4/98/0486/0F1...

G32 **ROLLING - DRUMLINS AND RIDGES**

This is 'typical' Cumbrian working countryside, with villages, woods, hedges, walls, plantations and a variety of small hills or ridges and valleys. (The varying character of the hills will have implications for the design characteristics of any acceptable turbine developments). The area occupies intermediate ground between the uplands and the lowlands, valleys and plains, and is found chiefly in South Westmorland and Furness with smaller pockets in West Cumbria and the Vale of Eden. Most of South Westmorland is County Landscape. The wind resource is very variable, with good potential on the Scout Hill ridge in South Lakeland

G9 **Within this often hummocky landscape, there may be scope for development up to the scale of a small cluster where it can be sited sympathetically with the local landform.**

The justification for limiting the development type to a small cluster in the majority of this landscape category relates to issues of visual dominance and the capacity of the landscape to absorb the strong vertical component provided by wind developments (see also para 4.19). In particular areas (ie the South Westmorland drumlin field) population density would indicate local issues of visual dominance and intrusion may be particularly important, restricting development opportunities. Because of variations in local topography, design criteria would be expected to lead to different configurations in different parts of these areas. For instance, in many cases individual drumlin summits may be locally sensitive. More generally, a scatter of turbines on the tops of drumlins could create a fundamental change in the character of this quite distinctive landscape type.

G33 **ROLLING - LOWLAND**

This is again 'typical' Cumbrian working countryside, with villages, woods, hedges, walls, plantations and undulating terrain. The area is quite extensive in North Cumbria and the Vale of Eden. The wind resource is very variable, with good potential in western Allerdale and parts of Inglewood.

G10 **In much of this rolling landscape, there may be scope for development up to the scale of a small cluster. Exceptionally, a larger cluster might be considered where the scale of the landscape can absorb such a development.**

The generally broad scale, and the presence of a variety of screening features in this landscape, mean that small clusters, though visible, may be able to be absorbed without great difficulty.

G34 **ROLLING - MAIN VALLEYS**

This includes all major river valleys, dales, corridors and gorges. In many cases, these areas will be the least likely to have any significant wind resource, with the possible exception of parts of the Alston and Kirkby Stephen areas. For wind energy development purposes, some of the smaller and narrower valleys may be most easily treated as features within the adjacent landscape type.

G11 **Wind turbine development is likely to have significant adverse landscape and visual impact in the major Cumbria valleys. However, there may be scope for 'domestic scale' turbines if they are visually and functionally related to and in proportion with existing used buildings.**

Appendix 6

Lowca Windcluster

Ecological Assessment

by

R Jerram

for

PowerGen Renewables Ltd

24th April 1998

Introduction

The Lowca Windcluster Site was originally surveyed in November 1994 and May 1995 as part of the planning application for the Lowca opencast coal mine. The assessment of the ecological impact of the windcluster presented here is based on this data, backed up with a verification site visit made on 9th March 1998.

Ecological survey

The field of rough pasture north of Andrews Gill was surveyed on 22nd May 1995 to National Vegetation Classification standards. Five 2m x 2m quadrats were recorded in each visually distinguishable vegetation stand present, excluding the gorse scrub. Species presence and ground cover were recorded in the quadrats. Cover was recorded using the Domin scale:

Domin score	Percentage ground cover
10	91-100%
9	76-90
8	51-75
7	34-50
6	26-33
5	11-25
4	4-10
3	many individuals
2	<4 several individuals
1	few individuals

Constancy tables were then produced from this data to allow comparison with NVC constancy tables (Rodwell 1991 & 1993).

The remainder of the site was surveyed to phase I survey standard on 21st November 1994. This data has subsequently been ascribed to NVC communities to aid the impact assessment.

Map 1 shows the ecological habitats present on the site and the location of the turbines and access track.

Ecological habitats

Flushed acid grassland

This is the main semi-natural vegetation community present on the site and covers all the southern most field. *Nardus stricta* and *Carex nigra* tend to be the main components of the sward with a large number of other constant species occurring at lower cover including: *Juncus conglomeratus, Potentilla erecta, Anthoxanthum odoratum, Lotus corniculatus, Trifolium repens, Luzula multiflora, Carex nigra, C. pulicaris, Cynosurus cristatus, Ranunculus acris, Agrostis capillaris* and *Pseudoscleropodium purum*. Over much of the field *Sanguisorba officinalis* is also a regular component. While the relative proportions of these species vary slightly throughout the field depending on the slope and degree of flushing (three groups of five quadrats were recorded in this community to account for this variability) overall there is a high level of uniformity in the basic constituents of the sward suggesting that it all belongs to the same community. This community however does not have a strong affinity with any NVC communities but instead has elements of a number of communities

including U5c *Nardus stricta - Galium saxatile* grassland, *Carex panicea - Viola riviniana* sub-community, M6b *Carex echinata - Sphagnum recurvum/auriculatum* mire, *Carex nigra - Nardus stricta* sub-community and MG5c *Centaurea nigra - Cynosurus cristatus* grassland, *Danthonia decumbens* sub-community. Tables 1 and 2 show the 1995 data for those quadrats recorded outside the excavation area.

