1 **Objection is sustained that AMEC's assessment of the impact of the Edinbane Wind Farm on golden eagles is unrepresentative and systematically underestimates the impact on golden eagles and the Cuillins SPA. Objection is sustained that the Edinbane Wind Farm will have a severe adverse impact on golden eagles and damage the conservation interest of the Cuillins SPA. It is requested that the Council either a) refuse consent for the Edinbane Wind Farm; or b) seek from AMEC a scientific assessment of the impact of the proposal on golden eagles and the Cuillins SPA, including rational mitigation proposals.**

Summary

2 Previously, AMEC has variously asserted that the development would:

- have no adverse impact on golden eagles[1];
- have an impact on golden eagles no worse than the impact of wind farms in Argyll[2];
- have an impact on golden eagles not worse than ten times the impact of wind farms in Argyll[3];
- have an impact of one golden eagle death every 14.6 years[4].

However, all the available scientific evidence contradicts AMEC's assessments.

3 AMEC's current assessment:

- uses data said to have been collected during 2001 according to SNH guidelines but is demonstrably flawed and lacks credibility;
- uses data from January to July only in 2002 and does not represent all seasonal conditions;
- uses an unreasonably large area to normalise flight data, which dilutes the flight density in the wind farm risk zone to one sixth of its actual value;

[1] AMEC Edinbane Wind Farm Non-technical Summary, February 2002
[2] AMEC Edinbane Wind Farm Written Statement, June 2002, 7.4.2
[3] AMEC Edinbane Wind Farm Private Annex, June 2002,
[4] AMEC Edinbane Wind Farm Eagle Activity Assessment V3, Further Information, October 2004

- uses an avoidance rate of 99.62% said to be based on Thelander et al. 2003, when the evidence of Thelander et al. 2003 supports an avoidance rate of 95%;

- asserts that the Band et al. method predicts that the development will destroy one golden eagle every 14.6 years, when the Band et al. method applied to the wind farm risk zone predicts that the development will destroy 5.4 golden eagles per year;

- proposes measures described as mitigation which have been scientifically demonstrated to increase the risk of golden eagle blade strike.

4 Proper interpretation of the site-specific data and the available scientific evidence indicates:

- the locality serves as a dispersion area for non-breeding golden eagles of the Skye population;

- the golden eagle utilisation rate inside the wind farm risk zone at Edinbane is an order of magnitude greater than that reported for Altamont in Thelander et al. 2003;

- the Band et al. method predicts that the development will destroy 5.4 golden eagles per year;

- the development will, on its own and in combination with RDC's Ben Aketil wind farm, have a severe adverse impact on the Skye golden eagle population and on the Cuillins SPA;

- there is insufficient site-specific data to reliably (ie with statistical significance) discriminate between the impacts arising from individual turbines.

5 It is concluded that the adverse impact on golden eagles is of unacceptable magnitude and that this impact has not been rationally assessed or mitigated by AMEC.

6 It is Scottish Executive policy to achieve 40% of electricity from renewable resources by 2020 and this is intended to include 4-6 GW of onshore wind power. A significant proportion of this capacity is already in EIA development consent proceedings throughout Scotland, including more than 1 GW in golden eagle habitats. To put this in context, the cumulative impact of 1 GW wind power capacity would kill 130-200 golden eagles per year if the Altamont attrition rate were repeated here[5]. If the impact of this policy on golden eagles and other birds is to be minimised then great care must be exercised in the scientific assessment of risk and rational selection of sites. On the basis of the scientific evidence available, Edinbane is an inappropriate site for such development.

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[5] Smallwood, K.S. and Thelander, C.G., *Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area*, Public Interest Energy Research Program Contract No. 500-01-019, Final Report to the California Energy Commission, 2004. www.energy.ca.gov/pier/final_project_reports/500-04-052.html

Obligation to perform appropriate assessment on the Cuillins SPA

7 Article 6.3 of the Habitats Directive 92/43/EEC has:

> *"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public."*

8 Advocate General Kokott said[6]:

> *"… an appropriate assessment is always necessary where reasonable doubt exists as to the absence of significant adverse effects"*

and

> *"… the decisive considerations must be set out in the authorisation. They may be reviewed at least in so far as the authorising authorities' margin of discretion is exceeded. This would appear to be the case in particular where the findings of an appropriate assessment on possible adverse effects are contested without cogent factual arguments."*

9 The European Court of Justice ruled that appropriate assessment means[7]:

> *"Under Article 6(3) of Directive 92/43, an appropriate assessment of the implications for the site concerned of the plan or project implies that, prior to its approval, all the aspects of the plan or project which can, by themselves or in combination with other plans or projects, affect the site's conservation objectives must be identified in the light of the best scientific knowledge in the field. The competent national authorities, taking account of the appropriate assessment of the*

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[6] Opinion of Advocate General Kokott in C-127/02 *Landelijke Vereniging tot Behoud van de Waddenzee & Nederlandse Vereniging tot Bescherming van Vogels v Staatssecretaris van Landbouw and Natuurbeheer en Visserij*, 29 January 2004, paragraphs 74 and 109.

[7] European Court of Justice, Grand Chamber, Judgment in C-127/02 *Landelijke Vereniging tot Behoud van de Waddenzee & Nederlandse Vereniging tot Bescherming van Vogels v Staatssecretaris van Landbouw and Natuurbeheer en Visserij*, 7 September 2004, Fourth Ruling.

implications of mechanical cockle fishing for the site concerned in the light of the site's conservation objectives, are to authorise such an activity only if they have made certain that it will not adversely affect the integrity of that site. That is the case where no reasonable scientific doubt remains as to the absence of such effects."

10 Consequently it would be unlawful for this project to be consented on the basis of the assessments submitted by AMEC to date.

Assessment of golden eagle blade strike risk

11 The likelihood of golden eagle blade strike depends primarily on:

- the golden eagle utilisation rate in the risk zone after wind farm construction;
- the rotor swept volume and its configuration; and
- the vulnerability of the species to blade strike.

Site-specific flight data

12 The pre-construction golden eagle flight data for the site comprises two distinct sets collected in 2001 and 2002.

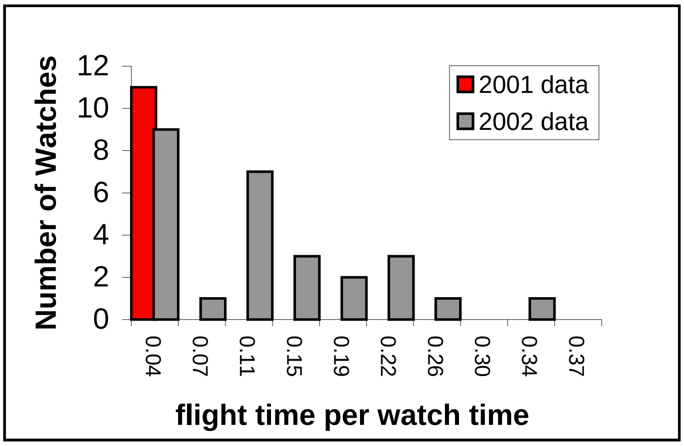

Figure 1: comparison of golden eagle flight data observed in watches during 2001 and 2002

13 Comparison of the 2001 and 2002 data suggests that the sets may represent two distinct populations, and it is necessary to examine the methods of data collection.

14 The 2001 data set is variously described as:

- 70 hours of observation[8];
- 19 hours 15 minutes of observation[9]; and
- 22 hours 5 minutes of observation[10].

15 There is an unreasonable degree of uncertainly regarding the 2001 watch time. The following table summarises the known circumstances of the 2001 data set[11]:

Date	**Start Time BST**	**Watch**	**VP**	**Grid ref**	**Duration**	**Observer**	**in/out of wind farm zone**	**Contemporaneous Activities by Observer**
15/05/01	9:00	1	R	351450	50 min	SL	In	Habitat Survey
15/05/01	15:15	2	S	337466	3hr	SL	Out	Habitat Survey
17/05/01	11:20	3	T	336477	2hr 15 min	SL	Out	
19/05/01	11:40	4	U	338469	2hr 15 min	SL	Out	
20/05/01	09:00	5	V	358455	2 hr	SL	In	
23/06/01	14:20	6	R	351450	1hr 35 min	SL	In	
23/06/01	16:00	7	U	338469	2hr 10 min	SL	Out	Observer moves ~2.3km in 5 min
25/06/01	17:00	8	W	354474	2 hr	SL	In	Moorland Bird Survey
26/06/01	10:00	9	X	352483	2hr 20 min	SL	In	Habitat Survey
26/06/01	16:00	10	Y	359480	2hr 20 min	SL	In	Habitat Survey
27/06/01	08:00	11	Z	361457	1hr 20 min	SL	In	

Table 1: Vantage point watches in 2001

8 AMEC Edinbane Wind Farm Written Statement, February 2002, private annex 2.2.1.2

9 AMEC Edinbane Wind Farm Eagle Activity Assessment V3 Further Information, October 2004

10 SNH, "SK VPW data for Edinbane & Ben Aketil.xls"

11 compiled from SNH, "SK VPW data for Edinbane & Ben Aketil.xls"; AMEC Edinbane Wind Farm Private Annex, February 2002, Table 1; and AMEC Edinbane Wind Farm Written Statement June 2002.

