

Despite national surveys the species remains under-recorded because of its capacity for surviving in small, isolated colonies. No national surveys were conducted in Grid square NC81 but important vole colonies were recorded on adjacent catchments further north in Caithness. At Gordonbush the species has been observed as a prey item at fox dens (R. Rowntree; pers.comm.).

Water voles are relatively habitat specific favouring slow or sluggish watercourses (typically with a stream gradient of less than 3%) with densely vegetated margins, providing cover and food and soft banks suitable for burrows. Characteristically, this results in scattered colonies – frequently small – which are interdependent for their long term stability.

In Scotland colonies extend to altitudes of at least 600m and upland populations are assuming greater significance as lowland populations decline because they occur in relatively unmanaged habitats lying above the core activity zone of mink, their most damaging predator. Mink do not yet appear to have colonised the Gordonbush area but scattered records exist north of the Dornoch Firth suggesting that their appearance is imminent.

#### c) Badgers

National survey data suggests that badgers are uncommon around Brora but are more widely, if thinly, distributed regionally. Local records of badger setts exist for the Strath of Kildonan but the species is said not to be resident at Gordonbush (R. Rowntree; pers.comm.). In addition, most of the survey area lies above the altitudes (up to 200m) at which badgers most commonly exist and consists of acid, waterlogged soils offering limited food and shelter. Consequently a full search was not conducted for this species but signs were looked for in the course of the otter and water vole surveys.

## 2. LEGISLATION

The otter is protected by both the Wildlife and Countryside Act (1981) and the Conservation (Natural Habitats etc.) Regulations 1994. It is an offence to intentionally disturb an otter or to damage, destroy or obstruct access to an otter shelter, whether intentionally or otherwise.

The water vole is protected by the Wildlife and Countryside Act (1981). It is an offence to intentionally disturb a water vole in its shelter or to intentionally damage, destroy or obstruct access to a shelter.

The badger is protected by the Protection of Badgers Act 1992. It is an offence to recklessly disturb, damage, destroy or obstruct access to a badger sett.

For all three species damaging or disturbing operations might not be illegal if it could be shown that they were the incidental effects of lawful operations which could not reasonably be avoided. However, such actions would require prior consultation with Scottish Natural Heritage and (for otters) with the Scottish Executive. Impacts upon badger and otter shelters would – if agreed – be controlled by conditions issued under licence.

In addition to these legal restraints, guidelines have been issued by both statutory and voluntary bodies seeking to minimise the impacts of development on protected species across the full range of their habitats by the adoption of best practise methodology. Where relevant these publications are referred to later in this text.

## 3. METHODOLOGY

The survey area is depicted on Map 1. All watercourses, water bodies and adjacent wetland were surveyed in full including minor aquatic features not shown on the map. In addition, transects were walked across watersheds and marshy ground.

For all species a search was made for tracks, paths, dropping, food remains and shelters and notes were taken of habitat characteristics and quality.

## 4. RESULTS

### a) Otters

Otter Habitat and Otter Activity - both watercourses present on site are small spate rivers, of similar size, with progressively declining current speeds along the upper reaches of head and side streams. Migratory fish do not reach the survey area because of natural obstacles (R. Rowntree; pers.comm.) suggesting that species diversity, as well as productivity, is likely to be low. Hunting effort in the more rapid sections of the watercourses will also be energetically costly.

Apart from fish the only significant otter prey item present on site comprises frogs which were observed at a number of locations. In the uplands during the spawning season these can constitute 90% of otter diet. At Gordonbush there are only minor developments of bog and pool habitat favourable to spawning amphibians but these are sporadic and widespread, occurring not only along watercourses but also at old peat workings and along hill grips. As a consequence otter movements are complex and wideranging.

Across the survey area a total of 126 otter spraints (= droppings) were identified located at 52 widely distributed spraint sites (Map 1).

About one quarter of spraints were of fresh or recent origin and a similar percentage consisted primarily of amphibian remains (Table 1). On hill ground within one kilometre of the proposed turbine sites the percentage of fresh and recent spraints was rather higher than lower downstream (30% c.f. 24%) and the frequency of spraints containing amphibian remains also increased (33% c.f. 23%). These increases reflect the availability of frogs in the spring and early summer and might be expected to reduce or even reverse as the year progresses and otters focus upon fish predation at lower altitudes.

The density of otter spraints and spraint sites was rather higher on the Allt a Mhuilinn than on the Allt Smeorail which may reflect the gentler character of the former watercourse (Table 1). The efficiency of prey capture in moving water is influenced,

in part, by turbulence. Nonetheless, for both catchments the sprinting frequency was rather low due to the austere nature of the aquatic habitat.

Even so, otter activity on site is repetitive and widespread suggesting the presence of resident otters exploiting established – though probably not prime – sections of home ranges whose boundaries will reach outwith the area surveyed. Total otter habitat within the survey area (at c.21km of watercourse) equates to approximately one adult female home range plus half the range of an adult male otter. In practice, it is more likely that it serves a larger number of individuals, each to a lesser degree.

Otter activity on the Allt a Mhuilinn extended to an altitude of 375m whilst on the Allt Smeorail it reached 355m. In both cases this was sufficiently close to watersheds (most of which are of gentle gradient) to suggest that cross watershed movements might also occur – both within and outwith the survey area. Such movements would be characteristic for otters in this type of habitat.

Otter Shelters – two probable and one definite otter holts were discovered on the Allt Smeorail. One probable and two definite holts were identified on the Allt a Mhuilinn. Four of these shelters were under rock or amongst boulders; one other was tunnelled into peat and the last consisted of adapted rabbit holes in a sandy bank. Their general location is indicated on Map 1.

Otters use large numbers of shelters in freshwater because of their extensive, linear home ranges. Sites are commonly changed on a daily basis. At Gordonbush there will be some shelters (between 3-6 judging by radio-tracking data) which have not been identified because they are currently little used. These are most likely to be situated in the northern section of the survey area. On these uplands otters are just as likely to shelter above ground in dense heather or rush as below ground (e.g. in peat cavities) but potential shelter of both types is readily available.

#### b) Water Voles

With the exception of a few small developments of mire and backwater adjacent to the main stems of the watercourses most of the potential water vole habitat on site is confined to the upper reaches of head and side streams draining the central peat core. Of these the most productive burns appear to be those which are margined with grass and rush rather than with heather or sphagnum. Current vole distribution may also be affected by land management practice since burning in the northern survey area has reduced and simplified the existing vegetation cover. This has the potential to deny vole occupation by restricting the food supply and increasing the risk of predation.

Within the survey area one significant population of water voles was located spread along central headstreams of the Allt a Mhuilinn (Map 2).

In addition, old burrows were discovered in good quality habitat on the upper Allt a Mhuilinn where active signs were recorded in 2002 (D. Painter; pers.comm.).

Finally, a limited spread of signs was discovered at two locations about 850m apart on the upper reaches of the Allt Smeorail.

As expected, no signs of mink were identified.

Further, potential vole habitat exists on site but is nowhere abundant. Headwaters of the Allt a Mhuilinn outwith the survey area also appear promising (judged from the map) and could contain further components of the water vole metapopulation for this catchment.

Of the three vole localities identified in this survey the southern Allt a Mhuilinn colony was the only one of any extent with about 60 burrows counted over about 520m of stream length. Accurately quantifying burrow and latrine density in order to obtain some measure of population size was not possible because streams were periodically subterranean and vole signs inaccessible but an observed burrow density of 11.6 burrows per 100m of burn compares with a mean for the first Scottish national survey of 24 sites per 100m.

Between 10-12 burrows were counted on the Allt Smeorail with very limited indications of current activity, including signs of predation by fox. Favourable vole habitat on this catchment is small scale and widely dispersed. The current distribution may result from (or be dependent upon) emigration from the Allt a Mhuilinn.

#### c) Badgers

No signs of badgers were identified.

In addition to the habitat limitations imposed by elevation and unproductive soils the removal of sheep from the hill ground and the collapse of a once extensive rabbit population has coarsened the vegetation cover and encouraged sward heights in excess of the 5cm below which badgers forage most successfully for invertebrates.

## 5. PERCEIVED IMPACTS OF THE PROPOSED DEVELOPMENT

### i) Construction Impacts

Construction impacts will extend over approximately 10 months with most work occurring during daylight, at an acceptable distance from aquatic habitats. Apart from the possibility of pollution – which is being handled centrally – perceived impacts upon otters and water voles are as follows:-

#### a) Otters

Otter Shelters – all of the shelters identified in this survey lie outwith the 20m buffer zone which Scottish Natural Heritage advise in order to prevent unacceptable disturbance. The closest separation distance is c.70m on the lower reaches of the Allt Smeorail.

There may be further shelters located in the turbine area which were not identified during the survey. These are likely to lie within 5-10m of the permanent watercourses. No potential sites were located around the various stream crossings associated with the development.

Otter Habitat – access tracks cross and turbine sites etc. approach watercourses at a number of locations. Otter habitat in the turbine site area is fragile and sustains only a single prey resource. Losses of this resource during construction could arise from pollution, from impacts upon hydrology or from the direct loss of bog and pool systems. Such losses would probably be minor but would also be undesirable.

General Disturbance – from construction will be concentrated in the turbine site area during the spring and early summer when frogs are most available.

Because the amphibian habitat is dispersed disturbance will affect only a minority of localities at any one time. Predation of frogs by otters in the uplands can occur diurnally (pers.obs.) so there may be a localised impact upon feeding behaviour. However, experience at a variety of projects (e.g. the Skye Bridge; the M74 upgrade etc.) indicates that otters will continue to exploit the Gordonbush site and general disturbance impacts will be minor.

#### b) Water Voles

Damage and Disturbance – there are no Scottish Natural Heritage guidelines about what constitutes unacceptable disturbance to water voles but for a small species with individual territories extending to a maximum of 300m and most activity confined to a 2-3m wide strip of bank issues of damage and disturbance are conjoined.

None of the observed water vole distribution on site is subject to direct construction impacts but turbine sites approach closely to two of three vole populations. Elsewhere, access tracks cross two areas of potential vole habitat – at the stream crossing 500m southwest of turbine 29 and at the stream crossing immediately south of turbine 07. Since water vole habitat is also commonly suitable for spawning amphibians impacts there could have repercussions for both voles and otters.

Impacts might arise from pollution (though this is less significant for water voles than for otters), from the disruption of hydrology or from direct damage to streams or pools and their marginal vegetation. In the current scheme such impacts should be minor and may be largely avoidable.

#### ii) Operational Impacts – Both Species

No significant impacts are anticipated for the operational phase of the development.

Water voles are notably tolerant of human disturbance and have profited from this in urban settings and at golf courses etc. by being less sensitive to human activity than predators such as mink.

Otters will experience impacts on site at the individual level. More mobile and secretive than water voles they, too, have adapted to background human disturbance and are now resident within Greater Glasgow and other Scottish conurbations. Access tracks and turbines will impinge on otter habitat directly or indirectly but the effects in what will remain a remote, secure landscape will be minor.

The risk of otter road mortalities – a significant hazard on many public roads – will be minimised by low traffic speeds and density.

## 6. PROPOSED MITIGATION

i) For both species good working practice is required to ensure that hazardous chemicals, fuel oils etc. do not pose a risk to wildlife. For the same reason, pipelines should be capped at the end of each working day.

ii) For both species stream crossings should be sited at hard margins, where possible. Current speed should not be enhanced through stream culverts and work around the culverts should be minimised and conducted from one bank only.

iii) For both species losses of pools and adjacent wetland should be avoided. This may require the flexing of some proposed tracks e.g. the access track to turbine 29. If losses cannot be avoided consideration should be given to habitat restoration with emphasis placed upon the habitat requirements of frogs and water voles. Details of construction techniques are available in a variety of publications including the Water Vole Conservation Handbook and Ponds, Pools and Lochans (see References).

iv) To minimise disturbance to water voles a buffer zone 5m wide is commonly recommended for watercourses. At Gordonbush the physical and hydrological impacts associated with establishing footings for turbines on blanket peat suggest that this might be insufficient.

In addition, a separation distance of 20m is desirable to minimise impacts upon otter shelters, some of which remain undiscovered. Consequently, the general application of a 20m buffer zone throughout the turbine site area would have a precautionary value for both species

## 7. REFERENCES

Cresswell P, Harris S & Jefferies D J (1990). The history, distribution, status and habitat requirements of the badger in Britain. NCC. Peterborough.

Green J & Green R (1980). Otter survey of Scotland 1977-79. The Vincent Wildlife Trust. London.

Green J & Green R (1994). Otter survey of Scotland 1991-94. The Vincent Wildlife Trust. London.