Table 1 Flushed grassland quadrats 7-11 (lower slope - outside extraction area)

Quadrat number	7	8	9	10	11	Constancy
Carex panicea	5	6	7	5	7	V
Juncus conglomeratus	4	4	2	2	3	V
Lotus corniculatus	3	2	5	4	3	V
Potentilla erecta	3	3	4	3	3	V
Ranunculus acris	2	2	2	1	2	V
Sanguisorba officinalis	4	3	2	2	3	V
Trifolium repens	2	2	1	3	1	V
Achillea ptarmica	-	1	1	1	1	IV
Anthoxanthum odoratum	3	-	3	3	3	IV
Carex nigra	3	3	1	-	2	IV
Carex pulicaris	3	4	2	-	2	IV
Festuca ovina	6	-	5	5	3	IV
Leontodon autumnalis	2	2	2	-	2	IV
Luzula multiflora	2	2	2	3	-	IV
Nardus stricta	6	6	5	6	-	IV
Plantago lanceolata	1	2	1	-	2	IV
Prunella vulgaris	2	2	2	-	2	IV
Agrostis capillaris	2	2	-	2	-	III
Cynosurus cristatus	2	-	-	1	2	III
Pseudoscleropodium purum	-	1	5	4	-	III
Taraxacum sp.	1	1	1	-	-	III
Cerastium fontanum triviale	-	-	1	1	-	II
Cirsium palustre	-	1	1	-	-	II
Equisetum arvense	-	1	1	-	-	II
Juncus articulatus	-	-	1	-	3	II
Bellis perennis	-	-	-	-	1	I
Calluna vulgaris	-	-	-	1	-	I
Carex viridula oedocarpa	-	-	2	-	-	I
Centaurea nigra	-	1	-	-	-	I
Holcus lanatus	-	-	-	2	-	I
Ranunculus flammula	-	-	-	-	2	I
Ranunculus repens	-	4	-	-	-	I
Vicia cracca	-	2	-	-	-	I
Viola riviniana	-	1	-	-	-	I
Rhytidiadelphus squarrosus	-	-	-	4	-	I
Number of species per sample	19	24	24	19	19	

Table 2 Flushed grassland quadrats 12-16 (mid-slope - outside extraction area)

Quadrat number	12	13	14	15	16	Constancy
Anthoxanthum odoratum	3	3	3	3	3	V
Carex panicea	2	3	2	4	4	V
Cynosurus cristatus	2	3	3	3	3	V
Holcus lanatus	2	4	7	2	3	V
Juncus conglomeratus	3	2	2	1	4	V
Nardus stricta	7	5	2	2	5	V
Potentilla erecta	2	2	2	3	3	V
Festuca ovina	5	6	-	6	4	IV
Lotus corniculatus	-	3	2	3	3	IV
Luzula multiflora	3	-	1	3	3	IV
Trifolium repens	2	3	3	3	-	IV
Pseudoscleropodium purum	6	6	2	2	-	III
Achillea ptarmica	-	-	2	2	1	III
Agrostis capillaris	-	-	2	3	4	III
Sanguisorba officinalis	-	2	-	1	2	III
Rhytidiadelphus squarrosus	-	5	5	5	-	II
Carex nigra	4	-	3	-	-	II
Equisetum arvense	-	-	1	1	-	I
Cirsium palustre	-	-	-	1	-	I
Hypochaeris radicata	-	-	-	1	-	I
Plantago lanceolata	-	-	-	1	-	I
Prunella vulgaris	-	-	-	-	2	I
Ranunculus acris	-	2	-	-	-	I
Ranunculus flammula	-	-	-	-	1	I
Number of species per sample	12	14	16	20	15	

This vegetation may be in transition between a more improved, species-poor sward and unimproved grassland. Exactly which way the change is occurring is unclear. The sward may either have been formerly more agriculturally improved, but is currently reverting to a less improved vegetation type due to lowered inputs of fertilisers and reduced maintenance of field drains; or may have undergone some agricultural improvement such as increased application of fertilisers, or possibly increased stocking rates.

Never-the-less this is a species-rich community and stands of flushed rough pasture are uncommon, particularly in such extensive stands, on the Cumbrian coast.

Gorse scrub

Stands of dense common gorse *Ulex europaeus* scrub are present along the northern edge of the field of flushed grassland. The groundflora around the edges of these stands is similar to that of the surrounding grassland, whilst within the scrub the ground is largely bare. This scrub belongs to the W23 *Ulex europaeus - Rubus fruticosus* underscrub NVC community.

Broadleaved woodland

Cat Gill has a low, wind pruned canopy of hazel, gorse, hawthorn and oak over bracken and brambles, plus *Dryopteris dilatata*. It is open to grazing from the northern side. This woodland has affinities to the W10 *Quercus robur - Pteridium aquilinum - Rubus fruticosus* woodland NVC community.

