golden eagle and white-tailed eagle were recorded within the Study Area in both the 2016-2017 and 2017-2018 study periods. In 2017, a single golden eagle nest was confirmed to the north of the Site, and although a chick was seen on a number of occasions, it was not seen during July of that year, and it was considered likely that the nesting attempt had failed. Golden eagle activity was again recorded consistently through every month of the survey period described in the 2017-2018 bird survey report (February - August 2018, inclusive) and in April 2018, an active nest site was identified within the Breeding Eagle Study Area. This nest, which was located within the known golden eagle territory (although the actual nest site differed to that used in 2017), was monitored throughout the season; one chick was reared and successfully fledged. During the August visit, the fledged juvenile was recorded flying around an area in close proximity to the nest. As expected, there was a



large amount of golden eagle flight activity in the area surrounding the active nest. The majority of the golden eagle activity was recorded within 3 km of the active nest. Details of the nest location and flight activity are contained within Confidential Technical Appendix 8.4.

- 3.10 White-tailed eagle was also recorded frequently throughout the 2016-2017 and 2017-2018 survey periods, likely to be associated with nearby breeding territories, and as shown in Confidential Technical Appendix 8.4. A successful nesting attempt was recorded in 2017 south-west of the Site, but in 2018 no white-tailed eagle nests were recorded within the Breeding Eagle Study Area.
- 3.11 Observations of other Schedule 1 raptor species encountered during the 2018 Breeding Eagle Surveys are summarised below in **Table 3.2**.

Table 3.2: Other Schedule 1 raptor species encountered during the 2018 diurnal raptor surveys.

Species	Description
Osprey	One flight of an individual bird was recorded over the eastern end of Loch Awe in June 2018, and another flight of an individual bird was recorded over Loch Etive in the north-west section of the Breeding Eagle Survey Area, in July 2018.
Goshawk	A single flight of a male was recorded in August 2018 in the north of the Breeding Eagle Survey Area between Beinn a' Chochuill and Sron an Isean.
Hen harrier	A male and female were recorded (separately) hunting at the south-west of the Breeding Eagle Survey Area in February 2018.
Merlin	A single flight of a male bird was recorded in the north-west of the Breeding Eagle Study Area during April 2018.

2021 field surveys

Vantage point surveys

- 3.12 A summary of the non-confidential target species flights recorded during the 2021-2022 survey period is provided in **Figure 3.3** and **Table 3.3** below. Flights for raptor species can be found in **Map 4** in Confidential Technical Appendix 8.4.
- 3.13 The 2021-2022 data cannot be directly compared to those recorded in 2016-2018 because fewer vantage point locations were utilised, and the survey did not coincide with a golden eagle nesting attempt. Only one golden eagle flight was recorded crossing the Upper Works part of the Site, in addition to two very short flights over the Access Track. In contrast however, in 2021-2022 more white-tailed eagle activity was recorded around Cruachan Reservoir than in previous years.
- 3.14 Overall, the number of flights of scarce raptors over the Site was fairly consistent across all study years, with the exception that in 2021-2022 no peregrine were recorded.



Table 3.3: Summary of scarce raptor flights in all study years.

Species	2016-2017		2017-2018		2021-2022	
	Over Site	Over Site + 2 km	Over Site	Over Site + 2 km	Over Site	Over Site + 2 km
Golden Eagle	1	9	3	16	3	4
Hen Harrier	0	0	1	6	0	0
Osprey	4	14	0	9	3	10
Peregrine Falcon	7	20	5	22	0	0
White-tailed Eagle	3	7	3	4	6	10
Totals	15	50	12	57	12	24

Diurnal raptor walkovers

- 3.15 The target of the diurnal raptor walkovers was the pair of golden eagle that habitually hold territory to the north of the Site. However, this pair failed to nest in 2021, and as a result there were no results to report for this part of the survey suite.

Black grouse

- 3.16 No black grouse were seen or heard during the 2021 surveys, and no signs such as droppings were found during the surveys.
- 3.17 However, the area around the Site retained suitable habitat for black grouse with a mosaic of mature, young, and cleared forest and extensive stretches of forest edge.

GET model

- 3.18 The full GET model report can be found in **Appendix D**, with a summary provided in **Table 3.4** below.
- 3.19 The author of the GET model report estimated that there are probably more than 20 occupied golden eagle ranges within 20 km of the Proposed Development and possibly two to three pairs with part of their range within 5 km. The closest range centre is < 6 km from the Proposed Development and, given the extent and connectivity of good eagle habitat, this pair will use of the land within the Site, although they are more likely to remain north of the Ben Cruachan ridge and away from the Proposed Development. This was also seen in the result of the vantage point surveys. The recently reoccupied Beinn Ghlas range pair are also known to cross Loch Awe and make use of the western slopes of Ben Cruachan (Scott Smith, pers comm).
- 3.20 The GET model showed that there are 9,388 ha of open GET 6+ habitat within 5 km of the Site, and 85,949 ha within 20 km, and in both cases c. 80 % of the open habitat is GET 6+ indicating that there is a large amount of potentially good eagle habitat in the vicinity. The Proposed Development will result in the loss of 59 ha of such high suitability ground (c. 1 % of that within 5 km of the Proposed Development and c. 0.1 % of that within 20 km). All of the open habitat at the Upper Works is modelled by GET as being good golden eagle habitat but the total loss is minimal at 3 ha. The largest, but still small, loss is associated with the main access track. The habitat around the main access track is almost all good

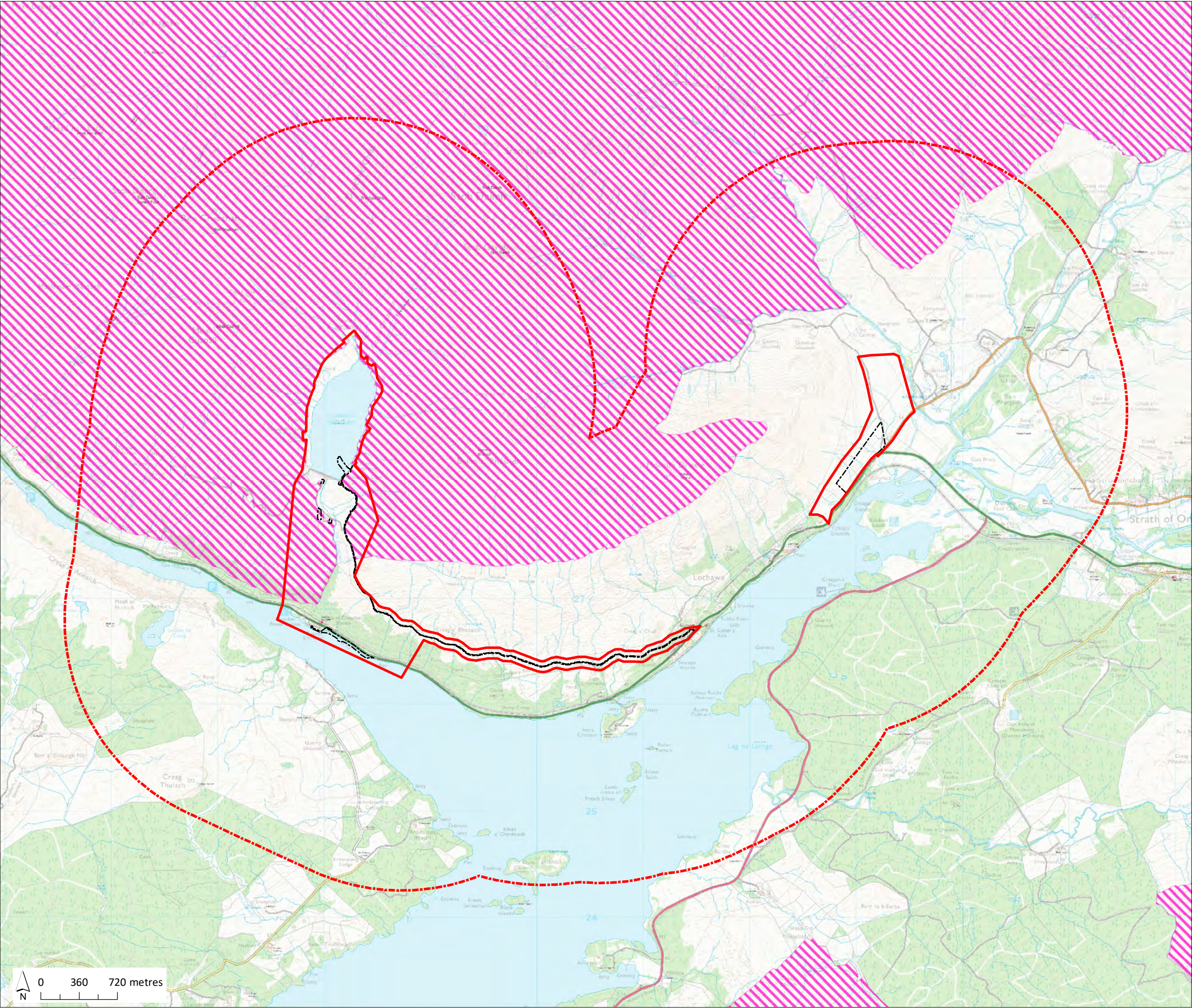


eagle habitat (96 %) but the modelled loss will be small, at 44 ha, and the majority of this access track is already extant.

Table 3.4: Areas (ha) of good golden eagle habitat at various distances from the Proposed Development and within the four modelled exclusion buffers.

