Planning Applications no. H/2014/0252, /0253 and /0254
Hartlepool Wind Farm

Appraisal
of
Noise Impact Assessment

John Yelland MA DPhil (Oxon) MInstP FIET MIOA

28th July 2015

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1 Introduction

1.1 About the Author

1.1.1 I am John V Yelland MA DPhil (Oxon) MInstP FIET MIOA; I am an independent consultant with experience in many areas of acoustics and physics. My earliest encounter with acoustics was in the course of research into the high frequency acoustic impedance of liquid helium three for my doctoral thesis at the Clarendon Laboratory, Oxford University some 45 years ago. My latest is in research into the low frequency acoustic emissions of wind turbines.

1.1.2 I have worked in senior research and development positions in large and small companies in the UK and Europe. I was founder of Milmega Ltd, a high technology company on the Isle of Wight, and its Chairman and Managing Director for 12 years.

1.1.3 I have been elected to corporate membership of the Institute of Physics and its offshoot the Institute of Acoustics. I have also been directly elected by invitation to fellowship of the Institute of Engineering Technology.

1.1.4 I am principal acoustic consultant to the UK Independent Noise Working Group currently investigating the amplitude modulation of wind turbine noise and reporting to Parliament.

1.1.5 Although I have many years of experience in the above fields I believe that the rigorous application of the principles of good science, and an in depth understanding of the mathematics that this requires, are the most important attributes when acting as a wind farm noise consultant. I prefer to offer transparent and accessible evidence to support my findings rather than offer bland assurances of my "professional judgement".

1.2 About the Application

1.2.1 I have been commissioned by local residents to examine perceived inadequacies in the noise impact assessment ("the NIA"), ref. H/2014/0252, H/2014/0253 and H/2014/0254 submitted to Hartlepool Borough Council ("the Council") as a part of each of three planning applications by Mr Mark Whitehead ("the applicant") [1], for full planning permission to develop a three turbine wind farm on land near Seaton Carew in the Borough of Hartlepool.

1.2.2 I note that separate planning applications have been made by the same applicant for the three turbines; from an acoustic viewpoint however the project can only sensibly be considered as a single entity. I further note that the turbines initially proposed by the applicant were significantly smaller than is the Siemens model presently proposed. All this may explain how it has come about that we have here in reality a three turbine 13.2 MW windfarm application which proposes the highest power and the tallest onshore turbines ever proposed onshore in the UK, yet the Council did not require a full EIA.

1.2.3 The applicants initial noise assessment, which is just over one page in length, is for a single turbine, and moreover a turbine of different model and manufacture from that now proposed. It is therefore not relevant to the application, so its non-compliance with ETSU [1], with the IOAGPG [2], and with ISO 9613-2 [3] is of no consequence.

1.2.4 The applicant's revised noise assessment by Dragonfly Acoustics addresses the three turbines as a single wind farm; it is this document that I will appraise.

[1] References to the applicant include any parties employed by or contracted to the applicant.

1.3 About this Appraisal

1.3.1 Wind farm noise continues to be a highly contentious matter. It is also a highly technical matter, regulated by planning policy and guidance which, some informed opinions claim and others deny, may provide inadequate protection to the wind farm neighbour. I must therefore emphasize that I seek here primarily to determine whether or not the application follows best practice and demonstrates compliance with current planning policy and guidance, irrespective of any doubts about the adequacy thereof.

1.3.2 Any other matters I raise which I consider to be treated inadequately, or not at all, by current planning guidance as embodied in ETSU and the IOAGPG will be clearly identified.

1.3.3 The first such matter is the abundant and increasing evidence that a particular characteristic of wind turbine noise, somewhat misleadingly referred to as “excess amplitude modulation”, has seriously affected the health of a significant minority of wind farm neighbours. Its cause and effect is now fairly well understood by independent acousticians in the UK, USA, Australia, Canada and other countries. It is not observed at all wind farms, and it shows dependence upon terrain and turbine model. It is not addressed at all in ETSU or the IOAGPG. Because it is an unpredictable but not uncommon phenomenon it is essential that it is controlled by an effective planning condition, which should be composed and imposed by local planning authorities.

1.3.4 Because the present application is so seriously flawed I will however concentrate more on exposing the deficiencies of the application rather that the recently emerging deficiencies in the UK’s planning guidance on wind turbine noise.

2 The ETSU Procedures

[This section is purely explanatory and makes no comment on the applicant's NIA.]

2.1 Protection against Noise

2.1.1 There are two procedures, referred to as "standard" and "simplified", prescribed in ETSU for assessing the impact of wind turbine noise on wind farm neighbours.

2.1.2 ETSU states that the procedures are intended [2] :

"to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development or adding unduly to the costs and administrative burdens on wind farm developers or local authorities".

2.1.3 The ETSU standard procedure is complex; it requires synchronized measurement of wind speed, wind direction, rainfall, background noise and time, usually at more than one location, over a period of several weeks. This is followed by considerable data processing and calculation.

2.1.4 The ETSU simplified procedure imposes more constraint on the wind farm design, but offers a lower cost for the developer. The level of protection which the simplified procedure offers wind farm neighbours is at least equal to that of the standard procedure. The background noise survey of the standard procedure is not necessary, but a site visit is still required to ensure that all turbine setback distances[3] are correctly determined and to assess the current terrain and site conditions.

2.2 The Simplified Procedure

2.2.1 The ETSU simplified procedure just applies an absolute 35 dB(A) outdoor immission[4] noise limit at all times and at all wind speeds up to 10 m/s. This obviates the need for a background noise survey (BNS) and thus greatly reduces the complexity of the NIA.

2.2.2 All wind farm NIAs start with the simplified procedure, which is essentially the creation of a noise map with a 35 dB(A) contour. If there are no receptors within this contour the standard procedure is unnecessary. If there are receptors within it they must be assessed using the standard procedure, whereas those outside have already been predicted to meet the requirements of the simplified procedure.

[2] Blue background indicates quotation from planning guidance, appeal decisions and standards; pink background indicates quotation from application documents and their appendices.
[3] Distances between turbine and homes.
[4] The sound pressure (i.e. noise level) at a receptor (i.e. home of wind farm neighbour).

2.3 The Standard Procedure

2.3.1 The ETSU standard procedure imposes relative rather than absolute limits on turbine noise; at nearby homes it must not exceed the measured background noise by more than 5 dB at any wind speed[5] up to 12 m/s. Both turbine noise and background noise increase with wind speed, but differently.

2.3.2 As wind speed increases above 3-4 m/s turbine rotation starts, and the noise level rises fairly rapidly until at around 8-9 m/s wind speed, above which the rotational speed, and thus the output power and noise power, of the turbine are constrained to remain fairly constant as wind speed increases further (assuming a modern upwind turbine).

2.3.3 The background noise in rural environments is largely caused by vegetation – trees, hedges, crops etc. – moving in the wind, so it too rises with wind speed, slowly at first, then more rapidly with increasing wind speed. For homes near roads traffic noise can also contribute to (and sometimes dominate) the background noise, in which case there is little direct correlation between background noise and wind speed.

