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Planning Application 09/94039
Proposed Installation of 6kW
Proven Wind Turbine
at Sopley Primary School

Assessment of Noise Issues

September 2009

Project 8329

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1 Introduction

1.1 Hampshire County Council have received a planning application (also from the Council) to erect a wind turbine in the grounds of Sopley Primary School, South Ripley, near Christchurch. Concerns have been expressed by local residents and by New Forest District Council Environmental Health (as consultees) about the possibility of noise from the wind turbine causing unreasonable disturbance. Hampshire County Council Planning and Development Department have commissioned ISVR Consulting to carry out an independent assessment of the likely impact of noise from the wind turbine. The assessment is presented in this Report.

1.2 The assessment is based on:

- Information on the noise emission of the Proven WT6000 wind turbine, as supplied by the applicant. This is contained in two reports, referred to in this report as (1) and (2):

1. Report by SgurrEnergy (Document no. 64154/001/O/RT/07/001) *6kW WTGS at Neilston – Noise Survey – April 2007.*

2. Report by Proven Energy (undated) *Proven WT6000 Wind Turbine Mounted on 15m self supporting tower – Noise Emission Report*

- A visit to the site on September 2009 to inspect the proposed turbine location and the surrounding area.

- The results of noise measurements at a location in the rear garden of No 1 N Ripley Cottages between 16 and 24 September 2009.

2 Description of the Site

2.1 The site is located at the junction of Thatchers Lane and Harpway Lane in South Ripley. The layout is shown on Figure 1, which shows the proposed position of the wind turbine to the east of the school buildings and about 10 metres from the northern boundary. The nearest houses, Nos. 1 and 2 South Ripley Cottages, are also shown. The turbine would be approximately 50 metres from the nearest point of the rear garden of No.1, and approximately 100 metres from the houses themselves.

2.2 The proposed wind turbine is a Proven 6kW type. The turbine would be mounted on a mast at 15 metres above local ground level.

2.3 From inspection, the site and local area is substantially flat. There is a mixed hedge and some substantial trees on the northern boundary of the school site. Nos. 1 and 2 South Ripley Cottages are the closest dwellings to the wind turbine location. It was judged that the view of the wind turbine would be screened from the ground floor windows of No 1, but that it would be visible from the first floor and from both ground and first floor windows of No. 2.

2.4 There are currently major building works in progress at the school and noise from construction equipment was clearly audible in the vicinity. Therefore noise measurements made during working hours on weekdays are likely to be unrepresentative of 'typical' levels. However, evening and night-time levels should be representative of the 'normal' situation.

3 Measurement Survey

3.1 An unattended noise survey was carried out between 16 and 24 September at a location in the rear garden of No. 1 South Ripley Cottages, approximately 5 metres from the rear façade of the house. This location is relatively sheltered by the cottages and the school building and background noise levels at this location would be expected to represent the lowest levels likely to be experienced at any location close to the rear of the cottages.

3.2 Measurements were made using a Rion Type NL-31 sound level meter. The microphone was mounted on a pole at a height of approximately 1.3 metres above the ground. The system was check-calibrated before and after use with a Brüel and Kjaer Type 4231 Calibrator. No calibration drift was detected. The meter was set to record noise levels continuously, the measurement interval being 10 minutes. The meter position is illustrated in Photographs 1 and 2.

3.3 Background noise levels, and the noise generated by the wind turbine, increase as wind speed increases. The assessment is based on a comparison between predicted wind turbine noise and the existing background noise levels. This comparison has to be made for a range of wind speeds: therefore it is necessary to determine the typical background noise levels at any particular wind speed. An anemometer was therefore installed on the school site to measure average wind speed (and wind direction) in 10 minute intervals which were synchronised with the noise measurements. The anemometer used was the unit from a Davis Weather Wizard 3 weather station, comprising a rotating-cup anemometer and wind vane supported on a 6 metre mast, with associated data logger. The installation is shown on Photograph 3.

3.4 During the survey period the weather (from local forecasts and reports) was generally fine and dry. There was light rain overnight on 22-23 September although there is no evidence that the measurements were affected. Winds were generally light-to-moderate, initially northerly but becoming westerly or south-westerly from 21 September. There is no reason to expect background noise levels to be particularly sensitive to wind direction. It would have been desirable to extend the survey to

obtain data at higher wind speeds, but this was not possible within the timescale set by the Council. In the event, between the termination of the survey and the date of writing this report (30 September), winds have remained light, and there is no prospect of stronger winds in the near future. Therefore the assessment is necessarily based on extrapolated data (as explained in 4.7).

