East Anglia ONE North and East Anglia TWO Offshore Windfarms

Expert Report on Noise

Applicants: East Anglia ONE North Limited and East Anglia TWO Limited
Document Reference: ExA.AS-5.D7.V1
SPR Reference: EA1N_EA2-DWF-ENV-REP-IBR-001334

Date: 4th March
Revision: Version 01
Author: Colin Cobbing

Applicable to East Anglia ONE North and East Anglia TWO

East Anglia One North (EA1N) and East Anglia Two (EA2) Offshore Wind Farms

Expert Report on Noise

2150-R1

Final | 4 March 2021

This report takes into account the particular instructions and requirements of our client.

Job number 2150

Pinnacle Acoustic Consultants Limited

Document Verification

Job title		East Anglia One North (EA1N) and East Anglia Two (EA2) Offshore Wind Farms			**Job number** 2150
Document title		Expert Report on Noise			**File reference**
Document ref		2150-R1			
Revision	**Date**	**Filename**			
Final	4th March 2021	**Description**	Final		
			Prepared by	Checked by	Approved by
		Name	Colin Cobbing	Colin Cobbing	
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	✓

Contents

1 Scope and purpose

I have been instructed by East Anglia TWO Limited and East Anglia ONE North Limited (the Applicants) to perform a review of the representations and provide advice on the key areas of difference on noise matters between the parties into the examination of East Anglia ONE North (EA1N) and East Anglia TWO (EA2) Offshore Wind Farms (the Projects). In particular, I have been asked to provide advice on the following:

- The interpretation of BS4142 in relation to key matters that are not agreed. For example, the Applicants' approach to setting background sound levels and interpretation of the rating method.
- Review of the context in which the limits of 32dB and 31dB have been selected.
- Proposed noise limits vs. modelled levels.
- Use of BS5228 for the construction noise assessment.

As part of this review, I have considered the following documents:

- APP-073 – Chapter 25 Noise and Vibration of the Environmental Statement
- APP-525 – Appendix 25.4 Construction Phase Assessment of the Environmental Statement
- REP1-132 – The Councils' Joint Local Impact Report (Appendix 4)
- REP2-011 – Noise and Vibration Clarification Note
- REP3-071 – Applicants' Response to Appendix 4 of the Local Impact Report
- REP4-023 – Applicants' Comments on Substation Action Save East Suffolk (SASES) Deadline 1 Submissions
- REP4-043 – Noise Modelling Clarification Note
- REP5-048 – East Suffolk Council's Response to Additional Information Submitted by Applicants at Deadline 4
- REP5-097 – SASES Comments on Applicants Deadline 4 Submissions
- REP5-100 – SASES Post Hearing Submission (ISH4)
- REP5-022 – East Anglia ONE Operation Phase Noise Monitoring Report
- REP6-135 – SASES Deadline 6 Comments on the EA1 Operation Phase Noise Monitoring Report

2 Relevant experience

I have an honours degree in Environmental Health and a Post Graduate Diploma in Acoustics. I am a Chartered Environmental Health Practitioner, a Fellow of the Chartered Institute of Environmental Health and a Corporate Member of the Institute of Acoustics.

I am a Director of Pinnacle Acoustic Consultants Limited.

I have practiced as an Environmental Health Practitioner for more than thirty years and have specialised in the field of environmental noise for most of that time. I have worked for local authorities and in environmental consultancy. A copy of my CV is provided in Appendix 1.

I am recognised as an expert in the UK in relation to environmental noise and vibration and worked extensively on the UK's largest infrastructure projects including Heathrow Terminal 5, the Thameslink Programme, Crossrail, HS2, A14 Huntingdon to Cambridge Road Scheme, and Heathrow Expansion.

I have acted as an expert witness in numerous nuisance cases and appeals. This includes preparation of written evidence for an appeal to the Secretary of State under the appeal provisions contained in the Crossrail Act, taken with respect to unreasonable consent conditions imposed in a consent issued by a local authority under section 61 of the Control of Pollution Act 1974. I have also provided expert evidence at planning inquiries and DCO Hearings (the application to develop a fifth terminal at Heathrow Airport, Hitchin Grade Separation Junction, the Thameslink Programme, the A14 Cambridge to Huntingdon Improvement Scheme).

I sit on a number of committees and working groups responsible for noise standards and guidance. Amongst others, these include:

- Environmental Health/1/3 Committee, responsible for BS4142,
- Professional Practice Guidance: Planning and Noise for New Residential Development, and
- The IEMA Guidelines for Noise Impact Assessment.

I have had a long association with E/H/1/3 and must be one of the longest standing members, overseeing several revisions of the standard. I was part of the core drafting team responsible for the substantial revision of BS4142 in 2014. I was also closely involved in the consultation and took BS4142 through to final publication. I also presented at a number of launch events to explain the changes to the standard.

Additionally, I wrote a number of articles and papers to give further explanation of the BS4142 standard and how it should be interpreted.

3 Policy background

A summary of noise policy and guidance relating to operational noise is presented in Appendix 1.

The Noise Policy Statement for England (2010) sets the overarching policy for noise in England. Paragraph 1.7 states three policy aims:
"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

o *Avoid significant adverse impacts on health and quality of life;*

o Mitigate and minimise adverse impacts on health and quality of life; and

o Where possible, contribute to the improvement of health and quality of life."

• *"…all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur." (Paragraph 2.24, NPSE, March 2010).*

It can be seen that these policy objectives have been carried into the National Policy Statements that are relevant to the Projects, namely:

• NPS for Energy (EN-1) (DECC 2011);

• NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011); and

• NPS for Electricity Networks Infrastructure (EN-5) (DECC 2011).

Para. 5.11.9 of EN1 states:

"The IPC should not grant development consent unless it is satisfied that the proposals will meet the following aims:
● *avoid significant adverse impacts on health and quality of life from noise;*
● *mitigate and minimise other adverse impacts on health and quality of life from noise; and*
● *where possible, contribute to improvements to health and quality of life through the effective management and control of noise."*

Para. 5.11.8 advises:

"The project should demonstrate good design through selection of the quietest cost-effective plant available; containment of noise within buildings wherever possible; optimisation of plant layout to minimise noise emissions; and, where possible, the use of landscaping, bunds or noise barriers to reduce noise transmission."

These requirements are also reinforced by EN5, at paras. 2.9.10 and 2.9.11, which state:

"The IPC should ensure that relevant assessment methodologies have been used in the evidence presented to them, and that the appropriate mitigation options have been considered and adopted. Where the applicant can demonstrate that appropriate mitigation measures will be put in place, the residual noise impacts are unlikely to be significant.

Consequently, noise from overhead lines is unlikely to lead to the IPC refusing an application, but it may need to consider the use of appropriate requirements to ensure noise is minimised as far as possible."

So, it can be seen that there is a strong degree of imperative to avoid significant adverse impacts and to mitigate and minimise other adverse impacts on health and quality of life from noise.