Green J, Green R & Jefferies D J (1984). A radio-tracking survey of otters *Lutra lutra* on a Perthshire river system. *Lutra* 27: 85-145. Leiden.

Harris S, Morris P, Wray S & Yalden D (1995). A review of British mammals: population estimates and conservation status of British mammals other than cetaceans. JNCC. Peterborough.

Scottish Natural Heritage (1997). Scotland's wildlife: otters and developments. Edinburgh.

Scottish Environment Protection Agency (2000). Ponds, Pools and Lochans. Stirling.

Scottish Natural Heritage (2001). Guidelines on the environmental impacts of windfarms and small scale hydroelectric schemes. Perth.

Strachan R (1998). Water vole conservation handbook. English Nature, the Environment Agency and WildCRU. Stafford.

Strachan R & Jefferies D J (1993). The water vole *Arvicola terrestris* in Britain 1989-90: its distribution and changing status. The Vincent Wildlife Trust. London.

Strachan C, Strachan R & Jefferies D J (2000). Preliminary report on the changes in the water vole population of Britain as shown by the national surveys of 1989-90 and 1996-98. The Vincent Wildlife Trust. London.

**TABLE 1. Otter Signs at Gordonbush**

	<u>Spraints No./km</u>	<u>Spraint Sites No./km</u>	<u>Recent Spraints</u>	<u>Frog Spraints</u>
<b>Allt Smeorail</b>	n = 25 5.1/km	n = 23 2.1/km	25%	22%
<b>Allt a Mhuilinn</b>	n = 71 7.1/km	n = 29 2.9/km	21%	24%
<b>Total</b>	<b>126</b>	<b>52</b>	<b>23%</b>	<b>23%</b>



## Appendix 9.1 **Birds Technical Report**

(Note: Survey undertaken prior to layout finalisation)



# Technical Report: Birds

## 1. Scope of the ornithological survey

The baseline ornithological survey was undertaken with the following objectives:

- To quantify the breeding bird population.
- To determine the level of flight activity by birds.
- To investigate the use of the proposed windfarm by non-breeding birds.

The location of the survey area is shown in Fig. 1. Note that this is based on the turbine layout supplied to Natural Research at the commencement of surveys in May 2002. The envelope enclosed by the outer turbines + 500m was surveyed. Subsequently, a number of design iterations have occurred, such that a small part of the windfarm extends outside the survey area.

## 2. Methods of the ornithological survey

Field surveys were undertaken during May 2002 – March 2003. The surveyors were Helen Duguid, Richard Schofield, Bob Stakim, Jeff Stenning and Andrew Thorpe.

Field surveyors received extensive training prior to and during survey work. Aspects covered included navigation, application of the various survey methods, techniques to minimise fieldworker effects on bird detection, and recognition of birds and bird behaviour. This training was provided irrespective of the field surveyors' previous experience. Emphasis was placed on the importance of carrying out the surveys in a systematic, standardised way to effect direct comparability of all data collected.

### 2.1 Breeding bird survey

#### Field methods

Breeding bird territories were surveyed using an intensive version of the Brown and Shepherd (1993) method for upland bird survey. All bird species were surveyed with the exception of meadow pipit.

To allow for differences in detection rates between early and late breeding species, two visits were made to the site; the first on 31 May, the second on 22 June 2002. Fieldwork was undertaken between sunrise and sunrise + 6 hours. Weather conditions can greatly affect bird detection rates. In order to reduce this effect, work was not carried out in winds greater than Beaufort Scale Force 4, in persistent precipitation or when visibility was poor (<300m).

The survey was systematic with a constant search effort maintained throughout. All points within the survey area were approached to within 100m. By following a route that included raised ground and vantage points, fieldworkers ensured that all ground was clearly visible. Rocky outcrops and patches of scree were approached and examined. All burns were walked. Surveyors paused at regular intervals to scan and listen for calling and singing birds.

Careful attention was given to recording behaviour indicative of breeding (see Section 2.1.2).

When individual or pairs of birds were encountered, efforts were made to establish whether, in the fieldworker's opinion, such birds were different from those previously encountered. This involved careful attention to the

whereabouts of birds and their movements, and the sex and plumage characteristics of individual birds. If necessary, surveyors retraced their steps in order to check the continued presence of previously recorded birds.

With the exception of skylark, the location and activity of all birds surveyed were recorded on to 1:15,000 scale maps using standard BTO species and activity codes (Marchant 1983). For skylark, the location of territorial males was mapped (i.e. males singing, advertising or defending territories). Most of the birds recorded moved around, e.g. whilst displaying or when flushed. In these cases, the position of birds was mapped at the point they were first detected. Only the flight lines of birds seen flying over the survey area were recorded.

#### Compilation of the bird distribution maps

At the end of each visit, a summary map was compiled showing locations of breeding territories or breeding 'pairs'. Registrations were considered to represent breeding territories / pairs if any of the following were observed:

- song / courtship / display,
- territorial behaviour / territorial dispute,
- nest building (including excavating nest hole),
- adult(s) visiting probable nest site,
- a nest or newly fledged young,
- agitated behaviour by adult bird(s) indicating nearby presence of nest or young (e.g. repetitive alarm calling, distraction display),
- adult(s) carrying food to nearby nest or young,
- adult(s) removing a faecal sac.

Where a number of breeding individuals were present and it was not possible to determine the exact number of breeding pairs, registrations of individual birds were deemed to represent discrete breeding territories / pairs if the distance between them was more than 250m (200m in the case of red grouse, 50m in the case of dunlin). Whilst it is recognised that these distances are arbitrary and that territory size varies both inter- and intra-specifically, this approach produces a standardised index of abundance based on the distance that members of a breeding pair are likely to move within a survey period. In cases where individuals were considered to constitute a pair of birds, the location of the pair was placed centrally by convention.

Population estimates were derived by examining the summary maps for each visit in combination. Pairs were considered to be separate from one another if they were located more than 1000m apart (500m in the case of red grouse and skylark, 200m in the case of dunlin). Again, these distances were chosen arbitrarily to broadly reflect the distances birds might have plausibly moved between survey periods. For mapping purposes, the location of such pairs was taken as equidistant from both mapped observations.



## 2.2 Observations of bird flight activity

The aim was to quantify flight activity over the proposed development site in order to:

1. Identify areas of critical importance to birds.
2. Estimate the likelihood of collisions with wind turbines.

In particular, information was gathered on *raptors*<sup>1</sup>, *waterfowl*<sup>2</sup> and *raven*. An important component of the work was to quantify use by *target species*<sup>3</sup> and collect information on the relative use of different parts of the proposed development site by these birds. Information on the proportion of time that *target species* spent flying at different elevations was also gathered. These data can be used to predict the amount of time *target species* spend flying at turbine rotor blade height within the proposed windfarm.

The information on bird flight activity was collected during watches from strategic vantage points (VPs). These were chosen parsimoniously in order to achieve maximum visibility with the minimum number of points and such that no point was greater than 2km from a VP. VPs close to the nest sites of rare or scarce birds were avoided. The location of the two VPs selected and the ground area visible from each<sup>4</sup> are shown in Table 1 and Figs. 2-3.

Table 1. Location of vantage points at Gordonbush in 2002/03.

VP	Grid reference	Planimetric area visible (ha)
1	NC 85686 15270	164.83
2	NC 87317 13628	240.51
	<b>Total (visible area)</b>	<b>405.34</b>
	<b>Total (survey area)</b>	<b>741.04</b>

Observers positioned themselves at VPs so as to minimise their effects on bird movements. Watches were undertaken during daylight hours by a single observer in conditions of good ground visibility (> 3km) and when the cloud base was higher than the most elevated ground observed. A summary of monthly observations undertaken is shown in Table 2.

<sup>1</sup> i.e. all raptors + short-eared owl.

<sup>2</sup> i.e. divers, grebes, cormorant, herons, swans, geese, ducks, waders, skuas, gulls & terns.

<sup>3</sup> i.e. bird species listed on Annex 1 of the EC Directive (79/409/EEC) on the Conservation of Wild Birds (the Birds Directive 1979) and/or in Schedule 1 of the Wildlife and Countryside Act (WCA) 1981.

<sup>4</sup> Measurements made using GIS (ground beyond the survey area excluded).

Table 2. Summary of flight activity observations at Gordonbush in 2002/03.

VP	Observation time (hours)											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	9.0	3.0	9.0	0	3.0	0	2.0	2.0	2.0	1.0	2.0	3.0
2	9.0	3.0	9.0	0	3.0	0	2.0	2.0	2.0	1.0	1.5	3.0
<b>Total</b>	<b>18.0</b>	<b>6.0</b>	<b>18.0</b>	<b>0</b>	<b>6.0</b>	<b>0</b>	<b>4.0</b>	<b>4.0</b>	<b>4.0</b>	<b>2.0</b>	<b>3.5</b>	<b>6.0</b>

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

1. Focal bird sampling. The area in view was scanned constantly until a *target species* was detected in flight. Once detected, the bird was followed until it ceased flying or was lost to view. The time the bird was initially detected and the time it spent within the survey area (to the nearest second) were recorded. The route followed by the bird was plotted in the field on to a 1:25 000 scale map, with direction of flight indicated. Routes were plotted regardless of whether or not the bird was within the survey area. Within the survey area, the bird's flying elevation above the ground was estimated at the point of detection and at 15 sec intervals thereafter, using a countdown timer with audible alarm. Flying elevation was classified as <10m, 10-100m, or >100m. These observations had priority over method (2).
2. Activity summaries. At the end of each 5 min period, the number of all flying *raptors*, *waterfowl* and *raven* observed in the survey area was recorded. If a *target species* was being tracked at the end of the 5 min period, the activity summary for that period was scrapped and a new 5 min period was begun once observations of the *target species* had ended. The number of birds recorded in any one period was the minimum of individuals that could account for the activity observed.

Data were entered in the field on to recording sheets and later transferred to Excel spreadsheets. Maps of flight activity by *target species* were compiled for each watch. Each flying bout was numbered consecutively and cross-referenced to the relevant flight-path on the map. Summary maps were compiled for each species at the end of the season.

## 2.3 Survey of birds during the autumn and winter

A combined walkover and scan method was used. Walk routes were selected that linked VPs used during the observations of flight activity (see 2.2) and that allowed as much ground as practicable to be examined. In particular, all areas of potential ornithological interest e.g. water bodies, ridges potentially holding flocks of golden plovers, habitat potentially holding concentrations of waders or wildfowl. The routes differed between visits so that the entire site was covered over time. Surveys were undertaken in conditions of good visibility (at least 3km). Emphasis was placed on recording birds of high nature conservation importance i.e. VP *target species*.

During the walk routes the following details were recorded:

1. For *target species* the time each individual was first detected, along with details of age, sex and behaviour. These details were cross-referenced to a 1:25 000 scale field map where the location and flight route (if applicable) were plotted.
2. For all other species, the number of individuals and location where first detected were plotted on the map.

Methods used during the VP watches are given in Section 2.2. Thus, unlike the walk route method, flights within the survey area by *target species* were timed and their flying height above the ground recorded. *Non-target species* were recorded separately.

At the end of survey a check list was compiled of all species encountered giving summary details of general status on site, information relating to any notable concentrations or behaviour etc.

## 2.4 Survey of lagomorphs, sheep and deer carrion

The number and location of brown hares, mountain hares, rabbits, sheep carcasses and deer carcasses were recorded during all other survey routines.

## 3. Results of the ornithological survey

### 3.1 Results of the Breeding Bird Survey

Nine species were recorded during the breeding period (April-July; Table 2) of which five species bred. The approximate locations of breeding territories are shown in Fig. 4.

**Table 2. Bird species recorded at Gordonbush during April-July 2002. Breeding densities are shown for species where comparable data exist from other localities in the UK (waders and skylark). B = common breeder, territories not mapped, P = present, no evidence of breeding.**

Species	No. territories	Territories km <sup>-2</sup>
Buzzard	P	
Golden eagle	P	
Kestrel	P	
Red grouse	11	
Golden Plover	26	3.51
Dunlin	10	1.35
Skylark	173	23.35
Meadow Pipit	B	
Raven	P	

The site's breeding bird community was typical of an upland plateau in the heart of the peatlands of Caithness and Sutherland. Golden plover, skylark and meadow pipit bred commonly throughout the site; dunlin on more localised, flatter and wetter areas; red grouse in areas providing suitably abundant heather *Calluna vulgaris* for feeding.

Buzzard, golden eagle, kestrel and raven all foraged on the site.