4 Survey Results

4.1 The survey data has been analysed to determine the range of background noise levels prevailing at the measurement site during the survey, and how background noise level varies with wind speed. Background noise levels are expressed in terms of the A-weighted noise level exceeded for 90% of the time in each measurement interval – the so-called L_{A90} level, in decibels (dB), as is standard practice.

4.2 The variation in background noise level with time over the survey period is shown in Figure 4.2-1 below.

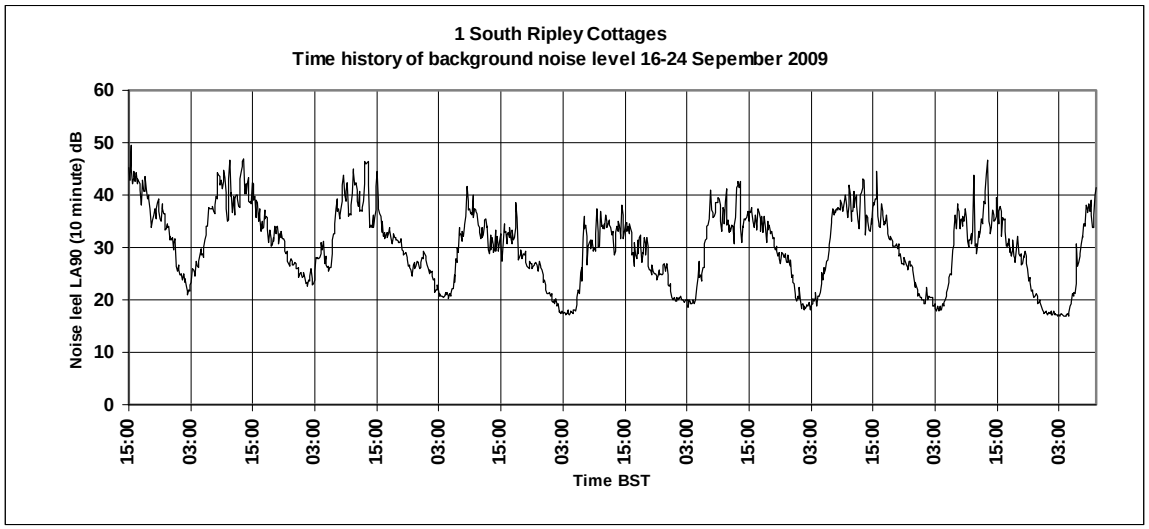


Figure 4.2-1

4.3 This shows the pattern of day-to-day variation in background noise level. The daytime noise levels on weekdays exhibit 'peaks' assumed to be caused by the construction works on the school site (perhaps with some contribution from the school playground).

Noise levels fell below 30 dB L_{A90} in the evenings and below 20 dB L_{A90} at night. This is clearly a quiet and tranquil area at these times, as would be expected since the nearest significant source of reasonably continuous noise, the A338, is about 3 km away to the west.

4.4 To present a 'worst case' situation, the assessment has been based on the mean background levels measured during the period between midnight and 5.00 a.m., when background noise levels are lowest. Figure 4.4.1 shows the measured noise levels in this period (for the 8 nights of the survey) in the form of a scatter plot. Each 'dot' on the plot represents a single 10 minute measurement. A small number of obvious 'outlying' data points have been excluded from the analysis. Mrs Passmore (the resident at No 1) reported that during the earlier pert of the survey, when northerly winds prevailed, aircraft talking off from Bournemouth Airport were overflying the site. These events may explain the intermittent higher levels at night, although such events would have been of relatively short duration and would not have been expected to affect the L_{A90} levels.