16 In 2001, 7 out of the 11 watches are from locations within the survey area, with potential to modify golden eagle activity. Moreover, watches 1 and 2 (15 May 2001) and 9 and 10 (26 June 2001) were performed on the same days[12] on which the National Vegetation Classification habitat survey of the site was apparently being conducted by the same observer. The Habitat Survey involved extensive walkover of the golden eagle survey area with potential to modify golden eagle activity. In addition, the grid reference of watch 2 is variously described as 337466 and 377486. Watch 8 (25 June 2001) occurred on the same day[13] that the same observer was also described as conducting the Moorland Bird Survey using the Brown and Shepherd method. Brown and Shepherd requires the survey of 500m x 500m areas for 20-25 minutes with a constant search intensity of 0.8-1.0 min per ha, the survey to be conducted between the hours of 08.30 and 18.00. This allows coverage of up to 4 km^2 per day according to the Brown and Shepherd method[14]. The Moorland Bird Survey area defined by AMEC is some 14 km^2, and it is not possible for a single observer to survey it using Brown and Shepherd in the time described by AMEC, let alone conduct a simultaneous vantage point watch for golden eagles. On 23 June 2001, watch 6 began at 14:20 at NG 351450 and lasted for 1 hour 35 minutes, and the same observer is then described as commencing watch 7 at 16:00 at location NG 338469. To achieve this the observer would have had to moved approximately 2.3 km over rough ground in five minutes.

17 It is concluded that in 2001 only 2 watches are not demonstrably flawed (3 and 4 on 17 and 19 May 2001 respectively, with a total of time of 4 hours 30 minutes). However, the inconsistencies and contradictions in the 2001 data raise significant doubt regarding its reliability and credibility as a representative measure of bird utilisation, and consequently all the 2001 data is rejected. It is requested that the Council advise AMEC to withdraw the 2001 vantage point watch data and the 2001 Moorland Bird Survey data.

18 The 2002 watch data collected by Crane and Nellist appears to be of acceptable quality, with the exception of the watches from vantage points A, B, and C, which are within the wind farm development zone, and are rejected. However, the 2002 data is restricted to January to July and as a result there exists uncertainty regarding the golden eagle utilisation rate over all seasons of the year. In addition, the 2002 data represents an insufficient sample size for the purpose of identifying statistically significant correlations at the individual turbine level (see below). These scientific uncertainties could be reasonably reduced by further observation. In view of the potential impact on a Natura 2000 site, it is requested that the Council advise AMEC to collect further vantage point watch data, such that the data set covers all seasons in line with SNH guidelines[15].

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[12] AMEC Edinbane Wind Farm Written Statement, June 2002, 5.2
[13] AMEC Edinbane Wind Farm Written Statement, June 2002, 7.1.2.
[14] Letter from RSPB to Highland Council, 25 April 2002
[15] SNH, *Survey methods to assess windfarm impacts on upland bird communities*, June 2002.

19 There is concern that the 2002 data as reported by AMEC may be incomplete. The watches from point G on 13 March 2002 and 17 July 2002, and from point F on 17 April 2002 and 7 May 2002, are not reported in Table 1 of AMEC's Further Information[16]. The watch from point F on 3 July 2002 is reported, but does not record any observation time[17] and should be discarded. Flights 3 and 7 observed during the watch from point G on 15 April 2002 record a golden eagle moving close to turbines 1, 3, 7, 8, and 9 (see also turbine proximity table), but no flight time is given. Flights 3 and 4 observed from point F on 3 June 2002 also give zero flight time, but the turbine proximity data record these events as birds moving close to turbines 10, 12, and 13. Flight 1 observed from point B on 12 March 2002 also records zero flying time, and the Council should clarify whether this event was a sitting bird. In general, it is requested that the Council refer to the original data sheets recorded by the Crane and Nellist in 2002 and confirm that the information in Table 1 of AMEC's Further Information is an accurate reflection of those observations.

Golden eagle utilisation rate at Edinbane

20 AMEC asserts[18] that it has used the Band et al. collision model[19] to assess the effect of turbine configuration and total rotor swept volume on the golden eagles utilising the site. It is said that this model indicates 18 golden eagle collisions per year before adjustment for avoidance. However, RDC asserts[20] in its assessment that it has used the same model to bring out 110 golden eagle collisions per year at Edinbane before avoidance. It is therefore necessary to examine the reasons for the discrepancy between these two claims.

21 AMEC uses[21] a golden eagle utilisation rate for the Edinbane development of 8.4×10^{-6} ha^{-1}, whilst RDC uses[22] 5.1×10^{-5} ha^{-1}, ie AMEC asserts that golden eagle flight activity at the site is six times lower than RDC's estimate.

22 The greater part of this difference is explained by AMEC's choice of a larger (approximately 4 times greater) area with which to normalise the flight data. This has the effect of diluting the flight data over a wider area which proportionately reduces the ostensible utilisation rate.

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[16] It is believed that the time for these watches is included in AMEC's calculations but the watches are not included in the list. Although the watches observed no golden eagle flight activity they ought to be included in the breakdown in order that the reader may reasonably understand AMEC's subsequent data manipulations.
[17] SNH, "SK VPW data for Edinbane & Ben Aketil.xls"
[18] AMEC Edinbane Wind Farm Eagle Activity Assessment V3 Further Information, October 2004
[19] Band, W., Madders, M., Whitfield, D. P., *Developing field and analytical methods to assess avian collision risk at wind farms*, In: de Lucas, M, Janss, G., Ferrer, M. (eds). *Birds and Wind Power*. Lynx Edicions, Barcelona, in press.
[20] Madders, M., *Proposed Windfarms at Ben Aketil and Edinbane: A quantitative collision risk model for golden eagle*, Ben Aketil Wind Farm Further Information, March 2004, Annex B.
[21] AMEC Edinbane Wind Farm Eagle Activity Assessment V3 Further Information, October 2004, Table 4, Line 5
[22] Madders, M., *Proposed Windfarms at Ben Aketil and Edinbane: A quantitative collision risk model for golden eagle*, Ben Aketil Wind Farm Further Information, March 2004, Annex 1B, under "Flying Time ha^{-1} hr^{-1} Overall". Note that the dimension of utilisation rate is per area (ha^{-1}), not per area per time (ha^{-1} hr^{-1}) as reported by RDC.

Vantage Point	Area used by AMEC (ha)	Area used by RDC (ha)	AMEC / RDC
B/B*	2137	263.42	8.11
E	3691	1011.24	3.65
F	4213	1527.19	2.76
G	2780	1150.91	2.42
mean	**3173**	**988.19**	**4.23**

Table 2: Comparison of the areas used by AMEC and RDC to normalise flight data

23 AMEC uses an area more than 4 times greater than RDC to normalise similar flight data. This raises the further question of how AMEC and RDC define the visible area used in the watches.

24 Band et al. states[23]:

> *"Since the ultimate purpose of analysis is to estimate the risk of collision with turbines, it is the visibility of the airspace containing the rotors (the "collision risk volume") that is of prime importance. Therefore, it is recommended that visibility be calculated using the least visible part of this airspace, i.e. an imaginary layer suspended at the lowermost height passed through by the rotor blade tips (typically around 20m above the ground)."*

25 RDC asserts[24] that it uses *"ground + 20 m within the survey boundary only"*. However, the areas given by RDC do not correspond with the either the 20m A.G.L.[25] or 100m A.G.L. visibility zones defined by AMEC, when either the wind farm development envelope or the Moorland Bird Survey envelope are overlaid. Without further information concerning the precise cuts applied by RDC it is not possible to comment in detail on its selection. Nonetheless, it is apparent that for vantage point G, RDC uses an area greater than that corresponding to AMEC's definition of 20m A.G.L. visible area, ie the definitions of visible area used by AMEC and RDC are clearly inconsistent. It is requested that the Council seek further information from RDC regarding the exact nature of its definition of visible area for both Edinbane and Ben Aketil.