### 3.2 Observations of flight activity

Flight activity by six species of bird was recorded, including two species listed on Annex I of the EC Birds Directive (golden eagle and peregrine; Table 3, Figure 5).

**Table 3. Summary of flight activity by Annex I bird species observed at Gordonbush in 2002/03. For each species, the table shows the total number of hours watched from each VP, number of flights, total duration of flying time in seconds and percentage of 15s recording intervals that birds were recorded within the three categories of flying height.**

Golden eagle				Flying height (% time)		
VP	Obs. hrs	No. flights	Fly. time (s)	<10m	10-100m	>100m
1	36.0	3	706	20	30	50
2	35.5	3	190	6	67	27
<b>Total</b>	<b>71.5</b>	<b>6</b>	<b>896</b>	<b>18</b>	<b>38</b>	<b>44</b>

Peregrine				Flying height (% time)		
VP	Obs. hrs	No. flights	Fly. time (s)	<10m	10-100m	>100m
1	36.0	1	47	0	100	0
2	35.5	0	0	0	0	0
<b>Total</b>	<b>71.5</b>	<b>1</b>	<b>47</b>	<b>0</b>	<b>100</b>	<b>0</b>

Four of the six observations of flying golden eagles were made between 1515-1706 hrs on 1 May 2002 and were considered to have related to a single sub-adult foraging in the area. The bird was recorded flying over the higher ground along the north and east sides of the site for a total of 5.45 minutes. The other observations were on single days in September 2002 and April 2003. The sightings are thought to relate to a bird / birds occupying a known breeding / roosting site located or alternative potential nesting / roosting sites. A female peregrine was seen flying over the site on 12 November 2002.

Three non-target species were observed; buzzard, kestrel and raven. All three species occasionally foraged on the site (Table 4).

**Table 4. Summary of flight activity for non-target species observed at Gordonbush in 2002/03. For each species, the table shows the total number of hours watched from each VP and the percentage of five-minute recording periods that each species was recorded flying over the site. BZ = buzzard, K = kestrel, RN = raven.**

VP	Obs. Hrs	Species		
		BZ	K	RN
1	36.0	4%	1%	1%
2	35.5	3%	3%	3%
<b>Total</b>	<b>71.5</b>	<b>3%</b>	<b>2%</b>	<b>2%</b>

### 3.3 Results of the autumn / winter bird surveys

Surveys were undertaken on nine dates between 6 August 2002 - 15 March 2003 (Table 5).

Table 5. Numbers of birds recorded at Gordonbush during August 2002 – March 2003. P = Present, no count made.

	06/08/02	22/09/02	30/10/02	12/11/02	03/12/02	18/01/03	19/01/03	21/02/03	15/03/03
Greylag				4					
Golden eagle								2	
Buzzard	2		2						2
Kestrel	1								1
Red grouse	P	P	P	P	P	P	P	1	1
Golden plover									10
Woodcock									1
Skylark		1							
Meadow pipit	P	P			1				
Carrion crow					3				
Raven			18		23		2		
Snow bunting							1	41	

The bird interest recorded during the winter walkovers was generally limited. Two golden eagles (an adult and a fourth-year bird) foraging on the site on 21 February 2003 and snow buntings on 19 January (a single bird) and 21 February 2003 (a flock of 41 birds) were the only sightings of note. The ten golden plover recorded on 15 March 2003 were almost certainly returning breeding birds; five discrete pairs were recorded.

### 3.4 Results of the lagomorphs, sheep and deer carrion survey

No lagomorphs, sheep or deer carrion were recorded.

## 4. The proposed access route

Instructions were received to survey the proposed access route to the site in autumn 2002. A breeding bird survey was therefore not possible. Flight activity watches undertaken are summarised in Table 6.

Table 6. Gordonbush Windfarm proposed access route: summary of flight activity observations undertaken in 2002/03.

VP	Grid Reference (NC)	Observation time (hours)						
		Oct	Nov	Dec	Jan	Feb	Mar	Apr
3	84504 12344	1.0	1.5	1.5	1.5	2.0	2.0	2.0
4	84306 12353	1.0	1.5	1.5	1.5	1.5	0	2.0
<b>Totals</b>		<b>2.0</b>	<b>3.0</b>	<b>3.0</b>	<b>3.0</b>	<b>3.5</b>	<b>2.0</b>	<b>4.0</b>

Other than a single peregrine which flew over on 15 March 2003, no bird sightings of any note were made. Small numbers of buzzards, kestrels and ravens were recorded foraging in the area. A snipe flew over on 12 November 2002 and a greylag goose flew over on 15 March 2003.

## 5. Additional data

RSPB supplied miscellaneous ornithological data for the Gordonbush area. The following records are notable:

- A pair of golden eagles bred SE of the site in 1982. At least one bird lingered at this site during 1998 and 2001.
- A pair of hen harriers bred c.2km NE of the site in 1 km-square NC 8818 in 1988, a pair probably bred at NC 893180 in 1991.
- There appear to be at least two traditional merlin breeding sites within 3km of the site. A pair bred c.2km NE of the site in 1 km-square NC 8818 in 1988, a pair probably breeding nearby at NC 893176 in 1991. Another pair probably bred c.2km SSE of the site at NC 910145 in 1974, a sighting of a single bird nearby at NC 906135 on 13 June 2001 suggesting that birds continue to breed in this area.

Brian Etheridge (Highland Raptor Study Group) confirmed that golden eagles' use of the above site is traditional, but that the pair is rarely productive.

## 6. References

- Brown, A.F. and Shepherd, K.B. (1993). A method for censusing upland breeding waders. *Bird Study* **40**: 189-195.
- Marchant, J.H. (1983). *BTO Common Birds Census Instructions*. British Trust for Ornithology, Thetford.

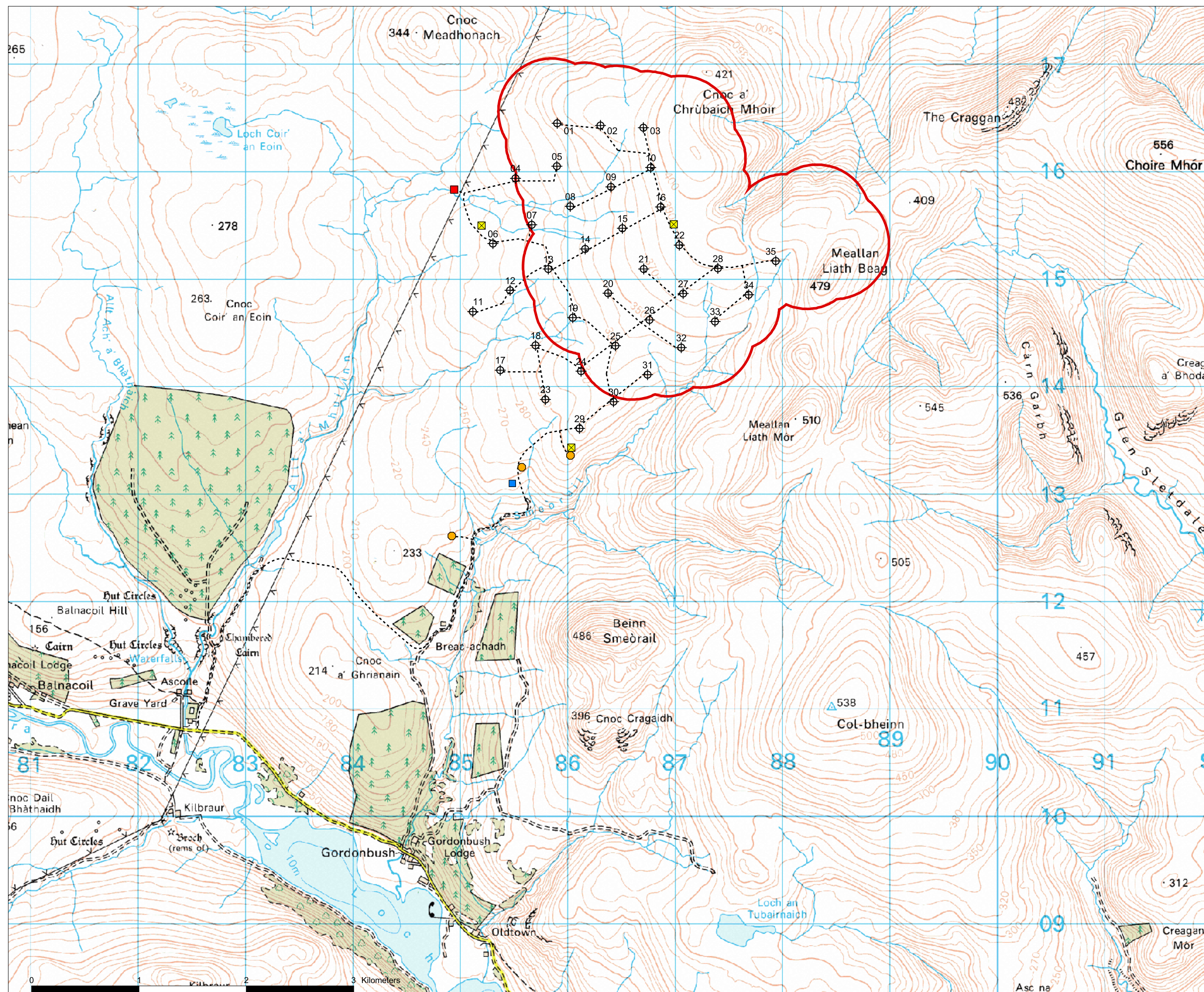
# GORDONBUSH WINDFARM

Scottish and Southern Energy

## Bird Survey Area

- ⊕ Turbine Location
- Substation
- Construction Compound
- ⊠ Permanent Anemometer Masts
- Borrow Pit
- Access Track
- Survey Area

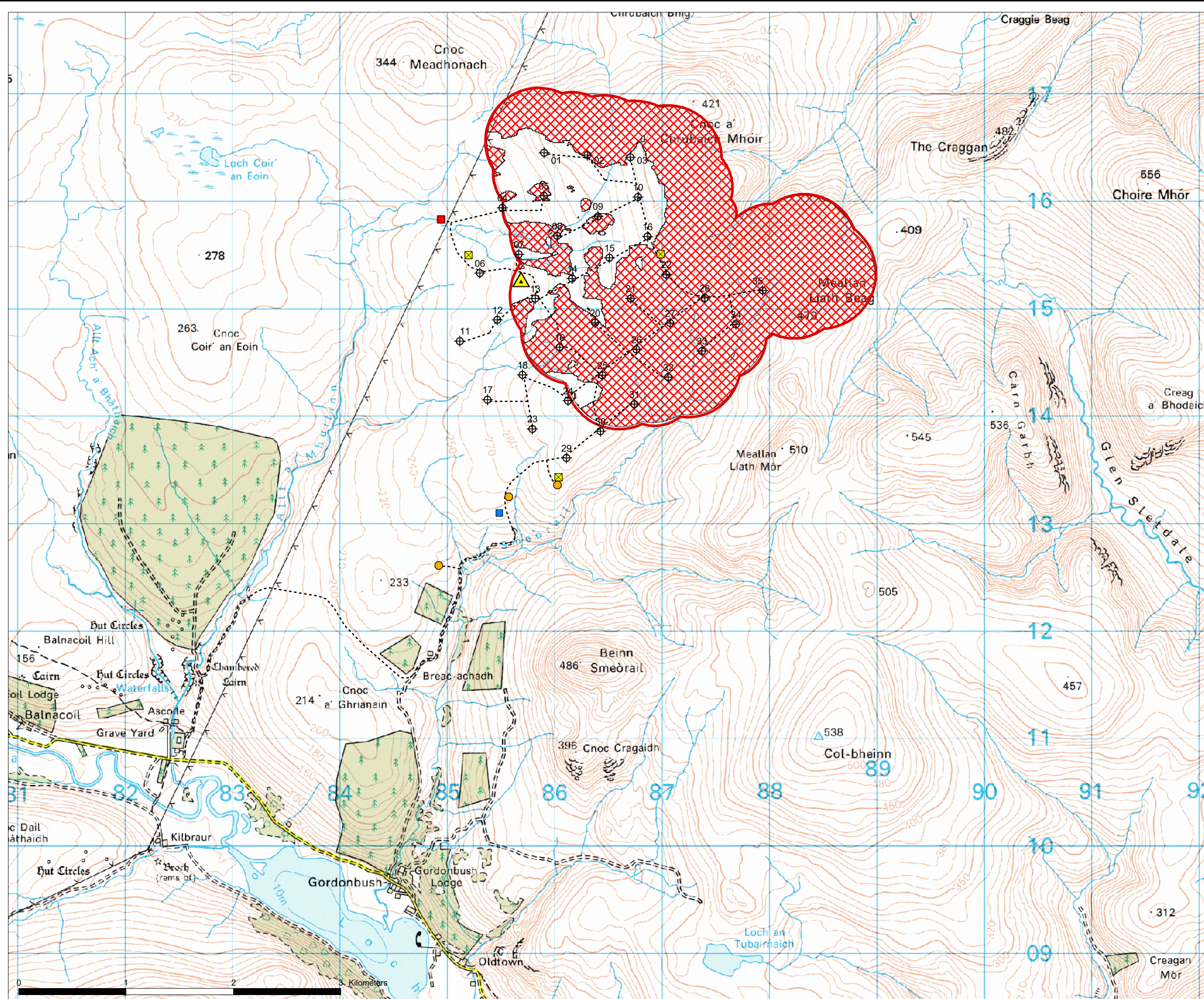
Scale 1:35,000



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Figure 1





**GORDONBUSH WINDFARM**

Scottish and Southern Energy

**Vantage Point 1 and Visible Area**

- ⊕ Turbine Location
- Substation
- Construction Compound
- ⊠ Permanent Anemometer Masts
- Borrow Pit
- Access Track