2.3.4 See for example figure 1 below, taken from the noise impact assessment for a location with relatively high background noise from surrounding trees and road traffic. A wind speed versus immission noise plot curves upwards from the left, whereas the background noise trend line curves downwards from the right. The 5 dB relative limit is therefore most likely to be exceeded at wind speeds typically between 4 and 8 m/s.

2.3.5 Background noise surveys are a major part of any ETSU wind farm NIA that uses the standard procedure. The averaged background noise and meteorological data (wind speed, wind direction and rainfall) are recorded in synchronised contiguous 10 minute periods.

2.3.6 The background noise level in the quietest of rural locations is less than $LA_{90,10min}$ = 20 dB[6] at low wind speeds; see figure 2 for an example. ETSU considers that, however low the background noise is, 35 dB(A) or less of turbine noise is unlikely to cause annoyance. ETSU therefore defines the maximum permitted turbine noise level in the external amenity area of a dwelling to be the greater of 35 dB(A) and 5 dB above the background noise level, rather than simply 5 dB above background noise level, at all wind speeds up to 12 m/s (see for example figure 1).

2.3.7 The above noise limits apply during evenings (1800 to 2300 hrs local time) and during weekend daytime (1300 to 1800 hrs on Saturdays and 0700 to 1800 hrs on Sundays). A higher limit applies at night (2300 to 0700hrs); this is set at 43 dB(A), on the premise that there would be 8 dB of noise attenuation through an open window.

2.3.8 The 35 dB(A) and 43 dB(A) lower fixed limits of §2.3.6 can be increased if the installed power level of the wind farm is such that its environmental benefits are considered to outweigh harms to the wind farm neighbours. The noise limits for "financially involved" receptors can also be higher.

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[5] Here and elsewhere in this document wind speeds are referred to a standard measurement or prediction height of 10 metres above ground level unless stated otherwise. This is necessary because wind speed increases with height above ground level, a phenomenon known as wind shear.

[6] ETSU uses the $LA_{90,10\ min}$ descriptor; see §9, page viii, therein. This is often presumed in my use of the term dB(A).

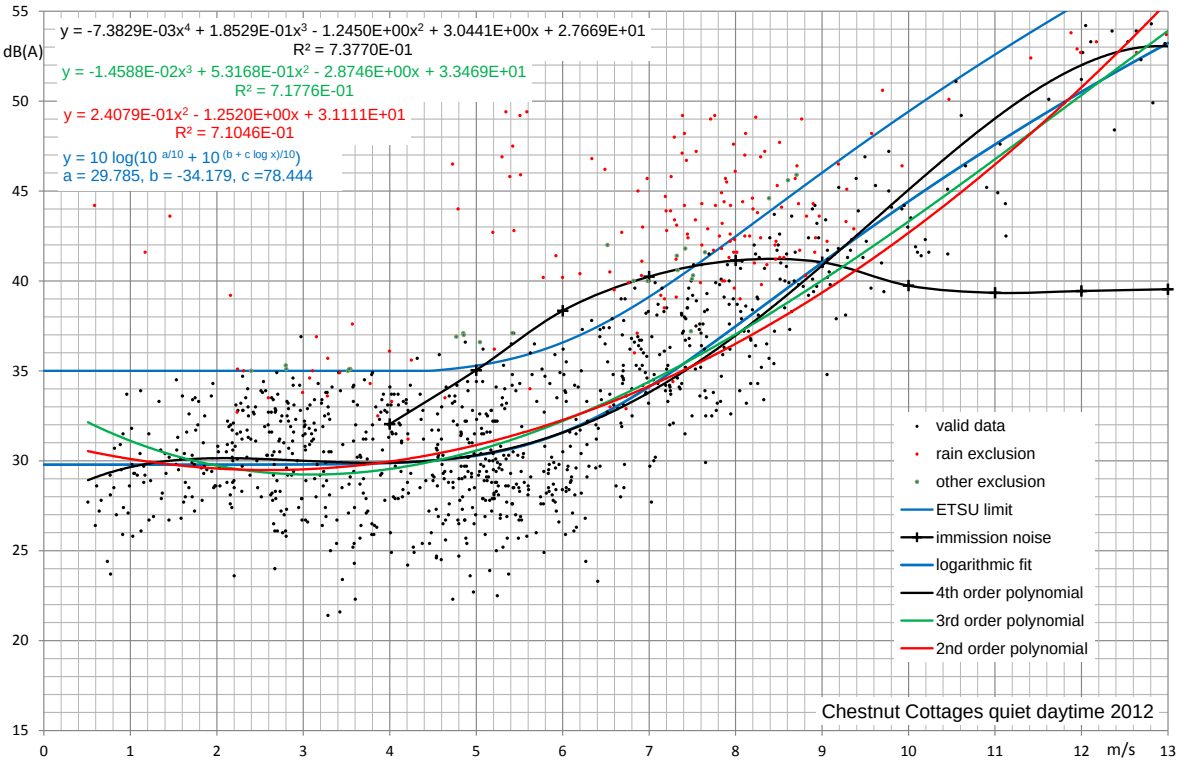


Figure 1: A typical complete noise chart for a forest edge location close to a road

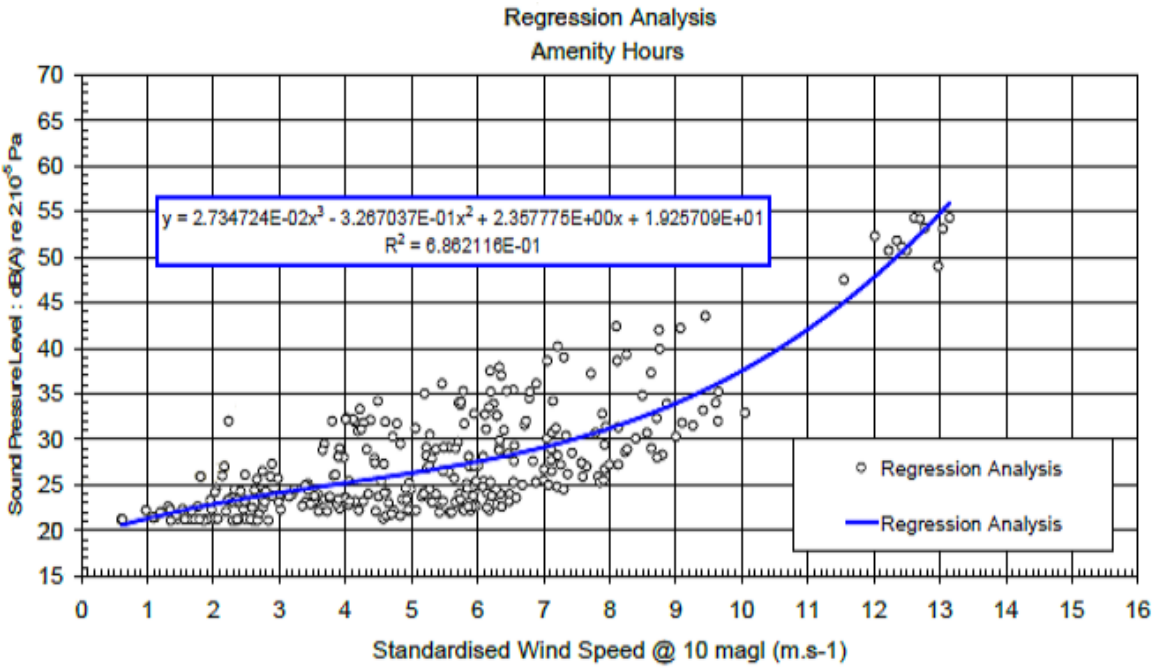


Figure 2: A typical quiet daytime noise chart (from the IOAGPG consultation document).