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[23] Band, W., Madders, M., Whitfield, D. P., *Developing field and analytical methods to assess avian collision risk at wind farms*, In: de Lucas, M, Janss, G., Ferrer, M. (eds). *Birds and Wind Power*. Lynx Edicions, Barcelona, in press.
[24] Madders, M., *Proposed Windfarms at Ben Aketil and Edinbane: A quantitative collision risk model for golden eagle*, Ben Aketil Wind Farm Further Information, March 2004, paragraph 8.
[25] Above Ground Level

26 On the other hand, AMEC defines[26] visible area as land within a 360-degree field around the vantage point, including all land within 4 km for which any part (but not all) of the airspace less than 100 m above ground level is visible.

27 AMEC's choice of area is indefensible: its minimum requirement for inclusion in the visible area is visibility 100m above ground level, when the object of the analysis is to determine the golden eagle utilisation rate in the rotor risk zone, ie between 20-100m. AMEC's area is one for which the full range of 20-100m flight data could not possibly be collected, because a substantial portion of it is out of view. Using an area greater than the actual area with visibility between 20-100m biases the golden eagle utilisation rate downwards and is inconsistent with a precautionary approach and contrary to the Band et al. method. It is also inconsistent with AMEC's claim that its analysis represents a 'worst case' scenario.

28 Should AMEC be concerned that the utilisation rate normalised to the 20m A.G.L. visibility area might include flight data from a wider area having only partial visibility in the airspace between 20-100m, then it ought to either: a) cut the flight data to the 20-100m visibility area only; or b) assess the utilisation rate in the visible volume of variable thickness below 100m and express this as a utilisation rate per unit volume.

29 AMEC's choice of a 360-degree field is also contrary to the Band et al. method, which requires a maximum visual field of 180 degrees. AMEC's field of view definition includes the area behind the observer's head, and further biases the golden eagle utilisation rate downwards.

30 AMEC's selection of visible area out to 4 km is also unjustified. The method of Band et al. recommends that a survey area of up to 500m around the wind farm development zone be included in the study and that VPs should be selected such that all parts of the survey area may be studied within 2 km as far as possible. Detection efficiency is reduced as distance from the VP increases. Flights observed beyond the survey area are noted in order to determine whether there might be any neighbouring 'hot spots' of flight activity, not to justify the inclusion of land remote from the survey area and thereby reduce the utilisation rate within the wind farm risk zone. The object of the assessment is to determine utilisation rate in the wind farm area, and the flight data and the area used to normalise it should reasonably be concentrated on the wind farm zone of risk.

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[26] AMEC presents figures for both 20 m and 100 m A.G.L., but uses the 100m A.G.L. area in the utilisation rate calculation - see *AMEC Edinbane Wind Farm Eagle Activity Assessment V3 Further Information, October 2004,* Table 4 Line 5, which cites a utilisation rate of 8.38682×10^{-6} ha^{-1}, which is the figure calculated at the bottom of AMEC's Table 1 using the 100m A.G.L. areas defined in AMEC's Table 2 (with the exception of the utilisation rate for VP G, which is further diminished by a factor of 1.4, discussed further below).

31 AMEC also relocates[27] VP B to a position VP B* with increased visibility. This significantly biases downwards the utilisation rate measured from VP B, which has the greatest flight time recorded of any VP. It is requested that the Council seek clarification from AMEC regarding the relocation of VP B to VP B*.

32 There are also significant differences between the watch times recorded by the observers for each VP and the watch times used by RDC and AMEC:

VP	Watch Time (s)		
	AMEC	RDC	Recorded by Observers
B/B*	75600	75600	73500
E	64800	64800	60900
F	64800	64800	54000
G	90000	64800	57900
D	10800	-	-
Sum	306000	270000	246300
% of recorded	124%	110%	100%

Table 3: comparison of watch times recorded by observer and those used by AMEC and RDC

33 It is clear that neither RDC nor AMEC use the watch times actually recorded by the observers[28], but instead assume nominal 3-hour watch times. The effect of using times greater than the actual watch times biases downwards the golden eagle utilisation rate. The watch times of AMEC and RDC are rejected in favour of the recorded watch times.

34 AMEC also inflates[29] the watch time for vantage point G by a further factor of 1.4 over and above the nominal (18 hours) watch time it assumes for VP G. It is considered likely that it is AMEC's intention to include a subset of the scientifically invalid 2001 data in the analysis by this operation, but it is not understood why vantage point G might have been selected for this purpose when it was not used in 2001. The 2001 data has no relationship whatsoever with VP G or the visible area from that location. In any event, in view of the uncertainty surrounding the 2001 data, a precautionary approach is adopted and all of the 2001 data is rejected, together with AMEC's definition of the watch time for VP G.

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[27] In its calculation of area AMEC uses NG340466 for VP B, whereas it defines VP B as NG338465 in *Edinbane Wind Farm Written Statement June 2002* Appendix 9.
[28] SNH: "SK VPW data for Edinbane & Ben Aketil.xls"
[29] AMEC's inclusion of this factor is obscure, but examination of AMEC Edinbane Wind Farm Eagle Activity Assessment V3 Further Information, October 2004, Table 1, asserts that the utilisation rate for VP G is computed using 1031 s of flight activity, 6 x 3 hour watches, and the 100m A.G.L. visible area of 2780 ha. This ought to give a utilisation rate for VP G of $5.7x10^{-6}$ ha^{-1}, but the figure that appears in AMEC's table is $4.1x10^{-6}$ ha^{-1}.

35 There are also differences between the flight times at rotor height used by AMEC and RDC:

VP	Flight time between 20-100m (s)	
	AMEC	RDC
B/B*	4716	3246
E	1290	1290
F	840	840
G	1031	946
D	5	-

Table 4: Comparison of flight times used by AMEC and RDC

36 With the exception of the data from vantage point D, which is within the wind farm development envelope and was (correctly) discarded by RDC, there is not enough information to determine the reason for the difference in flight times used by AMEC and RDC for VPs B/B* and G.

37 Without further specification of the area and flight data selections, it is not possible to comment in detail on the reliability of RDC's analysis of utilisation rate. However, from the foregoing consideration of visible area, flight time, and duration of watches, it is evident that AMEC does not correctly compute the golden eagle utilisation rate at the wind farm site. The scientifically invalid assumptions and data selections noted in AMEC's analysis all tend to bias downwards the golden eagle utilisation rate.

38 Nevertheless, it is possible to perform for comparison an independent analysis on the flight data inside the wind farm development envelope, since AMEC's classification of the data does discriminate between flight times in and out of the wind farm zone[30]. This also has the advantage of measuring golden eagle utilisation rate in the area of risk, and such an analysis is undertaken below[31].

39 It must be emphasised that this analysis is still based on the data as reported by AMEC, and upon AMEC's definition of 20m A.G.L. visibility when overlaid with the wind farm development boundary (a GIS program is not independently available). As a preliminary step, the flight details in the wind farm development zone as they are reported by AMEC have been examined and correlated with the flight path maps reported by RDC and AMEC, and are found to be generally consistent[32].

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[30] Ideally such an analysis would be performed including a 500m buffer zone around the wind farm, but this is not possible without access to the data sheets.
[31] see Appendix A for a summary of the Band et al. method calculation in the wind farm risk zone.
[32] Note remarks in paragraph 19, and note there are a small number of differences between AMEC and RDC's maps.