- Vantage Point
- ▲ Vantage Point 1
  - Survey Area
  - ⊠ Invisible
  - Visible

Scale 1:35,000

Figure 2

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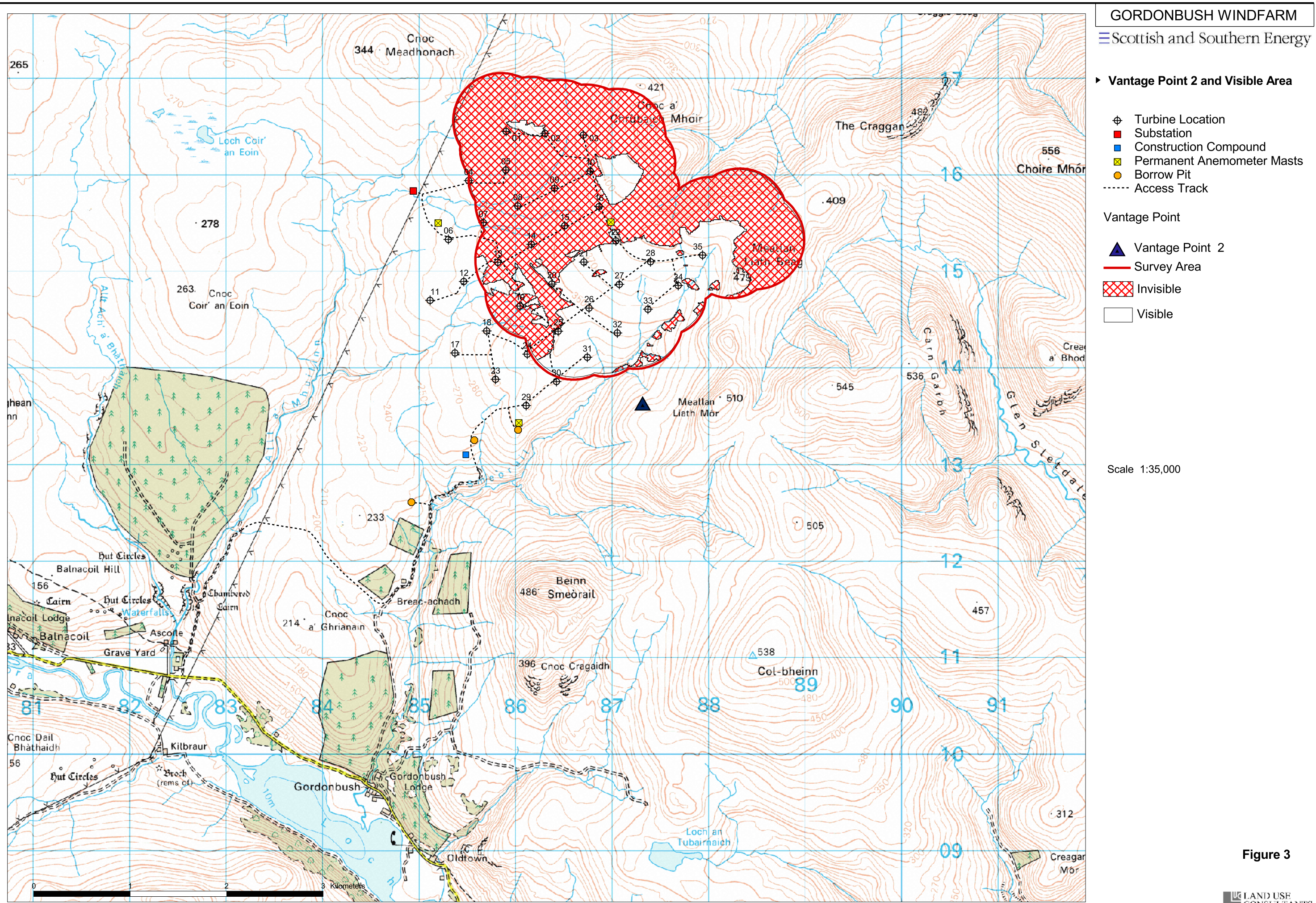


Figure 3

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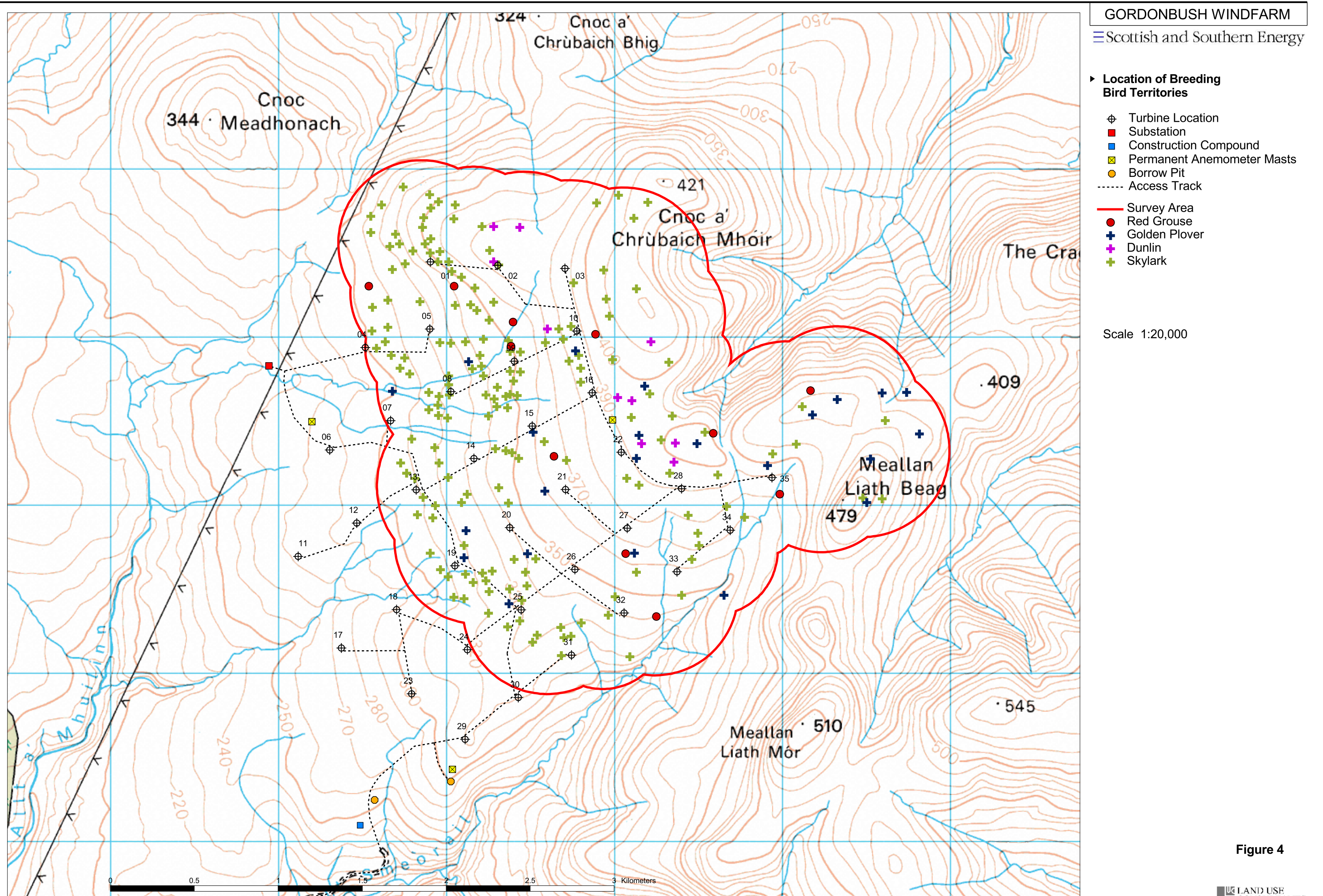


Figure 4

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**GORDONBUSH WINDFARM**

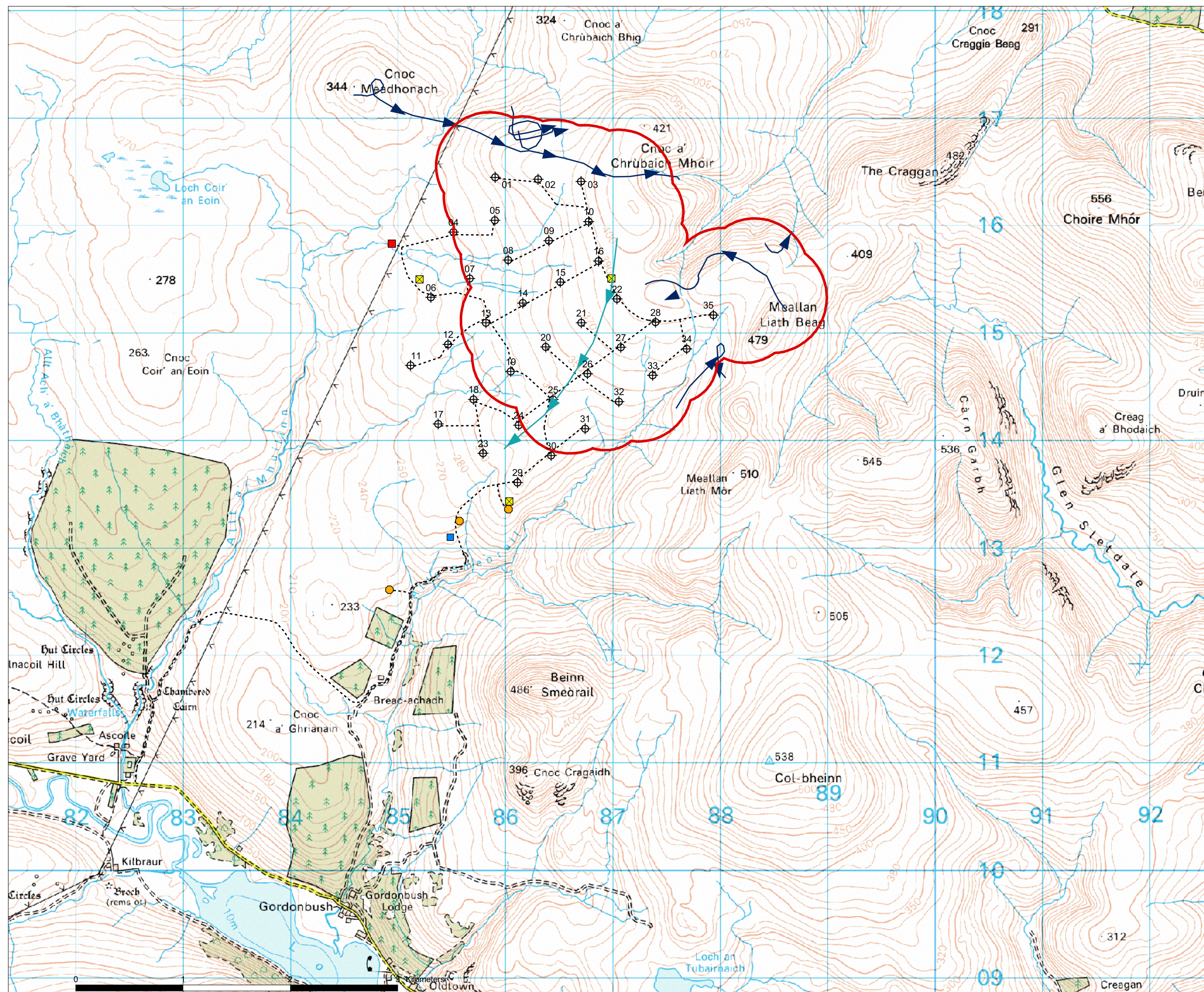
Scottish and Southern Energy

**Flight Activity**

- ⊕ Turbine Location
- Substation
- Construction Compound
- ⊠ Permanent Anemometer Masts
- Borrow Pit
- Access Track

- Survey Area
- ▶ Peregrine Flight Activity
- ▶ Golden Eagle Flight Activity

Scale 1:35,000



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Figure 5



## Appendix I I.1 **Archaeological Field Survey Report**



**Report of Archaeological Desktop  
& Walkover Survey  
for the proposed  
Gordonbush Wind Farm  
NC 860/150 (centred)**

**By  
Stuart Farrell  
B.A A.I.F.A F.S.A.Scot.  
August 2002**

**Introduction**

This report is for an archaeological desktop and walkover survey conducted on for Landuse Consultants Ltd on behalf of Scottish & Southern Energy Plc by the author as an environmental impact assessment for the proposed wind farm at Gordonbush by Brora, Highland.