This does not mean that adverse impacts cannot occur. Rather, all reasonable and practical steps should be taken whilst having regard to other factors such as cost, technical feasibility and visual appearance.

Appropriate mitigation measures can also include sound insulation packages (see EN1 para. 5.11.13).

4 Areas of difference between the Applicants and East Suffolk Council

East Suffolk Council's (ESC) position is summarised in their Deadline 5 submission (REP5-048**)**.

ESC do not accept that at an industrial noise generating a noise rating level of 31 or 32 dB LAr throughout the day and night in an extremely quiet rural area would not have an adverse impact. ESC maintains that operational noise limits should be set at the rating level equal to a truly representative background noise level as discussed in Appendix 4 of the Council's Local Impact Report (REP1-132).

Further it argues that operational levels should be set according to a Lowest Observed Adverse Effect Level (LOAEL) of the rating level equal to a truly representative background. The truly representative background sound level being:
- *SSR2 – 27 dB LAF90,5mins*
- *SSR3 - 24 dB LAF90,5mins*
- *SSR5 (NEW) - 29 dB LAF90,5mins*

If it is not practical to set differing noise limits at different receptors these should be set according to the lowest of the above figures in line with the methodology used previously.

In the event that noise limits based on these background levels are not achievable in practice, ESC maintains that the Applicants should use the above figures to assess the impact of operational noise at the receptors to allow the Examining Authority to make an informed decision on the true impact of the proposed development.

ESC also raises related matters in relation to feature corrections and the treatment of uncertainty.

4.1 Application and interpretation of policy on relation to the areas of non-agreement

Throughout their submissions ESC consistently argue that any adverse impacts should be prevented or avoided. Their submissions also suggest that any adverse impacts should be prevented or avoided without any regard to costs or other factors.

Their position is plainly at odds with policy that requires the Applicants to avoid significant adverse impacts on health and quality of life from noise and **mitigate and minimise** other adverse impacts on health and quality of life from noise (my emphasis).

4.2 Application and interpretation of BS4142 in relation to the key areas of non-agreement

ESC's position is inconsistent and incompatible with BS4142, because they have failed to consider the *context in which the sound occurs*. Specifically, they have failed to consider Section 11 (reproduced in full in Appendix 2) of the standard and the absolute level of sound.

It is clear from the wording of Section 11 of BS4142 that the difference between the rating level and the background sound level only provides an indication of the impact and that the context must be considered before any conclusions can be drawn about the magnitude of any impacts.

The standard states (my emphasis):

"Typically, the greater this difference, the greater the magnitude of the impact.

- *A difference of around +10 dB or more is likely to be an **indication** of a significant adverse impact, **depending on the context**.*
- *A difference of around +5 dB is likely to be an **indication** of an adverse impact, **depending on the context**.*
- *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. **Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context**."*

The terminology used in Section 11 is deliberate and aligned to the expressions used in the NPSE and the NPS EN1, namely significant adverse and adverse impact. An adverse impact would not normally be identified when the rating level does not exceed the background sound level. This is an indication of a low impact i.e. something less than an adverse impact. An adverse impact could arise however if the rating level did not exceed the background sound level if the context in which the sound would occur suggested that the impact should be modified.

The BS4142 committee was aware of the issues that that can occur when background sound levels are low. The 1997 version of BS 4142 advised that the standard did not apply to situations where the background sound level or the rating level was very low, defined as a background sound level as being equal or less than 30 dB, and a low rating levels being equal to or less than 35 dB. This advice was not taken forward when the standard was substantially revised in 2014. Rather, it was replaced and addressed by the need to consider the absolute level of sound, which gives clearer advice and places more emphasis in the need to consider absolute sound levels as part of the assessment itself.

This part of the standard goes to the crux of the differences between the Applicants and ESC (and SASES that I will address later in this report) and so I have reproduced it in full below (my emphasis).

"1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be ***greater for an acoustic environment where the residual sound level is high*** *than for an acoustic environment where the residual sound level is low.*

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse."

The residual sound referred to is the ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

It is obvious that the level of impact, indicated by the difference between the rating level and background sound level, is greater in high noise environments and lower where background sound levels and rating levels are low, as they are in this case.

There is also an important note in BS4142 that gives further explanation about the way the standard should be interpreted. Note 3 states:

Consideration should be given to evidence on human response to sound and, in particular, industrial and/or commercial sound where it is available. A number of studies are listed in the "Effects on humans of industrial and commercial sound" portion of the "Further reading" list in the Bibliography.

In other words, the assessment should be based on the scientific evidence relating to noise and effects on health and quality of life.

The noise hierarchy table set out in PPG-N suggests that above the Lowest Observable Adverse Effects Level (LOAEL):

Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more

loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.

There is nothing in the mainstream scientific evidence to suggest that a rating level of 35 dB or lower could result in any changes in behaviour such as those described in PPG-N for a LOAEL, even if the noise rating level was significantly above the background sound level.

All of ESCs representations focus on the night-time background sound levels. BS4142 is quite specific in this regard and advises that absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background and this " ***is especially true at night".***

There is no evidence linking sleep disturbance to the difference between the rating level and the background sound level. All of the guidance and research on sleep disturbance focusses on absolute levels of sound. This is for a particularly good reason and that is when we are asleep, we do not perceive sound in the same way as we do during the day. When we are asleep, we are not conscious of our own bodies and response to noise is more of an autonomic response. For the night period a rating level of 35dB would be highly precautionary. We can be confident that no adverse effects on sleep would be possible at such low levels of external noise.

In my opinion, there is no reasonable justification for setting noise limits at a rating level below 35 dB. This view is shared by the Working Group of the Association of Noise Consultants that has produced guidance on the application of BS4142, which recommends that:

The WG suggest that similar values would not be unreasonable in the context of BS 4142, but that the assessor should make a judgement and justify it where appropriate.

The similar values they are referring to are a noise rating of 35dB and a background sound level of 30 dB.[1]

ESC's position that the rating levels should be limited below 30 dB or even below 25dB. Their position simply cannot be justified if BS4142 is properly interpreted and applied. It would appear that ESC has effectively ignored the requirements of the standard to consider the absolute sound level. This is a significant omission. As a member of the EH/1/3 committee it is disappointing to see that the standard is being misinterpreted in this way.

4.3 Representative background sound levels

ESC argues that the truly representative background sound levels for the night period are:

- SSR2 – 27 dB LAF90,5mins
- SSR3 - 24 dB LAF90,5mins

[1] BS 4142:2014+A1:2019 Technical Note. ANC March 2020. https://www.association-of-noise-consultants.co.uk/wp-content/uploads/2020/05/ANC-BS-4142-Guide-March-2020.pdf

• SSR5 (NEW) - 29 dB LAF90,5mins.