3 Review of Applicant's Noise Impact Assessment

[My comments are made with the benefit of a site visit made on 10th June 2015.]

3.1 Document Structure

3.1.1 The applicant's NIA, reference DC1548-R1v2, is dated February 2015. It postdates the DECC endorsement in May 2013 of the IOA Good practice Guide to ETSU (IOAGPG) and should therefore comply with the guidance therein.

3.1.2 The NIA is not well structured. For example the title *"2.1 Site Conditions"* is followed by descriptions of the proposed wind turbines and their noise specification, and a miscellany of other topics unrelated to the site conditions. Nevertheless for simplicity I will review its content sequentially. I will also refer to paragraphs therein as if numbered separately in each section, even though they are not numbered. Quotations, from whatever source, are italicised. To aid navigation, titles from the applicant's NIA are quoted ***"in bold italics"*** in the following text.

3.2 Initial Appraisal

"2.1 Site Conditions"

3.2.1 The turbines are described as both *"Siemens SWT 3.3-130 3.3MW"* and *"Endurance X-29 225kW"* wind turbines. The former description is correct; the latter suggests that the applicant's NIA may be based on its earlier NIA for Poplar Farm, Cottingham, dated August 2014.

3.2.2 The applicant states in *§2.1.4* that:

"The third octave band data for this turbine is not considered suitable for undertaking an assessment using ISO9613-2, Equation (9)."

No explanation is offered for this arrogant assertion, no copy of the data source is provided to allow independent assessment of its suitability, and no explanation is offered of how the prediction calculations were done without using the data.

It is almost inconceivable that a turbine manufacturer with the status and reputation of Siemens would publish data that was "not suitable" for its intended purpose.

I have noticed Dragonfly's tendency to declare that wind turbine spectral data are *"not considered suitable"* in several of their NIAs; I have however never found any explanation why they are so considered.

3.2.3 Having stated in §2.1.4 that it will not use ISO 9613-2, Equation (9) the applicant then claims full compliance with §4.3 of the IOAGPG, which states in §4.3.3 that:

"Equation (9) of the ISO 9613-2 standard should be used to calculate ground effects for different octave bands, ***based on the turbine emission spectra****."* [my emphasis throughout]

This failure to comply with the IOAGPG is by definition a failure to use good practice; the preceding claim to have complied is manifestly untrue.

3.2.4 In the §2.1.7 the applicant denies the presence of "any existing turbines in the vicinity of the proposed installation". Yet it does not appear that the applicant has considered, as required by the IOAGPG, turbines consented but not yet built or turbines still in planning.

3.2.5 Moreover the applicant's submitted cumulative site plan (figure 7.17 of the application documents) clearly shows the 27 turbines of the 62 MW Teeside offshore wind farm a

little over 5 km from the proposed site. This would undoubtedly add to the immission noise levels at sensitive receptors, particularly as the propagation path from Teeside Offshore is substantially over water, and the lower attenuation thereof must be calculated using the equations of SGN6 of the IOAGPG.

3.2.6 The 27 offshore turbines will also have contributed contribute to background noise measurements, as the wind farm has been operational since June 2014, six months before the applicant's background noise surveys.

"2.2 Residential Properties"

3.2.7 The applicant appears not to fully comprehend the standard ETSU procedure, for which it is first necessary to identify all receptors which do not meet the requirements of the ETSU simplified procedure, then to ensure that those identified do meet the requirements of the standard procedure. The correct approach to a background noise survey is therefore to predict a 35 dB(A) 10 m/s noise contour around the wind farm. This defines the area within which the standard ETSU procedure, supplemented by the IOAGPG, must be used to predict the immission noise levels at the homes nearest to the turbines using ISO 9613-2. By definition all receptors outside the 35 dB(A) contour comply with the simplified procedure. The IOAGPG states (in SB2 on page 6):

"SB2:The study area should cover at least the area predicted to exceed 35 dB LA90 at up to 10 m/s wind speed from all existing and proposed turbines."

For the standard procedure a knowledge of the background noise level as a function of wind speed is required at each receptor to be assessed. As it may be impractical to measure background noise at all of them, and clearly is impractical in the densely populated urban areas of the present application, the use of appropriate proxies is accepted.

3.2.8 Common sense dictates that measured background noise levels are less reliable when used as proxies than when used at the receptor at which they were measured. From this it follows that the receptors selected for background noise surveys should include those closest to the wind farm, where immission noise would be highest, but where the existing background noise is not likely to exceed that at any of the receptors for which it would be used as a proxy. Put simply, the surveyed receptors must be quiet and close to the turbines; in the present case they were neither quiet nor close.

3.2.9 The applicant's choice of just three noise sensitive receptors for background noise surveys was arbitrary and inadequate. It failed to cover any of the nearest receptors, with the single exception of Graythorp Farm Cottage. It is not necessary to assess all receptors within the 35 dB(A) contour, but it is essential that turbine noise is predicted at those most impacted, and compliance is best determined by comparing immission noise predictions with background noise levels measured at the receptors rather than at a distant proxy.

3.2.10 Given the size and number of turbines and the number of noise-impacted receptors I consider that more than three background noise surveys were required.

Missed/Ignored Receptors

3.2.11 The applicant states in §2.2.1 that:

"There are three residential properties with no financial interest (Noise Sensitive Receptor – NSR), situated in the vicinity to the proposed turbine locations."

This is very far from the truth. There are in fact several hundred affected receptors, many established, some under construction, some just consented and some still in planning.

The applicant has not assessed any receptors other than the three selected for background noise surveys. It also appears that no search was made for impacted receptors consented or still in planning. I have made no such search either, but I have in passing come across two developments, shown on the location map (figure 7), at Brenda Road and The Dunes. The latter would be the most impacted of the two. It is for 244 homes, which are already well into construction; it is therefore surprising and unfortunate that it was overlooked by the applicant. A plan of the new development is appended to this document as figure 8. The aerial photograph of figure 6 predates the development.

3.3 The Background Noise Surveys

3.3.1 Before addressing (both sequentially and collectively) the three background noise surveys listed in table 2.1 of the applicant's NIA I quote from SB8 from of the IOAGPG:

Measurements should be made in amenity areas between 3.5 and 20 metres from a dwelling.

The measurement position should permit measurement of 'background noise levels judged to be typical/ indicative of the area around the associated dwelling and any other dwellings for which the measurement location will serve as a proxy.

The influence of noise from local sources should be taken into account when selecting measurement locations.

The person selecting background noise monitoring positions and visiting these locations should record subjective impressions of sources contributing to local ambient noise levels.

Residents should be consulted to establish the occurrence of unusual noise events during the monitoring period.

Photographs showing the positions of measuring equipment should be provided.