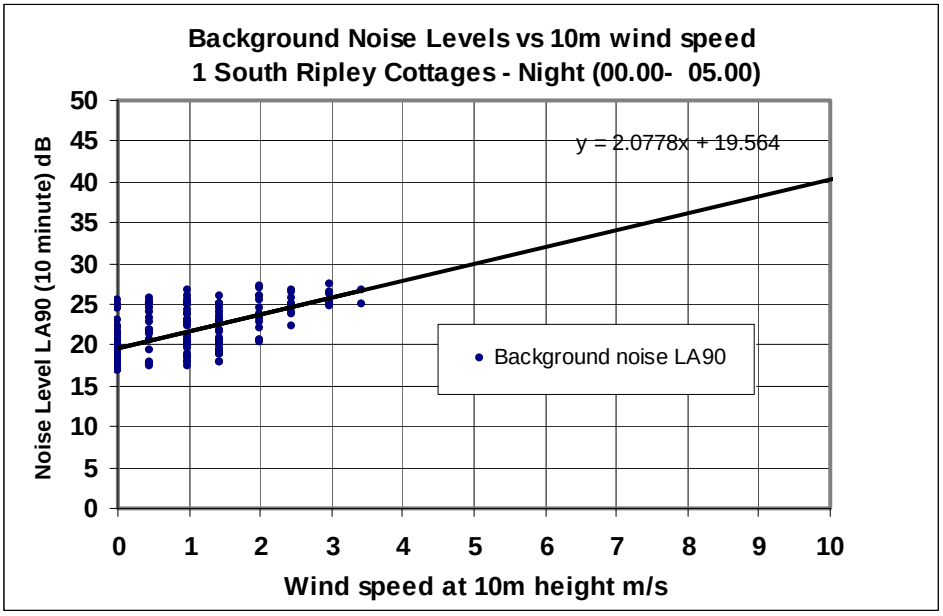


Figure 4.4-1

4.5 The noise levels on this graph are plotted against wind speed. The data logger records wind speeds in increments of 0.5 m/s. As noted, the wind speed was measured at a height of 6 metres. The noise data for the wind turbine (Report 1) is referred to the wind speed at 10 metres height (not the actual height of the wind turbine, which is 15 metres at the hub), as is industry practice. Wind speeds near the ground increase with height ('wind shear'). The wind speeds measured on the site anemometer have been corrected to a height of 10 metres using a standard wind shear formula (which is adopted in ETSU-R-97 *The Assessment and Rating of Noise from Wind Farms*,

although the difference in wind speed between 6 and 10 metres height is not in fact very great in the context of this exercise (about 10%).

4.6 It is clear that no noise data was collected at 10m wind speeds above 3.5 m/s., whereas the Proven turbine operates at higher wind speeds: Report 1 listed in 1.2 provides noise data for wind speeds up to about 12m/s. It was unfortunate that the timing of the survey coincided with an extended period when winds were light.

4.7 The solid line on the graph is the 'best fit line to the measured data, assuming a linear relationship between background noise level and wind speed (which is not in fact the case although an adequate representation here). The extrapolation of this line to higher wind speeds provides an estimate of background noise levels at these higher wind speeds. Although such extrapolation outside the range of measured data is questionable, the resulting estimated mean background noise levels, rising to 40 dB L_{A90} at a wind speed of 10m/s, are similar to (and at the lower end of the range of) levels measured at other sites in quiet rural areas. There is a large body of such measurement data collected in connection with assessments of background noise levels near proposed wind farms. Therefore the line in Figure 4.4-1 is considered to present a reasonable estimate of the background noise levels at the rear of South Ripley Cottages at various wind speeds.

5 Prediction of Wind Turbine Noise Levels

5.1 As far as is known, Report (1) by SgurrEnergy provides the only reasonably comprehensive information available on the noise emission of the Proven 6kW wind turbine. The Proven Report (2) is based on very limited measurements, made at the base of the mast, at only two wind speeds, and is of questionable value (although the limited results appear to be generally consistent with those in Report (1).