It is evident from the section above that the difference between the rating level and background sound level is not particularly relevant when either the rating level or background sound level is very low and that this is especially the case at night. As explained, where background sound levels are so low the absolute level of sound should be considered to be more important. Even so, I have considered the arguments on this point and do not accept that the Applicants' analysis of the background sound levels is invalid or unsound. The analysis presented by the Applicants has been carried out fully in accordance with the requirements of BS4142.

The BS4142 committee was aware of the way in which the 1997 version of the standard was being abused, with many practitioners seeking to drive the background sound level down to the lowest number possible. That is the reason why the committee made a number of revisions in an attempt to prevent such practices from happening and to encourage a balanced approach.

Section 8 of the standard states (my emphasis):

In using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, ***the objective is not simply to ascertain a lowest measured background sound level****, but rather to quantify what is typical during particular time periods.*

Since the intention is to determine a background sound level in the absence of the specific sound that is under consideration, it is necessary to understand that the background sound level can in some circumstances legitimately include ***industrial and/or commercial sounds that are present*** *as separate to the specific sound.*

ESC argues that (REP5-048, page 11 et seq):

The Applicants' background noise surveys are clearly affected by one of more local noise sources which were not present when ESC officers and the Council's consultants visited the site on 7/8 November 2019.

The Applicants identify noise from existing overhead transmission lines as a potential noise source in the ES (see Paragraph 30, Appendix 25.3 – APP-524). ESC's consultant's experience of surveys in and around National Grid transmission equipment is that overhead lines can generate significant levels of noise under some environmental conditions but not others. Noise from the existing overhead lines is therefore a likely candidate for the unexplained variations in noise levels within noise survey data. If this is not the case, it remains that the Applicants' survey data if affected by an unknown and unexplained noise source or sources. It is not possible to determine whether the measured levels are representative without understanding what caused these variations or under what conditions they occur.

The reference to local roads as potential causes of these variations in measured background noise levels in not accepted. Given the short duration of any vehicle passes in comparison to the 15-minute assessment period, there would have to be a very large number of vehicle movements on the surroundings roads in a night-time survey period (23:00 – 07:00) to generate constant traffic noise and have an effect on the overall LAF90 figure. This is not considered likely and is not consistent with our visits to the site.

Later in the Deadline 5 submission (REP5-048 at page 20), they make similar arguments that:

The graphs provided by the Applicants show that the noise climate at the site consists of a very quiet noise environment apparently affected by one of more unknown local noise sources which are not identified or discussed in the noise assessment. Unless these sources are identified, it is impossible to determine whether the measured levels are representative of typical conditions at the assessment locations.

Those sections of the BS4142 that I have highlighted explain that it is not necessary to remove or exclude noise of an industrial or commercial nature from the background sound. If noise from the existing overhead lines was contributing to the background sound levels at times when the proposed substations will be operating, then it would form part of the background against which the new sound should be assessed. Unless, of course, there was some reason for suggesting that this component of the background sound would not exist or otherwise change in the future, which is not the case in this situation. Neither is it necessary to understand and attribute what sources of sound contributed to the background sound level and the causes of any variations in the background sound levels throughout the survey period. This would be disproportionate and impractical. The standard merely requires that sensible and practical steps be taken to understand the measured data and exclude any data that is not representative of the background sound level. For example, if there were excessive winds or some other known reason why background sound levels were untypically low or elevated.

ESC presented an analysis of the background sound level data obtained by the Applicants and explained their reasons why they consider lower values to be more representative. The differences arise mainly because ESC prefer to use modal values of the lower peaks of the frequency distribution plots. There is nothing wrong with their analysis and there is nothing to suggest from BS4142 that their analysis is invalid or inappropriate. Having looked at the modal distribution plots however I would suggest that the arithmetic means of the whole dataset is more representative. The modal distribution plots for SSR1 and SSR3 show different peaks, which is unlike the example given in the standard where there is only one modal peak. When faced with such data I prefer to use the cumulative distribution of the data. In my opinion this provides a better method of analysing data with these distribution patterns and improves consistency.

4.4 Uncertainty

BS4142 requires practitioners to consider the level of uncertainty in the data and associated calculations. Where the level of uncertainty could affect the conclusion, take reasonably practicable steps to reduce the level of uncertainty. The level and potential effects of uncertainty should be reported.

ESC has raised a number of points that suggest there is uncertainty in the assessment. For example, they have raised points about the work presented by the Applicants to suggest that the specific noise will not contain tones or other features that would attract a correction to be applied in order to obtain the rating level.

However, the points about uncertainty largely fall away because the proposed DCO Requirements will impose a limit on the rating level itself. In this respect, the Applicants are accepting the risk and will need to take all necessary steps to comply with the limit. This is a perfectly normal and satisfactory way of controlling noise of an industrial and commercial nature and entirely consistent with policy and practices that have been widely used on other major DCO projects. In setting a noise limit, any uncertainty will be avoided such that the impacts cannot be greater than expected.

The Examining Authority should however be satisfied that any limit imposed is necessary, reasonable, and capable of being met without incurring excessive costs.

ESC refers to ISO9613-2 and its stated uncertainty of ±3dB. They then argue:

"if the reported levels were 3 dBA higher, they would exceed the operational limits at SSR2 (32.9 dBA) and SSR3 (32.2 dBA).

For the reasons explained, I do not consider it to be necessary to limit the rating level below 35dB. Limiting the levels below 35dB is already highly if not ultra-precautionary.

ESC makes a further point that to ignore the inherent uncertainty in the calculation methodology:

"is not in accordance with the Rochdale envelope approach which requires an assessment of the worst case where there is not sufficient information at the time of the assessment."

The points about the Rochdale envelope are misguided. The noise limit itself will set the envelope for the Projects and is inherently precautionary because the noise limits will avoid adverse effects completely.

It is also worth noting that the ISO9613-2 is a calculation method for predicting sound levels under meteorological conditions most favourable for the propagation of sound, namely mild downwind or temperature inversions. In this way, the ISO9613 method is regarded as a reasonably conservative method. In addition, the method is validated up to 1km from the source. Uncertainty in the calculations will always be greater at greater distances and the ±3dB should be considered within the circumstances of each situation.

BS4142 does not require any stated uncertainty to be added to the predicted noise levels. It recommends that practitioners take reasonable steps to minimise the uncertainty in the assessment and specifically:

"Use a validated method of calculating sound levels, e.g. ISO 9613-2 or similar. If an alternative calculation method is used, fully describe the method and state the reasons for using this method."

5 Areas of difference between the Applicants and SASES

I have considered the representations made by SASES in respect of operational noise.

SASES' Deadline 5 Post hearing Submissions (REP5-100) refers to the evidence given by Rupert Thornley-Taylor and presents a summary of their position.