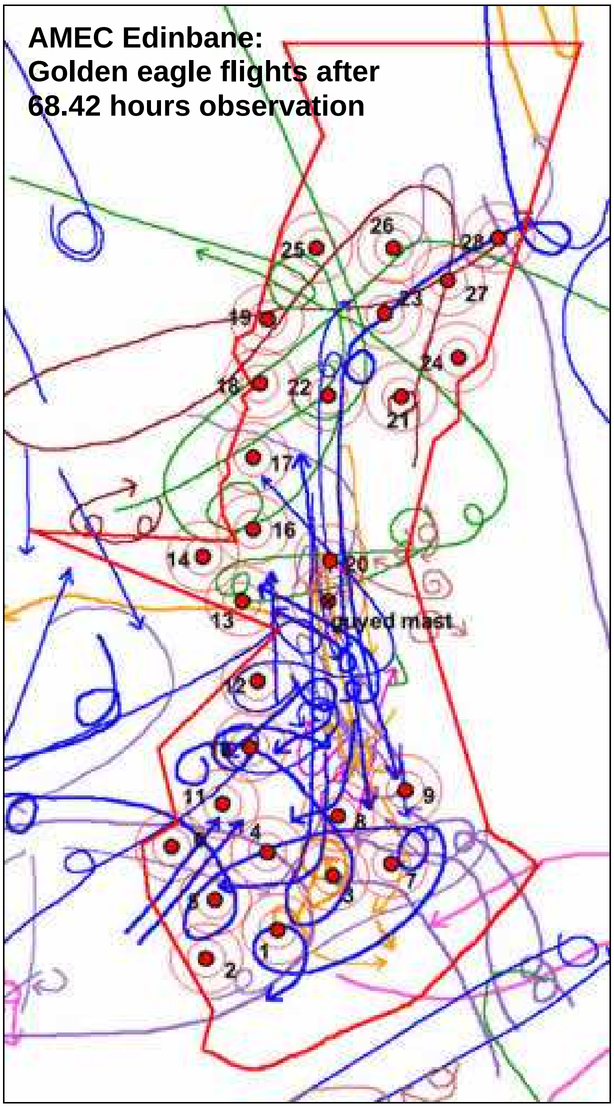

Figure 2: Golden eagle flights observed during in 68.42 hours in the wind farm development zone, derived from RDC's map. The development zone boundary is shown in red; the red circles indicate 100m and 200m proximity to turbines.

40 The determination of visible area is made as follows: AMEC's definition of 20m A.G.L. visibility from each vantage point is overlaid with the wind farm development boundary and the visible area within the wind farm development boundary masked and measured in a graphics program. The pixel count is converted to hectares by scaling to a known reference area. As a check, the 20m A.G.L. visibility area in a 360-degree field within 4 km around each vantage point is also determined for comparison with AMEC's 20m A.G.L. figures. For VP B, for which the area is not reported by AMEC, a conservative estimate of the visibility is made by reference to the topography.

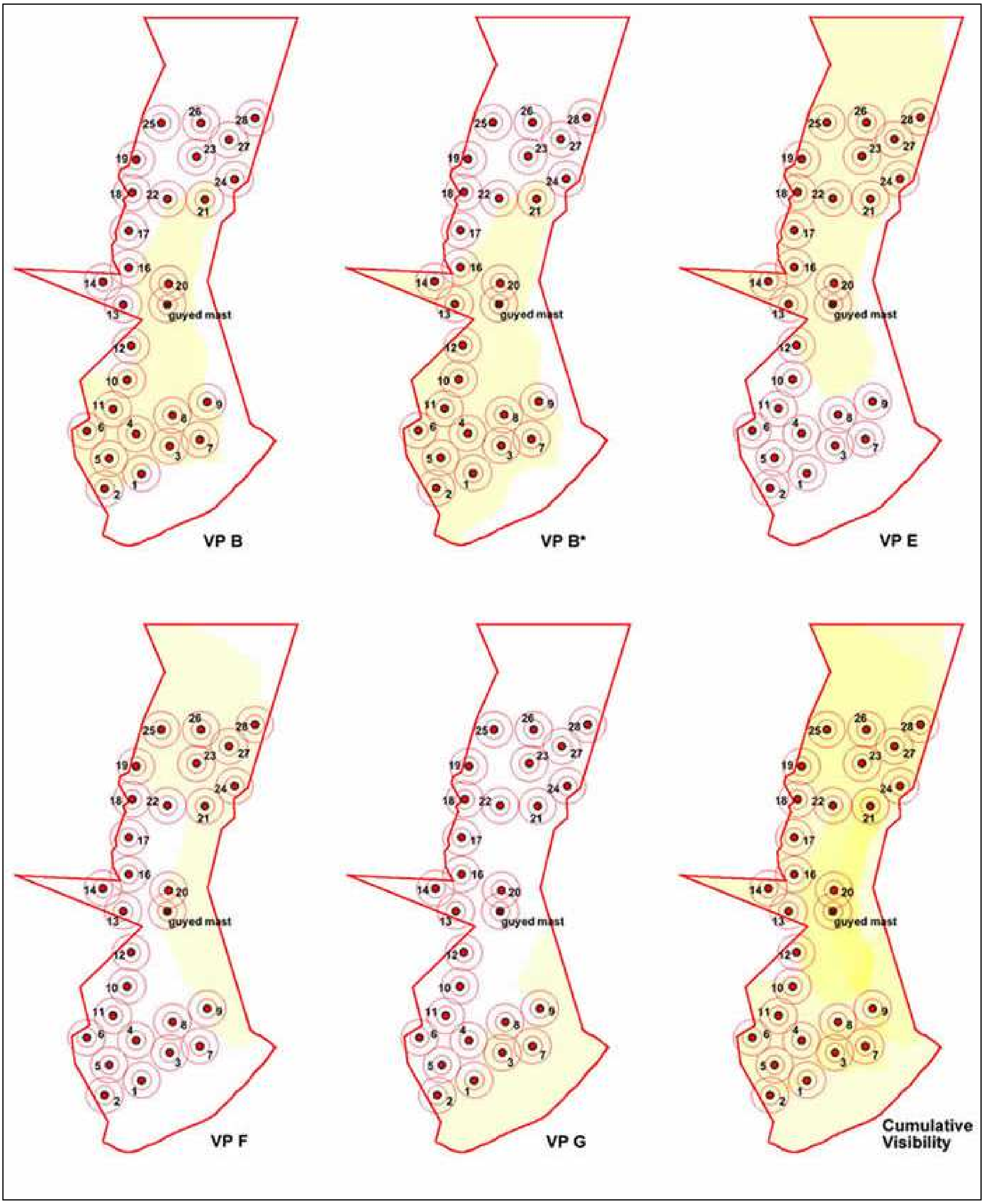

Figure 3: the 20m A.G.L. visible areas in the wind farm envelope are shown shaded in yellow for each vantage point and in combination (increased cumulative visibility is indicated by darker shading).

41 The sizes of the 20m A.G.L. visibility areas in the wind farm envelope are shown in the table below, together with the check data for 'within 4 km 360-degree 20m A.G.L. visibility area', and the 'within 4 km 360-degree 100m A.G.L. visibility area' that was actually used by AMEC in its analysis.

VP	Grid Ref	Visible Area (ha)			
		20 m A.G.L.			100 m A.G.L.
		AMEC: 360 Degrees Within 4km	**Check:** 360 Degrees Within 4km	**Within Wind Farm Envelope**	**AMEC:** 360 Degrees Within 4km
B	NG338465	-	-	**319**	-
B*	NG340466	1091	1092	**431**	2137
E	NG343490	2286	2307	**502**	3691
F	NG371482	1673	1670	**376**	4213
G	NG368447	799	799	**214**	2780

Table 5: visible area within the wind farm development zone

42 Under the assumption that the output of AMEC's GIS program is correct, the close correspondence between AMEC's "within 4 km 360-degree 20m A.G.L. visibility" areas and those determined by this method gives reasonable confidence that the overlay is sufficiently well located and scaled for a reliable determination of the 20m A.G.L. visibility areas within the wind farm development boundary. In the absence of a GIS program there remains some uncertainty concerning the visibility inside the wind farm boundary for VP B, and consequently the utilisation rate within the wind farm development envelope will be determined using both VP B and AMEC's relocated VP B* as alternatives.

43 The golden eagle utilisation rate in the wind farm zone is determined for each VP by taking the flight time in the 20-100m band inside the wind farm zone observed from that VP, and dividing it by the recorded watch time and by the area of 20m A.G.L visibility within the wind farm zone for that VP. The unweighted mean is computed for VPs B,E,F,G and B*,E,F,G. The results are shown in the table below.

Edinbane: golden eagle utilisation rate in wind farm risk zone				
VP	**Visible Area in wind farm zone (ha)**	**Watch Time (s)**	**Flying time in Wind Farm zone 20-100m (s)**	**Utilisation Rate 20-100m (ha^{-1})**
B	319	73500	2385	1.01615E-04
B*	431	73500	2385	7.53413E-05
E	502	60900	390	1.27565E-05
F	376	54000	180	8.86720E-06
G	214	57900	971	7.82232E-05
Unweighted mean using VP B				**5.03654E-05**
Unweighted mean using VP B*				4.37970E-05

Table 6: Golden eagle utilisation rate within the wind farm risk zone

44 The effect of AMEC's relocation of VP B to VP B* is a reduction of approximately 13% in the utilisation rate. The location of AMEC's VP B* is rejected in the absence of any evidence to support it, in favour of the recorded location at VP B. The golden eagle utilisation rate in the 20-100m height band in the wind farm risk area is therefore determined to be 5.04×10^{-5} ha^{-1}.