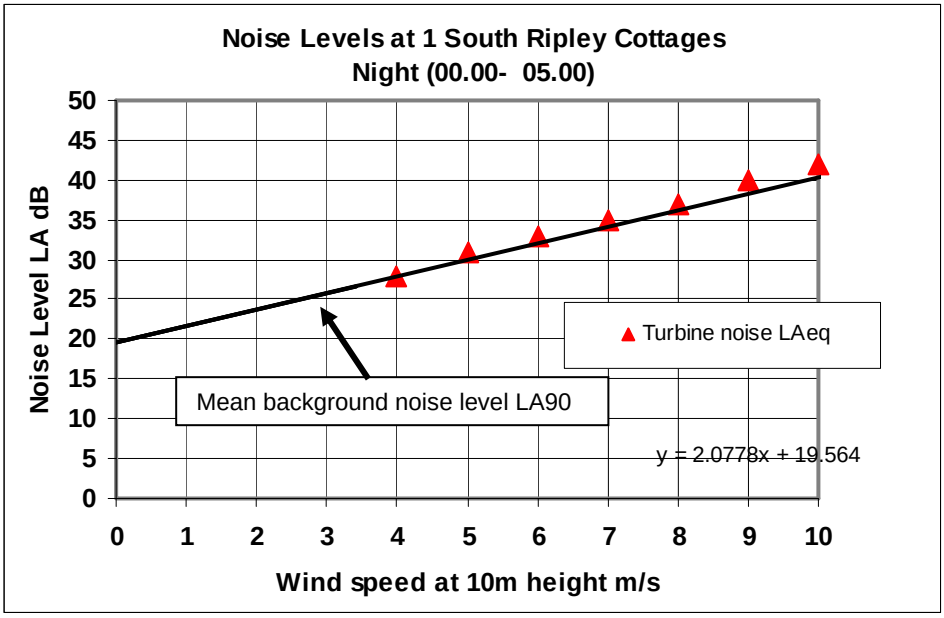
5.2 The measurements detailed in Report (1) were made at 10 metres from the base of the turbine tower using a microphone mounted on a reflective ground board. The measurement method is generally the same as that employed for measuring the noise emission of large wind turbines, as described in BS EN 61400-11 (2003). Measured noise levels are plotted in the form of a scatter plot (Figure 1 of Report 1) and a mean 'best fit' line calculated - the same technique as applied to the background noise measurements described in 4.4 – 4.7 above. The mean noise levels are used to calculate the Sound Power Level (the overall sound energy emitted by the turbine, expressed in dB re 10^{-12} Watts) at any wind speed. The calculated Sound Power Level is 85.4 dB L_{wA} at a wind speed of 8m/s, with a coefficient of regression (the 'slope' of the curve) of 2.24 dB per m/s of wind speed.

5.3 The measurements of wind turbine noise shown on Figure 1 in Report 1 show considerable scatter, and the Report accepts that the measurement conditions were not ideal (paragraph 8) and that "*The Sound Power Level and regression coefficient obtained should be treated as provisional until a test under properly controlled conditions is conducted*". Therefore the noise data in the Sgurrenergy Report must be treated with some caution, although there is no reason to believe that they are subject to a significant error. Anecdotal information from other consultants suggests that the stated noise levels are of the correct order.

5.4 Note that the noise levels stated in Report 1 are equivalent-continuous or time-average noise levels, expressed as L_{Aeq} levels.

5.5 Report 1 also stated that measurements using one-third octave analysis did not reveal any prominent tonal components in the noise emitted by the wind turbine. In fact the presence of an audible tonal component or other distinctive characteristic (such as a 'rattle') would not necessarily be detected by one-third octave analysis. It is unfortunate that the Report does not include a subjective judgment on the 'quality' of the noise emitted. The author of the current report (R A Davis) has experienced the noise of a Proven wind turbine (although of unknown type at an unknown wind speed) and would describe the sound as a broad-band 'rush' with no distinctive tonal component. However, other anecdotal reports have described 'rattling' noise from this type of turbine. Therefore the possibility that the noise emitted by the Proven wind turbine might have a distinctive (and therefore potentially annoying) characteristic should be borne in mind.

5.6 Figure 5.6.1 below shows the predicted wind turbine noise levels (the triangle markers) at the rear of Nos. 1 and 2 South Ripley Cottages for a range of wind speeds, compared with the line representing the mean existing night-time background noise level. The predicted levels are based on the Sound Power Level stated in Report 1 and ignore the screening effect of the school building (which would reduce noise levels slightly at the ground floor of No.1). The prediction assumes that the ground between the turbine and the houses is 'hard' (acoustically reflective) and is therefore slightly pessimistic (i.e. actual levels would be 1-2 dB lower).



It is seen that the predicted wind turbine noise levels are very close to the existing background noise levels, being no more than 2 dB higher at 9-10 m/s wind speed.

5.7 It is emphasised that the data shown on Figure 5.6-1 is subject to some uncertainty. The background noise levels at higher wind speeds rely on extrapolation of the measured data, and the turbine Sound Power Level is extracted from Report 1 which is accepted as being provisional. However, there is a small safety margin inherent in the predicted noise levels and the analysis is therefore considered to be a reasonable basis for assessing the noise impact.