GET category	5 km buffer	20 km buffer	Upper Works	Reservoir	Main Access Track	Lower Site Compound	All buffers totalled
1	61	496	0	0	0	0	0
2	531	3103	0	0	0	2	2
3	479	4375	0	0	0	1	1
4	506	5616	0	11	0	0	11
5	907	7713	0	1	2	6	9
6	995	10816	0	4	2	1	7
7	1068	12568	0	3	5	0	8
8	1085	15145	1	1	8	0	9
9	1734	18300	1	2	8	0	11
10	4506	29121	1	2	22	0	25
Total area	11872	107252	3	23	46	9	80
Total GET 6+	9388	85949	3	11	44	1	59
% GET 6+	79	80	100	48	96	11	74
% GET 6+ loss within:							
5 km	-	-	0.03	0.09	0.37	0.00	0.63
20 km	-	-	0.00	0.01	0.04	0.00	0.07





Cruachan 2

Location of the Glen Etive and Glen Fyne SPA

- Site boundary
- 2 km from Site boundary
- Proposed Development footprint
- SPA

SPA data Copyright NatureScot. Contains Ordnance Survey data © Crown copyright and database right (2022).

Figure 3.1

Map Scale @ A3: 1:35,000

Surveyed by: -
Survey date: -
Drawn by: RAH
Checked by: DS
Status: Final





Cruachan 2

2017-2018 Breeding Bird Results Red-Listed BoCC

- Site boundary
- 1.5 km from Site boundary
- Proposed Development footprint

Species:

- Cuckoo
- Grasshopper Warbler
- Ring Ouzel
- Skylark
- Spotted Flycatcher
- Tree Pipit
- Whinchat
- Wood Warbler

Excludes Schedule 1 bird species which can be found in Confidential Technical Appendix 8.4.

Figure 3.2

Map Scale @ A3: 1:30,000

Surveyed by: SS

Survey date: April-July 2017

Drawn by: RAH

Checked by: DS

Status: Final





Cruachan 2

2017-2018 Breeding Bird Results Amber-Listed BoCC

- Site boundary
- 1.5 km from Site boundary
- Proposed Development footprint

Species:

- Common Sandpiper
- Dunnock
- Grey Wagtail
- Mallard
- Oystercatcher
- Redstart
- Reed Bunting
- Snipe
- Song Thrush
- Spotted Redshank

Excludes Schedule 1 bird species which can be found in Confidential Technical Appendix 8.4.

Figure 3.3

Map Scale @ A3: 1:30,000

Surveyed by: SS

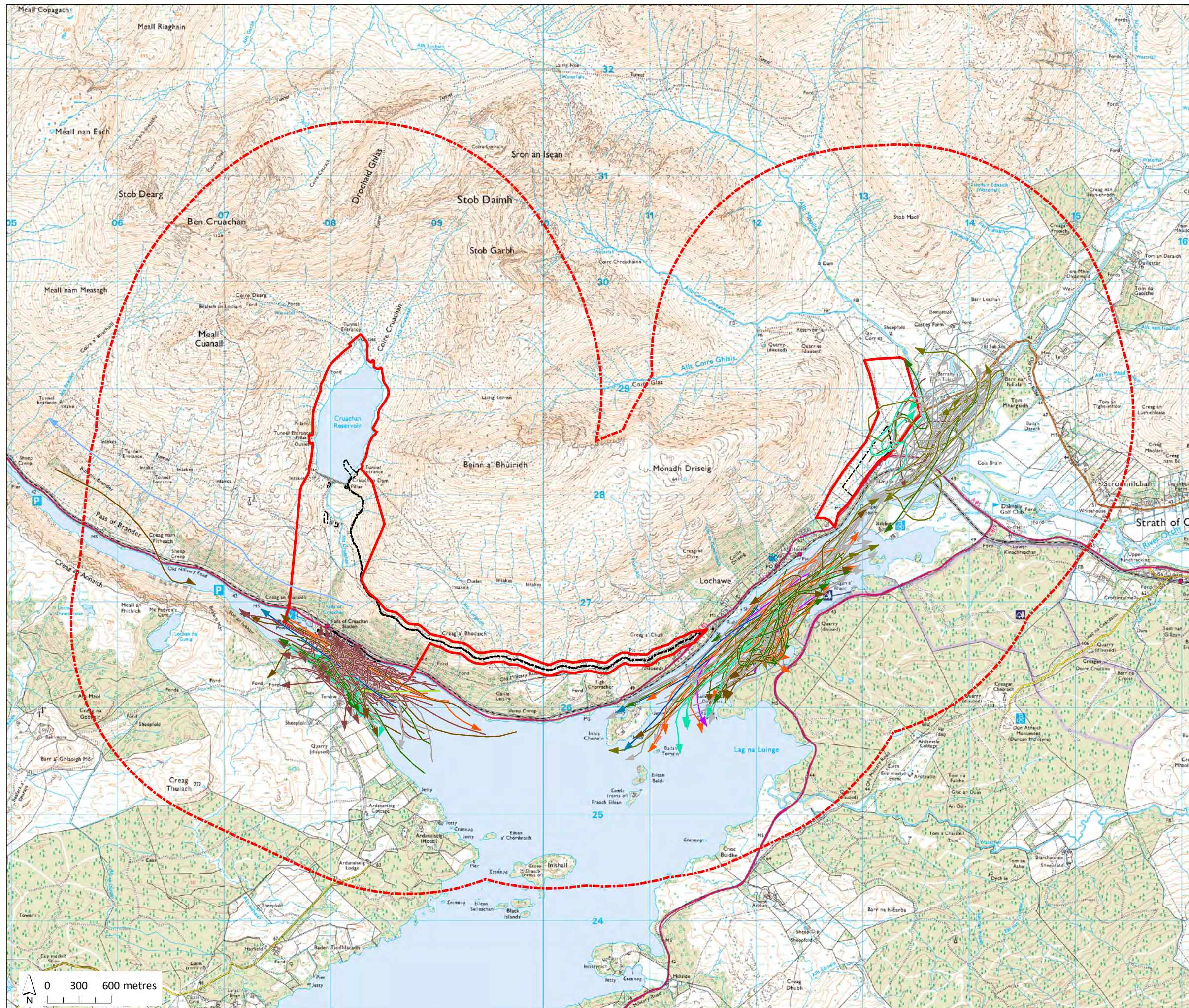
Survey date: April-July 2017

Drawn by: RAH

Checked by: DS

Status: Final





Cruachan 2

2016-2018 Vantage Point Results Target Species (Non-Confidential)

- Site boundary
 2 km from Site boundary
 Proposed Development footprint
- Species:**
- Barnacle Goose
 - Canada Goose
 - Common Sandpiper
 - Goldeneye
 - Goosander
 - Grey Heron
 - Greylag Goose
 - Herring Gull
 - Oystercatcher
 - Pink-footed Goose
 - Razorbill
 - Red-breasted Merganser

Figure 3.4

Map Scale @ A3: 1:35,000

Surveyed by: SS
Survey date: Spring '16- Autumn '18
Drawn by: RAH
Checked by: DS
Status: Final





Cruachan 2

Black Grouse Survey Results 2018

- Site boundary
- 1.5 km from Site boundary
- Proposed Development footprint
- Black grouse lek