45 Comparing the utilisation rate in the wind farm risk zone with the utilisation rates reported by AMEC and RDC:

Method	Utilisation rate ha^{-1}	% of Band et al. method in wind farm zone
Band et al. in wind farm zone	5.03654E-05	100%
RDC	5.09638E-05	101%
AMEC	8.38682E-06	17%

Table 7: Comparison of golden eagle utilisation rate in the wind farm risk zone with the utilisation rates used by AMEC and RDC

46 Without further information it is not possible to comment in detail on the numerical equivalence of RDC's result and the result of the Band et al. method in the wind farm envelope. It is noted, however, that although RDC use flight times similar to those used by AMEC, ie approximately all the recorded flight

data in the 20-100m band, the area used by RDC to normalise this flight data is approximately one quarter of that used by AMEC. In particular, RDC's choice of area for VP B (263 ha) contributes significantly to its final utilisation rate.

47 On the other hand, AMEC's utilisation rate is one sixth of that of the Band et al. method applied within the wind farm risk zone, for the reasons already discussed regarding AMEC's choice of visible area, watch times, and relocation of VP B to VP B*. Since many of the assumptions and data manipulations used to compute the utilisation in the AMEC method are scientifically flawed and its result is contradicted by the Band et al. method applied in the wind farm zone, AMEC's golden eagle utilisation rate is rejected.

Predicted turbine transits and collisions before avoidance

48 With regard to the computation of the number of rotor transits and the number of transits that collide per year before adjustment for avoidance, AMEC and RDC both use the same parameters applied to their respective utilisation rates[33]. Applying these same parameters to the utilisation rate in the 20-100m band determined using the Band et al. method in the wind farm risk zone brings out a figure of 993 rotor transits per year, resulting in 108 blade strikes per year before consideration of avoidance. The transit and collision results for the wind farm zone are compared with the estimates by AMEC and RDC in the following table:

Method	Predicted Rotor Transits per year	Predicted Collisions per year before avoidance
Band et al. in wind farm zone	993	108
RDC	1005	110
AMEC	136	18

Table 8: Comparison of transit and collision rates before consideration of avoidance.

49 All of the predicted transit rates use the assumption that golden eagle presence in conditions favorable for flight activity coincide with turbines operating for an average of 8.2 hours per day. No evidence has been offered to support the validity of this assumption, which is adopted here because it is used by both AMEC and RDC and in the absence of any reliable alternative. The available time for flight per day that coincides with turbine operation is computed by applying a factor of 0.82 (ie 82% turbine operation) to

[33] ie turbine size; 82% turbine operation; 13.29% collision probability per transit; 10 hour per day bird presence; 13 ms^{-1} bird speed; etc.. See for example: Madders, M., *Proposed Windfarms at Ben Aketil and Edinbane: A quantitative collision risk model for golden eagle*, Ben Aketil Wind Farm Further Information, March 2004, Annex B, for a full list of these parameters.

the assumption that golden eagles are present and conditions are favorable for flight for a nominal 10 hours per day. Implicit in this assumption is that turbine operation is uncorrelated with conditions favorable to golden eagle flight. However, it is likely that golden eagle flight activity is also correlated with wind speed and that periods in which the wind is insufficient for turbine operation are likely to be periods of low eagle flight activity[34]. If consideration of wind speed has already been factored into the assumption that flight conditions are favorable for a nominal 10 hours per day, then the further application of a turbine non-operation factor would double count the effect of wind speed, leading to a non-precautionary estimate that potentially reduces the transit rate by up to 18%. It is requested that the Council seek further information from AMEC concerning the scientific basis for its estimate of 8.2 hours per day available for potential flight activity in the locality.

Observed transits

50 AMEC asserts that its estimate is the ‘worst case’. In order to test this hypothesis, AMEC’s estimate for the number of transits may be compared with the actual number of transits observed during the watches. This comparison must be treated with caution however, due to the low statistics involved and the uncertainty in flight position.

51 AMEC reports 40 flights passing within 100m of a turbine in the 20-100m height band in 68.42 hours of observation. However, examination of the flight path maps provided by RDC and AMEC indicates that 49 transits were in fact observed in the 20-100m band, in particular when double transits[35] are included. The table below compares the observed transits with the number of transits predicted by the various methods.

[34] See, for example, Hoover J, *The Response of Red-Tailed Hawks and Golden Eagles to Topographical Features, Weather, and Abundance of a Dominant Prey Species at the Altamont Pass Wind Resource Area, California,* National Renewable Energy Laboratory Report SR/500-30868, 2002

[35] a double transit is considered to be one in which a bird enters, leaves, and then returns to the zone within 100m of a turbine position

Method	Edinbane: golden eagle transits per 68.42 hours
Observed: all transits within 100m of turbine location, 20-100m height band	49
Observed: transits (AMEC counting method) within 100m of turbine location, 20-100m height band	40
Prediction: RDC, transits through rotor swept area	8
Prediction: Band et al. in wind farm zone, transits through rotor swept area	8
Prediction: AMEC, transits through rotor swept area	1

Table 9: Comparison of observed transits with predicted transits.

52 It is important to note that the observed transits are flights of maximum risk, ie they are in the region of the rotor swept area of the proposed turbines, and the large number of observed transits is of concern. The transit window used in the observations is larger (80m x 200m) than the rotor swept area per turbine (3.421 m^2). Assuming that the observed transits are randomly distributed in the 80m x 200m window and adjusting the number of observed transits for the ratio of the window to the rotor swept area per turbine, there are 9 observed 'rotor' transits (AMEC counting method) or 11 observed 'rotor' transits (all observed transits counting method) per 68.42 hours. These observed 'rotor' transits are consistent with the predictions of the Band et al. method in the wind farm zone and with the RDC method (both predict 8 transits per 68.42 hours), but are greater than the predictions of the AMEC method (1 transit per 68.42 hours). As has been noted, interpretation of the significance of the number of observed transits should be treated with caution due to low statistics and uncertainty in flight location. Nevertheless, it is concluded that there is no evidence in the observed flight data to support AMEC's assertion that its analysis is conservative.

Avoidance

53 With regard to the modeling of avoidance of turbines by golden eagles, RDC use a value of 99.5% (ie RDC assume that for every 200 transits that would occur if no turbines were present, only one transit would actually occur through the rotor, because the bird would take avoiding action 199 times in 200). AMEC prefers the use of 99.62% avoidance, ie only one transit out of every 263 potential transits would actually occur. SNH recommends an avoidance rate of 95%, ie one transit out of every 20 potential transits would actually occur due to avoiding action.

54 AMEC asserts that its 99.62% avoidance rate is based on observations made at Altamont by Thelander et al. 2003[36]. However, Thelander et al. 2003 directly contradicts AMEC's claim. In particular, the golden eagle utilisation rate and golden eagle mortality per rotor swept area reported in Thelander et al. 2003 are substantially different from AMEC's representation of that study. Consequently, AMEC's ostensible avoidance rate is substantially (order of magnitude) greater than that actually observed at Altamont.

55 AMEC represents[37] Thelander et al. 2003 as studying 1,110 turbines. However, Thelander et al. 2003 clearly states[38]:

> *"We sampled 1,110 individual tower and turbine configurations from March 1998 through December 2000 (Table 1). During the project, we added groups of turbines as they became available to us. In particular, Altamont Infrastructure Company (AIC) wind towers (n = 425) were added to our study much later than the others. By December 2000, we had sampled these turbines only one-third as many times as we did the other turbines in our sample.* ***This differential search effort would confound our analysis if we included all turbines being surveyed as of 31 December 2000. Therefore, we have separated many of the analyses in this report into AIC and non-AIC wind turbines. Unless specifically indicated, the findings presented in this report represent results only for non-AIC turbines/towers (Table 2; n = 685)."***

and[39]:

> ***"685 turbines were sampled once every five to six weeks"***

56 It is therefore clear that the results reported in Thelander et al. 2003 are for 685 turbines, not 1,110 turbines. AMEC also represents the effective mean rotor diameter of turbines in the study as 20m, when Thelander et al. 2003 clearly describes[40] an effective mean rotor diameter of 18.8m.

57 The effect of inflating the number and size of turbines above that actually used in the study is to diminish the Altamont mortality rate per rotor swept area. The ostensible avoidance rate is therefore artificially inflated (because the observed casualties are said to result from a total rotor swept area approximately twice that of the wind farm actually searched for golden eagle carcasses).

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[36] Thelander, C. G,Smallwood, K.S., Rugge, L., *Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area Period of Performance: March 1998-December 2000,* National Renewable Energy Laboratory Report SR-500-33829, 2003.