6 Assessment of Noise Impact

6.1 It is recommended that the assessment of noise from the proposed wind turbine is based on the method of BS4142 *Method for Rating industrial noise affecting mixed residential and industrial areas.* This standard is generally used by Local Authorities as a basis for setting noise limits for industrial operations. Government guidance (PPS 22 *Planning Policy Guidance Note: Renewable Energy*) recommends that different assessment criteria are applied to commercial wind farms (ETSU-R-97). The ETSU-R-97 criteria lead to noise limits that are less restrictive than would be applied using BS4142: this 'relaxation' is considered appropriate for large commercial wind farms because of the need to reach a compromise between residential amenity and the wider benefits derived from a significant renewable energy resource. However, it does not seem to be reasonable in this case to resort to such a compromise, since a single 6kW wind turbine will not provide any 'wider benefits' in terms of electricity generation. Therefore noise limits based on BS4142 should apply.

6.2 The BS4142 method relies on comparing the noise from the development, expressed as a time averaged (L_{Aeq}) level, with the prevailing background noise level (in the absence of noise from the new development), which is measured as an L_{90} level (L_{90} is a statistical measure of noise level – the level exceeded for 90% of the time). Noise levels are those that would be measured outside and in the vicinity of dwellings. If the noise is distinctive in character, a correction of + 5 dB(A) is added to the specific (source) noise level, because it is recognised that tonal or impulsive noises are likely to be more annoying than continuous noise with no discernible 'character'. The noise from the 'new' source, with the addition of the 5 dB(A) correction if necessary, is termed the **rating noise level**. The Standard states that if the rating noise level exceeds the background noise level by more than about 10 dB, this is an indication that complaints about noise are 'likely'. A difference of around +5 dB is of 'marginal significance'.

6.3 It is common practice, in setting noise limits for an industrial development. to permit a maximum BS4142 Assessment Level of +5 dB – the 'marginal likelihood of

complaints' level. This requires that the noise from the development (measured as an L_{Aeq}) does not exceed the existing background noise (L_{A90}) by more than 5 dB. If the 'new' noise contains any tonal component or other distinctive characteristic which would attract the 5 dB 'penalty, the new noise is restricted to the level of the existing background noise.

6.4 This is quite a restrictive requirement, and monitoring compliance presents some practical difficulties (because the noise limit at the houses would be of the same order as the ambient noise from other sources). However, it would be unsafe for a planning authority to permit significantly higher levels – assessment levels of around +10 dB would indicate 'complaints likely'. The compliance monitoring problem can be overcome in this case by specifying noise limits (adjusted to take account of the relative distances) at a position closer to the turbine, where noise levels will be higher and therefore more readily measured.

6.5 As shown on Figure 5.6.1, predicted turbine noise levels at the rear of the Cottages are no more than 2 dB above the derived mean existing background noise level (at night between midnight and 05.00). Therefore even if the turbine noise attracted a +5 dB BS4142 penalty (see 6.3) the Assessment Level would be no higher than +7 dB*. Therefore the turbine noise could reasonably be assessed, at worst, as having a 'marginal' noise impact even during the quietest night time periods. On this basis, noise from the wind turbine would not cause a significant loss of amenity to neighbours, although the wind turbine might occasionally be audible during the evening and at night outside the houses (and possibly just-detectable inside the house at night when windows are open).

* BS41242 is not strictly applicable in this case at low wind speeds, below about 5m/s, because both the background noise level and the predicted wind turbine levels are below 30 dB. However, this is a fine technical point and can reasonably be ignored here.

7 Conclusions

7.1 On the basis of the data available, the noise generated by the proposed Proven 6kW wind turbine will not lead to unacceptable levels of noise at the nearest dwellings (South Ripley Cottages), although the wind turbine might be occasionally be audible during the evening and at night outside these houses (and possibly just-detectable inside the houses when windows are open.

7.2 However, the assessment is subject to some uncertainty. The uncertainty associated with the predicted noise levels (which rely on 'provisional' source noise data) can be addressed, if planning permission is granted, by imposing a condition which has the effect of limiting limits noise levels to the predicted levels. If the actual Sound Power Level of the turbine exceeds the level claimed by Proven (in Report 1) then the condition would be breached and the School would need to take remedial action. Such action could involve restricting the operation of the turbine to specified hours.