Figure 3.5

Map Scale @ A3: 1:30,000

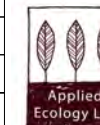
Surveyed by: SS

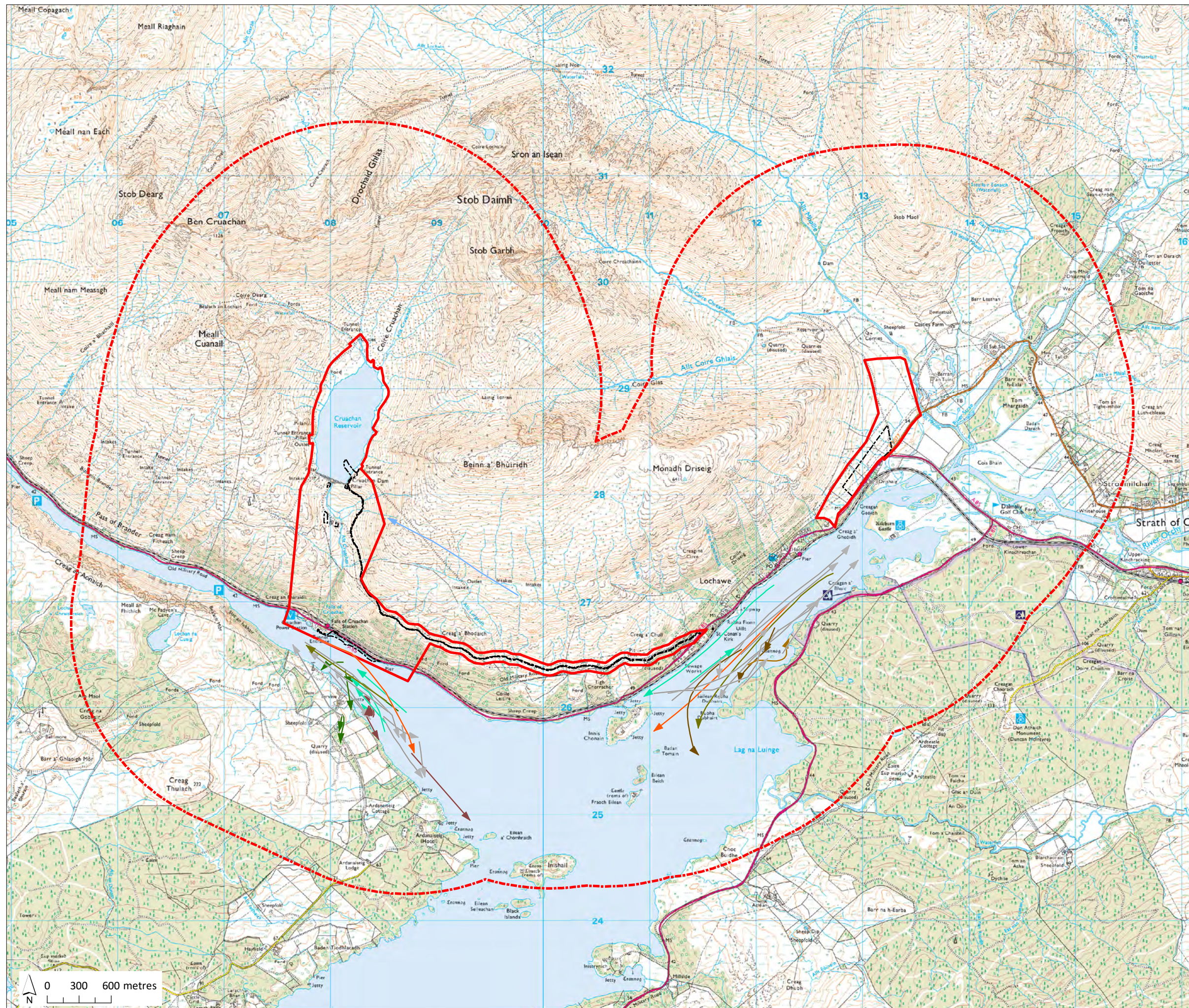
Survey date: April-May 2018

Drawn by: RAH

Checked by: DS

Status: Final





Cruachan 2

2021-2022 Vantage Point Results Non-Target Species (Non-Confidential)

- Site boundary
- 2 km from Site boundary
- Proposed Development footprint
- Species:**

Barnacle Goose

Canada Goose

Common Sandpiper

Goldeneye

Goosander

Grey Heron

Greylag Goose

Herring Gull

Mallard

Oystercatcher


Pink-footed Goose

Razorbill

Red-breasted Merganser

Figure 3.6

Map Scale @ A3: 1:35,000

Surveyed by: SS/KD	
Survey date: April '21 - March '22	
Drawn by: RAH/SH	
Checked by: DS	
Status: Final	

4 Discussion

Designated sites

- 4.1 Given the close proximity of the Glen Etive and Glen Fyne SPA to the Site, it is possible that the Proposed Development will have an effect on its notified avian interest features. The SPA will therefore be covered in full in Chapter 8 (Ecology) of the EIAR as an Important Ecological Feature (IEF) of **International** importance. The EIAR will also contain the information needed for a shadow Habitats Regulations Assessment (HRA).

Ornithological interest

- 4.2 Combining the results from the 2016-2018 ornithological surveys with the data from 2021-2022 provides an accurate snapshot of the typical composition and distribution of the ornithological assemblage within the Study Area and associated bird use of the Site.
- 4.3 Approximately 70 species were recorded across the whole study period, most of which would be considered to be typical of the locality and the habitat mosaic comprising this. As expected, several species of particular conservation concern, including Schedule 1 raptors and black grouse, have been known to use the wider Study Area regularly, and, in some years, to breed here. The survey data covered years when black grouse were, and were not present, and also years when the known golden eagle territory closest to the Proposed Development did, and did not, have a successful nest attempt. It is considered that this was a good representation of the temporal fluctuations in the ornithological interest within this area.

Scarce raptors

- 4.4 The majority of flights of scarce raptor species recorded in all survey years were associated with Loch Awe, including areas in proximity to parts of the Proposed Development. Flights from scarce raptor species were generally concentrated to the west and north of the Site, and the closest nest of such species was c. 1.4 km from the Site boundary.
- 4.5 It therefore remains that although the golden eagle territory was not occupied by a breeding pair in 2021-2022, and the nest location changed slightly between 2017 and 2018, it is an established nest location for the species. The GET model has shown that there will be insignificant loss of golden eagle habitat arising from the construction and operational of the Proposed Development, but the potential impacts on it as result of the Proposed Development will still need to be assessed in the EIAR because breeding golden eagle are known to be highly sensitive to sources of disturbance at relatively large distances from their nest site (750-1000 m for a person on foot, as reported in Ruddock and Whitfield, 2007¹⁵). Golden eagles and their nest sites are protected year-round (under Schedules 1A and A1 of the Wildlife and Countryside Act 1981, as amended) and therefore good practice measures will be required to ensure that the nest and any birds using are protected from

¹⁵ Ruddock, M. & Whitfield, D. P. (2007). *A review of disturbance distances in selected bird species*. Contract report produced for Scottish Natural Heritage by Natural Research (Projects) Ltd.



disturbance at all times. Given their association with the SPA, these golden eagles will therefore be included in the EclA as an IEF of **National** importance.

- 4.6 Regular white-tailed eagle activity was recorded within the Eagle Study Area in 2016-2018, and it is likely that the pair that was confirmed as breeding in the south-west of the original (wider) Eagle Study Area in 2016-2017 bred again in 2017-2018, but this location was not formally investigated as it was over 5 km from the Site. During 2021-2022 white-tailed eagle were recorded overflying Cruachan Reservoir more frequently than in 2016-2018, but again did not nest within the Study Area. However, given the number of flights recorded within the Site, and Loch Awe is known to be an expansion area for the species, white-tailed eagle will be considered as an IEF of **Council** level importance in the EclA.
- 4.7 Osprey and peregrine were both confirmed to be breeding within the wider Study Area. However, the stated disturbance distance for both species is put at around 750 m¹⁶, and the recorded nest locations were both well over 1 km from the Site. Given that neither of these species are associated with the SPA, and no impacts are expected, they will not be considered as IEFs in the EclA.

Black grouse

- 4.8 Black grouse is currently a species on the Red list BoCC, with range contractions of c. 28 % between 1970 and 1990, and catastrophic population crashes over the last 20 years (loss rates of 10-40 % each year in some parts of the UK). These declines include in parts of its Scottish range, while it does seem to be maintaining its numbers in others¹⁷. It is a Priority Species within Argyll and Bute's Biodiversity Action Plan (BAP)¹⁸.
- 4.9 No black grouse were recorded in the Study Area during any of the dedicated surveys in 2021, or during any other survey work undertaken in that year. Given the good, often perfect weather conditions for surveying, and the good coverage and accessibility of suitable habitat, it is considered unlikely any birds were missed.
- 4.10 It is therefore considered likely that in 2021 black grouse were absent from the immediate vicinity of the Proposed Development, following the downward trend seen in other parts of Scotland. As there were only three males recorded in 2018, including at two single-bird leks, it is possible the species has become locally extinct in the years subsequent to that earlier survey.
- 4.11 There will be a separation distance of c. 1.3 km between the Proposed Development and the nearest historic black grouse lek, and at that distance it is not expected that any disturbance impacts will occur. Therefore black grouse will not be considered as an IEF in the EclA.

¹⁶ Ruddock, M. & Whitfield, D. P. (2007). *A review of disturbance distances in selected bird species*. Contract report produced for Scottish Natural Heritage by Natural Research (Projects) Ltd.

¹⁷ Game & Wildlife Conservation Trust (2020). <https://www.gwct.org.uk/blogs/uplands-blog/2020/may/black-grouse-study-groups-in-scotland/>. Accessed 28 May 2020.

¹⁸ Argyll and Bute Council (2010) *The Argyll and Bute Local Biodiversity Action Plan 2010-2015*. Available online at <https://www.argyll-bute.gov.uk/planning-and-environment/biodiversity> Accessed April 2022.



Other breeding birds

- 4.12 During the breeding bird surveys, a total of 50 species were recorded, including 17 BoCC considered to be breeding or holding territory within the Study Area. If the criteria proposed by Fuller (1981)¹⁹ are used, this would place the breeding bird assemblage to be of Council level importance (50-69 species). However, since the assemblage reflects typical species of the wide variety of habitats falling within the Site, and that the 2016-2018 breeding bird surveys covered a much wider Study Area than that formed by the final Site boundary, non-scarce raptor breeding birds at the Site should be considered to be an IEF in the EcIA of **Local** importance.

Other ornithological features scoped out of the assessment

Migratory birds

- 4.13 During the migratory bird surveys undertaken in 2016-2017, no wildfowl were observed using Cruachan Reservoir. Following those surveys, the ornithological survey suite was reviewed in consultation with SNH (as was) and as a result of that review, migratory birds were removed from the schedule, and consequently were also not specifically surveyed in 2021. Migratory birds will not therefore be included in the EcIA as an IEF.

Wintering birds

- 4.14 Winter walkover surveys were undertaken for the Site in November 2017 and February 2018. A total of 38 bird species were recorded, including 17 classified as being Red- or Amber-listed BoCC. Few birds were recorded in the upland areas with the majority of observations being made within the wooded areas and the open farmland in the east of the Site.
- 4.15 Following consultation with NatureScot in 2021, it was agreed that wintering birds were unlikely to be and IEF in the context of the Proposed Development and were not included in the survey suite for 2021/2022. They will not therefore be included in the EcIA.

¹⁹ Fuller, R.J. (1980) A method for assessing the ornithological interest of sites for conservation. *Biological Conservation*, **17** pp229-239.



