Air Studios

Potential Noise & Vibration Effects of the Proposed Construction Works at 11 Rosslyn Hill, London, NW3 5UL

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Contents

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1 Introduction

1.1 This report has been prepared under instruction from Air Studios. The Studios are concerned that the proposed development at their neighbours' property at 11 Rosslyn Hill, London NW3 5UL will l have a significant impact on their recording facilities, their clients and staff.

1.2 Air Studios are built in Lyndhurst Hall, a former church and missionary school, which is located in a quiet area of Hampstead, London.

1.3 The proposed development at 11 Rosslyn Hill comprises;

- Amalgamation of the main house and studio dwellings,
- Demolition of two single storey buildings
- Construction of a new dining room extension with a two storey link to the main house,
- Ground excavation and construction of a new basement media room where piling would be required,
- Ground excavation and construction of a new basement swimming pool where piling would be required,
- Part demolition and conversion of an existing studio dwelling and replacement with a single storey pavilion.

1.4 This report discusses:-

- the sensitivities of Air Studios, its ability to record audio and the effects on clients and staff caused by the potential noise and vibration impacts of 11 Rosslyn Hill development, in particular in respect of construction activities,
- a review of the relevant noise and vibration policy and standards that provide advice regarding acceptable levels of noise and vibration,
- A review of the documents submitted with the planning applications.

2 Effects of Construction

Sensitivity of Air Studios

2.1 Air Studios is a world-class recording facility comprising of state-of-the-art recording equipment. The facility comprises of four major recording studios, eight programing rooms and three 5.1 surround sound mixing rooms. The main hall is one of the largest recording rooms in the world and is large enough to house a full symphony orchestra. The facility is renowned for producing some of the finest film scores, classical and rock music. Air Studios operates 24 hours a day and with the high demand for its use, the studios cannot be comprised by construction or operational noise and vibration.

2.2 The effect of construction noise and vibration is of particular concern to the studios as it can pose an unacceptable impact in terms of:

- The highly sensitive recording equipment,
- the artists and musicians performing in the studios,
- the staff and engineers working in the facility.

2.3 Noise and vibration can be picked up by the recording microphones and recorded along with the intended musical or vocal performance. This kind of unwanted noise in the recording is not acceptable to producers and artistes who may not be able to use the recorded material to create the end product such as a film score or music album. This effect can render the facility completely unusable if construction noise is audible in the relevant rooms.

2.4 The effect of intrusive noise and vibration can have both short term and long term effects on the recording studio business. In the short term recording contracts may have to be cancelled due to the impact of the potential noise and vibration and in the long run the reputation of the business may suffer leading to loss of income.

2.5 Furthermore, whilst the studios are built with a ‘box-within a box’ construction to isolate most forms of external noise, the hall is not isolated in this way due to its size and historic building constraints. This facility in particular, therefore, is the most sensitive and vulnerable to noise and vibration impact.

2.6 In summary, the studios are a highly sensitive receptor that need to be protected against any risk of potential noise and vibration impacts.

Construction

2.7 In law the term 'construction' includes demolition. The greatest risk of disturbance to the studios is the excavation and piling works which are proposed extremely close to Lyndhurst Hall. This is likely to generate high levels of noise and in particular ground borne vibration which manifests itself as re-radiated noise in the studios. It should be noted that groundborne noise and perceptible vibration are hard to predict and when they occur, hard to control. For these reasons, this is a significant risk to the operation of the studios.

2.8 The extent to which noise and vibration will affect the studios will be determined by the phasing of the demolition and construction process, the possibility of hidden structural links and the propagation characteristics of the ground, as well as by the techniques and machinery used. This variables are difficult to predict and again this highlights the risk to the studios.

Noise

2.9 Airborne noise is 'predictable' in both literal and figurative senses. Noise levels can be predicted from source levels using the simple models presented in the relevant British and International Standards. Figuratively people are used to the sound of noise propagated through a window into a room. Groundborne noise is not predictable in either sense. It is very difficult to make any quantitative prediction of noise levels likely to be broadcast into a room after propagation through the structure of a building. Furthermore, subjectively the resultant is unfamiliar because its frequency distribution is likely to be quite different from that of similar airborne noise.