3.3.2 **8 The Drive:** The background noise charts D-1 and D-2 in the applicant's appendix D can only be described as very noisy. The location has many large mature trees, which would explain proportionately higher background noise at higher wind speeds. Also the A689 some 65 m away would deliver significant traffic noise during daytime hours, but rather less at night. The noise charts however show only a small degree of correlation with wind speed in daytime and no correlation whatever at night, just a wide scatter of nearly 30 dB.

3.3.3 If the unusually high noise levels were from traffic on the A 689 filtering by wind direction would be required as explained in SB19 of the IOAGPG (page 16):

"SB19: Directional analysis of prevailing background noise levels may be necessary in specific circumstances, where a wind farm is located upwind of a receptor but a significant contributor to the background noise environment is downwind of the receptor in the same wind conditions."

By failing to acknowledge this important aspect of wind farm noise assessment the applicant has deviated from the guidance of the IOAGPG.

3.3.4 The distance of this receptor and the heavily wooded terrain make the survey data from this receptor unsuitable for assessment of any receptors close to turbines.

3.3.5 **126 Kildale Grove:** Neither the location of this receptor within the proposed wind farm site nor the location of the microphone within the receptor curtilage complies with the IOAGPG.

3.3.6 As with D-1 and D-2 above, the daytime and the night time charts (D-3 and D4) are extraordinarily and equally noisy, with the night time chart showing no correlation with wind speed. The railway line just 150 m away would deliver some train noise, but it carries no scheduled services during the ETSU night time and only one train per hour in each direction during the ETSU quiet daytime. If the railway line were a significant source of noise the applicant should have instead surveyed one of the receptors in the southernmost part of Lingdale Drive, where the contribution of train noise to background noise would have been lower, and indeed the predicted turbine noise would be higher.

3.3.7 The microphone was positioned within 1 m of vegetation and within 1.5 m of the rear wall of the residence. This is well under the 3.5 m minimum quoted above (§3.3.1) from SB8 of the IOAGPG. It was also on a hard concrete patio. I note that neither of the two microphone photographs provided in the applicant's NIA reveal the offending wall. My own photograph (figure 3) corrects that omission. SGN1 of the IOAGPG states in §2.5.19 that:

"Reports on noise assessments which rely on background noise measurements should include photographs on the measurement positions (GPG 6.1). These photographs should illustrate the ***position relative to the dwelling(s)*** *and the locations of local trees and other vegetation. This generally requires photographs from* ***at least 2 viewpoints****."*

Figure 3: Microphone tripod positioned as was the applicant's microphone tripod, revealing the reflecting wall.

3.3.8 Hard ground, such as a patio, increases background noise by acoustic reflection. The appropriate position for a microphone at this receptor is clear from the aerial photograph in figure 4 below. The black spot indicates the inappropriate microphone position selected by the applicant; the red spot indicates a compliant position that was available to the applicant.

Figure 4: Red spot shows appropriate microphone position available to applicant; black spot shows position chosen by applicant.

3.3.9 **Graythorp Farm Cottages:** This receptor is just 140 m from turbine T3, which is 176 m high to tip. It is thus well within topple distance of T3, at tip height + 10%. and is unsurprisingly acoustically non-compliant by a margin of many dB. The applicant's NIA states in §3 on page 15 that the owner of the cottages and adjacent chicken farm has a financial involvement in the application, and that the cottage(s) serve as accommodation for farm worker(s), who according to the applicant *"has supported the application and is involved with the project"*. Mr Justice Cranston, in judgement of case no. CO/347/2014 Joicey vs Northumberland County Council [5], disagrees (§64 et seq.) with the applicant's interpretation of financial involvement, and clearly defines the meaning of financial involvement in the context of wind farm planning applications.

3.3.10 The applicant's NIA also states that the cottage(s) *"will ultimately be demolished"* and that occupants *"could ultimately be rehoused".* The application however did not include such demolition, and should never have been determined on the basis of such fragile assertions.

3.3.11 **All three surveyed receptors:** The IOAGPG states in SB7 that:

"Enhanced microphone windscreens should be used. Standard windshields of a diameter of less than 100 mm cannot be relied upon to provide sufficient reduction of wind noise in most circumstances."

SGN1 of the IOAGPG, *"Data Collection",* states in §2.4.8 that:

- *The use of 'standard' windscreens with a diameter of (typically) less than 100mm should be avoided because there is a serious risk that measurements using this type of windscreen will be corrupted by wind-induced noise at the microphone. Measurements using standard windscreens can only be considered reliable where the measurement location is sheltered and there is evidence that local wind speeds at microphone height did not exceed 5 m/s during the survey period.*
- *The windscreen should be of a type that can be demonstrated to provide a significantly greater reduction in wind-generated noise than a standard windscreen.*

The caution concerning the use of <100 mm windscreens does not imply that a single – layer foam windscreen of (say) 110 mm diameter is acceptable. An assessment report should state the type of windscreen used. If non-proprietary, the construction of the windscreen in terms of compliance with the 1996 ETSU Report should be described."

Figure 9
Inadequate windscreen

Figure 5: The DMK wind shield, an "inadequate windscreen" according to SGN1 of the IOAGPG

3.3.12 The microphone and wind shield used by the applicant is a model DMK10, by the French manufacturer Acoem 01dB-metravib (see figure 5). It is a single layer wind shield of diameter 70 mm. It is not recommended for wind speeds in excess of 5 m/s. As it happens it is the very model of wind shield shown in figure 9 of SGN1 of the IOAGPG, where it is captioned as an ***"inadequate windscreen"***; "inappropriate" would be a fairer description, as for most non-wind farm applications it is entirely adequate, but for the present application it is far from compliant and therefore **invalidates all three background noise survey results**.

For the avoidance of doubt, the DMK10 windshield, like any outdoor low-wind microphone wind shield, has a single layer of open cell expanded foam plastic for wind noise reduction and a waterproof membrane to keep the microphone dry. The secondary windshields, required by ETSU, the IOAGPG and SGN1, is the outer one of two separate expanded foam plastic wind shields with a gap between them – and of course the waterproof membrane in addition. The use of the DMK10 wind shield is non-compliant because it can add several dB to the background noise level.

3.3.13 The applicant states in §4.1.6 that:

Records of the prevailing weather conditions were collated throughout the duration of the survey and, when significant precipitation had occurred, the results during those periods were excluded from the assessment.

Although there appears to be a rain gauge in one of the applicant's microphone photographs the *"pulse 101A pulse recorder"* listed in the applicant's monitoring equipment table B1 is a Madgetech $99 pulse recorder, not a rain gauge at all. I note the use of the word *"collate"* which implies collection of data from more than one source. I

further note that there is no evidence in the NIA to support the applicant's above statement. The IOAGOG requires:

"Clear Representation of Excluded Data In Time Histories or Scatter Plots".

There is no representation, clear or otherwise, of rainfall or of any other exclusions in the applicant's scatter plots or elsewhere in his NIA, and the applicant has submitted no time histories.