5 Conclusions

- 5.1 Between 2016 and 2018, and then 2021-2022, a range of ornithological surveys were undertaken for a study area at Cruachan in Argyll and Bute, to inform proposals for a second pumped storage hydro scheme at Cruachan Power Station. The Site was adjacent to the Glen Etive and Glen Fyne Special Protection Area, and therefore particular attention was paid to the survey of scarce raptor species associated with that designated site.
- 5.2 Activity levels of SPA qualifying species within the Site were low, and the vast majority of such flights were recorded between 2016 and 2018, when golden eagle successfully nested within a known territory. Activity was much lower in 2021-2022 because this pair of golden eagle failed to breed, although the recorded activity of white-tailed eagle at Cruachan Reservoir was higher than in previous years. Regardless, the use of a GET model has shown that a very small percentage of suitable eagle habitat would be affected by the construction or operation of the Proposed Development.
- 5.3 The wooded and open moorland areas of the Site were otherwise associated with assemblages of bird species typical of these habitats, and there was no conclusive evidence that species of conservation concern such as black grouse were present within the likely disturbance zone associated with the proposals.
- 5.4 The results of these surveys have informed constraints mapping for the proposed Development and will underpin assessment of ornithological impacts in Chapter 8 of the EIAR, and to compile the information needed to support a Habitats Regulations Assessment.



Appendix A

List of Abbreviations Used in this Report



Abbreviation	Full terminology
AEL	Applied Ecology Ltd
BAP	Biodiversity Action Plan
BoCC	Birds of Conservation Concern
CIEEM	Chartered Institute of Ecology and Environmental Management
DTM	Digital Terrain Model
EcIA	Ecological Impact Assessment
EIAR	Environmental Impact Assessment Report
GET Model	Golden Eagle Topographical Model
GIS	Geographical Information System
GPS	Global Positioning System
IEF	Important Ecological Feature
LBAP	Local Biodiversity Action Plan
NBN	National Biodiversity Network
SBL	Scottish Biodiversity List
SNH	Scottish Natural Heritage (now NatureScot)
SPA	Special Protection Area
SPI	Standardised Preference Index
SSSI	Site of Special Scientific Interest
VP	Vantage Point



Appendix B

Details of 2021-2022 Vantage Point Surveys



Key: Wind speeds refer to the Beaufort Scale. Cloud cover estimated in Octads. Cloud height (base) and visibility codes as indicated. Precipitation codes are: 0 : nil; 1 : mist or drizzle; 2 : light showers; 3 : heavy showers. Frost codes are: 0 : nil; 1 : ground frost; 2: frost remaining all day. Snow codes are: 0 : none; 1 : snow on Site; 2 : snow on high ground. n/a : data not available.

Date of visit	Start time	Finish time	Survey VP	Weather								
				Period	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
23/04/2021	09:25	12:25	3	Hr 1	1	NE	0	4/8	2	2	0	0
				Hr 2	2	NE	0	4/8	2	2	0	0
				Hr 3	2	NE	0	4/8	2	2	0	0
23/04/2021	13:05	16:05	3	Hr 1	3	NE	0	6/8	2	2	0	0
				Hr 2	1	NE	0	6/8	2	2	0	0
				Hr 3	1	NE	0	8/8		2	0	0
28/04/2021	06:15	9:15	1	Hr 1	3	E	0	7/8	2	2	0	0
				Hr 2	3	NE	2	7/8	2	2	0	0
				Hr 3	3	NE	0	5/8	2	2	0	0
28/04/2021	8:40	11:40	5	Hr 1	4	E	0	5/8	2	2	0	0
				Hr 2	4	E	0	5/8	2	2	0	0
				Hr 3	4	E	0	5/8	2	2	0	0
28/04/2022	12:10	15:10	5	Hr 1	3	E	0	7/8	2	2	0	0
				Hr 2	3	E	0	8/8	2	2	0	0
				Hr 3	3	E	0	8/8	2	2	0	0
29/04/2021	09:45	12:45	1	Hr 1	3	NE	0	5/8	2	2	0	0
				Hr 2	3	NE	0	5/8	2	2	0	0
				Hr 3	3	NE	0	5/8	2	2	0	0
05/05/2021	09:40	12:40	1	Hr 1	4	NW	0	7/8	2	2	0	2
				Hr 2	4	NW	0	7/8	2	2	0	2
				Hr 3	4	NW	0	7/8	2	2	0	2
05/05/2021	13:10	16:10	1	Hr 1	4	NW	2	7/8	2	2	0	2
				Hr 2	3	NW	2	7/8	2	2	0	2
				Hr 3	4	NW	2	7/8	2	2	0	2
07/05/2021	08:10	11:10	5	Hr 1	3	NW	0	7/8	2	2	0	0
				Hr 2	3	NW	0	5/8	2	2	0	0
				Hr 3	3	NW	0	5/8	2	2	0	0
07/05/2021	11:40	14:40	5	Hr 1	3	W	0	5/8	2	2	0	0
				Hr 2	3	W	0	5/8	2	2	0	0
				Hr 3	3	W	0	5/8	2	2	0	0
14/05/2021	7.35	10:35	3	Hr 1	2	NE	0	4/8	2	2	0	0
				Hr 2	3	NE	0	6/8	2	2	0	0
				Hr 3	2	NE	0	7/8	2	2	0	0
14/05/2021	11:05	14:05	3	Hr 1	2	E NE	0	8/8	2	2	0	0
				Hr 2	2	E	0	8/8	2	2	0	0



Date of visit	Start time	Finish time	Survey VP	Weather								
				Period	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
				Hr 3	3	E	0	8/8	2	2	0	0
10/06/2021	06:55	09:55	5	Hr 1	3	W	0	7/8	2	2	0	0
				Hr 2	3	W	0	7/8	2	2	0	0
				Hr 3	4	W	0	7/8	2	2	0	0
10/06/2021	10:25	13:25	5	Hr 1	4	W	0	7/8	2	2	0	0
				Hr 2	4	W	0	7/8	2	2	0	0
				Hr 3	4	W	0	7/8	2	2	0	0
28/06/2021	15:15	18:15	3	Hr 1	4	W	0	3/8	2	2	0	0
				Hr 2	4	W	0	4/8	2	2	0	0
				Hr 3	4	W	0	4/8	2	2	0	0
28/06/2021	18:45	20:30	3	Hr 1	5	W	0	4/8	2	2	0	0
				Hr 2	1	W	0	8/8	2	2	0	0
				Hr 3	1	W	0	8/8	2	2	0	0
29/06/2021	09:10	12:10	1	Hr 1	2	W	0	3/8	0-1-2	2	0	0
				Hr 2	2	W	0	3/8	2	2	0	0
				Hr 3	2	W	0	3/8	2	2	0	0
29/06/2021	12:40	15:40	1	Hr 1	3	W	0	3/8	2	2	0	0
				Hr 2	3	NW	0	1/8	2	2	0	0
				Hr 3	3	NW	0	1/8	2	2	0	0
12/07/2021	10:40	13:40	5	Hr 1	2	W	0	7/8	2	2	0	0
				Hr 2	2	W	0	7/8	2	2	0	0
				Hr 3	2	W	0	5/8	2	2	0	0
12/07/2021	14:10	17:10	5	Hr 1	2	W	0	7/8	2	2	0	0
				Hr 2	2	W	3	7/8	2	2	0	0
				Hr 3	2	W	3	7/8	2	2	0	0
15/07/2021	09:50	12:50	1	Hr 1	3	W	0	5/8	1-2	2	0	0
				Hr 2	3	W	0	5/8	1-2	2	0	0
				Hr 3	3	W	0	3/8	2	2	0	0
15/07/2021	13:20	16:20	1	Hr 1	3	W	0	3/8	2	2	0	0
				Hr 2	3	W	0	1/8	2	2	0	0
				Hr 3	3	W	0	1/8	2	2	0	0
30/07/2021	10:45	13:45	3	Hr 1	2	W	0	8/8	1	2	0	0
				Hr 2	2	W	0	8/8	1	2	0	0
				Hr 3	3	W	0	8/8	2	2	0	0
30/07/2021	14:15	17:15	3	Hr 1	3	W	0	8/8	2	2	0	0
				Hr 2	4	W	0	8/8	2	2	0	0
				Hr 3	4	W	0	7/8	2	2	0	0
09/08/2021	10:35	13:35	1	Hr 1	3	SW	0	7/8	1-2	1-2	0	0
				Hr 2	3	SW	0	3/8	2	2	0	0