**Acknowledgements**

I would like to thank the following for their help during the work :

- Dr. F Simpson, of Landuse Consultants Ltd;
- Mr. C Marden, of Scottish & Southern Energy Plc;
- Mr. R Rowantree, of Gordonbush Estate;
- Mrs. Geddes, of the National Library of Scotland (Manuscripts Division);
- Staff of the Royal Commission on the Ancient and Historical Monuments of Scotland, Edinburgh;
- Staff of the National Monuments Record of Scotland, Edinburgh;
- Staff of the National Library of Scotland (Map room);
- Staff of Highland Council Archaeology Unit;
- Staff of Highland Council Archives.



### Objectives

The author was commissioned by Landuse Consultants Ltd to conduct an archaeological desktop and walkover survey of the route of the proposed access routes and site of the new proposed wind farm with a 20 metre wide way-leave. This desktop to follow those guidelines as proposed by the Institute of Field Archaeologists (IFA, 1999) and to follow the enclosed specification as provided by Landuse Consultants Ltd.

### Desktop Results

A desktop survey was conducted using the following sources:

- Highland Council Sites and Monuments Record;
- National Monuments Record of Scotland, Edinburgh;
- Royal Commission on the Ancient and Historic Monuments of Scotland – aerial photograph collection;
- National Library of Scotland, Edinburgh (Maps);
- National Library of Scotland, Edinburgh (Manuscripts);
- Highland Council Archives;
- Inverness Library.

Both the aerial photography and the map coverage were very limited to the area of interest.

Aerial photographs, in particular were very limited with partial cover for 1946 and the latest coverage of 1989 was limited due to scale.

Map coverage was also limited as the 1<sup>st</sup> edition Ordnance Survey map of the 1879 (surveyed 1871) was almost the same as the 2<sup>nd</sup> of 1907 (revised 1904) and little survey work has been carried out in detail in the 20<sup>th</sup> century, with the next edition being late 1960's.

The following 18 archaeological sites were to be found on or close to the access routes proposed and in the area of the wind farm (the proposed access route and site of wind farm are shown on the 2<sup>nd</sup> location map, sites are numbered on the accompanying 1:5000 maps).

The walkover survey was conducted on the 23<sup>rd</sup> of August 2002, with weather conditions being slightly overcast with low cloud and showers.

Recommendations, where applicable are given after each site.

HSMR – Highland Sites and Monuments Record  
NMRS - National Monuments Record of Scotland  
n/a – not available

### General History

The estate of Gordonbush was formerly part of the sheep farm of Kilcalmkill, being bought by the Duke of Sutherland from Joseph Gordon in 1812 (Adam 1972) the name Gordonbush first appears in the County Valuation Rolls in 1884.

The Gordon Family farmed Kilcalmkill as part of the Carrol Estate and papers belonging to them show charters dating back to 1553 and are held in the National Library of Scotland under one of the deposits of the Sutherland Estate (see extract copy to rear). Included in the papers are accounts and crop records.

The Sutherland Estate Papers held in the National Library form 3 large accessions (313, 10225 and 10853) are very extensive and would need detailed study to extract information with regards Gordonbush's history. Though some history of the estate is available from the County Valuation Rolls and Adam's work on Sutherland Estate Management (Adam, 1972).

Adam notes that with effect from its purchase in 1812 its rent was increased by £210, again rent was increased in 1813 by £64 and again in 1815 by £74. The tenant in 1815 was Gabriel Reed with a rent of £531.18.3.

The County Valuation Rolls from 1874 notes that the rent increased to over double in the proceeding sixty years. Details from the Valuation Rolls are as follows:

1874-77	Tenants Col Tod Brown and G Lawson	Rent - £1182
1877-79	Tenant Col Tod Brown	Rent - £1171
1879-80	Tenant General Tod Brown	Rent - £1171
1880-83	Tenant ibid	Rent - £800
1884-85	Tenant His Grace Duke of Sutherland (Now named Gordonbush)	Rent - £700
1885-86	Tenant ibid	Rent - £650
1887-92	Tenant Major James Shaw	Rent - £448
1892-94	Tenant James Shaw	Rent - £448
1894-98	Tenant James Shaw	Rent - £449.4.11
1898-99	Tenant James Shaw	Rent - £446.4.11
1903-10	Tenant James Shaw	Rent - £376.5.8
1914-15	Tenant James Shaw	Rent - £316.3.11

It should be noted that from 1899 in the County Valuation Rolls agricultural subjects were calculated separate also that from 1884 the shootings and woodland of Kilcalmkill were also recorded separate from the farm. The Sutherland Estate sold estate in 1922 to descendants of the present owners.

## Sites Details

### 1 – Breac-Achadh

NMRS – NC81SW 46

HSMR – NC81SW 61

Grid Ref: - NC 847/115

Type – Township, sheepfold

Noted in HSMR and NMRS of 'the township of Breach-achadh comprises of 1 roofed, 2 unroofed and 2 unroofed circular structures, one of which is a sheepfold and a field system are depicted on the 1<sup>st</sup> edition OS map of 1879 sheet 88. 1 roofed, 3 unroofed buildings, 2 of which are L-shaped and have 2 compartments, a field system and a possible head dyke are shown on OS map of 1963'.

Noted in the Ordnance Survey Name Book of 'this name applies to a small one storey thatched house occupied by a shepherd it is in middling repair and is the property of his Grace the Duke of Sutherland, Dunrobin Castle'. (Page 79) House is not named in the County Valuation Rolls from 1874-1915.

Site is visible on aerial photograph of 1946 (RAF/CPE/Scot/UK 180/1476) with building to W side visible as unroofed, with number of field walls and sheepfold. Building is partly visible on aerial photograph of 1989 (OS 61889/50). 1 unroofed building marked on 2<sup>nd</sup> edition OS of 1907 with enclosure and sheepfold. (Sheepfold at NC 84845/11661 with enclosure centred at NC 8481/1163 2<sup>nd</sup> sheep fold at NC 84800/11771).

Site visit reveals number dykes visible and number of structures, to include the following:

A – sheepfold at NC 84796/11788 about 15m in diameter (not very discernible due to reeds) wall spread to 2m and up to 1m high, possibly robbed out for site 3.

B – rectangular structure aligned N-S 7m x 3m and up to 1.5m high.

C – sheepfold at NC 84848/11658 14m NS x 12m EW possible entrance to E with walls spread to 1.5m and up to 0.3m high, covered in bracken.

D – Enclosure, possible at NC 84761/11616 U shaped 10m x 7m N-S with walls spread to 1m and up to 1m high. No wall at SE.

E – Clearance cairn at NC 84769/11606 spread to 5m x 10m.

F – Farm at NC 84695/11568 longhouse aligned E-W of 2 compartments with enclosure to S forming L shaped structure with larger enclosing wall to N, possibly garden. House is 4.5m x 20m being divided at 10m with walls 0.5m thick and up to 1.2m high. Enclosure to S is 7m<sup>2</sup> with walls 0.4m thick and up to 1.2m high with cow-gate to W and drain to E. Enclosing wall on north side is 27m NS by 22m EW.

G – Clearance cairn at NC 84790/11516 5m x 4m and up to 1m high.

H – Clearance cairn at NC 84808/11497 2m NS x 6m EW and spread to 3m and up to 1m high.

*Some of the sites noted are within wayleave area; they are to be fenced off during construction work.*



View of rectangular structure facing N



View of house facing W - scale 1m

### 2 – Breac-Achadh

NMRS – n/a

HSMR – NC81SW 49

Grid Ref: - NC 848/116

Type – Depopulation

No information on HSMR database. Likely to be same site as 1.

### 3 – Breac-Achadh

NMRS – n/a

HSMR – n/a

Grid Ref: - NC 84818/11806

Type – Buildings

Group of 2 buildings to the N in area of Breac-Achadh that do not appear on 1<sup>st</sup> edition OS but do appear on 2<sup>nd</sup> edition OS of 1907.

Site is visible on aerial photograph of 1946 (RAF/CPE/Scot/UK 180/1476) as 2 roofed buildings, 1 with an enclosing garden wall to front. Only 1 roofed building without garden to front visible on aerial photograph of 1989 (OS 61889/50).

House is not named in the County Valuation Rolls from 1874-1915.

Site visit reveals ruined house (information from Mr. Rowantree, keeper Gordonbush Estate, that the house was built in 1880) constructed of dressed stone and south facing. Has lean-to porch to front with brick built addition to E and lean-to rubble built structure to the NW. 3 six pained skylights to roof, cast-iron drains and 2 fireplaces in each gable room and central staircase to room in attic. House is 5m x 12m in plan, with addition to E of 2m x 2.5m, to N of 5m x 3m and porch to S of 2m x 2m. No trace of 2<sup>nd</sup> building as depicted on OS map of 1907.

*Part of site lies within wayleave area, to be fenced off during construction work.*



View of front of house - scale 2m

**4 – Allt Smeoral**

NMRS – n/a

HSMR – n/a

Grid Ref: - NC 85099/12195

Type – Buildings, sheepfold

2 square buildings and a circular sheepfold marked but not named on latest OS map. Sheepfold is marked and named on 1<sup>st</sup> edition OS of 1879 and unchanged on 2<sup>nd</sup> edition OS of 1907. Sheepfold is located at NC 85101/12260.

Sheepfold is visible on aerial photograph of 1946 (RAF/CPE/Scot/UK 180/1476) but not buildings. Only the sheepfold is visible on aerial photograph of 1989 (OS 61889/50).

Walkover reveals site to be very heavily covered with bracken, no trace was made of the buildings in the vicinity of the sheepfold (information from Mr. Rowantree, keeper Gordonbush Estate, that they are visible as footings only when bracken dies off). Sheepfold is 13m in diameter with walls 1m wide at base and tapering to 0.5m at top with walls up to 1.3m in height. Entrance to W.

*No recommendations to be made.*



View of sheepfold facing SE

**5 – Ristocky**

NMRS – NC81SE 5

HSMR – NC81SE 6

Grid Ref: - NC 8514/1252

Type – Building

Noted in HSMR and NMRS of 'an unroofed building is depicted on 1<sup>st</sup> edition OS map of 1879 sheet 88 and on OS map of 1963'. Marked on latest OS map as an irregular shaped square.

Site is not visible on aerial photograph of 1946 (RAF/CPE/Scot/UK 180/1477). Site is partly visible on aerial photograph of 1989 (OS 61889/50). Unchanged on 2<sup>nd</sup> edition OS of 1907.

Site visit reveals site to be heavy with bracken. Site is discernible as not to be a house but an enclosure 8m x 9m with wall spread to 1m and up to 0.25m high. Wall only in an L shape with burn to north side and steep drop to E.

*No recommendations to be made.*

**6 – Ristocky**

NMRS – NC81SE 2

HSMR – NC81SE 2 & 14

Grid Ref: - NC 852/126

Type – Farmstead

Noted in HSMR and NMRS of 'farmstead of an unroofed building and enclosure is depicted on 1<sup>st</sup> edition OS of 1879 sheet 88. 1 unroofed building and 2 enclosures are depicted on OS map of 1963'.

Noted in the Ordnance Survey Name Book of 'this name applies to a small ruin situated on the western side of Allt Tomach between Badan and Ristocky Burn'. (Page 75)

Site is visible on aerial photograph of 1946 (RAF/CPE/Scot/UK 180/1477) as 1 unroofed building. Site is not visible on aerial photograph of 1989 (OS 61889/50). Unchanged on 2<sup>nd</sup> edition OS of 1907.