3.4 Wind Turbine Immission Noise I

"3.2 ISO 9613"

3.4.1 The applicant states in §4 page 6 that:

"The [ISO 9613-2] *model assumes downwind propagation, i.e. a wind direction that assists the propagation of noise from the source to all receptors and that the ground type is a combination of soft and hard ground (G=0.5) and a receptor height of 4m AGL has been used."*

It is in fact the IOAGPG, not ISO 9613-2, that defines the use of a ground factor of G = 0.5 and a receptor height of 4 m. In §4.3.5 however the IOAGPG further advises:

*"If the majority of the propagation between source and receiver occurs over paved ground (**such as may occur in urban environments**) or over large bodies of water such as wide rivers or lakes, the use of G=0.0 is advised."*

There is a substantial area of reflective ground – yards, concrete/paved areas and roofs of industrial building - but I accept the applicant's choice of G = 0.5.

3.5 The Background Noise Surveys II

"4.4 Environmental Noise Survey"

3.5.1 The applicant states:

*"Background noise measurements were undertaken over the period from 9th November 2014 to 10th December 2014 to establish existing background noise levels **at the nearest noise sensitive receptors."***

In truth NSR1, at nearly 2 km distance, was so far from being a "nearest receptor" that it is not even on my location map (figure 7). NSR2 is further away than clusters of houses in Lingdale Drive, in Bilsdale Road and in Brenda Road. NSR3 however, at 150 m setback (and proposed by the applicant for demolition), is by far the nearest.

3.5.2 There are thus hundreds of receptors nearer to the wind farm than NSR1 and NSR2 that have not been assessed at all, and all three homes that have been assessed have had background noise surveys which are non-compliant in several respects.

"4.1 Survey Methodology"

3.5.3 The applicant provides no information about wind speed and direction measurement beyond summarising a few of the requirements of ETSU. For example, the chart required by the IOAGPG (see table 1 therein, page 28) showing distribution of wind speed and direction is absent.

3.5.4 In general terms, the applicant describes what should have been done but produces little evidence that it was done. As a first example, the applicant claims on page 7 §4 that, as noted above, both of the NSR2 microphone photographs were taken from viewpoints from which the brick wall, though just a metre away, was not visible, as described above. Yet the applicant's NIA claims on page 7 that:

"The microphones were positioned 1.5m from the ground in conditions that were considered to be free-field."

ETSU and the IOAGPG require a minimum distance of 3.5 m from vertical reflective surfaces in order to approximate to free field; 1.5 m does not so approximate.

3.5.5 As a second example, as noted above, the applicant claims in §4.1.3 that:

"The noise measurements were recorded using a double windshield external microphone system to minimise the direct effects of wind on the microphone at higher wind speeds."

This is simply untrue, as explained in §3.3.12 above.

3.5.6 The applicant states that:

"For locations with low noise levels ETSU recommends that noise levels be limited to 35dB(A) during the daytime and 43dB(A) during the night time. These limits have been used for the measurement locations for the daytime and night time periods where appropriate."

The meaning of this is not clear. The ETSU simplified procedure requires that immission noise levels do not exceed 35 dB(A) at wind speeds up to 10 m/s at any time. The standard procedure requires that averaged immission noise levels do not exceed, at any wind speed up to 12 m/s, the greater of:

- 5 dB above the $LA_{90,\ 10min}$ background noise measured at that wind speed, and
- 35 dB(A) or 43 dB(A) for ETSU quiet daytime or night time respectively.

This is explained at greater length in section 2.

3.6 Wind Turbine Immission Noise II

"5.0 ASSESSMENT"

"5.1 Assessment of Noise from Proposed Wind Turbine"

3.6.1 The applicant states:

"Predicted noise level calculations have been completed for the nearest noise sensitive receptors."

This is simply not true; there are no predictions in the applicant's NIA other than those for the three arbitrarily and inappropriately selected for background noise measurement.

Even for them there is little transparency – indeed total opacity - in the applicant's calculation of the attenuation of noise in propagating from turbine to receptor. It might be supposed that professional acousticians would have sufficient numeracy and integrity for the arithmetic of calculation not to be questioned, but everyone (*mea culpa quoque*) is capable of making mistakes, which is why enough information should always be provided for peer verification of calculations.

"5.2 Uncertainty"

3.6.2 The applicant states:

"There is an inherent uncertainty factor within all acoustic calculations. The inherent uncertainty of the measurements completed has been assessed broadly following the procedure detailed in ISO 9613-2. This evaluation of the uncertainty estimates that the uncertainty of the calculations in this assessment will be +/- 1dB."

The applicant refers here to the statement of uncertainty in table 5 of ISO 9613-2, the International Standard endorsed by the IOAGPG for calculation of turbine noise attenuation between turbine(s) and receptor(s). Table 5 is reproduced below, where it will be seen that for distances above 100 m the stated uncertainty is ± 3 dB, not ± 1 dB as the applicant has stated. Thus the appellant's predicted immission noise levels would be understated by 2 dB, were they are correct in all other respects, which they are not.

Table 5 — Estimated accuracy for broadband noise of L_{AT} (DW) calculated using equations (1) to (10)

Height, h *)	**Distance, d** *)	
	$0 < d < 100$ m	100 m $< d <$ 1 000 m
$0 < h < 5$ m	± 3 dB	± 3 dB
5 m $< h <$ 30 m	± 1 dB	± 3 dB

*) h is the mean height of the source and receiver.
d is the distance between the source and receiver.

NOTE — These estimates have been made from situations where there are no effects due to reflection or attenuation due to screening.

4 Conclusion

4.1 Many Homes would Suffer Excessive Turbine Noise Levels

4.1.1 Without spectral data for the proposed turbine an IOAGPG-compliant calculation of the predicted immission noise levels at receptors is impossible, so I will accept the applicants immission noise predictions, but by doing so I do not endorse them as correct.

4.1.2 Whilst I do not have sufficient information to calculate absolute immission noise values I am able to calculate relative values, by using representative turbine spectral data and normalising the predictions to the applicants prediction for R2. The results are in the table below. My first concern is the 0.9 dB difference between the applicant's predictions and my own for R1 and R3; this may well be a consequence of the applicant's non-compliant use of ISO 9613-2.

	Receptor	Eastings	Northings	Quiet daytime immission noise, dB(A) at 7 m/s LA90	
				ISO 9613-2	Applicant
R1	8 The Drive	449458	527817	35.0	35.9
R2	126 Kildare Grove	451698	529047	41.8	41.8
R3	Graythorp Farm Cottage	451344	527523	54.4	53.5
R4	Lingdale Drive	451620	528995	42.7	
R5	Meryl Gardens	450170	529000	39.1	
R6	Brenda Road	451250	529190	42.2	
R7	The Dunes	451910	528940	41.3	
R8	Inglefield	450502	529325	39.1	
R9	Golden Meadows	450805	529430	39.4	
R10	Bilsdale Road	451565	528960	43.4	

4.1.3 R1 to R3 are the only receptors where background noise was measured and immission noise predicted by the applicant. I substantially agree with and have used the applicant's OS coordinates for them. The coordinates for R4 to R10 can be verified in figure 7 (Location plan).

4.1.4 R1 is somewhat irrelevant as it appears to be outside (or indeed on) the 35 dB(A) boundary. As, according to table 5.1 of the applicant's NIA, turbine noise emissions do not increase at wind speeds above 7 m/s R1 meets the requirements of the simplified ETSU and did not need a background noise survey.