Date of visit	Start time	Finish time	Survey VP	Weather								
				Period	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
				Hr 3	3	SW	0	3/8	2	2	0	0
09/08/2021	14:05	17:05	1	Hr 1	3	SW	0	3/8	2	2	0	0
				Hr 2	3	SW	0	5/8	2	2	0	0
				Hr 3	3	W	0	5/8	2	2	0	0
12/08/2021	10:50	13:50	5	Hr 1	3	S	0	7/8	2	2	0	0
				Hr 2	3	SW	0	8/8	2	2	0	0
				Hr 3	3	SW	2	8/8	2	2	0	0
12/08/2021	14:20	17:20	5	Hr 1	3	SW	2	8/8	2	2	0	0
				Hr 2	3	SW	2	8/8	2	2	0	0
				Hr 3	3	SW	2	8/8	2	2	0	0
26/08/2021	13:45	16:45	3	Hr 1	2	W	0	1/8	2	2	0	0
				Hr 2	3	W	0	1/8	2	2	0	0
				Hr 3	4	W	0	1/8	2	2	0	0
26/08/2021	17:15	20:15	3	Hr 1	4	W	0	1/8	2	2	0	0
				Hr 2	3	W	0	1/8	2	2	0	0
				Hr 3	3	W	0	1/8	2	2	0	0
10/09/2021	9:15	12:15	5	Hr 1	2	SW	0	8/8	1-2	2	0	0
				Hr 2	3	SW	0	8/8	1-2	2	0	0
				Hr 3	2	SW	0	8/8/	1-2	2	0	0
10/09/2021	12:45	15:45	5	Hr 1	2	SW	2	8/8	1-2	2	0	0
				Hr 2	2	SW	2	8/8	1-2	2	0	0
				Hr 3	2	SW	2	8/8	1-2	2	0	0
13/09/2021	11:00	14:00	1	Hr 1	3	SE	0	5/8	2	2	0	0
				Hr 2	3	SE	0	5/8	2	2	0	0
				Hr 3	3	SE	0	5/8	2	2	0	0
13/09/2021	14:30	17:30	1	Hr 1	3	SE	0	7/8	2	2	0	0
				Hr 2	3	SE	0	7/8	2	2	0	0
				Hr 3	3	SE	0	7/8	2	2	0	0
28/09/2021	11:10	14:10	3	Hr 1	3	SE	0	4/8	1	2	0	0
				Hr 2	3	SE	0	4/8	2	2	0	0
				Hr 3	3	SE	0	4/8	2	2	0	0
28/09/2021	14:40	17:40	3	Hr 1	3	SE	0	4/8	2	2	0	0
				Hr 2	3	SE	0	3/8	2	2	0	0
				Hr 3	3	SE	0	4/8	2	2	0	0
20/10/2021	08:50	11:50	3	Hr 1	3	SW	2	4/8	1	2		0
				Hr 2	4	SW	0	4/8	2	2	0	0
				Hr 3	4	SW	0	6/8	2	2	0	0
20/10/2021	13:05	16:05	3	Hr 1	5	W	0	4/8	2	2	0	0
				Hr 2	5	W	0	3/8	2	2	0	0



Date of visit	Start time	Finish time	Survey VP	Weather								
				Period	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
				Hr 3	5	W	0	4/8	2	2	0	0
22/10/2021	09:25	12:25	1	Hr 1	5	NE	0	5/8	2	2	0	0
				Hr 2	4	NE	0	7/8	2	2	0	0
				Hr 3	4	NW	0	7/8	2	2	0	0
22/10/2021	12:55	15:55	1	Hr 1	3	NW	0	7/8	2	2	0	0
				Hr 2	3	W	0	7/8	2	2	0	0
				Hr 3	3	W	0	7/8	2	2	0	0
25/10/2022	09:35	12:35	5	Hr 1	3	W	2-3	7/8	2	2	0	0
				Hr 2	4	W	2-3	7/8	2	2	0	0
				Hr 3	3	W	2-3	7/8	2	2	0	0
25/10/2021	13:05	16:05	5	Hr 1	3	W	2-3	7/8	2	2	0	0
				Hr 2	3	W	2-3	7/8	2	2	0	0
				Hr 3	3	W	2-3	7/8	2	2	0	0
19/11/2021	09:20	12:20	5	Hr 1	4	W	2	8/8	1	2	0	0
				Hr 2	4	W	2	8/8	1	2	0	0
				Hr 3	4	W	2	8/8	1	2	0	0
19/11/2021	11:50	14:50	5	Hr 1	4	W	2	8/8	1	2	0	0
				Hr 2	4	W	2	8/8	1	2	0	0
				Hr 3	4	W	2	8/8	1	2	0	0
22/11/2021	10:10	13:10	1	Hr 1	4	W	0	5/8	2	2	0	0
				Hr 2	5	W	0	5/8	2	2	0	0
				Hr 3	4	W	0	7/8	2	2	0	0
22/11/2021	13:40	16:40	1	Hr 1	4	W	0	7/8	2	2	0	0
				Hr 2	3	W	2	8/8	1-2	1-2	0	0
				Hr 3	3	W	2	8/8	1	1-2	0	0
24/11/2021	9:45	12:45	3	Hr 1	3	W	0	4/8	1	2	0	0
				Hr 2	3	W	0	4/8	1	2	0	0
				Hr 3	3	NW	3	4/8	1	2	0	0
24/11/2021	13:15	16:15	3	Hr 1	3	W	3	6/8	1	2	0	0
				Hr 2	3	W	3	6/8	1	2	0	0
				Hr 3	3	W	0	6/8	1	2	0	0
20/12/2021	8:50	11:50	3	Hr 1	2	NE	0	8/8	1	2	0	0
				Hr 2	3	NE	0	8/8	1	2	0	0
				Hr 3	3	NE	0	8/8	1	2	0	0
20/12/2021	12:00	15:20	3	Hr 1	2	NE	0	8/8	1	2	0	0
				Hr 2	1	E	0	8/8	1	2	0	0
				Hr 3	2	E	0	8/8	1	2	0	0
20/12/2021	10:05	13:05	1	Hr 1	2	SE	0	8/8	1-2	2	0	0
				Hr 2	2	SE	0	8/8	1-2	2	0	0



Date of visit	Start time	Finish time	Survey VP	Weather								
				Period	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
				Hr 3	2	SW	0	8/8	1	2	0	0
20/12/2021	13:35	16:35	1	Hr 1	2	SW	0	8/8	1	1-2	0	0
				Hr 2	3	SW	0	8/8	1	1	0	0
				Hr 3	3	SW	0	8/8	1	1	0	0
22/12/2021	08:15	11:15	5	Hr 1	2	ESE	0	8/8	1-2	2	0	0
				Hr 2	2	ESE	0	8/8	1-1	2	0	0
				Hr 3	2	ESE	0	8/8	2	2	0	0
22/12/2021	11:45	14:45	5	Hr 1	2	ESE	0	8/8	2	2	0	0
				Hr 2	2-3	ESE	0	8/8	2	2	0	0
				Hr 3	3	ESE	2	8/8/	1-2	2	0	0
03/01/2022	08:15	11:15	5	Hr 1	4	NW	2	8/8	2	2	0	0
				Hr 2	3	NW	2	8/8	2	2	0	0
				Hr 3	3	NW	2	8/8	2	2	0	0
03/01/2022	11:45	14:45	5	Hr 1	3	NW	0	7/8	2	2	0	0
				Hr 2	3	NW	0	5/8	2	2	0	0
				Hr 3	3	NW	0	3/8	2	2	0	0
14/01/2022	10:10	13:10	1	Hr 1	2	S	0	8/8	1	1-2	0	0
				Hr 2	2	S	2	8/8	1	1-2	0	0
				Hr 3	2	S	0	8/8	1	1-2	0	0
14/01/2022	13:40	16:40	1	Hr 1	2	S	2	8/8	1-2	1-2	0	0
				Hr:2	2	S	2	8/8	1-2	1-2	0	0
				Hr 3	2	S	0	8/8	1	1-2	0	0
27/01/2022	09:30	12:30	3	Hr 1	3	NW	0	7/8	1	2	0	0
				Hr 2	4	NW	0	4/8	1	2	0	0
				Hr 3	3	NW	0	4/8	1	2	0	0
27/01/2022	13:00	16:00	3	Hr 1	3	NW	0	4/8	1	2	0	0
				Hr 2	4	NW	0	5/8	1	2	0	0
				Hr 3	3	NW	0	6/8	1	2	0	0
21/02/2022	11:00	14:00	1	Hr 1	5	NW	0	5/8	2	2	0	2
				Hr 2	5	NW	0	5/8	2	2	0	2
				Hr 3	4-5	NW	0	3/8	2	2	0	2
07/03/2022	11:30	14:30	1	Hr 1	4	SE	0	3/8	2	2	0	0
				Hr 2	4	SE	0	3/8	2	2	0	0
				Hr 3	4	SE	0	1/8	2	2	0	0
07/03/2022	15:00	18:00	1	Hr 1	4	SE	0	1/8	2	2	0	2
				Hr 2	3	SE	0	1/8	2	2	0	2
				Hr 3	3	SE	0	1/8	2	2	0	2
10/03/2022	07:30	10:30	5	Hr 1	3	W	2	8/8	2	2	0	0
				Hr 2	3	W	2	8/8	2	2	0	0



Date of visit	Start time	Finish time	Survey VP	Weather								
				Period	Wind speed	Wind direction	Rain	Cloud cover	Cloud height	Visibility	Frost	Snow
				Hr 3	3	W	2	8/8	2	2	0	0
10/03/2022	11:00	14:00	5	Hr 1	3	W	2	8/8	2	2	0	0
				Hr 2	3	W	2	8/8	2	2	0	0
				Hr 3	3	W	2	8/8	2	2	0	0
02/04/2022	10:20	13:20	3	Hr 1	2	N	0	3/8	2	2	0	0
				Hr 2	2	N	0	3/8	2	2	0	0
				Hr 3	3	N	0	3/8	2	2	0	0
02/04/2022	13:50	16:50	3	Hr 1	2	N	0	3/8	2	2	0	0
				Hr 2	2	N	0	5/8	2	2	0	0
				Hr 3	2	N	0	5/8	2	2	0	0