SASES make reference to BS4142 and the need to consider the context and then, like ESC, neglect to consider the absolute level of sound. In doing so, they have materially failed to apply BS4142 correctly. I cannot therefore agree with the contentions made that suggest that significant adverse effects cannot be ruled out. Neither do I accept that adverse effects will occur.

It is claimed that the presence of tonal noise will add up to 6dB to the predictions. It is correct that BS4142 recommends a maximum correction of up to 6dB for tonality. These corrections apply for highly perceptible tones as perceived at the receiver location. Lower corrections should be applied for less prominent tones, namely a 4dB corrections where it is clearly perceptible and 2dB for a tone which is just perceptible at the noise receptor.

I have considered the Noise Monitoring Report for EA1, dated 3rd February 2021 (REP5-022). It reports that there were no perceptible tones or other acoustic features at listening positions around the substation, even when the practitioners conducted observations on the bridleway at its closest point to the EA1 substation (approximately 100m from the southern boundary of the EA1 substation).

SASES have been extremely critical of the noise monitoring report for EA1 (Deadline 6- Comments on EA1 Operation Phase Noise Monitoring Report) (REP6-135). A note from Rupert Thornley-Taylor is appended to the submission. I agree with Mr Thornley-Taylor that the approach adopted in the report to use indoor noise levels is a significant departure from BS4142 and not in accord with the standard. He quite rightly points out that BS4142 requires the sound to be measured and assessed outdoors. This is correct for most situations, unless the receptor is mitigated for noise in which case the design of the receptor is a matter that should be considered (see section 11 bullet point 3 of the standard). But then he embarks on a tortuous exercise and concludes that the method used by the Applicants leads to the reverse conclusion, namely that a tone would be highly perceptible and would therefore attract a +6dB penalty. To be fair to Mr Thornley-Taylor he is not saying that he has followed BS4142 and has concluded that tones would be highly perceptible. He is merely saying that a different conclusion can be arrived at if a different set of assumptions are used. The assumptions used by Mr Thornley-Taylor are implausible in my view and the conclusions set out in the note are little more than a distraction from the overall approach used in the report and the main findings. The fact is that the authors of the noise monitoring report set out their observations of the sound emanating from

EA1 whilst outdoors, including a position at about 100 metres from EA1, and could not hear any discernible or audible tones. These observations are entirely in accord with BS4142 and I see no reason to doubt the conclusions they reach, namely that there were no audible or discernible tones associated with any sound emanating from EA1.

SASES then go on to make the claim that the EA1 substation is not directly comparable with those proposed for EA1N or EA2 and infer that the noise monitoring report is of little or no relevance. Again, this position lacks balance. Of course, there are differences but there are also similarities between EA1 and the proposed substations. The findings of the noise monitoring report for EA1 provides a useful indication of the likelihood of the presence of tones associated with substations incorporating modern technology.

In my opinion, the Examining Authority can be confident that the Projects can be designed to avoid any highly perceptible or clearly perceptible tones and it is likely that any tones can be avoided altogether.

If any tones are perceptible at the receiver locations, it would attract a correction in accordance with the BS4142 method and this would be accounted for in the proposed noise limit. This will drive the designers to minimise tonal features or eliminate them altogether. As explained earlier, this is a perfectly normal and acceptable way of controlling noise from commercial and industrial noise.

Standing waves and interference patterns are also raised as a potential issue. These points, no doubt, are intended to cast doubt on the confidence that the Examining Authority can have in relation to these types of features. I agree in as much that this effect cannot be dismissed as a possibility, but it is highly improbable in my view. This is a matter that can be adequately addressed during the detailed design of the substations.

SASES also make similar points to those made by ESC, about uncertainty. I believe that the points that SASES make about uncertainty are all fully addressed in the section where I consider ESC's concerns.

The assertion made about excess attenuation due to the presence of soft ground is incorrect. ISO9613 predicts sound levels under meteorological conditions that are favourable to the propagation of sound. Accordingly, the amount of attenuation due to the presence of soft ground is inherently accounted for in the calculation method.

I agree that the Requirement should be capable of being enforced. Measuring the specific sound level at these locations will be challenging because the limit is set at such low levels of noise. I would recommend therefore that the Requirement should specify the method to be used for the determination of the noise rating levels. I understand that the wording of the requirement now clearly references the measurement procedure set out in BS4142. In my opinion, this revision is a worthwhile improvement in the specificity of the Requirement.

6 Construction noise

The Control of pollution Act 1974 (COPA) contains provisions for the control of construction noise from worksites.

The Applicants and their contractors are placed under a legal duty to use Best Practicable Means (BPM), as defined by Section 72 of the 1974 Act, to minimise construction noise and vibration.

The local authority can serve a notice on the contractor or person responsible for the works imposing requirements as to the way in which the works are to be carried out. Alternatively, the Applicants or their contractor could apply for consent from the local authority on the steps to be taken to control and minimise the noise.

BPM is not a fixed standard. It relates to the circumstances associated with the works and the surroundings and is continuously evolving and improving.

Developers often use the provisions under Section 61 of COPA to seek and obtain consent prior to starting the works. This is a proactive approach and one that is regarded as representing best practice for major infrastructure projects. I understand that the Applicants now intend to apply the Section 61 process in order to seek and obtain prior consent(s) prior to the start of works. This intent should be reflected in the proposed Code of Construction Practice.

Practical guidance on the steps that can be taken to manage construction noise are provided in **British Standard BS5228-1:2014**[2], which is an approved code of practice for methods of minimising noise from construction sites under the Control of Pollution Act 1974, as defined in The Control of Noise (Code of Practice for Construction and Open Sites) (England) Order 2015[3].

British Standard 5228 is the recognised standard for assessing and controlling construction noise and is widely used and accepted. It has been used, to good effect, on every single major construction project that I have worked on or am aware of.

It is also worth noting that there lots of best practice documents available that can be used to inform BPM. For example, the Crossrail learning legacy website provides resources on construction noise management.

7 SASES submission on construction noise

I agree with the point made by SASES that policy requires significant adverse impacts to be avoided and that significant observed adverse effect level (SOAEL) should be set in accordance with common and best practice. I would commend that the SOAEL levels contained in the HS2 Information Papers for Phases 1 and 2a: Control of Construction Noise and Vibration[4] (E23for Phase 1 and E13 for Phase 2a) are adopted and applied. The SOEAL values are reproduced below.