[37] AMEC, Edinbane Wind Farm Eagle Activity Assessment V3 Further Information, October 2004, Table 6, line 16

[38] Thelander, C. G,Smallwood, K.S., Rugge, L., *Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area Period of Performance: March 1998-December 2000,* National Renewable Energy Laboratory Report SR-500-33829, 2003, 4.1

[39] Ibid, 4.2

58 AMEC also represents[41] the area studied in Thelander et al. 2003 and used for the determination of the Altamont utilisation rate as being 565 ha. However, Thelander et al. 2003 clearly states[42] that the area of the study is 5,950 ha, not 565 ha.

59 The effect of the area used to normalise utilisation rate has already been noted in the context of AMEC's interpretation of the Edinbane flight data. In that case, AMEC used a larger area with the result that the Edinbane utilisation rate was diminished. In the Altamont case, AMEC uses a smaller area (approximately one tenth of that actually studied), which has the opposite effect of inflating the ostensible golden eagle utilisation rate at Altamont. This in turn further inflates the ostensible avoidance rate at Altamont, because the utilisation rate is said to be approximately ten times its actual rate, for the same number of observed golden eagle casualties.

60 AMEC asserts[43] that turbine operation at Altamont is 100%. Smallwood and Thelander report[44] that turbine operation at Altamont is approximately 49%. As noted above, there is uncertainty whether conditions unfavourable to eagle flight might be correlated with turbine non-operation. However, for reasons of consistency, the same factors ought to be applied in both the collision prediction and avoidance estimate, and AMEC has not done this. The effect of inflating the turbine operation time at Altamont is to inflate the ostensible avoidance rate, ie the observed casualties are said to be the result of turbines operating 100% of the time, when they are in fact operating for approximately half of that time.

61 Thelander et al. 2003 reported approximately 4 golden eagle casualties per year at the 685 turbines searched [45]. When the correct parameters reported in Thelander et al. 2003 are entered into AMEC's Altamont model[46], then an avoidance rate of 95% is required to achieve the observed collision rate of 4 golden eagles per year.

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[40] Ibid, Table 2

[41] AMEC Edinbane Wind Farm Eagle Activity Assessment V3 Further Information, October 2004, Table 6, line 1.

[42] Thelander, C. G,Smallwood, K.S., Rugge, L., *Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area Period of Performance: March 1998-December 2000*, National Renewable Energy Laboratory Report SR-500-33829, 2003, *Table 2: Plot Number, Plot Size, Tower Type, and Turbine Output Characteristics for 685 Non-AIC Turbines Included in Behavioral Observation Sessions* (note that the total area in Table 2 is given as 59.5 km^2 and there are 100 ha per square km, therefore the area studied is 5,950 ha)

[43] AMEC Edinbane Wind Farm Eagle Activity Assessment V3 Further Information, October 2004, Table 6, line 11 (AMEC uses 10 hours per day for flight hours per day for Altamont, cf its use of 8.2 hours per day in its Edinbane calculation, which is the product of 10 flight hours per day and 82% turbine operation).

[44] Smallwood, K. S., Thelander, C., Spiegel, L., *Raptor Mortality At The Altamont Pass Wind Resource Area*, Presentation to National Wind Coordinating Committee Meeting, November 17, 2003. (Turbine operation at Altamont is calculated from the mean of all months in the graph *Proportion of turbines operating during behavior observation session* on page 19 of the presentation)
www.nationalwind.org/events/wildlife/20031117/presentations/Smallwood

[45] Note that this is uncorrected for search efficiency or scavenger removal bias.

[46] AMEC Edinbane Wind Farm Eagle Activity Assessment V3 Further Information, October 2004, Table 6 – the correct parameters are: 5,950 ha at line 1; 4.9 hours at line 11; 18.8m at line 14, and 685 turbines at line 16.

62 It is concluded that the recommended SNH avoidance rate of 95% is consistent with Thelander et al. 2003. AMEC's ostensible avoidance rate of 99.62% is an order of magnitude greater and is contradicted by the scientific evidence upon which it is said to be based: therefore it is rejected. RDC's ostensible avoidance rate of 99.5% is also inconsistent with Thelander et al. 2003, and is also rejected.

63 The widespread use by the wind industry of arbitrarily diminished avoidance rates is of concern, as it reduces blade strike impact on paper but not in practice. It is requested that the Council advise AMEC to withdraw its claim that its 99.62% avoidance rate is based on Thelander et al. 2003.

64 Note that a golden eagle avoidance rate of 95% is not precautionary: it is the measured avoidance rate when the Band et al. method is applied using the observed data reported in Thelander et al. 2003.

65 Thelander et al. 2003 may overestimate the ability of golden eagles to avoid wind turbines: the blade strike statistics are low, not all turbines were searched every month[47], and the number of golden eagle carcasses reported is not adjusted for search efficiency or scavenger removal bias. While Thelander et al. 2003 predicts total golden eagle mortality in Altamont of 24 deaths per year, a complementary and more extensive study[48] by Smallwood and Thelander (Smallwood et al. 2004) involving search of 75% of all the turbines at Altamont predicts a golden eagle mortality of between 76 and 116 deaths per year. Therefore, the mortality measured in Thelander et al. 2003 likely understates the golden eagle collision rate at Altamont, and may imply an avoidance rate lower than 95%.

Golden eagle utilisation rate at Edinbane and Altamont

66 The golden eagle utilisation rate at Edinbane computed using the Band et al. method in the wind farm risk zone can be compared with the golden eagle utilisation rate at Altamont reported in Thelander et al 2003. Unfortunately, Smallwood et al. 2004 does not report the area used in its determination of utilisation rate, presenting instead risk in terms of deaths per MW per birds per hour, and direct comparison between the utilisation rate in Smallwood et al. 2004 and the Edinbane utilisation rate expressed in birds per hectare is not possible without further information[49].

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[47] Thelander, C. G,Smallwood, K.S., Rugge, L., *Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area Period of Performance: March 1998-December 2000,* National Renewable Energy Laboratory Report SR-500-33829, 2003, 4.2

[48] Smallwood, K.S. and Thelander, C.G., *Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area*, Public Interest Energy Research Program Contract No. 500-01-019, Final Report to the California Energy Commission, 2004, Section 4.4.1, www.energy.ca.gov/pier/final_project_reports/500-04-052.html

[49] The final report (currently in review) of the National Renewable Energy Laboratory contract study described in Thelander et al. 2003 is expected to report results for the same 61 study plots used in Smallwood et al. 2004, and this may provide sufficient information to make such a comparison.

Golden Eagle	utilisation rate ha^{-1}	Relative to Edinbane utilisation rate
Altamont (Thelander 2003)	3.17E-06	6.4%
Edinbane (Band et al. method in wind farm risk zone)	5.04E-05	100%

Table 10: Comparison of golden eagle utilisation rates at Edinbane and Altamont

67 It is of concern that the observed golden eagle utilisation rate in the Edinbane wind farm risk zone is an order of magnitude greater than the golden eagle utilisation rate measured at Altamont. Although there is no way of knowing whether the golden eagle utilisation rate at Altamont has increased or decreased since construction of the wind farm (there were no pre-construction studies), it is prudent to assume that the golden eagle utilisation rate post-construction at Edinbane will be comparable to or greater than that at Altamont.

Golden eagle blade strike rate

68 The predicted golden eagle blade strike rate is determined by multiplying the predicted collision rate by the non-avoidance rate[50]. Using the Band et al. prediction in the wind farm risk zone together with the avoidance rate measured in Thelander et al. 2003, 5.4 golden eagle blade strikes per year are predicted at Edinbane.

69 Smallwood et al. 2004 reports[51] between 0.1303 to 0.2008 golden eagle deaths per MW per year at Altamont. Assuming that the post-construction utilisation rates at Altamont and Edinbane would be equivalent, the 47.25 MW proposed by AMEC is predicted to kill between 6.2 and 9.5 golden eagles per year. Comparing the Smallwood et al. 2004 prediction with the various predictions for Edinbane:

Method	Collisions per year before avoidance	Avoidance rate	Golden eagle deaths per year predicted at Edinbane
Band et al. in wind farm zone	108	95.00%	5.41
RDC	110	99.50%	0.55
AMEC	18	99.62%	0.07
Smallwood (2004)			6.2 - 9.5

Table 11: Predictions of golden eagle blade strike rates at Edinbane

[50] ie 1 – (avoidance rate expressed as %)/100
[51] Smallwood, K.S. and Thelander, C.G., *Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area*, Public Interest Energy Research Program Contract No. 500-01-019, Final Report to the California Energy Commission, 2004, Table 3.11

70 The Band et al. method in the wind farm risk zone and a 95% avoidance rate is compatible with the observed blade strike rate at Altamont. In RDC's case, its unrealistic avoidance rate reduces the blade strike rate by one order of magnitude, while AMEC's use of 99.62% avoidance combined with its diminished utilisation rate reduces the predicted blade strike rate by almost two orders of magnitude. It is concluded that both RDC and AMEC underestimate the impact of the Edinbane wind farm on golden eagles; and that the Band et al. method with 95% avoidance is compatible with experiment but is not precautionary.