Walkover reveals site heavily covered by bracken. Only a semi-circular arc of wall is visible where a fire has removed the bracken being spread to 1.2m and 14m in length.

*Site lies within wayleave area, to be fenced off during construction work.*



View of enclosure facing W - scale 1m

**7 – Badan**

NMRS – NC81SE 1

HSMR – NC81SE 3 & 10

Grid Ref: - NC 8560/1282

Type – Farmstead

No information available on HSMR database. Noted in NMRS of 'a farmstead of an unroofed building and an enclosure is depicted on the 1<sup>st</sup> edition OS map of 1879 sheet 88. Three unroofed buildings and 2 enclosures are shown on the OS map of 1963'.

Noted in Ordnance Survey Name Book of 'this name applies to a small enclosure at the junction of the Badan Burn into the Allt Smeral there was once a few small houses inside the enclosure but all two of them except one small one have disappeared'. (Page 76)

No coverage for aerial photographs of 1946. Length of head dyke to N visible on aerial photograph of 1989 (OS 61889/49) but no buildings.

Building to south by burn marked as unroofed building marked on 2<sup>nd</sup> edition OS of 1907 with enclosure.

Walkover reveals site heavily covered by bracken. House at NC 85588/12807 is just visible aligned NNW-SSE measuring 4.5m x 9m with walls 0.5m wide and up to 0.5m high. Entrance to NE and partly covered with heather. Adjoining house to SE is an L-shaped structure (not easily discernible due to bracken) measuring 8m? x 4.5 with extension 5m x 3m with walls 0.5m high and 0.5m wide. Other structures depicted on OS maps not discernible due to bracken.

*Site lies within wayleave area, to be fenced off during construction work.*



View of house - scale 1m

**8 – Cnoc a' Ghnanain**

NMRS – n/a

HSMR – n/a

Grid Ref: - NC 83606/12031 (centred)

Type – Grouse butts

9 grouse butts aligned NW-SE is marked on the latest OS map. Not marked on the 1<sup>st</sup> or 2<sup>nd</sup> edition OS maps. Site is visible on aerial photograph of 1946 (RAF/CPE/Scot/UK 180/1474). Scale too high for aerial photographs of 1989.

Site visit reveals a number of huts visible all built of turf. 1 at NC 83746/11925 is 4m<sup>2</sup> with walls 0.5m thick and up to 0.6m high with entrance to NW.

*No recommendations to be made as should be unaffected by proposed new access road.*



View of shooting butt facing E - scale 1m

**9 – Loch Mhuilinn**

NMRS – NC81SW 31

HSMR – n/a

Grid Ref: - NC 83196/12325

Type – Hut circle

Hut circle marked on latest OS map. Not recorded in HSMR database. Noted in NMRS of 'a hut circle measuring 13.5m SSW-NNE by 13m within, slight wall spread to 2m. The structure is peat obscured with no stones visible. The entrance is in the SSW. There are no traces of contemporary cultivation in the area. OS 5/1/1976'.

Site is not visible on aerial photograph of 1946 (RAF/CPE/Scot/UK 180/1473). Scale too high for aerial photographs of 1989. Site is not marked on 1<sup>st</sup> or 2<sup>nd</sup> edition OS maps.

Site visit reveals that site is possibly not a hut circle but natural as entrance to SE is 5m wide! Looks more like erosion and natural rather than a man made structure.

*No recommendations to be made.*

**10 – Allt a' Mhuilinn**

NMRS – NC81SW 19

HSMR – NC81SW 19

Grid Ref: - NC 8275/1150

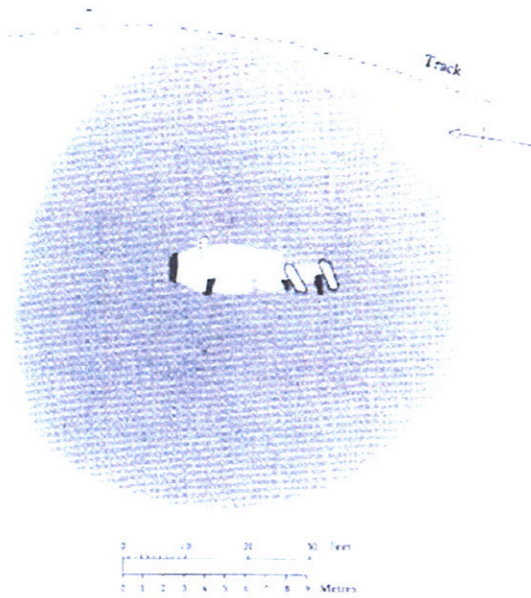
Type – Chambered Cairn

Noted in 1909 to be excavated partly but standing 6ft high (RCAHMS, 1911) with some of the stones later being used for a nearby dam (Davidson, 1948). Noted by the OS of 1964 and 1975 as to be as described by Henshall (1963) who visited in 1957 but now reduced to ground level and 19m in diameter. More recently a detailed survey and description has been undertaken in 1993 (see Henshall and Ritchie, 1995, 82-83).

Site marked as chambered cairn on 1<sup>st</sup> edition OS of 1879 but named Breaga on 2<sup>nd</sup> edition OS map of 1907. Site is not visible on aerial photograph of 1946 (RAF/CPE/Scot/UK 180/1473). Scale too high for aerial photographs of 1989.

Site visit reveals remains of chamber visible in heather (see photograph) as planned by Henshall and Ritchie. The hut circle marked on the latest edition OS map located to the NW of this site was not located during the walkover survey.

*Existing burrow pit to the north of site 10 should not be used for road construction as may cause damage to site. Site lies within wayleave area, to be fenced off during construction work.*



(From Henshall and Ritchie, 1995, 83)



Detail of chamber remains - scales 1m

**11 – Allt a' Mhuilinn**

NMRS – NC81SW 20

HSMR – NC81SW 20

Grid Ref: - NC 8280/1140

Type – Clearance cairns, hut circles

Recorded by Davidson (1948) as a stone circle. Noted by OS in 1964 of further 3 enclosures being identified. Revised in 1975 by the OS that 'structures form 4 hut circles of a-d with huts a-c oval varying in size from about 12m x 11m to 8m x 8m internally, the longer axis being through the entrance in the S. d, the best preserved is the "stone circle2 noted by Davidson, measuring 10.8m internally with a wall 1.3m thick entrance to S. Hut c is in poor condition obscured to the E by a land-slip. Apart from 3 or 4 scattered clearance cairns no sign of field system in vicinity, though system occurs up the hill to the E.'

Site is not visible on aerial photograph of 1946 (RAF/CPE/Scot/UK 180/1473). Scale too high for aerial photographs of 1989. Site is not marked on 1<sup>st</sup> or 2<sup>nd</sup> edition OS maps.

Walkover not conducted as site lies out with way-leave area.

*No recommendations to be made.*

**12 – Ascoile**

NMRS – n/a

HSMR – n/a

Grid Ref: - NC 82583/11040

Type – Sheepfold

Circular enclosure marked on 1<sup>st</sup> edition OS of 1879 and as sheepfold on 2<sup>nd</sup> edition OS map of 1907 but not marked on latest OS map. Situated to north side of track.

Site is visible on aerial photograph of 1946 (RAF/CPE/Scot/UK 180/1473). Site is partly visible on aerial photograph of 1989 (OS 61889/49).

Site visit reveals no trace of a structure at this location, possibly has been removed.

*No recommendations to be made.*

**13 – Ascoillbeg**

NMRS – NC81SW 7

HSMR – NC81SW 7

Grid Ref: - NC 829/107

Type – Deserted Settlement

Noted in HSMR and NMRS of 'Marked on Roy's military map of 1747 as Koylbeig of a group of 6 buildings with arable beside river. Noted by OS in 1964 of footings and remains up to 0.4m in height of at least 12 buildings ranging in sizes from 7.5m by 4m to 37m by 4.5m, together with enclosures.

Site is marked on 2<sup>nd</sup> edition OS map of 1907 with number of unroofed structures.

Site is visible on aerial photograph of 1946 (RAF/CPE/Scot/UK 180/1473) as a number of field walls and possible enclosures. Number of field walls visible on aerial photograph of 1989 (OS 61889/50).

Noted in Ordnance Survey Name Book of 'this name applies to a few small ruins which was once a Highland clachan. It is situated southeast of Ascoile'. (Page 71)

Noted by Adam (1972) that 5 named small tenants are recorded here in 1808 with rent of £25 later in 1812 with rent due on Whitsunday at £5. Tack had expired in 1807 and tenants were bound to leave premises in good order. In 1815 the tenant was the Rev Walker Ross with rent of £25.

Site visit reveals traces of structures in area of bracken, though site is out-with wayleave area. No sites close to the main road or access track.

*No recommendations to be made.*

Hub height	60 m	80 m	100 m
R1 Length of shunting area	18 m	18 m	18 m
R2 Length of shunting road	20 m	45 m	45 m
B Width of access road	4.5 m	4.5 m	4.5 m
S1 Width of crane area	18 m	18 m	18 m
S2 Length of crane area	22 m	22 m	22 m
A1 Distance crane centre - centre of turbine	22 m	22 m	22 m
A2 Distance crane area - centre of turbine	11 m	11 m	11 m
M1 Length of area necessary for crane jib assembly	110 m	110 m	110 m
M2 Width assembly space for crane jib	4 m	4 m	4 m
T Delta of entrance bend to be used	25 m	25 m	25 m

The crane area must be levelled (maximum gradient  $\pm 200$  mm).

The crane area is to be made according to the site-specific conditions. A free length for assembly of the crane jib has to be planned (see dimension M1).

The transformer station must not be placed on the crane area.

Around the crane area several meters of free space have to be available for slewing over, e.g. no trees, buildings, masts, etc.

Supplementary storage and assembly space is not reflected in the above sketch. The final layout for the specific site is to be planned after inspection of the location.

**Note:** The data shown is *for informational use only*. The values given are based on experience gained from previous projects. Depending on the local conditions various opportunities may exist. We strongly recommend to contact NORDEX in advance to seek advice on an appropriate solution.

### Road construction for transport

To avoid problems during the erection of the wind turbine, the following minimum requirements to the access roads are to be observed at **normal soil conditions**:

The access road must be capable of supporting the following loads:

**Vehicles:** approx. 50 concrete lorries

up to 22 heavy lorries for crane erection

approx. 11 heavy lorries with turbine components

(4 for tower parts, 3 for blades, 3 for nacelle and hub, 1 for switchboard and small parts)

max. length 52 m, required free height 5.00 m

diverse building vehicles

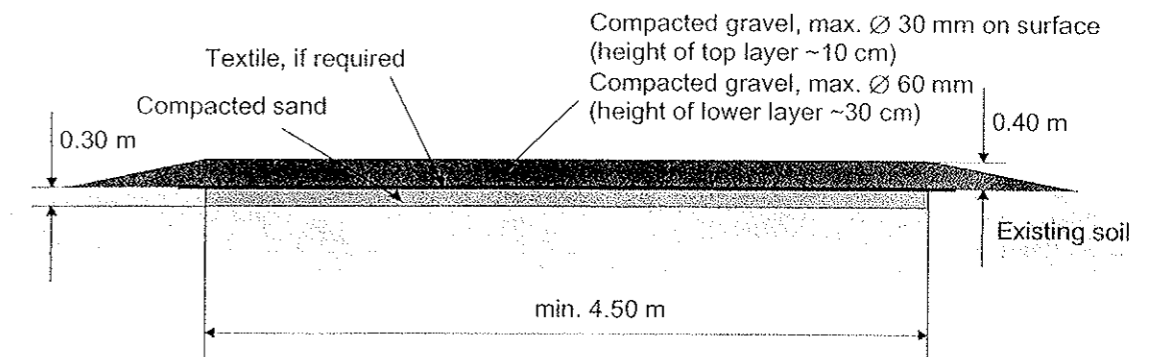
**Weight of vehicles:**

max. load per axle approx. 16 t

max. overall weight approx. 165 t

max. soil pressure of crawler crane approx. 25 t/m<sup>2</sup>

**Width of access roads:** min. 4.50 m



**Remarks:** The access road should be made of gravel (diameter max. 60 mm; layer thickness 0.40 m) on compacted sand (approx. 0.30 m). The top layer may in place of gravel be made of breakage material (diameter max. 60 mm) free of all demolition waste, such as glass, ceramics, steel or wood. If breakage material is used the thickness has to be increased to approx. 0.50 m. The material used on the surface may have a maximum diameter of up to 30 mm. In order to prevent inundation, a textile layer may be needed between the base (sand) and top layers (gravel). All layers must be properly compacted by adequate machinery to avoid later access problems with heavy loads.