[2] BS5228 Part 1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – noise.*
[3] See http://www.legislation.gov.uk/en/uksi/2015/227/made?view=plain
[4] file:///C:/Users/Colin/OneDrive/Technical%20folder/Information%20papers/E23_-_Control_of_construction_noise_and_vibration_v1.7.pdf

Construction noise effect levels for permanent residential buildings (outdoor at the façade)[5]

Day	Time (hours)	Averaging Period T	Lowest Observed Adverse Effect Level $L_{pAeq,T}$ (dB)	Significant Observed Adverse Effect Level $L_{pAeq,T}$ (dB)
Mondays to Fridays	0700 - 0800	1 hour	60	70
	0800 - 1800	10 hours	65	75
	1800 - 1900	1 hour	60	70
	1900 – 2200	1 hour	55	65
Saturdays	0700 - 0800	1 hour	60	70
	0800 - 1300	5 hours	65	75
	1300 - 1400	1 hour	60	70
	1400 – 2200	1 hour	55	65
Sundays & Public Holidays	0700 – 2200	1 hour	55	65
Any night	2200 – 0700	1 hour	45	55

Given that HS2 is promoted by government and that Phase 2a has just received Royal Assent, these values represent the best and most recent expression of policy on SOAELs for construction noise affecting residential premises.

As explained earlier, BPM is not a fixed standard and relates to the sensitivities of each worksite and the need to protect residents, or other sensitive occupiers. A bespoke plan could be incorporated into the application(s) for prior consent to be approved by ESC to protect any uses that are particularly sensitive to noise.

Using the HS2 SOAEL values is also advantageous in that the values are aligned with BS5228, which is the official recognised code of practice for managing construction noise. BS5228 is also recognised as the appropriate standard in the National Policy Statements.

SASES have recommended that the new Highways Guide is used to set the SOAEL. I believe that SASES are referring to LA 111 Noise and vibration-Revision 2, published by the relevant highway authorities in the UK. I am aware of this guidance and have contributed to it. It is not particularly helpful in these circumstances, not least because the guidance merely refers back to BS5228 and one of the examples set out in Appendix E of the standard (see Table 3.12 reproduced below).

Table 3.12 Construction time period - LOAEL and SOAEL

Time period	**LOAEL**	**SOAEL**
Day (0700-1900 weekday and 0700-1300 Saturdays)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1 [Ref 5.N] Section E3.2 and Table E.1 BS 5228-1 [Ref 5.N]
Night (2300-0700)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1 [Ref 5.N] Section E3.2 and Table E.1 BS 5228-1 [Ref 5.N]
Evening and weekends (time periods not covered above)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1 [Ref 5.N] Section E3.2 and Table E.1 BS 5228-1 [Ref 5.N]

There is a lot of commonality between LA111 and SOAELs adopted on other nationally significant schemes. It is however far simpler and more preferable, in my view, to refer to the SOAELs set out in the HS2 Information Papers.

In general, the worksites are not particularly sensitive from a construction noise perspective because of the nature of the works and the separation distances between the worksites and the nearest receptors. I have reviewed the construction noise assessments set out in the noise and vibration chapter of the environmental statement and the supplementary submissions (APP-073, APP-525, and REP2-011). The predicted construction noise levels are all substantially below the recommended SOAEL values. The predictions are consistent with the levels that I would reasonably expect for works of this scale and nature.

The Examining Authority can be confident therefore that the SOAELs for construction noise can be avoided through appropriate noise controls and the application of BPM. The Applicants and their contractors will seek and obtain prior consent from ESC under S61 of COPA and this process can be used to ensure that construction noise does not exceed the specified SOAEL values.

The S61 process can also be used to further control and mitigate any noise that may impact upon particularly sensitive occupiers.

Appendix 1- CV

Colin Cobbing BSc (Hons) CEnvH FCIEH MIOA

Colin is a technical expert in noise and health. He has many years' experience of taking complex and high-profile projects from inception through design, build and into operation. He has advised clients in both the public and private sectors including government. He has skills in research, policy development, environmental impact assessment, health assessment; sustainable development; sustainable design; and stakeholder engagement and consultation.

Colin is recognised in the UK as an expert in environmental noise and vibration with a particular focus on community involvement and sustainable outcomes.
He has a formidable record in the whole life cycle delivery of nationally significant infrastructure projects.
He is a leading advocate for human centred and total design, factoring all aspects of human health and comfort.
He has been influential in setting best practice in developing scientifically sound approaches for noise and health assessments, including the treatment of scientific uncertainty.
He has made significant contributions in shaping best practice in the UK on community engagement and consultation relating to consenting processes for nationally significant projects.

Profession
Acoustics Consultant

Current Position
Director of Pinnacle Acoustic Consultants Limited- 2020 onwards

Previous positions

Director with Arup: 2014 to 2020

ARM Environment Limited: 2007 to 2014

Temple Group:2002 to 2007

London Borough of Hillingdon:1994 to 2002

LSS: 1990 to 1994

London Borough of Camden: 1987 to 1990

London Borough of Brent: 1984 to 1987

Years of Experience
34

Nationality
British

Qualifications
BSc Environmental Health
Dip. Acoustics and Noise Control

Colin has enjoyed significant success at reducing the scale and intensity of objections to nationally significant infrastructure projects and other major projects through:

- Evidence led approaches;
- robust and defensible impact assessments;
- consensus building;
- sustainable mitigation strategies;
- public consultation and stakeholder engagement; and
- preparation and delivery of expert evidence.

Expert Witness
Colin has acted as an expert at several major planning inquiries and numerous court cases. Major planning inquiries include: Heathrow Terminal 5, M4 Widening, the Thameslink Programme, the Hitchin Grade Separation Junction and the A14

Professional Associations

Chartered Fellow of the Chartered Institute of Environmental Health

Member of Institute of Acoustics

External examiner for the IOA

Committees

BSI Committee EH/1/3 - responsible for residential and industrial noise including a member of the drafting panel for BS4142:2014

ANC Good Practice Committee

Member of IoA/ANC/CIEH working group preparing professional guidance on noise and planning

Member of ANC working group and joint author of ANC publication Measurement and Assessment of Groundborne noise and vibration

Publications

Case Studies of Common Sound Insulation Failures, Building Control June 1993

Noise Nuisance from Construction Sites, Proc. IOA

Development of Procedures for Predicting Ground Noise from Heathrow Terminal 5, Inter-Noise 1996- Keith Attenborough, Colin Cobbing, Michael Rickaby, James Griffiths and Angela Thompson

Models for Predicting A-weighted Noise from Airport Ground Operations, Proc.I.O.A. Vol 20 Part 1 (1998)- Keith Attenborough, Colin Cobbing, Michael Rickaby, James Griffiths and Angela Thompson

Perception and Significance of Transportation Noise Changes, Proc.I.O.A. Vol 20 Part 1 (1998)- Colin Cobbing and Michael Rickaby

Noise Assessment for Mixed Noise Source Environments, Proc.IOA. Vol 21 Part 2 (1999)- Colin Cobbing and Michael Rickaby

An Introduction to the Standardised Interview to Assess Domestic Noise Complaints and their Effects (SIANCE), Clean Air Vol 31 Winter 2001- Bernadette Brown, Colin Cobbing, Stephen A. Stansfeld

Cambridge to Huntingdon improvement scheme Development Control Order hearings. He has produced hundreds of expert reports and proofs of evidence for criminal and civil proceedings and negligence claims. This experience includes numerous cases acting as a Single Joint Expert and an Independent Acoustics Expert. Court cases include nuisance, possession, appeals and other hearings at Magistrates Court, County Court, Crown Court, High Court, Licensing Hearings and Planning Appeals/ Hearings.