Semi-improved marshy grassland

South of Cat Gill there is an area of heavily grazed, species-poor marshy grassland with

abundant *Lolium perenne, Cynosurus cristatus, Plantago lanceolata, Juncus effusus, Ranunculus repens, Rumex acetosa* and *Trifolium repens*. This grassland has affinities to the MG10 *Juncus effusus - Holcus lanatus* rush pasture NVC community.

Improved pasture

The remaining areas of the site outside the excavation areas are improved pasture, composed of *Lolium perenne, Cynosurus cristatus, Plantago lanceolata, Rumex acetosa* and *Trifolium repens*, belonging to the MG6 *Lolium repens - Cynosurus cristatus* grassland NVC community.

Changes since 1995

Two changes, other than the opencasting, are apparent since the 1994 and 1995 surveys.

Firstly there appears to have been an increase soil moisture south of Cat Gill, probably due to failed field drains. This has resulted in an area of pasture, mapped in 1994 as improved grassland, having changed to semi-improved marshy grassland (NVC: MG10) due to the increased occurrence of rushes *Juncus* spp.

Secondly stocking levels appear to be higher than they were in 1995. There is a large amount of poaching of the soil along the upper (eastern) edge of the site, particularly along the excavation boundary. This may have caused some reduction in diversity of the flushed grassland sward due to increased grazing and the effects of trampling. It is not possible however to properly ascertain whether this has occurred without recording more quadrat data in late May. Change has definitely occurred at the top end of the Cat Gill CWT site (outside the excavation boundary) were trampling around feeding troughs has removed most of the vegetation cover.

Assessment of ecological importance of the habitats present

Flushed acidic grassland is the most extensive habitat present. The sward is species-rich, particularly for an acidic grassland, though it contains no uncommon species. Both unimproved and relatively unimproved grassland, such as this, is uncommon on the west Cumbrian coast above the cliff edge. Both lowland dry acid grassland and purple moor-grass and rush pasture, to which this sward has affinities, are Key Habitats in the UK Biodiversity Action Plan. This grassland also supports a high density of breeding pairs of skylark, a Key Species in the UK Biodiversity Action Plan, which has undergone a 50% population decline in the past few decades. As such this vegetation must be considered to be of ecological and nature conservation importance in the context of both Allerdale District and the west Cumbrian coastal plain.

The coastal gill woodland in Cat Gill is an extremely rare habitat in Cumbria. Although this is a very small area this rarity makes it at least of District nature conservation importance and possibly County importance. Heavy grazing is currently leading to the degradation of the site.

Common gorse scrub is moderately common along the coast, however it potentially provides breeding habitat for a variety of breeding birds, particularly the stonechat, giving an extensive stand such as are found here ecological significance at the parish scale.

The semi-improved marshy grassland appears to have developed since 1995 as a result of the failure of field drains. It is species-poor but possibly has the potential to develop greater botanical diversity over the next few decades if the drains remain blocked. The current high stocking levels may hinder this however. This vegetation is at present of significance at the

parish level.

The improved pasture is species-poor and of limited nature conservation interest.

The windcluster

The windcluster development will consist of seven turbines, an 8m x 6m switchgear house and yard and a 1400m long, 4m wide access track. The turbines would be 3 bladed machines, Vestas V47 models or similar, with a hub height of 40.5m and a blade length of 23.5m. The turbine bases cover an area of $10m^2$.

Turbines 4, 5, 6 and 7 lie within the field of flushed acid grassland, while turbine 2 lies within the semi-improved marshy grassland. The access track also runs through these two habitats and the area of gorse scrub. Turbine 2 lies adjacent to, but entirely outside, the Cat Gill Site of Wildlife Interest. Turbine 1 and the switchgear house lie in an area of improved pasture. Turbine 6 lies adjacent to, but entirely outside, the Andrews Gill Site of Wildlife Interest.

Assessment of ecological impact

Both construction and operation phases of this project will result in land take of flushed acid grassland and semi-improved marshy grassland. Some 750m of track lie within the flushed acid grassland, which, together with the four turbines gives an area of $3,040m^2$ (0.3ha) of permanent land take. In addition to this some $810m^2$ of semi-improved marshy grassland will be lost to permanent land take. The total area of flushed acid grassland is approximately 13ha so the total permanent loss of this habitat in this field will be in the region of 2%.

Mitigation of impact

Construction of the turbines will involve the disturbance of a greater area of land than the final permanent land take. The loss of semi-natural vegetation around each turbine base can be minimised by removing the vegetation and top soil in the working area to a depth of 20 - 30cm in the form of turves. The turves can be stored temporarily and re-laid following the completion of construction work. The this will be covered in a method statement the details of which will be agreed with Cumbria County Council and English Nature.

Track construction can be limited to the working width of the track.