4.1.5 R3 is clearly irrelevant, as it would receive turbine noise way over even any financially involved maximum noise limit and be within topple distance of a turbine. The background noise survey is not relevant as a proxy for neighbouring receptors because there are no neighbouring receptors.

4.1.6 R2 is the only background noise survey of a useful location, although it was not of course a compliant survey as explained in §3.3 above. I have therefore used the applicant's immission noise figure of 41.8 dB(A) for R2 to reference the remaining receptors. It must be understood that I do not guarantee these figures any more than I guarantee the applicant's 41.8 dB(A) for R2 to which they are normalised, but I do guarantee their relative values.

4.1.7 The applicant predicts “headroom” [7] of 1.4 dB daytime and 1.2 dB night time at R2. As the background noise measurements were inflated by several dB by the flawed microphone position and microphone wind shield, R2 immission noise would in reality exceed the ETSU limit. Using the same background noise survey (because, though flawed, it is the least atypical) for assessing R4 to R10, **it is clear that immission noise at R4, R6 and R10 would also exceed the ETSU limit. Each of these receptors represents many homes, not just a single home.**

4.1.8 Note also that a compliant background noise survey at R2 would have been acceptable as a proxy for R4 and R10, both of which are within 200 m of it, but closer to the turbines so would suffer higher immission noise than R2.

4.1.9 Thus it is clear that compliant background noise surveys and compliant noise predictions for the nearest receptors would reveal many homes where turbine noise would be significantly above the levels permitted by ETSU and the IOAGPG.

[7] The margin between the predicted noise level and the maximum permitted noise level at any given wind speed.

4.2 The Westwood Farm Appeal

4.2.1 I recently represented local residents in the matter of noise in the Westwood Farm appeal, where the NIA had been contracted to Dragonfly Acoustics; I cite that appeal [6] in my bibliography. Although the application was for a single turbine much smaller than those proposed in the present case the resonance with the present case justifies the examination of relevant parts of Inspector Asquith's Decision:

> *20. The noise assessment has been subject to a detailed critique by a noise consultant on behalf of PAL and the issue was discussed at length within the Hearing. In particular, there is criticism of background noise measurement including the use, nature and position of proxy locations[7] rather than measurement at the actual noise-sensitive properties. There is also concern that readings do not seem representative of what appears to be a very quiet and tranquil rural location where the noise-sensitive properties are within sheltered positions[8]. The Council has also raised the question of uncertainty of topographical effects, with the two assessed receptor properties being lower down in the valley below the site of the turbine.*
>
> *21. The results obtained show compliance with ETSU and the Institute of Acoustics Good Practice Guide with a minimum margin of 5dB, whereas PAL's critique suggests that, with the application of elements of uncertainty, there could be an exceedance of the ETSU guidance. However, the appellant's noise consultants stand by their assessment methods and the results obtained. Nonetheless, from the evidence presented I am of the view that there are uncertainties relating to background noise levels which cast some element of doubt upon the likely noise levels that might be experienced by the nearest residential receptors.*
>
> *22. It is suggested that in the event of permission being granted a detailed condition could be imposed which would provide protection for noise-sensitive receptors. This condition would trigger action in the event of verified complaints alleging noise disturbance. However, in a situation where there is a degree of uncertainty as to likely potential noise levels which could be at the margins of acceptability, the efficacy and reasonableness of such a condition must be in question.*
>
> *23. I accept that the appellant has gone to considerable efforts to provide evidence to show that noise from this single turbine would not be an unduly disturbing feature for nearby residents. Nonetheless, on the basis of the evidence before me* ***I am not convinced that it has been clearly demonstrated that the nearest residential receptors would (or could be) adequately safeguarded from disturbance from operational turbine noise which could be detrimental to their living conditions.***
>
> ---
>
> *7 Proxy locations on the appellant's land were used as the noise consultants undertaking the assessment understood that permission to carry out measurements at the noise-sensitive dwellings had been refused. At the Hearing the residents concerned indicated they had never been asked whether measurements could be undertaken on their property and, had a request been made, they would have acceded.*
>
> *8 At the Hearing certain local residents referred to what they described as unusual and unrepresentative amounts of activity taking place close to their homes at the time the background noise measurements were taking place.*

4.2.2 I would also draw attention to the Inspector's agreement, in §22 above, with his colleague, Inspector Paul Griffiths, that a wind farm planning application with an inadequate NIA should not be consented (or allowed on appeal) by a planning condition which the wind farm may well be unable to meet [4].

4.2.3 The Inspector acknowledges in §23 that Dragonfly's evidence had attempted to demonstrate compliance but failed, and that my evidence had demonstrated non-compliance. The present case differs in that Dragonfly have not even attempted to demonstrate compliance.

4.3 A Noise Impact Assessment should Assess the Noise Impact

4.3.1 This is the first noise impact assessment I have encountered which has not attempted to assess the turbine immission noise level at the closest receptors. This is a fundamental omission, in a noise impact which suffers many other omissions and many errors.

4.3.2 The IOAGPG provides a useful check sheet (table 1 on page 28) for compliance of assessments to the ETSU and IOAGPG standards. I have highlighted below the topics therein about which I have expressed a concern relating to this project. Yellow implies inadequacy whereas red implies absence. This is by far the most colourful version of the table I have yet had to produce.

Background Measurements	Number of Monitoring Locations Map Showing Monitoring Locations; Description of Monitoring Locations Description of Noise Environment; Photos of Monitoring Locations Monitoring Period; Description of Noise Measurement Equipment Wind Shield; Certification / Calibration of all Equipment Used & any Calibration Drift ; Wind (speed and direction) & Rainfall Measurement Data Sources Clear Representation of Excluded Data In Time Histories or Scatter Plots; Chart Showing Distribution of Wind Speeds & Direction; Cumulative Issues in Background Measurements
Noise Predictions	Prediction Methodology; Candidate Turbine Model Turbine Source Noise Data (including noise-reduced modes if used) Turbine Source Octave Band Noise Levels Description of Noise Propagation/Attenuation Factors Atmospheric Attenuation - Assumed Temperature and Relative Humidity Ground Effects – Assumed Ground Factor Assumed Receiver Height; Barrier/Screening Attenuation Wind Direction Filtering (if considered); Noise Contours
Assessment	Wind Shear Assessment Method; Derivation of Prevailing Background Noise Type, Order and Coefficients of Regression Line Scatter Data Shown on Plots; Derivation of Noise Limits & Numerical Values Amenity Noise Limit; Justification for Amenity Noise Limit if Chosen Night-Time Noise Limit; Financially Involved Noise Limit Capping of Noise Limits at Highest Wind Speed Measured Comparison of Predicted Noise Level with Derived Noise Limits Correction from L_{Aeq} to L_{A90} ; Potential Tonal Content Properties Covered by Assessment Incorporated Mitigation (Turbines Running in Low Noise Mode) (if relevant) Cumulative Issues

4.3.3 I question the fundamental competence of the applicant's NIA. It is clear that the Council were in unfamiliar territory, which is unsurprising as large scale wind farms are normally proposed only in rural environments. Nevertheless I am disappointed that no competent external consultation appears to have been sought to appraise the applicant's NIA. The document is so fundamentally flawed that it does not require a high level of expertise to understand that it is a noise assessment that does not attempt to assess the noise.