71 AMEC asserts that Altamont is atypical, citing a one-year study at Foote Creek Rim which reported a single golden eagle casualty. However, Altamont is the only site with comparable golden eagle utilisation at which where there have been sufficient studies to allow statistically significant conclusions to be drawn. Where less robust studies at other sites do exist, they are generally compatible with the findings at Altamont. For example, Smallwood et al.[52] compare the wind power sites that have both mortality and utilisation data, and conclude:

> *"The assertion that the APWRA is anomalous in its bird mortality is largely untrue. It appears true for raptor mortality at face value, but factoring in relative raptor abundance clarifies that the impact is relative to the local abundance. The impacts in the APWRA are nearly equal to impacts elsewhere relative to local abundance. Whereas the available data suggest that the APWRA kills more raptors than do other wind energy generating facilities, the risk index demonstrates that the APWRA kills no more raptors relative to the number seen per hour than do most other wind energy facilities. Adjusting for local relative abundance, the existing data indicate that most wind energy generating facilities have an equal impact on the local raptors."*

72 AMEC also asserts that Blythe Harbour, Beinn an Tuirc, Novar, and Beinn Ghlas are relevant to predicting the blade strike risk at Edinbane. These comparisons are rejected, on ground that there are no golden eagles in Blythe Harbour, and there have been no carcass searches at Beinn an Tuirc and Beinn Ghlas, insufficient systematic carcass searches at Novar, and in any event the golden eagle utilisation rates at these wind farms do not approach the level at Edinbane. It is not rational to claim that absence of evidence is evidence of absence of impact.

73 AMEC also advances various arguments for the reduction of predicted blade strike risk, asserting that the Band et al. method overestimates impact. For example, AMEC proposes that the rotor swept area of its turbines ought to be reduced by 50% when calculating risk, yet there is no evidence whatsoever to

[52] Ibid, 4.4.1

support the assertion that the inner 50% of rotor swept area presents zero collision hazard to golden eagles. AMEC's arguments are rejected in favour of the evidence: the broad agreement between the Band et al. model using 95% avoidance and the observed impact elsewhere where sufficient scientific data exists to allow comparison, and the broad agreement between the observed transits at Edinbane with those predicted using the Band et al. model.

Turbine level collision risk

74 AMEC identifies[53] 4 turbines said to present 33% of the risk; however, there is insufficient data to reliably discriminate between individual turbines and AMEC's claims of statistically significant evidence of risk reduction arising from the removal of turbines 3, 10, 11, and 20 is rejected.

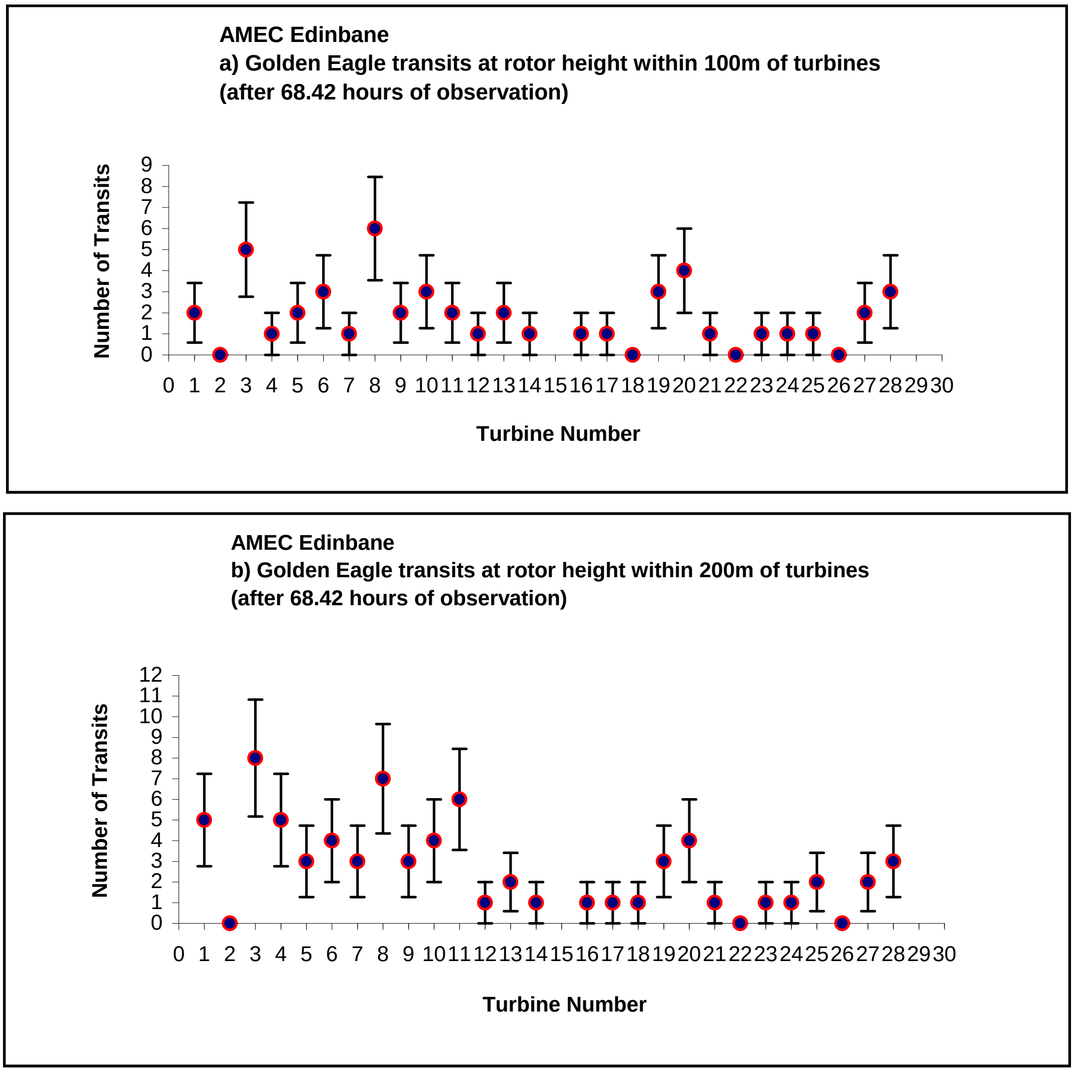

Figure 4: Observed transits within 100m and 200m of turbines at 20-100m height (all transits, unadjusted for turbine watch time)

[53] AMEC Edinbane Wind Farm Eagle Activity Assessment V3 Further Information, October 2004, 5

75 Note that the most frequently crossed turbines correlate with turbines having high cumulative visibility. Discrimination at the individual turbine level requires adjustment for turbine watch time, since turbines may have significantly different cumulative visibility from VPs used in non-simultaneous watches.

76 It is requested that the Council advise AMEC to collect further golden eagle flight data in order that the impact and mitigation of individual turbines might be analysed with reasonable statistically significance. This would also have the advantage of allowing a wind farm level estimate of the blade strike risk to the white-tailed eagles using the site[54].

Monitoring Mast

77 **Objection is lodged that the proposed location of the monitoring mast presents an unacceptable collision hazard to golden eagles.**

78 There are a significant number of transits in the area of the monitoring mast (including at least 5 within 100m in the 20-100m height band). AMEC propose that this structure will be supported by guy wires which are a known collision hazard, but offers no risk assessment for this structure.

Figure 5: Flights in the proximity of the guyed monitoring mast recorded after 68.42 hours of observation (red circles indicate 100m and 200m proximity zones around the mast).

79 It is requested that the Council advise AMEC to perform appropriate assessment of the impact of the monitoring mast on golden eagles and to consider alternative constructions and locations for this structure.

[54] this is of increasing concern, as there are now 14 white-tailed eagle blade strikes reported at coastal wind farms in northern Germany.