Appendix C

Summary of 2018 Breeding Bird Survey



Species	Conservation status**	Number of breeding territories***	Summary
Oystercatcher	A	1	An alarm-calling pair was recorded on the eastern end of the BBS Area near the shore of Loch Awe.
Common sandpiper	A	1	A single territory was identified on the north end of Cruachan Reservoir.
Cuckoo	R; SBL	23	Male cuckoos were recorded singing from a minimum of 23 locations throughout the BBS Area, including woodland and higher-elevation open habitats.
Kestrel	A; SBL	1	Individuals were recorded in the west of the BBS Area on every visit, indicating that this area is within an active breeding territory.
House martin	A	Undetermined	Individuals were recorded in flight near Lochawe village (where suitable nesting habitat is present) indicating breeding occurred in this area, but numbers could not be determined.
Wood warbler	A	26	An estimated 26 territories were present, all within woodland habitats in the south of the BBS Area.
Willow warbler	R; SBL	Multiple	Willow warblers were very common throughout the woodland areas of the BBS Area and were not mapped (see Survey Limitations section above).
Starling	R; SBL	Undetermined	Small flocks (of up to 17 birds in July) were recorded in the south of the BBS Area, indicating a small breeding population was present in the vicinity, likely associated with human habitation.
Song thrush	R	19	19 territories were identified, all in the lower area of the BBS Area within woodland and woodland edge habitats.
Mistle thrush	R; SBL	Undetermined	Many individuals and small flocks were recorded throughout the BBS visits but no territorial behaviour was recorded. It is likely that multiple pairs were breed throughout the woodland habitats in the BBS Area.
Spotted flycatcher	A	5	A total of five territories were recorded, all within woodland and woodland edge habitats.
Redstart	A; SBL	3	An estimated three territories were recorded, all within woodland habitats in the south of the BBS Area.
Dunnock	A; SBL	17	At least 17 territories were recorded in suitable habitat in lower-elevation areas of the BBS Area.
Meadow pipit	A	Multiple	Meadow pipits were very common throughout the BBS Area and so were not mapped (see Survey Limitations section above).
Tree pipit	R; SBL	25	A total of 25 territories were identified in woodland and woodland edge habitats, mostly in the lower elevations of the BBS Area.



Appendix D

GET Model Report



Ben Cruachan Pumped Storage Hydro Scheme
An analysis of potential golden eagle habitat loss
using the GET Model

Confidential report prepared for Applied Ecology Ltd

Alan Fielding

April 2022

1. Background

The impact of a proposed Ben Cruachan Pumped Storage Hydro Scheme (PSHS) on golden eagles is assessed using the GET model (Fielding *et al.*, 2020¹). This is an addition to a long established PSHS and so reduces any impacts from the proposed development because of the existing infrastructure, particularly the Cruachan storage reservoir, which remain unchanged.

Assuming that a PSHS has the effect of excluding golden eagles from suitable habitat the PAT model would have been an appropriate tool to assess the development's impact. Habitat loss for range holding golden eagles, arising out of wind farm construction or forest developments and rarely PSHS, was previously assessed using the PAT model (SNH, 2014)². In the case of PSHS the main habitat losses arise from the creation of a new reservoir, which is not the case for this proposed development.

The PAT model is applicable only to range holding birds; there is no equivalent protocol for assessing habitat loss for dispersing golden eagles. The PAT model (McLeod *et al.*, 2002³) was based on five assumptions about expected habitat use:

1. Preference for a proximity to ridge features.
2. Preference for areas close to the active nest site/territory centre, which degrades linearly with distance from the centre.
3. Territory boundaries can be modelled as Thiessen polygons which assign equidistant boundaries between neighbouring territory centres.
4. In the absence of a neighbouring territory centre, within 12 km, the maximum ranging distance from the territory centre is 6 km, i.e. a circle with a planar area of 113.1 km².
5. Several land covers are avoided, notably closed canopy forestry and large water bodies.

Satellite tracking devices have been fitted to 20 range holding birds (Natural Research, unpublished data) and a further 35 birds have settled in ranges after being tagged in the nest. It is clear from these 55 individuals that assumptions 1 and 5 are valid but the three assumptions (2, 3 & 4), related to territory boundaries, are unsupported by empirical data and therefore the PAT model is unreliable and should not be used. This has been recognised recently by NatureScot⁴. Consequently, a new approach is needed for range holding birds and it would be useful if a broadly similar approach could be developed for dispersing young eagles.

Currently, the GET model looks promising for both range holding and dispersing birds and it is used in following analyses. The GET model, which is derived from topographic data only, assigns a score between 1 and 10 to every 50m pixel across Scotland. **Habitat with a GET score of 6+ is a good indicator of potential golden eagle activity; habitat with a score of 5 or less is used infrequently.** The model has been subsequently tested with data from >50 range holding birds and 99 dispersing golden

¹ Fielding, A.H., Haworth, P., Anderson, D., Benn, S., Dennis, R., Weston, E. & Whitfield, D.P. 2020. A simple topographical model to predict Golden Eagle *Aquila chrysaetos* space use during dispersal. *Ibis* 162, 400-415.

² SNH. 2014. Guidance. Recommended bird survey methods to inform impact assessment of onshore wind farms. May 2014. SNH, Battleby.

³ McLeod, D.R.A., Whitfield, D.P., Fielding, A.H., Haworth, P.F. & McGrady, M.J. 2002. Predicting home range use by golden eagles *Aquila chrysaetos* in western Scotland. *Avian Science*, 2, 183-198.

⁴ <https://www.nature.scot/doc/naturescot-statement-modelling-support-assessment-forestry-and-wind-farm-impacts-golden-eagles>

eagles and it works well at identifying locations used by all golden eagles (Whitfield and Fielding, unpublished submission to NS, 2022).

However, irrespective of the GET score, golden eagles also tend not to use some areas such as large water bodies or closed canopy forest cover.

The appropriate baseline for an assessment of habitat loss arising from the construction of a PSHS is the current area of open GET habitat with a value of 6 or more. Open habitat is defined as land (lochs and reservoirs are excluded) with no closed canopy forest cover and not within 500 m of an existing or consented wind turbine. **All subsequent measures of good golden eagle habitat refer to open country habitat with a GET score of 6+.** Closed golden eagle habitat is all land with an extensive tree cover or within 500 m of a consented or constructed turbine tower. In these analyses current tree cover was assessed using an August 25th 2021 Sentinel 2 image (tile 30UUG). A false colour composite image was constructed from the 10m resolution bands 2, 3 and 4 while combining the 20m resolution bands 2, 6 and 12 enhanced tree cover (Ottosen *et al.*, 2020)⁵. Turbine locations were from a regularly updated database maintained by AF.

In the absence of formal guidance, the following approach is used to assess the area of good golden eagle habitat lost following construction the proposed PSHS and its possible significance.

1. Define an exclusion distance as a buffer around the Proposed Development.
2. Measure the amount of good eagle habitat within the exclusion buffer.
3. Assess the loss of habitat, within the exclusion buffer, with respect to a regional figure.

2. Exclusion distance

There is no guidance on how, or if, golden eagles are excluded from PSHSs. In this assessment exclusion areas refer to above ground, permanent structures. The proposed development is split into four areas for this assessment (Fig. 1). Permanent and temporary structures are highlighted in Fig. 1.

1. Temporary lower site compound (near to the B8077 and A85 junction).
2. Existing access track which runs from St Conan's Kirk to the Cruachan Dam.
3. Temporary lower works (land below the Cruachan Dam)
4. Permanent reservoir and upper works.

Tracks are not part of the normal PAT exclusion criteria but in this precautionary analysis they are buffered to 50m even though the access track to the dam is already there.

3. The current extent of good eagle habitat

Large parts of the landscape, in which the proposed development is located, is potentially good golden eagle habitat (Fig. 2 & 3). There are 58 constructed wind turbines within 20 km of the proposed development, but none within 5 km. The closest turbines are in the 14 Beinn Ghlas wind farm (~10 km south east). There are also the nine at Clachan Flats; 15 at An Suidhe and 20 at Carraig Ghael. There is

⁵ Ottosen, T.B., Petch, G., Hanson, M. and Skjøth, C.A., 2020. Tree cover mapping based on Sentinel-2 images demonstrate high thematic accuracy in Europe. *International Journal of Applied Earth Observation and Geoinformation*, 84, p.101947.

also considerable forest cover south of Loch Awe which reduces the extent of good golden eagle habitat but relatively little of this has a GET score of 6 or more. Golden eagle habitat, north and east of Loch Awe, is extensive with some large unbroken regions (Fig. 2) that offer many potential movement corridors. However, the forest cover south and west of Loch Awe has resulted in some fragmentation of the good golden eagle habitat.

Figure 1. Potential golden eagle exclusion areas. Background is a 25th August 2021 Sentinel image.



Using the Sentinel 2 image, and forest cover and turbine locations, the GET habitat was separated into the Open and Closed classes shown in Fig. 2. **GET habitat loss is assessed only against the current extent of open habitat shown in Table 1.**

4. Assess the loss of habitat with respect to a regional figure and assumed range areas.

There are probably more than 20 occupied golden eagle ranges⁶ within 20 km of the proposed development and possibly 2 to 3 pairs with part of their range within 5 km. It is impossible to assess the extent of predicted loss with respect to any of these ranges as we know that the PAT model's

⁶ As the precise number is unknown, this number is based on historical information. Golden eagle ranges in several regions have increased but there is no recent evidence to attach a precise number for this region.

boundary assumptions are incorrect. The closest range centre is <6 km from the proposed development and, given the extent and connectivity of good eagle habitat, this pair may make use of the land within the PSHS development but they are more likely to remain north of the Ben Cruachan ridge and away from the proposed development. The recently reoccupied Beinn Ghlas range pair are known to cross Loch Awe and make use of the western slopes of Ben Cruachan (Scott Smith, *pers comm*). This is a good example of how the PAT model’s boundary assumptions can be wrong.

Figure 2. GET landscape in the vicinity (20 km) of the Proposed Development. The GET score is on a darkening red scale for open land and a darkening blue scale for closed land. Contains Ordnance Survey data © Crown copyright and database right 2020.