The road surface must in general be even; some of the lorries have a ground clearance of no more than 10 cm. Crossfall from the road axis to the banking must be 2 to 3 % to ensure proper draining.

Depending on the specific site conditions these values may change. NORDEX must be consulted before construction of the roads is started.

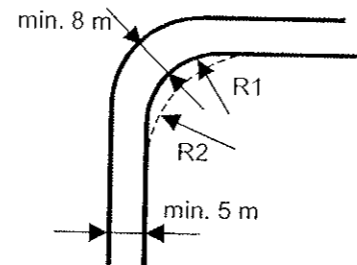
### Additional requirements to access roads

#### Slopes

At normal surface conditions (gravel or better), the gradient should not exceed 10 %. Steeper slopes may require an extra traction engine, the additional length must be considered.

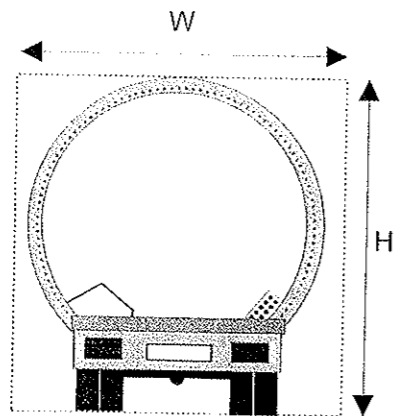
#### Bends

When driving on curves the road widths shown below must be observed and the area marked (---) must be free of all obstacles.



Hub height	60 m	80 m	100 m
R1 Inside radius bend	35 m	35 m	
R2 Inside radius of obstacle-free area	50 m	50 m	

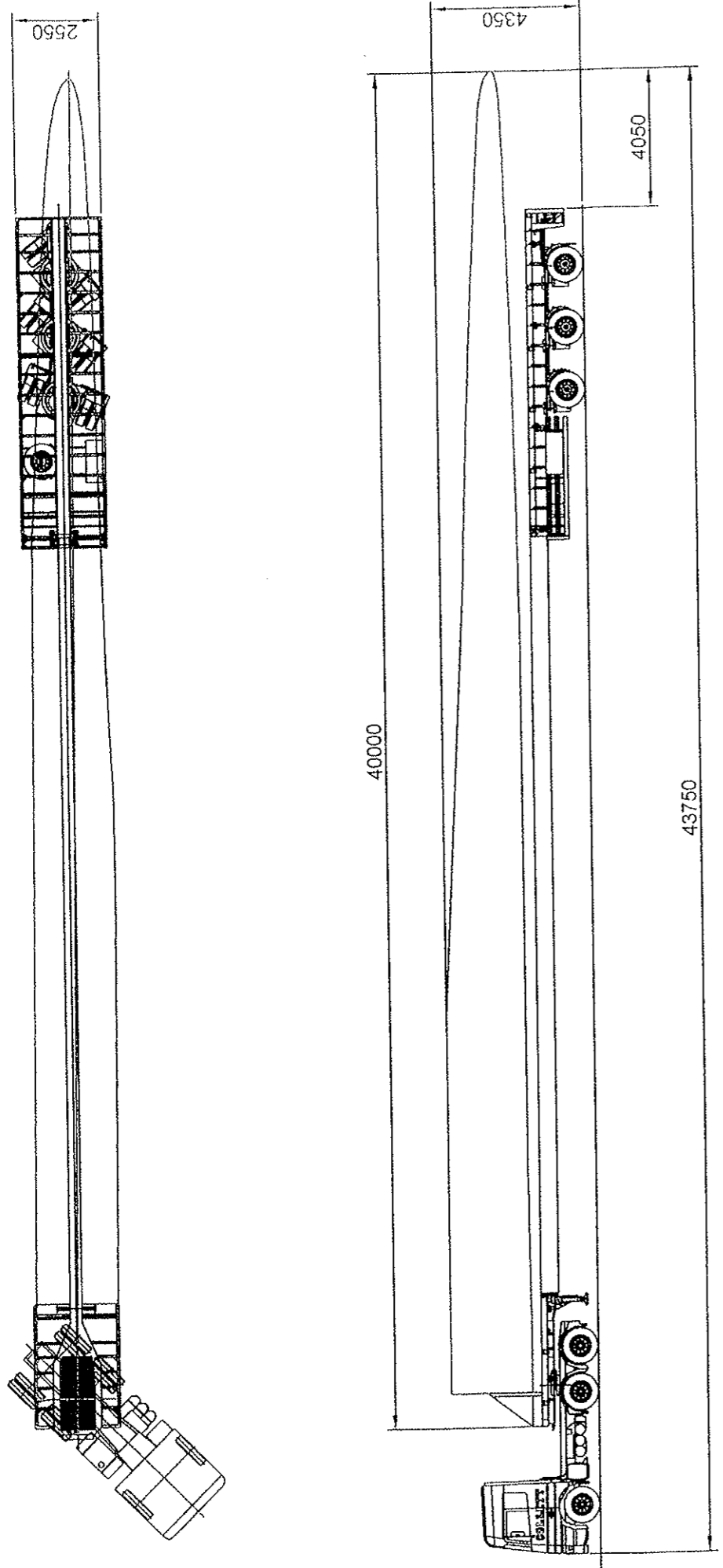
#### Load profile



Hub height	60 m	80 m	100 m
H Load profile height	5.00 m	5.00 m	6.50 m
W Load profile width	5.00 m	5.00 m	6.50 m

Note: All weights and dimensions are given in metric units.

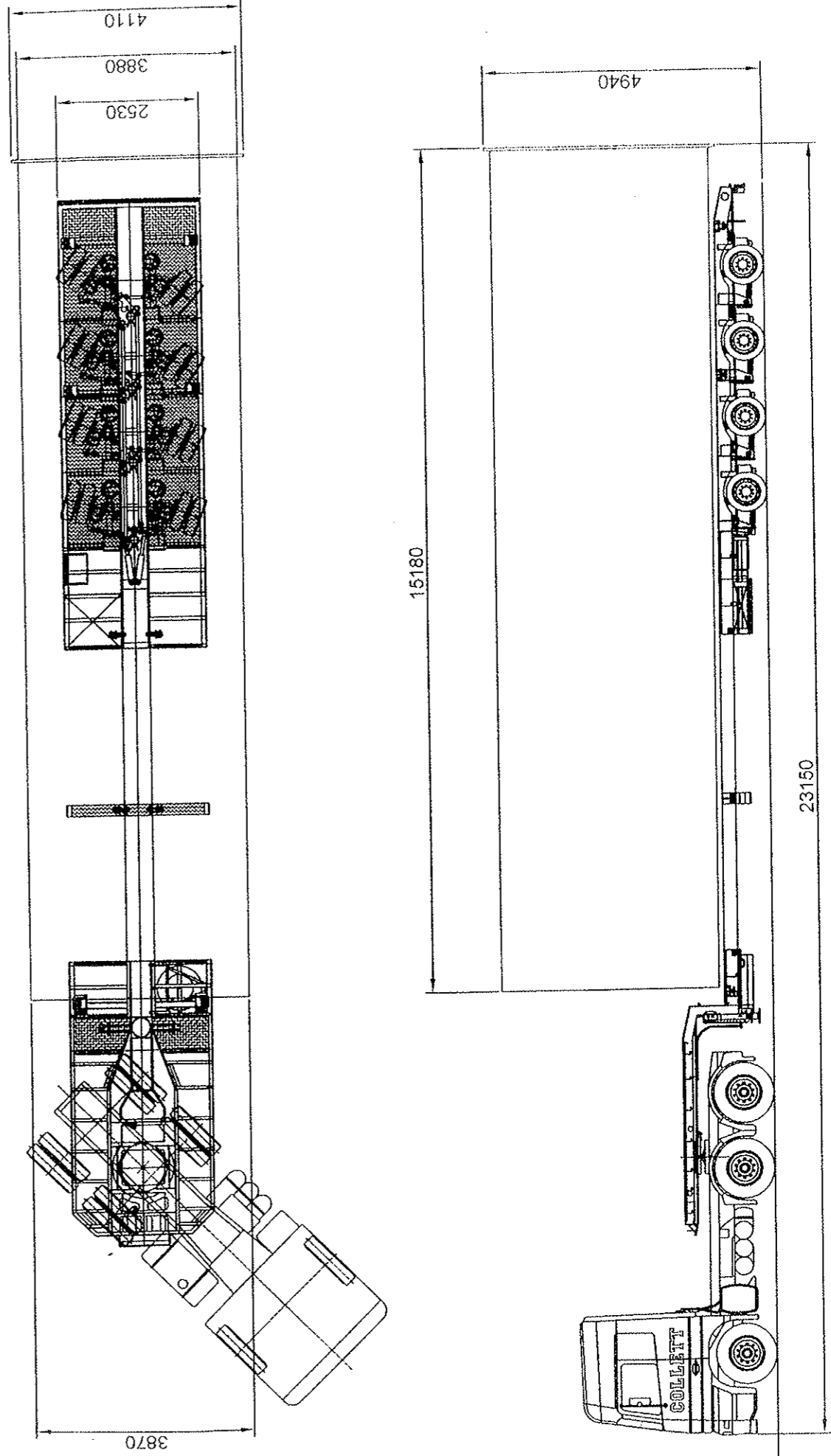
### APPENDIX 3: EXAMPLE ABNORMAL LOAD HAULAGE ARRANGEMENTS



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DRAWN **G. BODEN** TITLE **NORDEX 40m BLADE TRAILER**  
DATE **13/12/02** CUSTOMER **SCOTTISH & SOUTHERN ENERGY**  
SCALE **1:175** SITE **HADYARD HILL** DRG No **116854-01.**



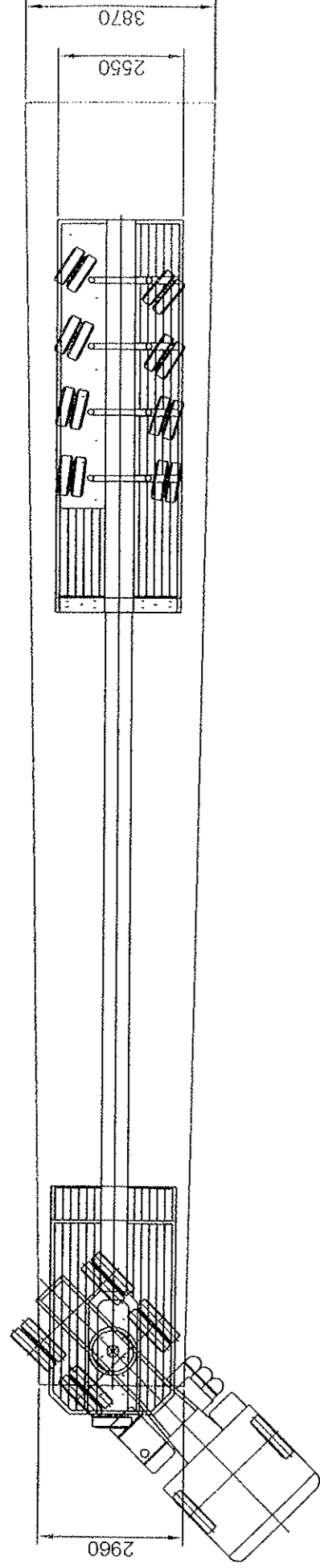
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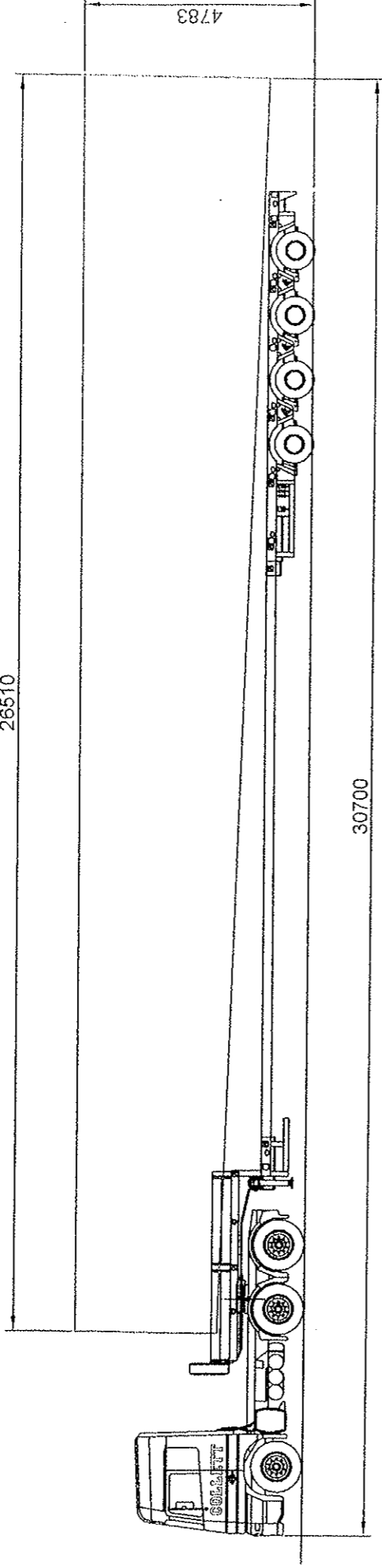
DRAWN **G. BODEN** TITLE **NORDEX N80 BTM TWR TRAILER**  
DATE **13/12/02** CUSTOMER **SCOTTISH & SOUTHERN ENERGY**  
SCALE **1:100** SITE **HADYARD HILL** DRG No **116854-02.**