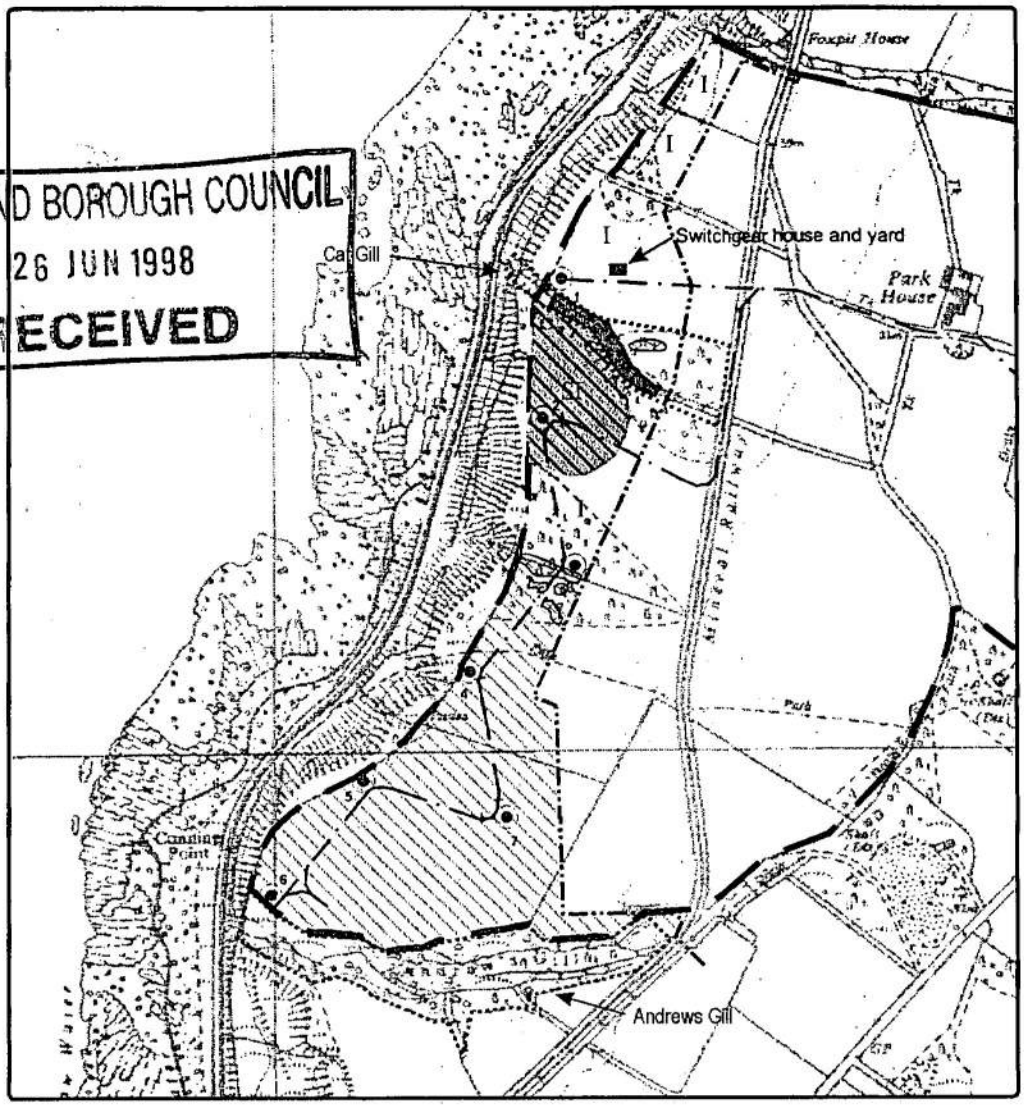
Further potential mitigation proposals, namely the enhancement of the unimproved grassland and gill woodland are already covered by a Section 106 Agreement between Gordon Harrison Ltd. and Cumbria County Council. The details of this agreement are given in Annex 1.

4/98/0486/OF1

Overall impact

The impact of this development can be limited to the permanent land take required for the turbines and access track, which, as previously stated will be approximately 2% of the flushed acid grassland, the main habitat of nature conservation significance affected. While this adds to the loss of this habitat that has already occurred due to the opencast mine workings it is not a significant impact at the County or District scale.