2.10 The level at which noise begins to annoy or disturb people is not a simple threshold. The character of the noise is a relevant factor. The activity in which the person receiving it is engaged is another. Impulsive noise is likely to be significantly more annoying and more likely to disturb than steady noise. This would be the case for the proposed piling works. All of these variables weigh in the question of what limiting level might define the threshold of tolerance.

2.11 For recording studios, another important factor is the effect of extraneous noise on the recording equipment from the microphone through the recording chain. The sensitivity of the microphones coupled with their frequency range can be greater than that of the human ear and therefore airborne and groundborne noise poses another risk to the successful operation of Air Studios.

Vibration

2.12 People are very much more sensitive to vibration than buildings are. The lowest magnitude of vibration that could cause superficial damage to a building, is an order of magnitude higher than the threshold of human perception. People are disturbed and worried by vibration at magnitudes not a great deal higher than the perception threshold. However, during demolition of a structure, there is a risk that very high magnitudes of ground vibration can be generated. If any structural link exists between buildings at foundation level, or if the ground condition supports propagation of vibration energy, neighbouring buildings can be excited by the motion. This ground borne transmission is clearly a potential risk for the studios.

2.13 Numerical standards for assessing building damage risk are set out in BS7385, Part 2, which is reiterated in BS5228-2:2009.

2.14 Vibration must be monitored in three dimensions. Buildings tend to sway in response to ground excitation and it is quite common to measure the maximum amplitude of motion in response to a source such as impact piling, which forces vibration energy into the ground vertically, in one or other of the horizontal axes.

2.15 The response of people to building vibration is influenced by the axis of motion and their relation to it as well as by the frequency, magnitude and time history of the excitation. Comprehensive guidance on annoyance risk is provided in BS6472. Although a protocol for measurement is specified in the Standard, the incidence of vibration in a studio environment and the particular demands of construction vibration monitoring tend to require a different, non-standard approach.

2.16 A digest of the standards for acceptable or limiting noise and vibration levels is set out in Section 3.

3 Noise & Vibration Policy and Standards

3.1 This section provides an outline of the relevant planning policy, guidance and standards that are applicable to the potential noise and vibration arising from construction activities. As noise from construction activities will intrude on the activities of the studios, there are two aspects which need to be considered;

- The acceptable levels of noise and vibration within the studio which do not have a significant adverse effects on the clients, artists and staff. This considers the more general guidance on noise and vibration given within the National Planning Policy Framework (2012), the Noise Policy Statement for England (2010), BS8233:2014, World Health Organisation Guidelines for Community Noise (1999), BS6472:2008, BS7835:1993 and DIN4150.

- Policy and standards which relate more directly to construction noise and vibration, this includes BS5228:2009 parts 1 & 2, The Control of Pollution Act 1974 and guidance given by the London Borough of Camden.

Part 1: Acceptable Levels of Noise & Vibration

National Planning Policy Framework (NPPF), 2012

3.2 The National Planning Policy Framework introduced in March 2012 extinguished and replaced the entire catalogue of Planning Policy Guidance (PPG) and Planning Policy Statements (PPS) including the well-established Planning Policy Guidance note PPG24: Planning and Noise.

3.3 The new guidance aims to devolve planning decision making to the local level, asserting the primacy of local development plans and especially of a presumption in favour of sustainable development. It encourages local planning authorities and communities to set their own standards for development within the National Policy Framework. Furthermore, it attempts to adopt a more holistic approach to various impacts and benefits of individual projects within the assumption of consent for sustainable development.

3.4 The NPPF addresses noise as a planning issue principally through a statement of four principles at paragraph 123:

"Planning policies and decisions should aim to:

- *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*

- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established, and*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."*

Noise Policy Statement for England, 2010

3.5 The NPPF refers to the Noise Policy Statement for England (NPSE) 2010 for advice on the achievement of these aims, and particularly for explanations of "adverse impacts."

3.6 The Noise Policy Statement for England (NPSE) seeks to clarify the underlying principles and aims in past and existing policy documents, legislation and guidance in relation to all forms of noise including environmental noise, neighbour noise and neighbourhood noise (but not noise in the workplace). It sets out the Government's long term vision (para.1.6) as to:

"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."