Mitigation Proposals

80 This site has the highest golden eagle utilisation of any under consideration in Scotland, an order of magnitude greater than the utilisation rate at Altamont, and there is scientific evidence to support the conclusion that its impact on golden eagle will be severe. There is reasonable doubt whether an impact of this magnitude can be satisfactorily mitigated. Nevertheless, under the circumstances, any mitigation measures that are proposed require to be robust and justified by rational argument.

81 AMEC does not quantify the effect of its mitigation measures, and in general its proposals lack specification and credibility. It is of concern that they include measures that have been demonstrated to increase the risk of golden eagle blade strike.

82 AMEC asserts that prior to the collection of site-specific golden eagle flight information, risk has been mitigated because *"the majority of wind turbines are set back from the main north south ridge and there are significant sized corridors to the nearest summit area of Ben Ska/Ben Aketil to the west"*[55].

83 Smallwood et al. report[56] golden eagle blade strike mortality is increased by 21% ($P<0.05$) when turbines are more sparsely distributed, by 12% ($P<0.05$) at turbines not in wind walls; by 17% ($P<0.05$) at end of string; by 2% ($P<0.05$) at gaps; and by 12% ($P<0.05$) at local clusters of turbines in a wind farm. The increased separation of turbines and the introduction of gaps and local clusters in order to provide corridors through the wind farm is likely to increase golden eagle blade strike, not mitigate it.

84 Smallwood et al. also report[57] golden eagle blade strike mortality is increased by 21% ($P<0.05$) when turbines are located on a ridgeline, and by 13% ($P<0.05$) in a canyon. Despite AMEC's assertion of 'set back' from the main ridge, turbines 9, 20, 21, 22, and the guyed monitoring mast remain on the ridge. Turbines 19, 18, 17, 16, 14, and 13 are located in the prominent canyon between Ben Sca and the Beinn a Chearcaill ridge. These configurations are likely to increase golden eagle blade strike risk, not mitigate it.

85 AMEC asserts that the suppression of prey resource in the wind farm zone is a mitigation measure, and claim that this will reduce golden eagle flight activity in the wind farm zone.

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[55] AMEC Edinbane Wind Farm Written Statement, June 2002, 7.4.2
[56] Smallwood, K.S. and Thelander, C.G., *Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area*, Public Interest Energy Research Program Contract No. 500-01-019, Final Report to the California Energy Commission, 2004, Tables 7.1 and 7.5
[57] Ibid

86 Smallwood et al. report[58]: *"all the focal raptor species in our study flew disproportionately closer to wind turbines in areas of intermittent rodent control, and golden eagles did so in areas of intense rodent control … All the focal raptors also made disproportionately more of their dangerous flights in areas of intense rodent control"*. Suppression of prey resource is likely to increase golden eagle blade strike risk, not mitigate it.

87 AMEC proposes to install audio bird deterrents, citing Dooling, and claim that this will reduce golden eagle blade strike risk.

88 Dooling states[59]: *"the hypothesis that louder (to birds) blade noises result in fewer fatalities is untested"*. In the absence of any scientific evidence, it remains possible that the scheme proposed by AMEC may increase blade strike risk, for example by confusing or startling birds into turbine rotors.

89 AMEC proposes to paint turbine blades, citing Hodos, including the use of UV paint, citing Young, and claim that this will reduce golden eagle blade strike.

90 Hodos states[60] *"it is important to note that these studies have only evaluated the visibility of anti-motion-smear blade patterns and not their ability to deter a flying raptor from approaching them"*.

91 Young et al. report[61] *"no statistically significant differences existed between fatality rates for the UV and non-UV turbines"*.

92 Smallwood et al. report[62] *"we found no evidence for any species that indicated colored blade tips or striped blades associated with fewer than the expected number of fatalities"*.

93 There is no scientific evidence to support AMEC's claim that a blade-painting scheme will reduce golden eagle blade strike.

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[58] Ibid, 8.3.3

[59] Dooling R., *Avian hearing and the avoidance of wind turbines*, National Renewable Energy Laboratory Report TP-500-30844, 2002, page 2

[60] Hodos, W. , *Minimization of Motion Smear: Reducing Avian Collisions with Wind Turbines. Period of Performance: July 12, 1999 to August 31, 2002*, National Renewable Energy Laboratory Report NREL/SR-500-33249, 2003, page ii

[61] Young D. P., Jr, Erickson W.P., Strickland M.D., Good R.E., and K.J. Sernka**,** *Comparison of avian responses to UV-light-reflective paint on wind turbines*, National Renewable Energy Laboratory Report NREL/SR-500-32840, 2003, page 12

[62] Smallwood, K.S. and Thelander, C.G., *Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area*, Public Interest Energy Research Program Contract No. 500-01-019, Final Report to the California Energy Commission, 2004, 7.3.2

94 AMEC proposes positive management outwith the wind farm zone, claiming that it will reduce blade strike risk. No details of the nature or extent of these management proposals is given.

95 There is no evidence that range management outwith the wind farm zone will reduce the flight activity inside it. At Beinn an Tuirc, the wind farm zone was infrequently used by golden eagles before construction, and it has not been possible to determine whether range management at Beinn an Tuirc development has modified golden eagle behaviour[63]. Without any specification of AMEC's range management proposals, it is impossible to comment on the potential for reduction or increase of blade strike risk that may arise from them. It is requested that the Council advise AMEC to provide specific details on these range management proposals.

96 AMEC also suggests that monitoring of impact might in some way mitigate golden eagle blade strike risk. Monitoring is not a substitute for mitigation, and it is inappropriate and unlawful to perform a monitoring experiment when the expected result is a severe impact on golden eagles and the Cuillins SPA. In any event, monitoring at Edinbane would be ineffective, since to date there has been no control study and insufficient pre-construction data collected to illuminate the significant factors that might arise post-construction. Should this wind farm proceed in any modified form, it is requested that the Council require AMEC to perform a full BACI study with a scientific experimental design, including assessment of the duration and scope of pre-construction and control studies necessary to achieve statistically significant discrimination between the different factors contributing to impact.

97 A number of other potential measures are described in the literature yet have not been considered by AMEC. It is requested that the Council advise AMEC to comprehensively and rationally assess the potential for mitigation, and provide quantified estimates for the reduction of risk expected for each measure.

Impact on Skye population

98 The development is likely to have a significant effect on the golden eagle population in Skye, including that in the Cuillins SPA.

99 AMEC has not performed any appropriate assessment of this impact on population. It is requested that the Council advise AMEC to provide an appropriate assessment of the impact of its proposal on the Skye and Cuillins SPA golden eagle populations, and make this available for public comment.

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[63] Letter from Saya Sheridan, Manager, Central Kintyre Habitat Management Plan, to Marilyn Henderson, Secretary, Avich & Kilchrenan Community Council, 17 February 2004

Appendix A

(for ease of comparison the layout here broadly follows Madders, M., *Proposed Windfarms at Ben Aketil and Edinbane: A quantitative collision risk model for golden eagle*, Ben Aketil Wind Farm Further Information, March 2004, Appendix B)

EDINBANE: BAND et al. MODEL OF GOLDEN EAGLE BLADE STRIKE IN WIND FARM RISK ZONE

WATCH DATA				
VP	**Visible Area (ha)**	**Watch Time (s)**	**Flying time 20-100m (s)**	**Utilisation Rate 20-100m (ha^{-1})**
B	319	73500	2385	**1.01615E-04**
E	502	60900	390	**1.27565E-05**
F	376	54000	180	**8.86720E-06**
G	214	57900	971	**7.82232E-05**
mean	353	61575	982	**5.03654E-05**

WIND FARM DATA	
Wind farm area (ha)	380.00
No. of turbines	27
Rotor diameter (m)	66.0
(% of 20-100m band)	82.5%
Max. rotor depth (m)	2
Turbine operation	82%

Mean activity in wind farm	
Rotor height	0.01579

BIRD DATA	
Length (m)	0.85
Flight speed (ms^{-1})	13
Hours per day bird present	10
Days per year bird present	365

Flight Risk Volume V_w (m^3)	250800000
Rotor Swept Area A_r (m^2)	92372
Rotor Swept Volume $V_r = A_r * (d+l)$ (m^3)	263261
Bird occupancy (hrs yr^{-1})	57.63
Bird occupancy of V_r (s yr^{--1})	217.78
Bird transit time (s)	0.22
No. of transits through rotors per year	**993.40**
No. of collisions per year	**108.26**
Blade strikes per year after avoidance	**5.41**
Years per blade strike	**0.18**
Blade strikes per 25 years	**135.33**

OUTPUT FROM COLLISION MODEL	
% transits that will collide	13.29%
% after turbine operation	10.90%

AVOIDANCE	
non-avoidance	0.05
(% avoidance)	**95%**