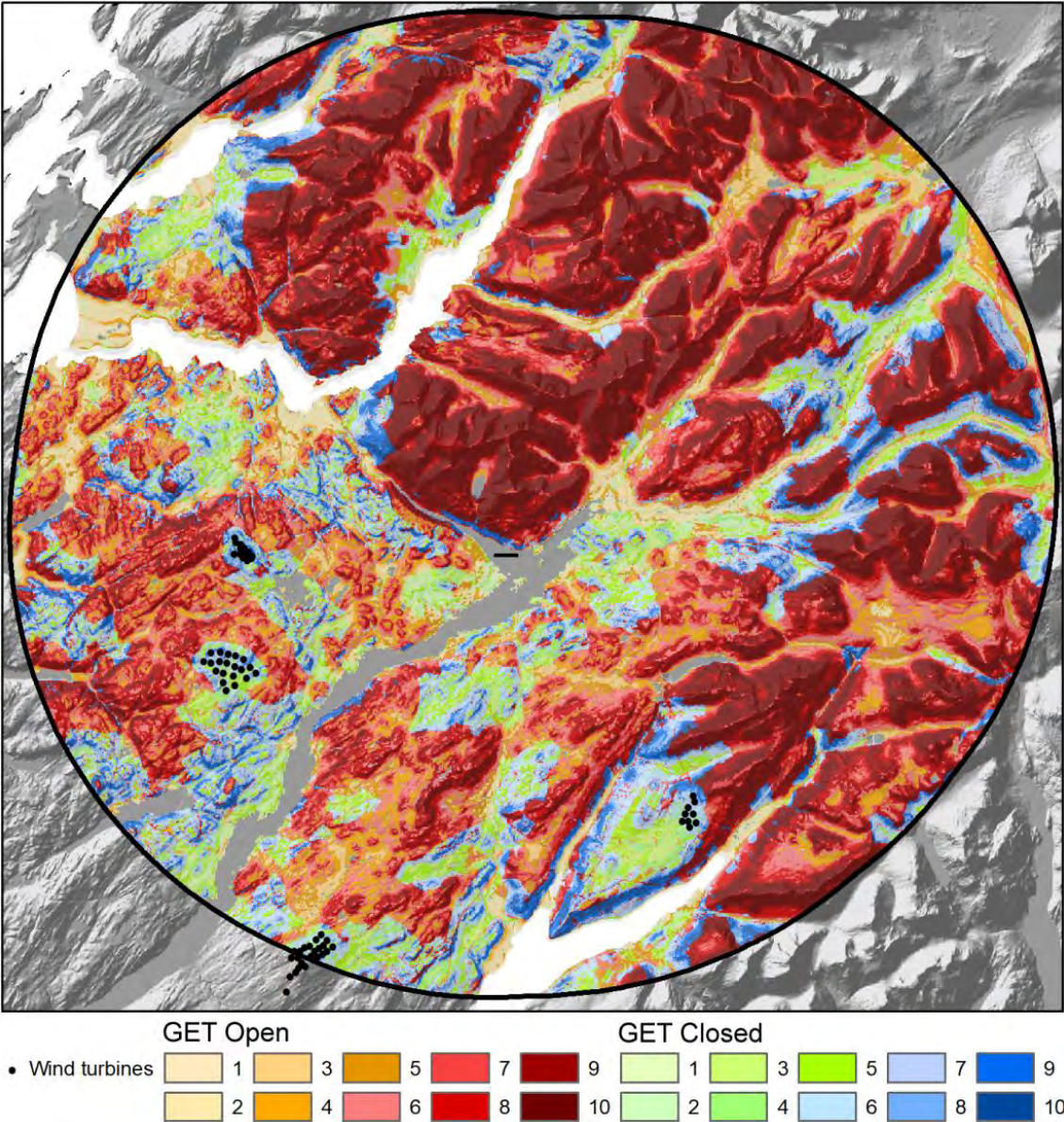


Table 1 has the areas of GET 6+ habitats within 5 and 20 km of the development boundary and the areas within the four exclusion areas. There are 9,388 and 85,949 ha of open GET 6+ habitat within 5 and 20 km of the development boundary. In both cases ~80% of the open habitat is GET 6+ so there is clearly a lot of potentially good eagle habitat in the vicinity of the proposed development.

The loss estimates in the four exclusion areas are maximums that are unlikely to be reached. Also, following construction, there will be few permanent above ground changes that affect golden eagles. In a very worst-case scenario, which includes temporary sites, only 59 ha of good habitat would be lost which is ~1% of that within 5 km of the proposed development and only ~0.1% of that within 20 km of the proposed development.

Table 1. Areas (hectares) of good golden eagle habitat at various distances from the proposed development boundary and within the four exclusion buffers.

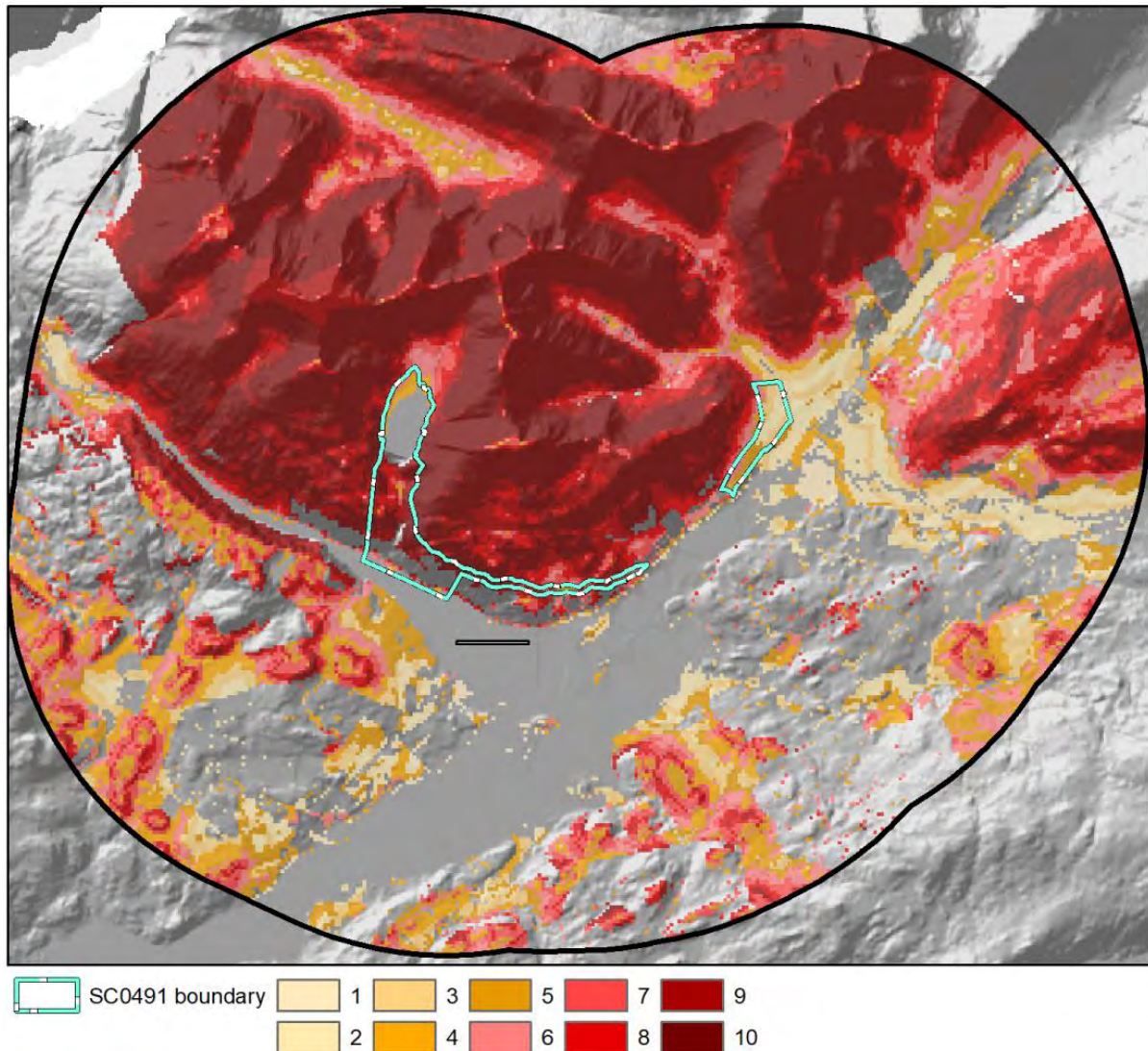
<i>GET</i>	<i>5 km</i>	<i>20 km</i>	<i>Upper works</i>	<i>Reservoir</i>	<i>Access Track</i>	<i>Lower compound</i>	<i>All</i>
1	61	496	0	0	0	0	0
2	531	3,103	0	0	0	2	2
3	479	4,375	0	0	0	1	1
4	506	5,616	0	11	0	0	11
5	907	7,713	0	1	2	6	9
6	995	10,816	0	4	2	1	7
7	1,068	12,568	0	3	5	0	8
8	1,085	15,145	1	1	8	0	9
9	1,734	18,300	1	2	8	0	11
10	4,506	29,121	1	2	22	0	25
<i>Area</i>	<i>11,872</i>	<i>107,252</i>	<i>3</i>	<i>23</i>	<i>46</i>	<i>9</i>	<i>80</i>
<i>Area 6+</i>	<i>9,388</i>	<i>85,949</i>	<i>3</i>	<i>11</i>	<i>44</i>	<i>1</i>	<i>59</i>
<i>% 6+</i>	<i>79</i>	<i>80</i>	<i>100</i>	<i>48</i>	<i>96</i>	<i>11</i>	<i>74</i>
<i>% 6+ loss within</i>							
<i>5 km</i>			<i>0.03</i>	<i>0.09</i>	<i>0.37</i>	<i>0.00</i>	<i>0.63</i>
<i>20 km</i>			<i>0.00</i>	<i>0.01</i>	<i>0.04</i>	<i>0.00</i>	<i>0.07</i>

The effect of the temporary lower site compound is minimal with a measured loss of only 1 ha of good eagle habitat and most (~89%) of the lower site compound is not good golden eagle habitat (Table 1). Similarly, the loss of good habitat surrounding the reservoir is small at another 11 ha. In this case ~50% of the land around the reservoir is good eagle habitat. As this is an existing 'loss' its contribution to the impact of the proposed development is effectively 0 but is included as a precaution.