4.3.4 The applicant initially attempted to demonstrate noise compliance by submitting separate applications for each of the three turbines, with each application ignoring the presence of the other two turbines (see figure 9). It is to the Council's credit that this was not accepted.

4.3.5 I have found no evidence of any consultation of or response from the Council's Environmental Health Department, which certainly should have been consulted, as a statutory consultee, about this application.

4.3.6 I find it almost beyond belief that an application with a noise impact assessment that does not even attempt to assess the noise impact on any of the nearest homes to the turbines was recommended for approval in the Officer's Report and given consent by the Council Planning Committee.

5 Bibliography

[1] ETSU, “The Assessment and Rating of Noise from Wind Farms” ETSU-R-97, ETSU 1997.

[2] The IOAGPG, “A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise”, published 20/05/2013 by the IOA.

[3] ISO 9613-2, “Acoustics – Attenuation of Sound during Propagation Outdoors” ISO 9613 2:1996(E), The International Organisation for Standardisation.

[4] Appeal decision, Land North of A30, Summercourt, appeal ref. APP/D0840 /A/12/2189483.

[5] Mr Justice Cranston, in High Court judgement of case no. CO/347/2014 Joicey vs Northumberland County Council.

[6] Appeal decision, Land associated with Westwood Farm, Robridding Road, Ashover, S45 OJA, appeal Ref: APP/R1038/A/14/2228756.

Please contact the author if difficulty is experienced in obtaining referenced documents.

Dr J V Yelland MA DPhil (Oxon) MInstP FIET MIOA
Signal House
Parkhurst Forest
Newport
Isle of Wight PO30 5UL

yelland.john@live.fr

01983 533655
07999 539000

Figure 6: Aerial photograph of site

Proposed turbine positions are indicated by red dots.

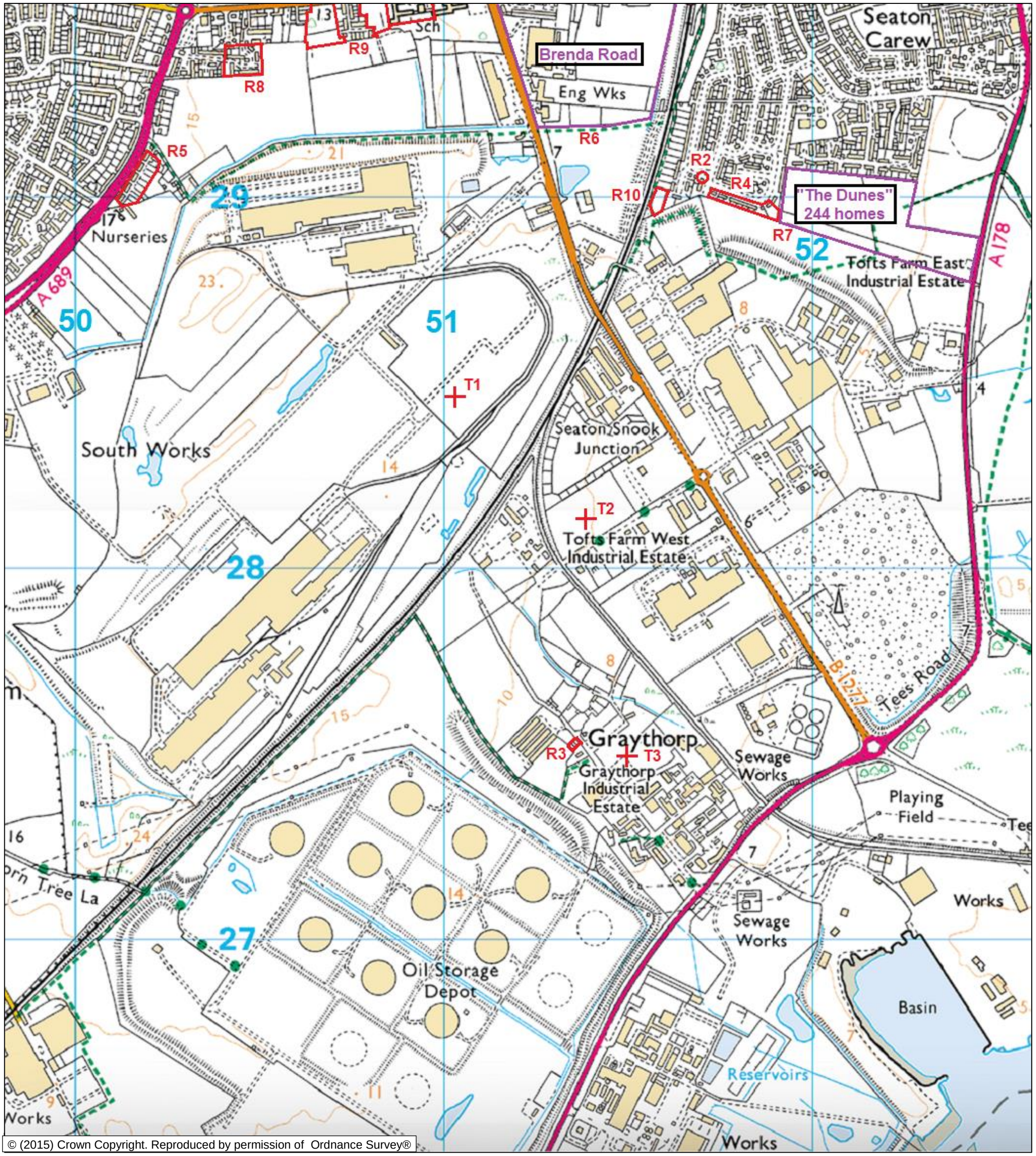


Figure 7: Location Map. Scale 1/10,000 printed on A3.

Turbine positions shown as red crosses. Existing receptors shown delineated in red; receptors consented or in construction labelled and shown delineated in purple.