7.3 Suitable forms of noise Condition have been proposed to Council and there is continuing discussion on these conditions.

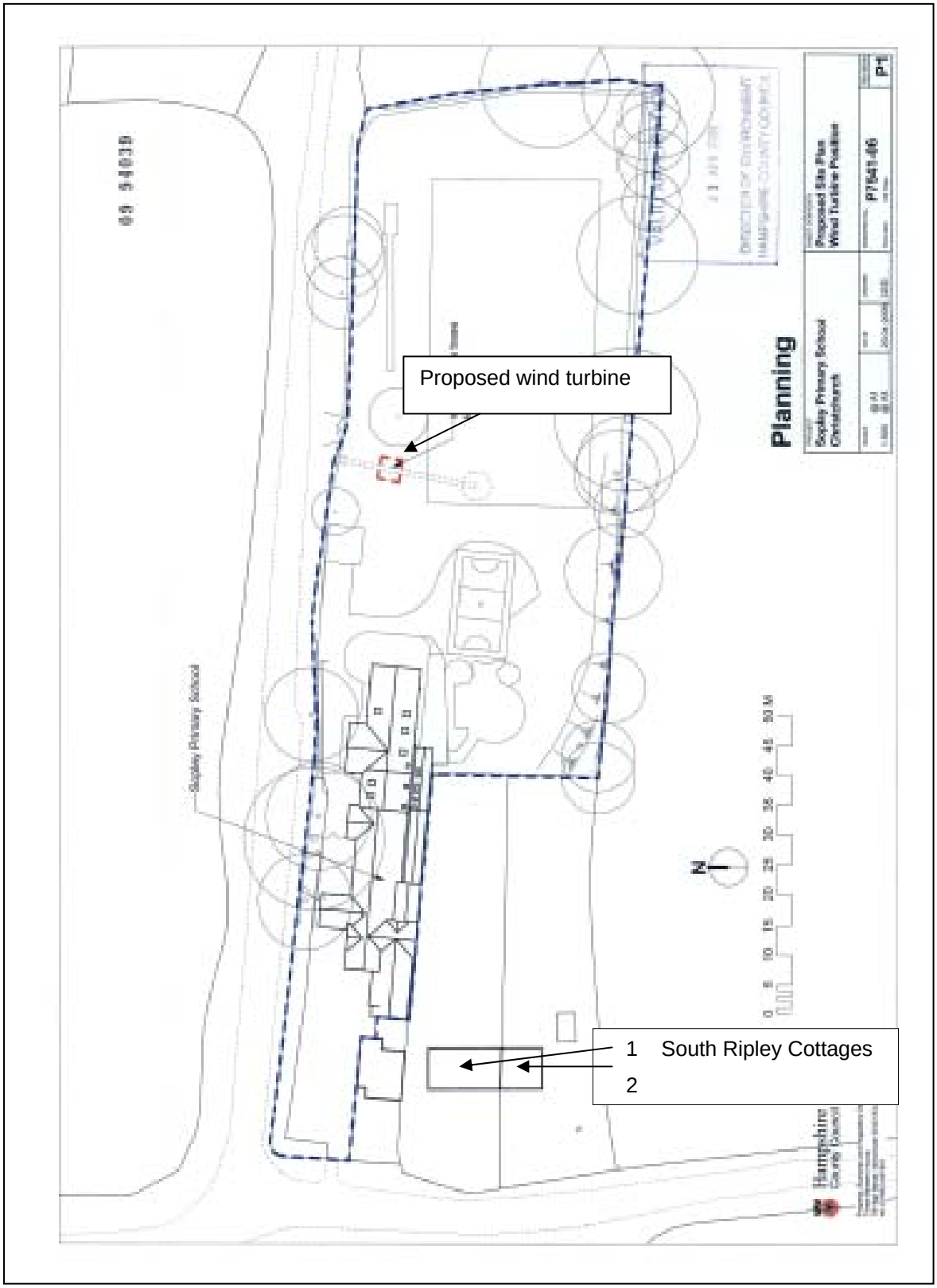


Figure 1 Site Location and Layout

Photographs 1 & 2

Noise Measurement equipment at rear of No. 1 South Ripley Cottages

Photograph 3

Anemometer mast on School site