BOTTOM TOWER SECTION - 46725Kg





26510

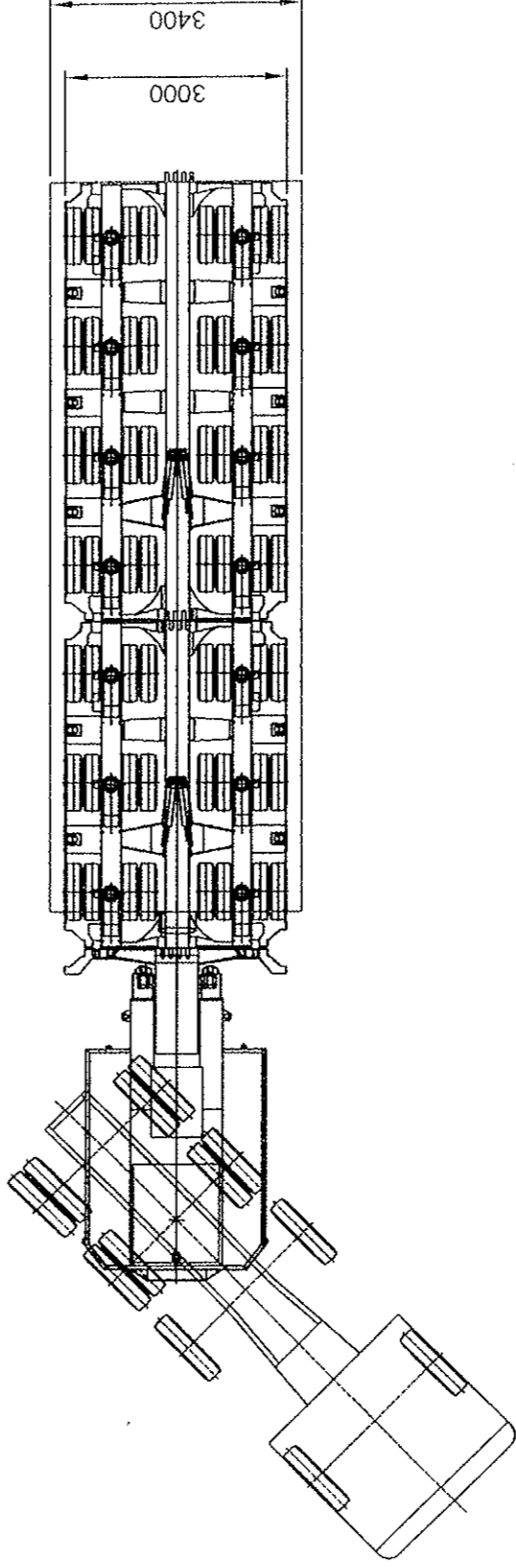


TOP TOWER SECTION - 41475Kg

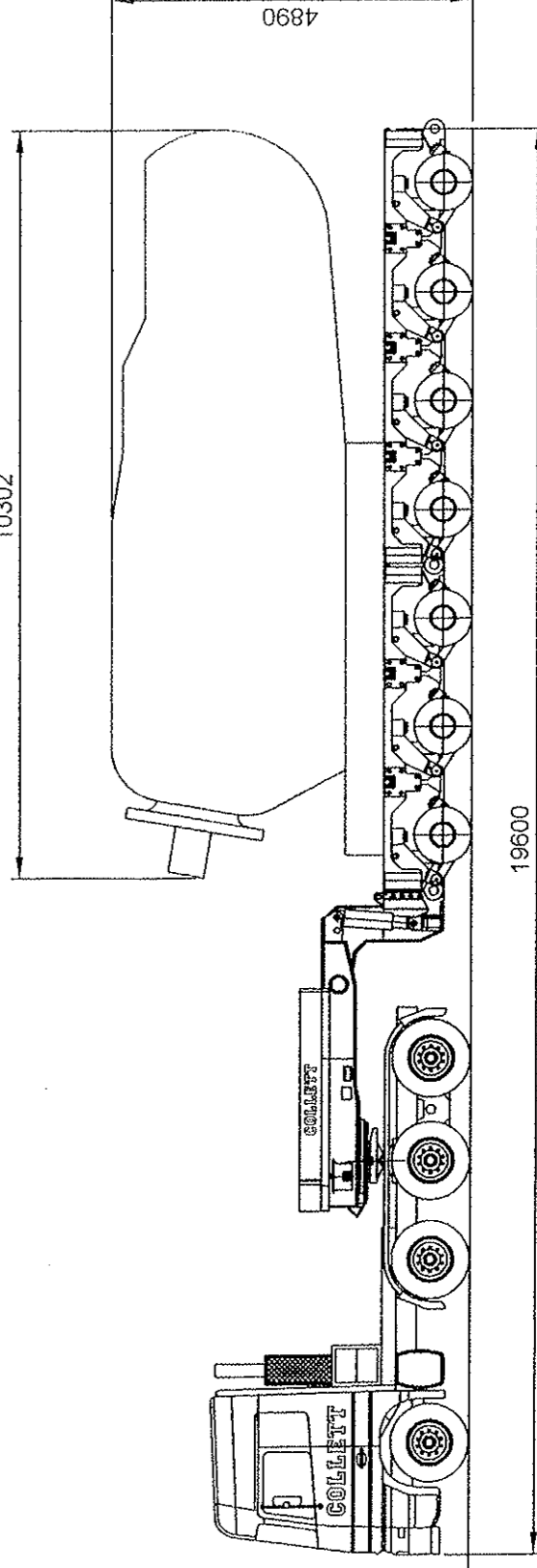
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DRAWN	G. BODEN	TITLE	NORDEX N80 TOP TWR TRAILER
DATE	13/12/02	CUSTOMER	SCOTTISH & SOUTHERN ENERGY
SCALE	1:125	SITE	HADYARD HILL DRG No 116854-03.



10302

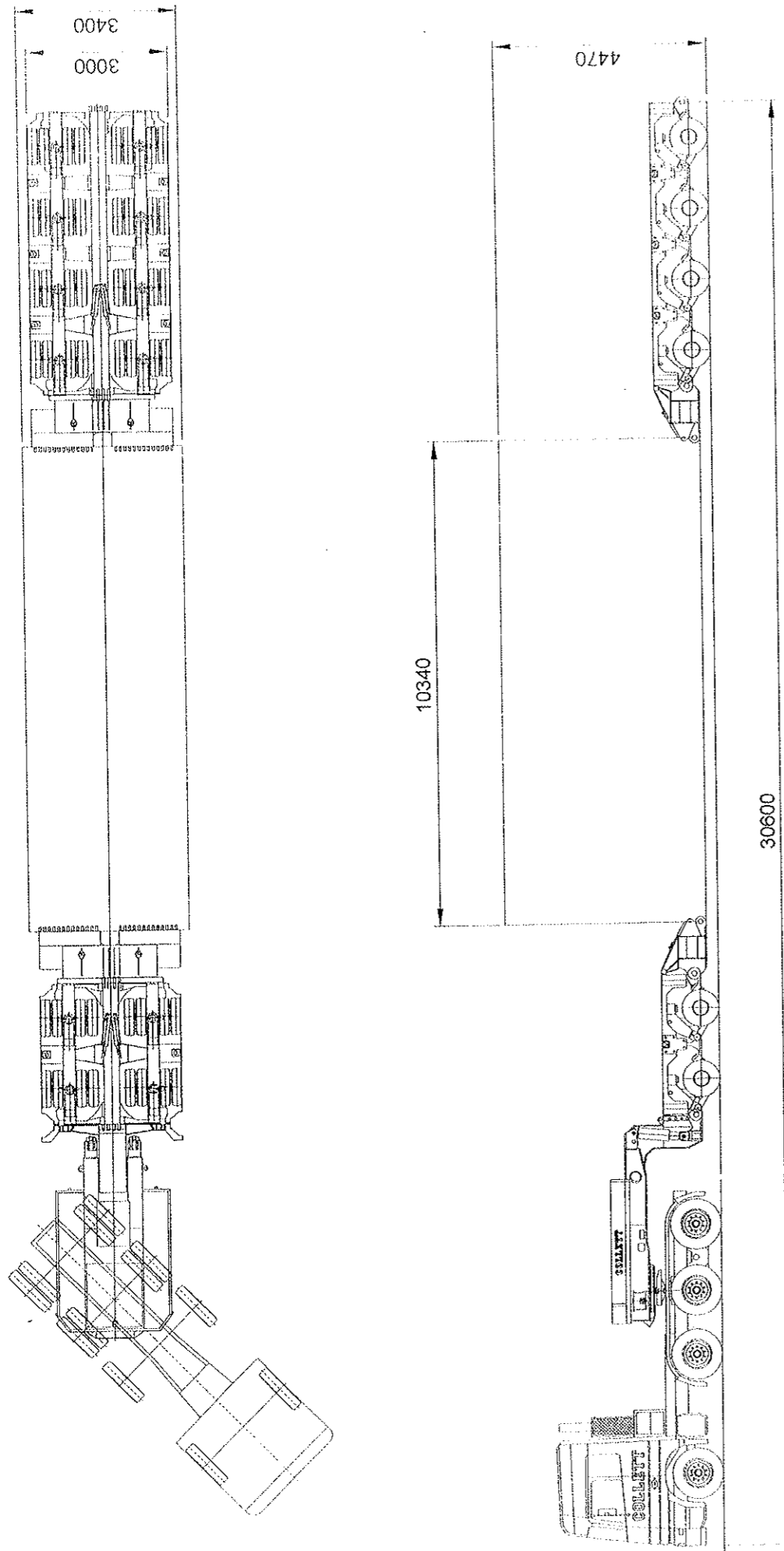


NACELLE - 97000Kg

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DRAWN	G. BODEN	TITLE	NORDEX N80 NACELLE TRAILER
DATE	13/12/02	CUSTOMER	SCOTTISH & SOUTHERN ENERGY
SCALE	1:100	SITE	HADYARD HILL DRG No 116854-05.



NACELLE - 75000Kg

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Web: www.collett.co.uk

DRAWN **G.BODEN**  
DATE 13/12/02  
SCALE 1:125

TITLE **VESTAS V80 NACELLE TRAILER**  
CUSTOMER **SCOTTISH & SOUTHERN ENERGY**  
SITE **HADYARD HILL** DRG No 116854-04.

APPENDIX 4: TYPICAL WINDFARM CONSTRUCTION PLANT

## 4.3 Plant Hire



# Edward Mackay Ltd Contractor

Rosslyn Yard | Brora | KW9 6NY



INVESTOR IN PEOPLE



Reg No: SC 170826



## 4.3.1 Introduction

With a full range of equipment from small tools to large earthmoving machines and quarrying plant, the company prides itself on being completely self-sufficient internally as well as being capable of fulfilling customer requirements within the industry.



To keep abreast of statutory regulations all plant comes equipped with oil spillage kits, 2-way radios, fire extinguishers, maintenance logs and technical data.

Regular renewal of plant ensures all equipment is modern, reliable and equipped with the latest technological innovations.

Skilled operators, who are trained in safety awareness, hold all necessary certificates including First Aid, as well as attending regular "tool box talks" to keep updated with current legislation.

## 4.3.2 Plant List

Tracked excavators 1 ton to 45 ton  
Wheeled excavators 10 to 20 ton  
Wheeled loaders 1m<sup>3</sup> to 3m<sup>3</sup>  
Bulldozers 8 ton to 20 ton  
Articulated dumptrucks  
JCB's  
Compaction equipment  
Rock crushers and screening plants  
Ready mix concrete plants  
Auxiliary equipment



## 4.3.3 Clientele

Edward MacKay Ltd  
Scottish Executive  
First Engineering  
The Highland Council  
Scottish Water  
Scottish and Southern Electricity