4/98/0486/0F1



Proposed Lowca Windcluster

Map 1 Ecological Habitats

Scale: 1:10,000

Drawn by R Jerram, 10/3/98

Rigby Jerram
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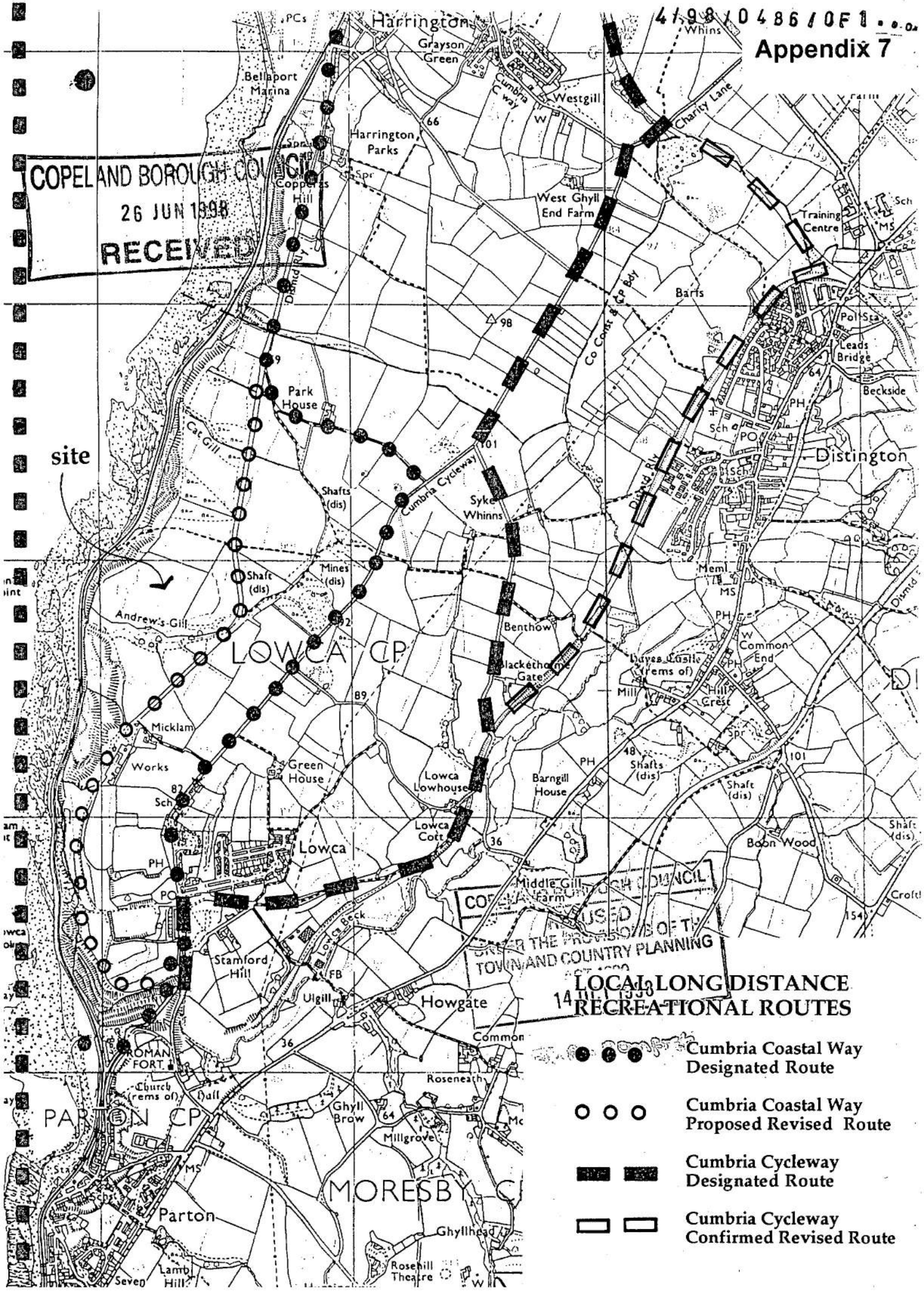
- Site boundary
- Excavation boundaries
- Boundary of CWT Site of Wildlife Interest
- Proposed access track
- Turbine
- Broadleaved woodland
- Gorse scrub
- I Improved grassland
- Flushed acid grassland
- SI Semi-improved marshy grassland
- Broken hedge

Appendix 7



LOCAL & LONG DISTANCE RECREATIONAL ROUTES

- Cumbria Coastal Way Designated Route
- Cumbria Coastal Way Proposed Revised Route
- Cumbria Cycleway Designated Route
- Cumbria Cycleway Confirmed Revised Route

SURVEY OF WALKERS PASSING THE SIDDICK AND HAVERIGG WINDCLUSTERS

In order to establish the impact of wind turbines on the amenity value of the Cumbria Coastal Way, Wind Prospect Ltd conducted surveys of walkers passing the windclusters at Siddick, Workington and Haverigg, near Millom.

The surveys were conducted from 10.00am to 4.00pm on each of 3 days:

- Sunday 7 September 1997
- Wednesday 10 September 1997
- Sunday 21 September 1997

Weather conditions on 7 September were dry and reasonable, on 10 September excellent and on 21 September again reasonable.

A sample questionnaire is attached. This summary reports on the key questions 4 and 5 which were designed to establish, for both sites, the acceptability or otherwise of the turbines in the field of view of the walkers.

RESULTS

SIDDICK

	No Questioned	Attracted/enhanced	Detracted/ put off	Made no difference
No of People	58	10	4	44
Percentage	100%	17%	7%	76%

HAVERIGG

	No Questioned	Attracted/enhanced	Detracted/ put off	Made no difference
No of People	26	0	2	24
Percentage	100%	0	8%	92%

OVERALL CONCLUSIONS

1. The results from both sites are remarkably similar, given the modest sample size.

2. An average of 92.5% felt that the windclusters were either attractive or made no difference to their enjoyment. 7.5% felt they detracted.