Heathrow noise strategy and stakeholder consultation

Client: Heathrow Airport Ltd

Strategic advice relating to the noise management strategy and stakeholder consultation and engagement programme for the Heathrow Expansion Programme and airspace design (applying the 2017 airspace policies and CAP 1616). This work includes: policy; regulation and control within the context of the ICAO Balanced Approach and EU Regulation 598; briefing the CAA, DfT, MPs etc; research into the effects on health and quality of life from aviation noise (sleep disturbance, respite); noise assessment; health assessment; land use planning, master planning; good acoustic design; noise modelling and reporting; noise action plans; airspace design; retrofit schemes for residential and other sensitive buildings; development of monetisation tools for undertaking cost benefit analysis to inform EU Regulation 598; economic evaluation; consultation; stakeholder engagement; development of the noise respite strategies; delivery of sound demonstrations (using SoundLab and interactive VR deployment at several major consultation events) for airspace design and noise mitigation proposals.

Aberdeen, Glasgow and Southampton Airports

Advice on the noise management and compensation strategy (including the noise insulation scheme); strategic advice on the ICAO Balanced Approach and EU Regulation 598; updating the Noise Action Plan; airspace design change programmes (working to CAP1616); environmental modelling and reporting; and stakeholder consultation and engagement.

Cambridge Airport

Planning and EIA advice to Cambridge City Council and South Cambridgeshire District Councils on a proposal to build a new four-sided Ground Run Enclosure as part of the Noise Action Plan and to enable new residential development at the fringe of Cambridge Airport.

Almondsbury Air Operations Base- BAE Systems

Preparation of the Environmental Statement for the construction of new operations base for emergency helicopters (Great Western Air Ambulance and National Police Air Service) at M4/M5 Interchange, Almondsbury, South Gloucestershire. The preparation of the Environmental Statement following a legal

The Emerging Role of BS 4142, Acoustics Bulletin Sept/ Oct 2001

Investigation and Assessment of Domestic Noise. The Institute of Acoustics Conference- Noise and Health- October 2002

Assessment and Control of Aircraft Noise Using Average Mode Equal Energy Noise Contours. C Cobbing, M Southwood & C Stanbury. Proc. IOA 13 May 2004

Defra research into human response to vibration in residential environments. Proc.IOA.

Co-author of the ANC Guidelines- Measurement and Assessment of Groundborne Noise and Vibration 2011

Planning and Noise, Implications of the Planning Policy Framework. Acoustics Bulletin 2012

WHO Guidance within Environmental Assessment. IOA. May 2013- Colin Cobbing, Richard Greer and Tom Marshall

B. Fenech, C. Cobbing, R. Greer and T. Marshall. Health effects from high-speed railway noise- a literature review. Internoise September 2013

Guidelines for Environmental Noise Impact Assessment. Peer review. Institute of Environmental Management and Assessment. October 2014

BS 4142:2014- revision of the methods for rating and assessing industrial and commercial sound.

Acoustics Bulletin Vol. 40 No 1. Jan/ Feb Edition 2015

Co-author of case study on the Crossrail learning legacy portal- http://learninglegacy.crossrail.co.uk/documents/vibration-management-and-listed-buildings. Vibration management and listed buildings. Feb. 2016

Track design to control railway induced groundborne noise and vibration from the UK's Crossrail project. C. Cobbing, O. Bewes, R Greer and J Webb. 23 Annual Congress on Sound and Vibration. July 2016

The factors associated with the management of combined rail/

challenge that was taken to the High Court on the basis that the development was considered to be EIA Development.

RAF Benson- South Oxfordshire District Council

Noise impact assessment of existing and future helicopter and fixed wing operations at eight prospective development sites around RAF Benson identified in the Strategic Housing Land Availability Assessment supporting the Core Strategy, setting out recommendations on suitability for development.

Newcastle Airport Masterplan (2017) and Noise Action Plan (2018)

Strategic advice and review to assist Newcastle Airport in updating their Masterplan to 2035, including compliance with aircraft noise legislation and policy and advice on mitigation strategies to meet the requirements of the ICAO Balanced Approach. Review and revision of Newcastle Airport's Noise Action Plan.

Aircraft Noise and Noise Control Policy, UK

Local Authority Clients
Extensive work on control of aircraft and ground noise, as well as arrangements to control aircraft noise under the provisions of the Civil Aviation Acts. Responses to Government proposals to build a third runway at Heathrow airport for noise.

Terminal 5 Inquiry, UK
Main witness for the planning authority on noise issues including noise and health. He led a team responsible for presentation of evidence on air quality, noise and vibration, and sustainability. Responsible for agreeing and discharging noise conditions and consents for the operation and construction of Terminal 5, including the Ground Maintenance Facilities and Engine Ground Run Pens.

Oxford East West Rail

Since July 2014 acted as a Review Expert for Oxford City Council where he advised on technical matters relating to the proposed Chiltern Railways/Network Rail East West Rail Scheme. The appointment involved review of the Environmental Statement, planning conditions and subsequent submissions by NRs contractors in support of the discharge of the planning conditions.

Lancashire Shale Gas Exploration Sites- Cuadrilla

Support to the team providing expert advice and evidence at the planning inquiry into the decision by Lancashire County Council to refuse two minerals applications for shale gas exploration at two separate sites.

wheel roughness to control groundborne noise and vibration from the UK's Crossrail project. C. Cobbing, J. Cronje, C. Jones, R. Methold and. 23 Annual Congress on Sound and Vibration. July 2016

Lancashire Shale Gas Exploration: Drilling Noise and the Planning Process. DM Hiller, C Cobbing and BJ Cox. Proc. IOA Vol. 38 Pt 1. August 2016.

Co-author of case study on the Crossrail learning legacy portal- http://learninglegacy.crossrail.co.uk/documents/vibration-management-and-listed-buildings- Managing Construction Noise and Vibration in an Urban Environment. **Authors:** Colin Cobbing, Andrew Bird, Cathy Myatt, Rhian Locke, Lorna Mellings, Melissa Wellings, Ashley Webb
Publication Date: 14/03/2017

T. Marshall, R. Greer, D. Owen, C. Cobbing, G. Sica, P. Lowery, Method for calculating the probability of noise-induced sleep state changes from intermittent sources of transportation noise, Proc. ICSV 24, 1160, London (2017).

Co-author of the Professional Practice Guidance on Planning and Noise for New Residential Development. A joint publication by the Institute of Acoustics, Chartered Institute of Environmental Health and the Association of Noise Consultants- June 2017.

Co-author of book- Uncertainty in Acoustics. 2020. CRC Press.