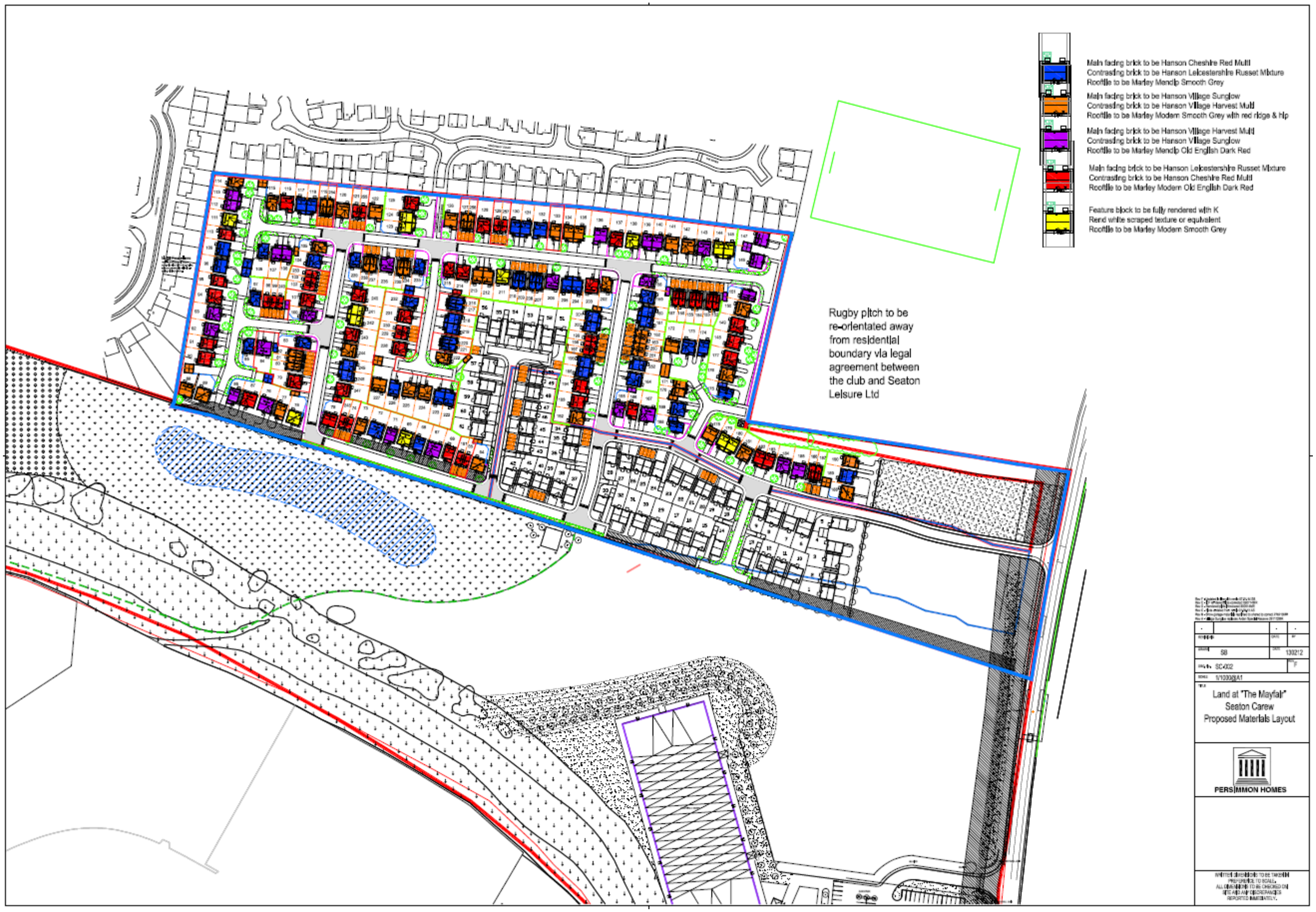
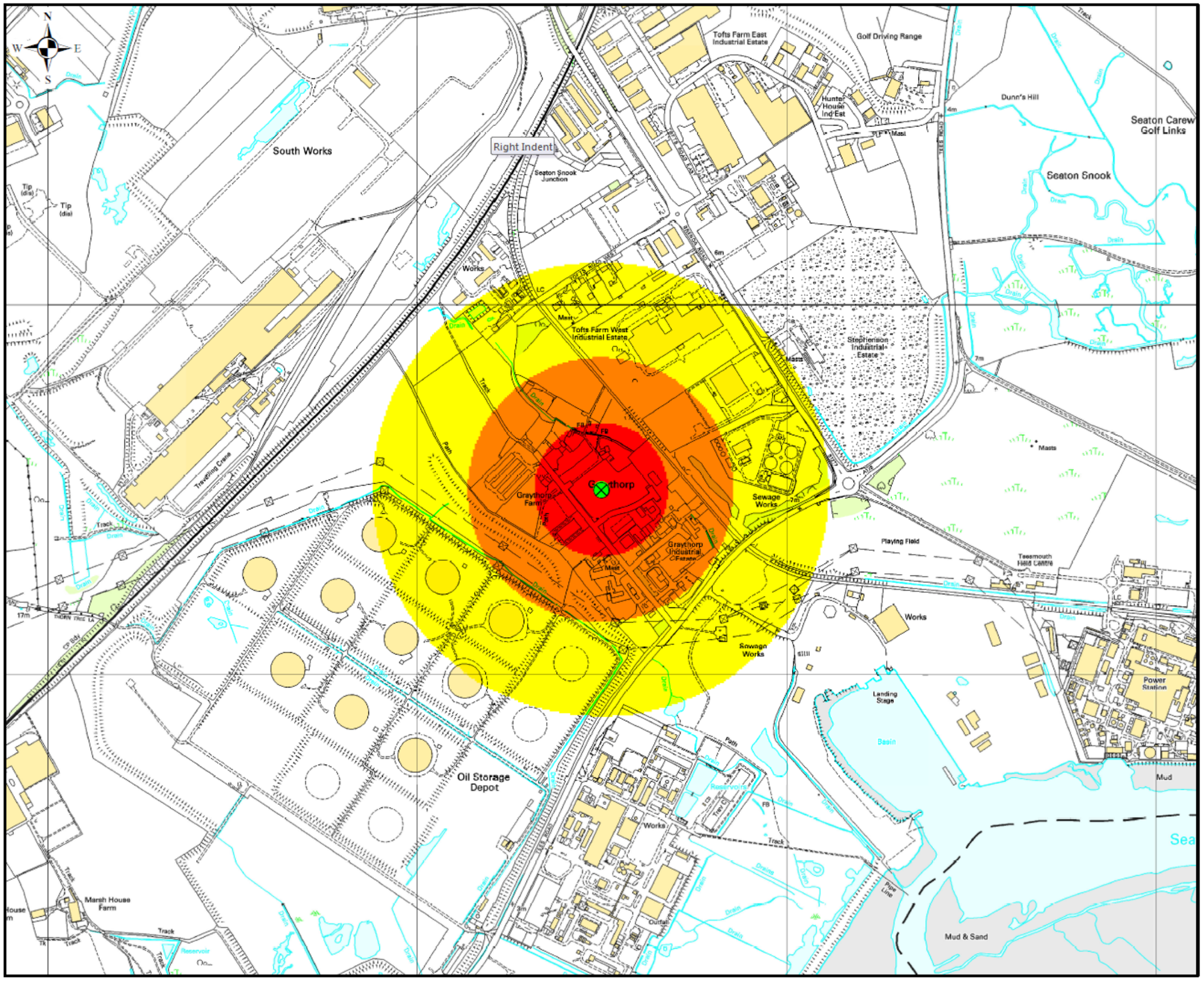


Figure 8: “The Dunes” housing development.



Graythorp

Figure 9.1

Noise Plot

- Turbine
- Noise Sensitive Receptors

- 35.0 - 39.9 dB(A)
- 40.0 - 44.9 dB(A)
- 45.0 - 49.9 dB(A)

PROJECTION SYSTEM	AUTHOR
OSGB 1936 BNG	J HARPER

SCALE

0 45 90 180 270 360 m

1:10,000

This document should not be used for scale drawings and is simply to be used for information purposes only

the energy workshop
THE MEDIA CENTRE
7, NORTHUMBERLAND STREET
HUDDERSFIELD
HD1 1RL

Drawing Number	Figure 9.1 - Noise Plot.pdf
Date Of Drawing	04/11/13

Figure 9: One of the three single turbine noise contour charts initially submitted by the applicant.