Wind Prospect Ltd
20 October 1997

4/98/0486/OF1...

QUESTIONNAIRE

I am carrying out a survey of reactions of users of the Cumbria Coastal Way to the Haverigg Windcluster.

Could you spare the time to answer the following few simple questions.

1. Where did you begin your walk today? _____

2. Where do you plan to finish today? _____

3. Before you started were you aware that the Coastal Way passed by the Haverigg Windcluster? YES NO

4. If yes, how did this influence your choice of walk?

ATTRACTED ME | PUT ME OFF | MADE NO DIFFERENCE

5. If no, how has it affected your enjoyment of the walk?

ENHANCED IT | DETRACTED FROM IT | MADE NO DIFFERENCE

6. Do you support the development of wind energy in the UK?

YES | NO | INDIFFERENT

7. If yes, would you like to be kept in touch with the development of wind energy?

NAME _____

ADDRESS _____

4/98/0486/OP1

acia

Report number: 413r06g2

LOWCA WIND FARM PROPOSAL

BY WIND PROSPECT LTD

NOISE SURVEY AND ASSESSMENT

Prepared for:
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15 May 1998

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4/98/0486/0F1

EXECUTIVE SUMMARY

A survey of ambient noise levels was undertaken through July and August 1994 in and about the proposed wind farm site. Automatic monitoring of noise levels was undertaken for correlation with measurements of the average wind speeds by others.

Predictions of the likely future noise emissions were made during April 1998 in accordance with the guidelines given in "The Assessment and Rating of Noise from Wind Farms", ETSU 1996. The method takes account of the attenuation due to ground effects and air absorption over distance, and the effect of wind direction. A computer based programme was used for all predictive work.

The predictions show that under the prevailing south westerly wind, the maximum excess noise level (L_{A90}) over the background level due to noise from the cumulative operation of all wind turbines will not exceed 4dB at any of the locations. For the majority of wind speeds and directions, residential properties in the locality will only experience noise from the wind farm which is at or below the existing ambient levels. For much of the time, the wind farm will therefore be barely audible.

This development satisfies the criteria given in "The Assessment and Rating of Noise from Wind Farms", ETSU 1996 and the essentially similar conditions proposed by Copeland Borough Council for other sites. It is concluded that no noise nuisance is likely to result from the development of the site, and there will be no grounds for justifiable complaint.

4/98/0486/0F1

1 INTRODUCTION

ACIA was commissioned by Wind Prospect Ltd to undertake a survey of ambient noise around the site of a proposed wind turbine development near Lowca, Cumbria, and to calculate the levels of noise likely to occur at local residential properties.

This report presents the results of the survey and predictions. The noise levels produced by the turbines are superimposed on the typical background noise levels under similar wind conditions.

2 NOISE SURVEY

2.1 Dates and times

Automatic noise monitoring took place from 14:00h on Tuesday 19 July to 23:00h on Wednesday 3 August 1994. Further "spot" readings of the ambient noise levels near the site were also made on 19 July during fairly calm weather, and these were compared with data from the automatic monitor. All monitoring took place before workings at the Lowca opencast coal site had commenced.

2.2 Instrumentation

The instrument used for automatic noise monitoring was a Larson-Davis 700 series data-logging sound level meter, fitted with an eight-millimetre electret microphone and showerproof windshield. The microphone assembly was mounted at a height of 1.2m above ground. The sound level meter was powered by a high-capacity external battery pack, and housed in a sealed weatherproof case to prevent tampering. Ambient noise levels expressed in the form of hourly L_{A90} values dB, were recorded continuously 24 hours a day throughout the survey period. The results were downloaded to a laptop PC at the end of the survey.

Spot readings were made using a Bruel & Kjaer type 2231 modular precision integrating sound level meter. This was fitted with a statistical analysis module type BZ7105, a half-inch prepolarised condenser microphone, and a foam windshield, and was mounted on a tripod at a height of 1.2 metres. The statistical noise indices L_{An} were measured for the 90th, 50th and 10th percentiles, and the equivalent continuous sound levels L_{Aeq} were measured over 10 minute periods.

Calibration of both instruments was checked before and after the measurement using an appropriate electronic calibrator. No significant drift was observed. Both instruments had been subject to laboratory calibration traceable to national standards within the last 12 months.

2.3 Measurement locations

The ambient noise measurement locations were chosen to represent the nearest residential properties to the development. They were:

- Foxpit House (spot checks)
- School House, near Micklam Villa (automatic monitoring)

3 RESULTS OF NOISE SURVEY

The results of the spot readings, and the automatic monitoring of noise and wind speed (by others) are presented in Appendix 1 to this report.