NuGen Nuclear Power Generating Facility

Client: Copeland Borough Council

Review of NuGen's environmental impact assessment on behalf of Copeland Borough Council for a 200-hectare option land to the north and west of the Sellafield complex, as part of its Moorside project. Leading pre-application discussions and negotiating Statements of Common Ground.

Glasgow Queen Street Station Upgrade- Network Rail

Provision of expert advice on behalf of Network Rail at the Planning Inquiry into the Transport and Works Act Order for the proposed upgrade of Glasgow Queen Street Station including the Compulsory Purchase Of Land And Rights In Land.

North London Heat and Power Project

Client: North London Waste Authority

Development of an Energy Recovery Facility generating electricity using residual waste as a fuel and capable of an intended electrical output of around 70 MW and the production of low carbon heat.

The noise and vibration lead for the DCO application. Leading engagement with the local authorities, Environment Agency and other stakeholders and negotiating Statements of Common Ground and the Environmental Permit. Appraisal of mitigation options and development of the noise control strategy.

A14 Huntingdon to Cambridge Improvement

This was the first time a major road scheme (£1.5Bn new highway and improvements) was taken through the DCO process. Colin was one of two noise and vibration experts supporting the DCO application during the examination period. Leading engagement with the local authorities, parish councils and other stakeholders and negotiating Statements of Common Ground. Economic appraisal of mitigation options and development of the noise mitigation strategy and proposals, including the consideration of quieter road surfaces.

Crossrail, UK

Noise and Vibration Manager for Crossrail responsible for all aspects of acoustic design and the management and mitigation of construction noise and vibration, including the noise insulation programmes. Discharge and implementation of numerous undertakings, assurances and commitments relating to noise and vibration. Colin also implemented all systems and procedures relating to construction noise and vibration such as: Section 61 procedures, cumulative noise management plans, noise insulation and temporary re-housing schemes. He was instrumental in securing 24 hour or extended hours working across all the Crossrail worksites thereby minimising risk to the construction programme. This strategy was based on collaborative working

and trust built with local authorities and communities. Where necessary it also included careful navigation of the legislative provisions. For example, Colin led a successful appeal to the SoS on matters relating to S61 conditions imposed by a local authority on the grounds that the conditions were unreasonable.

High Speed 2, UK
Senior member of the Environmental Overview Consultant team on noise and vibration and health impacts. This included preparation of all materials required to support the application for the Hybrid Bill for HS2, Scope and Methodology Report, Environmental Statement, Health Impact Assessment Report, Code of Construction Practice (CoCP), technical notes, information papers and consultation briefings/presentations including the CoCP and NI policy. Colin also built trust with the local authorities across the scheme and this was instrumental in reducing the range and intensity of objections on noise and securing key agreements on the proposed noise controls and protection measures.

Leader of the team responsible for supporting HS2s consultation on Phase 2 and the provision of sound demonstrations.

2017 onwards. Acoustic lead for the design house for the London Tunnels between Euston station and the Colne Valley. Responsible for the acoustic design and technical assurance including the submission of Schedule 17 applications; defending appeals and stakeholder engagement. Colin was pivotal to securing consents for programme critical assets for some of the most challenging Schedule 17 applications for the Phase 1 scheme.

Thameslink Programme, UK
Noise and Vibration Manager for the Thameslink Programme, responsible for all aspects of acoustic design and management of construction noise and vibration. Implemented and developed Network Rail's standards and procedures. Prepared several proofs of evidence and inquiry notes on noise and vibration. Successful application for a ruling from the planning inspector on the adequacy of the ES during the inquiry (Regulation 11 request), thereby helping to protect the programme from any subsequent legal challenge.

He was also instrumental in property negotiations on the scheme to remove constraints that would have otherwise resulted in significant risk to the overall construction programme.

Technical advisor to HE on noise management/ research

Provision of specialist advice on several research packages including:

- Development of an Interim Advice Note to update the DMRB;

- Technical advisor and procurement support on the Highways England Noise Insulation Project, including before and after studies on health and quality of life.

DLR Extension to Dagenham Dock, UK
Project manager of the multi-disciplinary environmental and sustainability team and specialist input to the noise and vibration assessment. Involvement included design development and other matters in preparation for the Transport and Works Act (TWA) application.

Airtrack, UK
Noise and vibration expert in support of the Transport and Works Order (TWO) application for the Airtrack rail scheme. The role included management of the noise and vibration assessment; consultation; scheme development; noise and vibration design; options appraisal; noise impact assessment; health impact assessment, and the preparation of the Environmental Statement, formulation of conditions and undertakings and stakeholder consultation.

Hitchin to Cambridge Grade Separated Junction, UK
Member of the TWA Order application team providing environment specialist support. Colin contributed to preparation of the Planning and Environmental Management Strategy (this defined the environmental requirements for the project and the environmental policies), as well as management of the Environmental Impact Assessment (EIA) and preparation of the Environmental Statement. Acted as the witness on the adequacy of the Environmental Statement. His evidence was pivotal to securing the Order for building the scheme with appropriate and proportionate commitments.

London International Freight Exchange UK
Expert written evidence at the public inquiry on construction and operational noise and vibration.

Heathrow Express Railway Extension and Piccadilly Line Extension, UK
Presented evidence on operational and construction noise. Formulation of consents and undertakings.

Kings Cross Land Development, UK
Baseline studies for the Kings Cross area.

Jubilee Line Extension, UK
Review of noise predictions and noise impact assessments.

M4 Widening, M25 Spur Road and Surface Access Proposals for Terminal 5, UK
Presented evidence at the Public Inquiry on construction and operational noise.

M25 Widening Scheme, UK
Member of the local authority/ Highways Agency consultation

and working group on the monitoring and discharge of consents, assurances and undertakings for the M25 widening scheme.

Redevelopment of Former Gas Works, Uxbridge, UK
Air quality and noise evidence at an appeal against a refusal to grant panning permission for 20,000 sq m for B1, B2 and B8 use. The appeal was held under the provisions of the Town and Country Planning Act 1990.

Mixed Use Development at Barking Station, UK
Project manager and preparation of the noise assessment and the sustainability appraisal of mixed use developments adjacent to Barking Station. Advice on development options and sustainable design.

DEFRA Vibration Research
This research project developed and piloted the instruments by which human exposure to vibration in residential environments could be assessed by a future extensive exposure-response study. The vibration sources considered are those affecting residents which are outside their control, e.g. road, rail, industry, construction and sources that are within the same building but are not within the resident's domicile (e.g. neighbouring gym, wind turbines etc.).

DEFRA Wind Farm Noise
Colin led the project team responsible for producing guidance for local authorities on the management of noise from wind farms, including guidance on the use of nuisance provisions, planning legislation and the Environmental Impact Assessment regulations.