- And the policy aim is to:
- Avoid significant adverse impact on health and quality of life and mitigate and minimise adverse impacts on health and quality of life.

3.7 This vision is supported by policy aims that echo the four principles set out in the NPPF (para.3.4).

3.8 There are several key phrases within the NPSE aims that require explanation. These are:

'Significant adverse' and 'adverse'

3.9 There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL – No Observed Effect Level

3.10 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.

LOAEL – Lowest Observed Adverse Effect Level

3.11 This is the level above which adverse effects on health and quality of life can be detected.

3.12 Extending these concepts for the purpose of the NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

3.13 This is the level above which significant adverse effects on health and quality of life occur.

3.14 It is not possible to identify a single objective noise value that defines SOAEL and that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged in the NPSE 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, it suggests that not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available[1].

3.15 The second aim of the NPPF and NPSE, to mitigate and minimise adverse impacts on health and the quality of life from noise within the context of Government policy on sustainable development, refers to noise impacts somewhere between LOAEL and SOAEL. The NPSE asserts that while this means that all reasonable steps should be taken to mitigate and minimise adverse effects, this does not mean that such adverse effects cannot occur[2].

Studio Design – Acoustic Criteria

3.16 BS 8233:2014 'Guidance on sound insulation and noise reduction for buildings' gives specific guidance on noise criteria for dwellings and non-domestic buildings. Section 7.7.4 of the document references recording studios but gives no detailed guidance stating that specific advice should be sought from a specialist consultant.

[1] Defra, 2010, Noise Policy Statement for England, page 9, paragraph 2.22.

[2] Defra, 2010, Noise Policy Statement for England, page 9, paragraph 2.24

3.17 Unlike many of the noise criteria specified for dwellings which are quoted as a single dB(A) figure, studio design requires the sound to be assessed over the complete frequency range. Some of the pioneering work was completed by Beranek, Kosten and Van Os and Gilford. They all produced very similar results published by Gilford 'Acoustics for Radio and Television Studios'. The BBC also published guidance 'The Good Practice Guide to Acoustics' in 1991 which gave a series of sound level with frequency curves depending upon the recording activity. The results were again similar to those described by Beranek et al and in practice follow the European standard of background Noise Rating curves (NR Curves). For Television Studios the BBC criterion is typically equivalent to NR 25 and for studios for radio drama, the value is typically NR20. These values of NR curves are equivalent to very low background noise levels and would therefore be very sensitive to extraneous noise.

3.18 The original criterion for the design of Air Studios is being established from historical test data which has been archived. These results were not available when preparing this report, so Vanguardia undertook sound level measurements with a precision grade Class 1 sound level analyser (B&K 2250 calibrated before and after the measurements). The results showed (Appendix B and C) that the hall and studios were recorded to have a Noise Rating of NR15. This rating level is exceptionally low and below the BBC noise threshold values. These very low background levels are required for the type of multiple microphone techniques used in the studios especially when recording a full symphony orchestra.

BS7385-2:1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration.

3.19 Structural damage from vibration is assessed in terms of peak particle velocity (PPV). Table 1 of the standard gives guidance as to the maximum levels which should not be exceeded to avoid cosmetic damage occurring to various construction types. These levels are reproduced in Table 3.1 below.

Table 3.1 Transient vibration guide values for cosmetic damage

Line (see Figure B.1)	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
2	Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
NOTE 1 Values referred to are at the base of the building. NOTE 2 For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.			

(Source: BS7385-2:1993 Table 1 page 5)

3.20 The standard also indicates that:

Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 1, and major damage to a building structure can occur at values greater than four times the tabulated values.