The largest, but still small, loss is associated with the existing access track. Habitat around the access track is almost all good eagle habitat (96%) but the actual loss is small at 44 ha. Again, the access track is not new and such tracks are not normally considered to be habitat losses for golden eagles so it should really be considered as no additional loss of habitat. Only the upper works are new and permanent structures but the habitat loss attributed to them is extremely small at 3 ha.

Although it is impossible to assess if the proposed development will have a significant impact on any current golden eagle ranges, average range size is potentially a useful metric for assessing habitat loss (as in the PAT model). Clearly, the larger the assessed area the less the impact will be so benchmark areas are needed. In the PAT model the range size is defined by a 6 km Thiessen polygon but evidence from satellite tagged adult golden eagles has shown this approach to be unreliable and misleading in unpredictable ways, as it can lead to both over- and under-assessments of impacts.

Figure 3. GET landscape in the vicinity (5 km) of the Proposed Development. The GET score is on a darkening red scale for open land. The development boundary is shown as blue polygons. Contains Ordnance Survey data © Crown copyright and database right 2020.



Given the number of golden eagle range centres around the proposed development site some will be less than 12 km apart so range sizes could be constrained by neighbours. Given the extent and connectivity of good eagle habitat (Figs. 2 & 3) it is possible that the number of ranges, within 20 km of the proposed development, will increase in the future; indeed, this has already have happened since the last national census with the re-occupation of the Beinn Ghlas range and the settlement of a tagged eagle north of Bonawe.

In the following analyses a range size of 5,000 ha of open eagle habitat is assumed for golden eagle ranges close to the proposed development⁷. This is a conservative estimate because assessed habitat

⁷ Golden eagle range size varies across Scotland, with the precise range size only known for a very small number of birds (mainly in Argyll). The term 'close' means the general area (c. 50 km). There are ~20 ranges within 20 km of the proposed development and, given the extent of good eagle habitat, they are likely to contain 5,000 – 7,000 ha of good eagle habitat. The lower end of the range is used in these calculations.

losses will be larger for smaller range areas and 5,000 ha is only ~50% of the 9,388 ha of good eagle habitat within a 5,000 m buffer around the development boundary (Fig. 3 and Table 1).

Although an estimated habitat loss can be obtained using a reference golden eagle range area of 5,000 ha of open eagle habitat, the actual range loss, *if any*, would depend on how much of the exclusion zone was within the reference range boundary, how large the range was and how important the area within the exclusion buffer was to the pair. Unless at least one range holding bird is satellite tagged, range boundaries are unknown for all currently occupied ranges in Scotland and unknowable for theoretical future ranges. In these analyses, a worst-case scenario is assumed such that all of the exclusion area is within the nearest range.

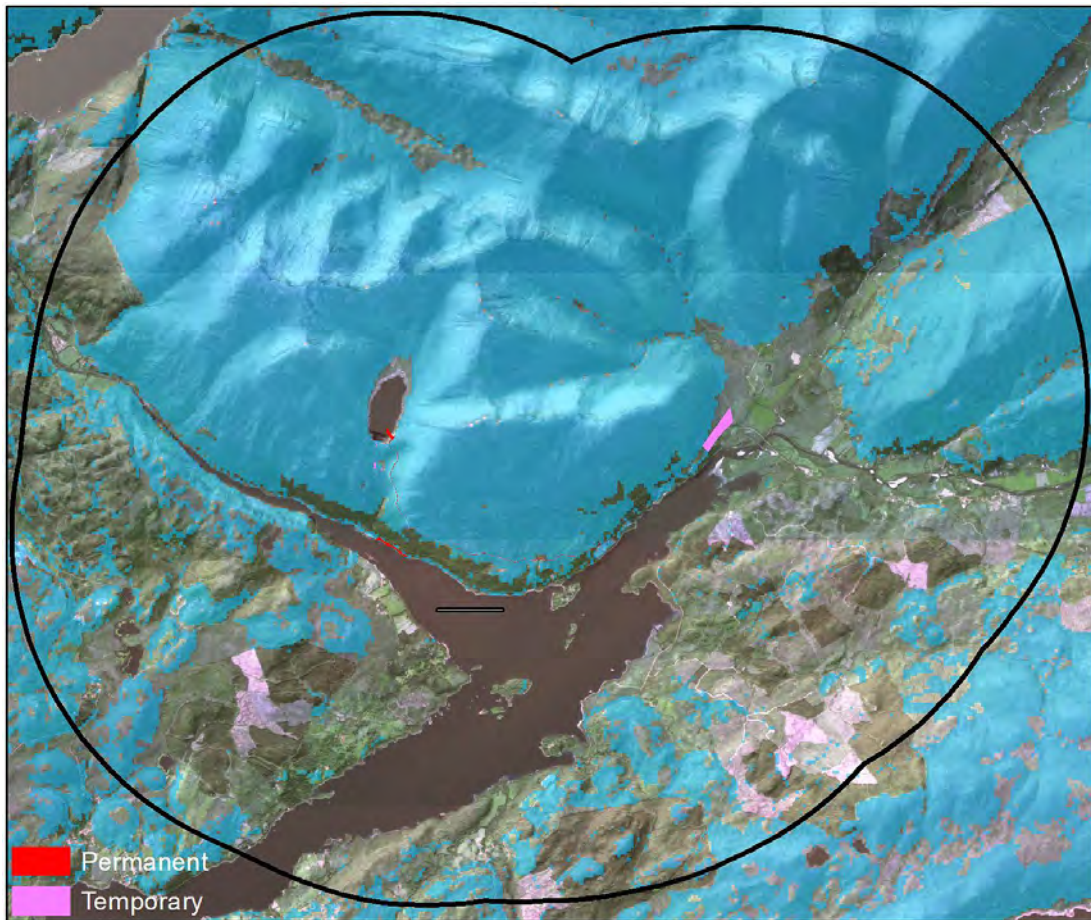
In this worst-case scenario, a theoretical range with 5,000 ha of open eagle habitat would lose 59 ha (Table 1), or ~1.0% of the total, as a result the construction of the Proposed PSHS Development. For the reasons given above, the loss of 59 ha is extremely pessimistic so any permanent loss would be much less than 1%. In the PAT model a loss of more than 5% was deemed significant but given the assumptions contributing to the estimated 1% loss, it is unreasonable to apply a strict loss threshold. The estimate is imprecise and the true loss will be smaller. Even if the range was 4,000 ha, a 59 ha loss of habitat would still be only 1.5%. A reasonable qualitative conclusion would be that the predicted range loss for an extant or future range close to the proposed development would not be significant, i.e., it would be very much less than 5%.

The proposed development could also result in a loss of habitat used by dispersing golden eagles. Generally, dispersing golden eagles stay outside of occupied ranges so if the proposed development is within an existing golden eagle range any losses for dispersing young eagles must be small. Given the proximity of the nearest golden eagle range this proposed development may not receive many visits from dispersing birds.

Assessing the impact on dispersing golden eagle habitat at, for example, the natural heritage zone level will result in a trivial loss of habitat. For example, the 20 km buffer around the proposed development currently has ~86,000 ha of open eagle habitat (Table 1) and the exclusion zones around the proposed development would result in a ~0.1 % loss of this open GET 6+ habitat (59 ha from 85,949 ha). The loss of open GET 6+ habitat within 5 km would be larger at 0.6 % (59 ha from 9,388 ha). **Clearly these are insignificant losses at local and regional scales and no further calculations are needed.**

Wind turbines have the potential to operate as barriers to golden eagle movements which requires additional investigation, but this is not the case for a PSHS which is unlikely to operate as a barrier because it does not have large above ground structures. Thus, the sole impact of a PSHS can be assessed as the direct habitat loss associated with its construction rather than also taking into account the impact on movement corridors. Fig. 4 shows the extent of good eagle habitat within 5 km of the proposed development boundary. It is difficult to see how the PSHS could act as a barrier to movements so no additional habitat loss estimates are needed.

Figure 4. GET landscape in the vicinity (5 km buffers) of the Proposed PSHS Development boundary. Open GET habitat (6 to 10) is shaded blue. The horizontal black line is 1 km. Background is a 25th August 2021 Sentinel 2 image. Contains Ordnance Survey data © Crown copyright and database right 2020.



5. Conclusion

There will be an insignificant loss of golden eagle habitat arising from the construction and operation of the Proposed PSHS Development and any loss would not create a significant impact on the extent of habitat used by any of the local pairs. Additionally, there will be no significant impact on dispersing young eagles.

Given the absence of large aerial structures, it is also very unlikely that there will be a significant reduction of habitat use outside of the exclusion zones and there should be no movement barriers.