4 PREDICTION METHOD

4.1 Turbine noise data

The Vestas V47 660 is a 660kW pitch-regulated upwind wind turbine with active yaw and a three blade rotor 47m in diameter. The hub height is 40.5m above ground level. The base data for the wind turbine was taken from actual measurements by Vestas' own acoustic consultants, undertaken as part of a continuous "sound optimisation programme" currently underway. The method used to obtain sound power data conformed with International Energy Agency (IEA) recommended practice, the most commonly used model, which calls for measurements close enough to the turbine that background noise is insignificant. Spherical sound radiation was therefore assumed.

The overall sound power level of the Vestas V47 wind turbine was found to be 100.8dBA at the reference wind speed of $8ms^{-1}$. This emitted sound power depends on wind speed and changes at a rate of approximately 0.5dB per ms^{-1}. It was found that this type of turbine has a directivity index of 0dB in all directions, so the noise source itself has no significant directional characteristics.

4.2 Calculation procedure

The method adopted for the prediction of noise from the proposed wind farm was the IEA method supplemented with air absorption and ground attenuation data extracted from the EEMUA 140 guidance. The model assumes hemispherical sound and the predictions are carried out in octave bands. Air absorption and ground effects vary with frequency and distance.

This method has also been approved by the *Noise Working Group* which was set up in 1993 by the DTI in response to the uncertainty amongst planners and developers of the noise targets for guidance when selecting sites and layouts for wind farms. The DTI Noise Working Group consisted of a group of independent experts on wind turbine noise, and published their Final Report in September 1996.

Once the noise from the wind turbine at the most sensitive reception locations has been calculated by this method, it can be compared with the existing background levels. The background noise level is characterised by the L_{A90} index measured at the location under consideration, with the same wind speed conditions. In paragraph 18 of the DTI Noise Working Group's Summary, it is proposed that:

"the background levels upon which limits are based, and the noise limits themselves, are based upon typical rather than extreme values at any given wind speed."

The report goes on to explain that:

"An approach based upon extreme values would be difficult to implement as the difference in measurements between turbine noise and background would depend upon the length of time one is prepared to take data. A more sensible approach is to base limits upon typical or average levels but to appreciate that both turbine and background noise levels can vary over several dB for the same nominal conditions."

Table 1 shows the correlation between the typical background L_{A90} at the automatic monitoring location and the wind speed. It was not possible to obtain L_{A90} data for wind speeds in excess of 13ms^{-1}. It was therefore necessary to estimate the L_{A90} which would occur at the prediction locations with higher wind speeds. In any case, the ETSU guidance recognises the difficulties in establishing limits for wind speeds in excess of 12ms^{-1}, as reliable measurements of background noise are difficult to make under such conditions.

TABLE 1: L_{A90} for various wind speeds

Wind speed (ms^{-1})	4.5	6	7	8	10	15
L_{A90} (dB)	36	37	38	39	43	51.5

4.3 Effect of wind direction

Although each turbine acts as an omni-directional noise source, the prevailing wind effectively superimposes directional characteristics. Downwind, the noise from the wind farm will increase with wind speed, and upwind, the noise will be attenuated with increasing wind speed. In order to incorporate this effect in the predictions, an additional spreadsheet is used to take into account the attenuation values for eight sectors of the compass at various distances. The measurements made by Vestas' consultants were made downwind of the turbine, so a crosswind would give an attenuation dependant on the distance from the source, and an upwind would give approximately double this attenuation. The values used in the calculation procedures originate from CONCAWE 4/81, which investigates the propagation of noise up to 2km by comparing experimental data with theoretical sound propagation models. However it must be noted that the attenuation due to wind direction is also affected by air temperature and the topography of the area, so the actual effect of wind direction may be subject to a small variation.

5 PREDICTED LEVELS

Tables 2 and 3 show the predicted L_{A90} values obtained for the reception points closest to the proposed Lowca site at various wind speeds. A set of results can be obtained for any wind direction, but south-westerly and northerly directions were chosen as an example since these result in the worst case noise levels. A graph of the predictions for Foxpit House under a south westerly wind (that which prevails in Cumbria), is shown below.