Supplementary Planning Document for London Boroughs of Richmond, Hillingdon and Hounslow

Joint author to the joint Council's draft SPD on planning and noise with a particular emphasis on good acoustic design

Appendix 2- Policy Background

Noise Policy Statement for England, 2010

The NPSE was published by Defra in 2010 and paragraph 1.7 states three policy aims:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

o *Avoid significant adverse impacts on health and quality of life;*

o Mitigate and minimise adverse impacts on health and quality of life; and

o Where possible, contribute to the improvement of health and quality of life."

The first two points require that significant adverse impacts should not occur and that, where a noise level falls between a level which represents the lowest observable adverse effect and a level which represents a SOAE:

• • *"…all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur." (Paragraph 2.24, NPSE, March 2010).*

Section 2.20 of the NPSE introduces key phrases including 'significant adverse' and 'adverse' and two established concepts from toxicology that are being applied to noise impacts:

• *"NOEL – No Observed Effect Level; this is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise";* and

• *"LOAEL – Lowest Observed Adverse Effect Level; this is the level above which adverse effects on health and quality of life can be detected".*

Paragraph 2.21 of the NPSE extends the concepts described above and leads to a significant observed adverse effect level (SOAEL), which is defined as the level above which significant effects on health and quality of life occur.

The NPSE states:

• *"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations". (Paragraph 2.22, NPSE, March 2010).*

Furthermore, paragraph 2.22 of the NPSE acknowledges that:

• *"Further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise".*

However not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

National Policy Statements

• NPS for Energy (EN-1) (DECC 2011);

• NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b); and

• NPS for Electricity Networks Infrastructure (EN-5) (DECC 2011c).

EN1 para. 5.11.6
"*Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards[137] and other guidance. Further information on assessment of particular noise sources may be contained in the technology-specific NPSs. In particular, for renewables (EN-3) and electricity networks (EN-5) there is assessment guidance for specific features of those technologies. For the prediction, assessment and management of construction noise, reference should be made to any relevant British Standards[138] and other guidance which also give examples of mitigation strategies.*

The project should demonstrate good design through selection of the quietest cost-effective plant available; containment of noise within buildings wherever possible; optimisation of plant layout to minimise noise emissions; and, where possible, the use of landscaping, bunds or noise barriers to reduce noise transmission."

5.11.9 "*The IPC should not grant development consent unless it is satisfied that the proposals will meet the following aims:*
● *avoid significant adverse impacts on health and quality of life from noise;*
● *mitigate and minimise other adverse impacts on health and quality of life from noise; and*
● *where possible, contribute to improvements to health and quality of life through the effective management and control of noise.*

When preparing the development consent order, the IPC should consider including measurable requirements or specifying the mitigation measures to be put in place to ensure that noise levels do not exceed any limits specified in the development consent."

EN-5, paragraphs 2.9.8 and 2.9.9
"While standard methods of assessment and interpretation using the principles of the relevant British Standards are satisfactory for dry weather conditions, they are not appropriate for assessing noise during rain. This is when overhead line noise mostly occurs, and when the background noise itself will vary according to the intensity of the rain. Therefore, an alternative noise assessment method to deal with rain-induced noise is needed, such as the one developed by National Grid as described in report TR (T) 94,199319. This follows recommendations broadly outlined in ISO 1996 (BS 7445:1991) and in that respect, is consistent with BS 4142:1997. The IPC [now the Planning Inspectorate and the Secretary of State] is likely to be able to regard it as acceptable for the applicant to use this or another methodology that appropriately addresses these particular issues".

It is worth noting that the guidance provided in TR(T) 94 referred to the 1990 version of BS4142, which has been substantially superseded by the 2019 version of the standard.

"*The IPC should ensure that relevant assessment methodologies have been used in the evidence presented to them, and that the appropriate mitigation options have been considered and adopted. Where the applicant can demonstrate that appropriate mitigation measures will be put in place, the residual noise impacts are unlikely to be significant*."

2.9.11 "*Consequently, noise from overhead lines is unlikely to lead to the IPC refusing an application, but it may need to consider the use of appropriate requirements to ensure noise is minimised as far as possible."*

National Planning Practice Guidance for Noise (NPPG) 2014

The National Planning Practice Guidance for Noise (NPPG Noise, December 2014), issued under the NPPF, states that noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or making decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.

A noise hierarchy table is given for LOAELS, SOAELS and UAELS

BS 4142:2014+A1:2019 – Method for Rating and Assessing Industrial and Commercial Sound

BS4142 describes a method for rating and assessing sound of an industrial and/or commercial nature. This method uses a Rating level to assess the likely effects from sound of an industrial or commercial nature on people using amenity space outside a dwelling or premises used for residential purposes upon which the sound is incident.

Section 11 concerns the assessment of the impacts. It is reproduced in full below so as to provide a full context.

The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.

Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level (see Clause 8) from the rating level (see Clause 9).

NOTE 1 More than one assessment might be appropriate.

a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

NOTE 2 Adverse impacts may include but not be limited to annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.

1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the

rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/ or commercial nature is likely to be perceived and how people react to it.

NOTE 3 Consideration should be given to evidence on human response to sound and, in particular, industrial and/or commercial sound where it is available. A number of studies are listed in the "Effects on humans of industrial and commercial sound" portion of the "Further reading" list in the Bibliography.

3) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:

i) facade insulation treatment;

ii) ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and

iii) acoustic screening.

WHO (2018) Environmental Noise Guidelines for the European Region

The guidance states:
"The main purpose of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise originating from various sources: transportation (road traffic, railway and aircraft) noise, wind turbine noise and leisure noise. They provide robust public health advice underpinned by evidence, which is essential to drive policy action that will protect communities from the adverse effects of noise."

WHO (2009) Night Noise Guidelines for Europe

An extension to the WHO Guidelines for Community Noise (1999). It concludes that:
"Considering the scientific evidence on the thresholds of night noise exposure indicated by Lnight outside as defined in the Environmental Noise Directive (2002148/EC), an Lnight outside of 40dB should be the target of the night noise

guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. Lnight outside value of 55dB is recommended as an interim target for those countries where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach."

WHO (1999) Guidelines for Community Noise

These guidelines present health-based noise limits intended to protect the population from exposure to excess noise. They present guideline limit values at which the likelihood of particular effects, such as sleep disturbance or annoyance, may increase. The guideline values are 50 or 55dB LAeq during the day, related to annoyance, and 45dB LAeq or 60dB LAmax at night, related to sleep disturbance. The Guidance states:

"The effects of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30dB LAeq for continuous noise and 45dB LAmax for single sound events. Lower noise levels may be disturbing depending on the nature of the source."

The WHO guidance also highlights that:
"Night-time, outside sound levels about 1 metre from facades of living spaces should not exceed 45dB LAeq, so that people may sleep with bedroom windows open. This value was obtained by assuming that the noise reduction from outside to inside with the window open is 15dB. To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35dB LAeq. To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB LAeq on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dB LAeq. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development."