Predicted noise levels at Foxpit House

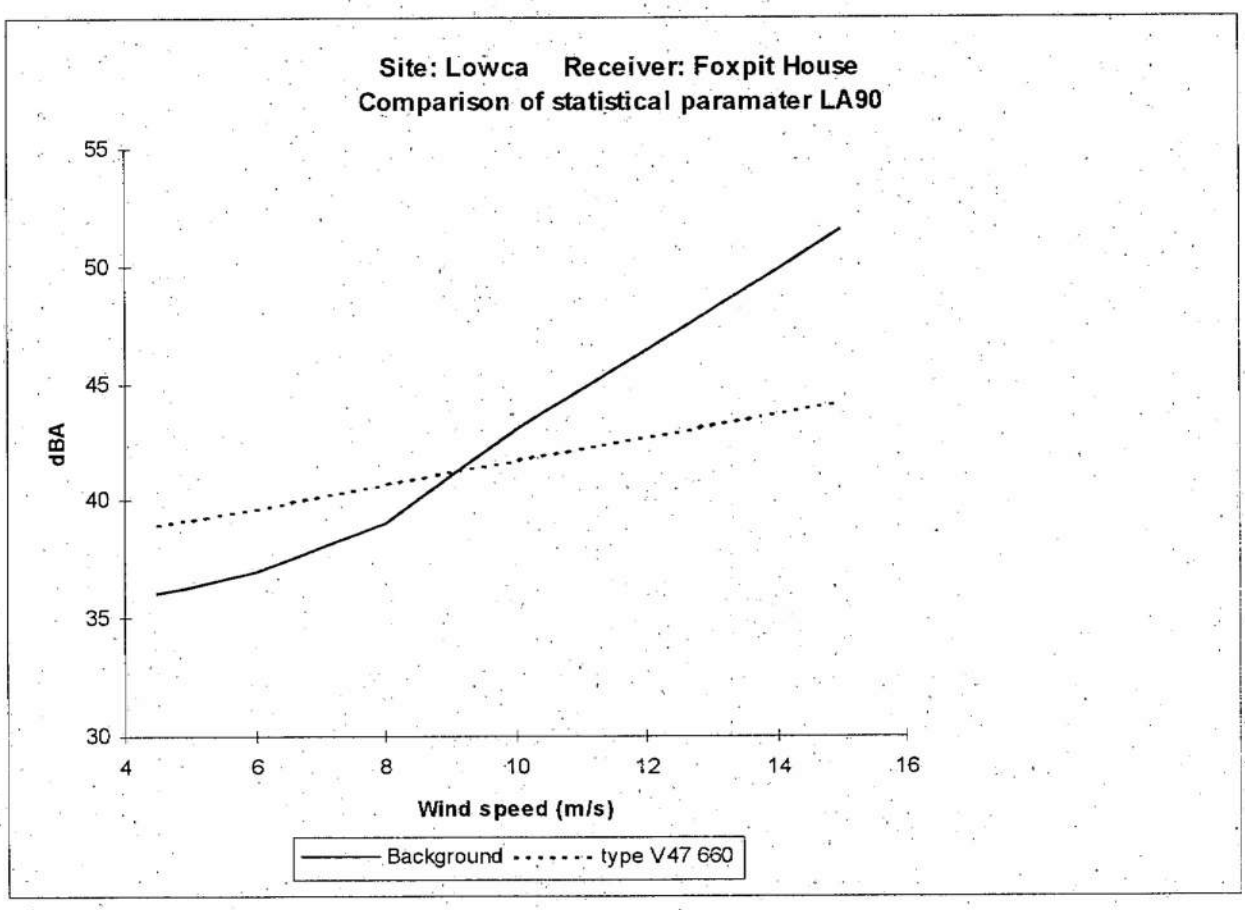

TABLE 2 - Noise level predictions for a south-westerly wind

wind speed 4.5ms^{-1}	L_{A90} (b/g)	L_{A90} (wind farm)	excess
Park House	36.0	35.0	-1.0
Micklam Villa	36.0	28.7	-7.3
Micklam Farm	36.0	32.6	-3.4
Foxpit House	36.0	39.0	3.0

wind speed 5ms^{-1}	L_{A90} (b/g)	L_{A90} (wind farm)	excess
Park House	36.3	35.2	-1.1
Micklam Villa	36.3	28.9	-7.4
Micklam Farm	36.3	32.8	-3.5
Foxpit House	36.3	39.2	2.9

wind speed 6ms^{-1}	L_{A90} (b/g)	L_{A90} (wind farm)	excess
Park House	37.0	35.7	-1.3
Micklam Villa	37.0	29.4	-7.6
Micklam Farm	37.0	33.3	-3.7
Foxpit House	37.0	39.7	2.7

wind speed 7ms^{-1}	L_{A90} (b/g)	L_{A90} (wind farm)	excess
Park House	38.0	36.2	-1.8
Micklam Villa	38.0	29.9	-8.1
Micklam Farm	38.0	33.8	-4.2
Foxpit House	38.0	40.2	2.2

wind speed 8ms^{-1}	L_{A90} (b/g)	L_{A90} (wind farm)	excess
Park House	39.0	36.7	-2.3
Micklam Villa	39.0	30.4	-8.6
Micklam Farm	39.0	34.3	-4.7
Foxpit House	39.0	40.7	1.7

wind speed 10ms^{-1}	L_{A90} (b/g)	L_{A90} (wind farm)	excess
Park House	43.0	37.7	-5.3
Micklam Villa	43.0	31.4	-11.6
Micklam Farm	43.0	35.3	-7.7
Foxpit House	43.0	41.7	-1.3

wind speed 15ms^{-1}	L_{A90} (b/g)	L_{A90} (wind farm)	excess
Park House	51.5	40.2	-11.3
Micklam Villa	51.5	33.9	-17.6
Micklam Farm	51.5	37.8	-13.7
Foxpit House	51.5	44.2	-7.3