Note: Damage categories are defined in 9.9 of BS 7385-1:1990.[3]

The guide values in Table 1 relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 1 might need to be reduced by up to 50%. [4]

The probability of damage tends towards zero at 12.5 mm Es.1 peak component particle velocity. [5]

[3] BS7385-2:1993, page 5 section 7.4.2
[4] BS7385-2:1993, page 5, section 7.4.3
[5] BS7385-2:1993, page 4, section 7.4.1

Important buildings which are difficult to repair might require special consideration on a case by case basis. A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.[6]

3.21 As the vibration could occur for a period of time and, consequently, resonant response is possible, 50% reduction in the limits may need to be considered for the studios. BS7385 notes this guidance is based on common practice. Assuming the studios can be considered under Line 2 classification, this would result in the vibration limits for cosmetic damage in Table 3.2 below.

Table 3.2 Reduced Limits to account for resonant response

	4Hz – 15Hz	**15Hz – 40Hz**	**>40Hz**
Vibration Limit (peak particle velocity)	8mm/s increasing to 10mm/s	10mm/s increasing to 25mm/s	25mm/s

DIN 4150: Part 3: 1986: Structural vibration in buildings – Effects on structures

3.22 The German standard often referenced, suggests slightly more conservative values to those shown above. This standard also gives advice on building types not covered by the Line 1 and 2 descriptions (which are broadly similar to those given in BS 7385), as follows:

Table 3.3 DIN4150 Vibration Limits

Line	**Type of Structure**	**Vibration velocity**			**Uppermost full storey all frequencies**
		<10Hz	**10Hz – 50Hz**	**>50Hz**	
3	Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3mm/s	3mm/s increasing to 8mm/s	8mm/s increasing to 10mm/s for frequencies greater than 100Hz	8

[6] BS7385-2:1993, page 5, section 7.5.2

3.23 Given the age of Lyndhurst Hall and its listed status, these criteria would be more appropriate in terms of assessing the potential for building damage.

BS6472-1:2008 Guide to evaluation of human Exposure to Vibration in buildings Part 1: Vibration sources other than blasting

3.24 Human perception of vibration is considered within BS6472-1:2008 which offers advice on the measurement and assessment of vibration affecting human beings in buildings. The first overt sign of an unfavourable reaction to building vibration is adverse comment, whereby occupants express negative responses to the vibration. The prevalence of adverse comment can be influenced by parallel effects such as re-radiated noise. The acceptable magnitudes for building vibration might depend similarly on these parallel effects.

3.25 The vibration tolerance of people at home or at work varies over a wide range. As well as a wide range of individual vibration sensitivity over the population, specific values depend on social and cultural factors, psychological attitudes and the expected degree of intrusion. Concern about damage to residential property is a factor in the response of owner occupiers [2] that might not be expected in office workers.

3.26 The thresholds of vibration perception across the population at the frequency of maximum sensitivity (f = 8Hz) for people sitting or standing on a vibrating surface are approximately:

Lower quartile: 0.01 m/s^2 (peak acceleration) or 0.2 mm/s (peak velocity)

Median: 0.015 m/s^2 (peak acceleration) or 0.3 mm/s (peak velocity)

Upper quartile: 0.02 m/s^2 (peak acceleration) or 0.4 mm/s (peak velocity)

3.27 BS6472-1 requires that human exposure to vibration is quantified cumulatively as a Vibration Dose Value (VDV) derived from the frequency weighted signal over time. The W_b weighting is applied for vertical motion while W_d weighting is applied for horizontal motion. Buildings affected by ground vibration generally exhibit the greatest magnitude of motion on their top floors.

3.28 The Standard does not offer any quantitative way of incorporating 'parallel effects' but advises that any noise accompanying the perceptible vibration including induced rattling, any visual effect and also the influence of a third party can modify the response. It is likely that the possibility of adverse comment increases if the subject has been influenced to take interest in the reported vibration by suggestion from third parties.

3.29 The Standard provides guidance on measurement of vibration, the most important component of which is to report meticulously the method used and reasons for having adopted it. Although ideally the experience of a person experiencing perceptible vibration should be represented by a measurement directly of their exposure, this is rarely achievable in practice and the Standard suggests approximations and the use of transfer functions to estimate true exposure values.

3.30 Numerical standards for assessing the results assuming residential occupancy are provided for 16 hour and 8 hour night exposures. It is appropriate to assume a working day's exposure and to rate it with respect to the residential day's standard. The suggested assessments are copied (Table 3.4) from the Standard in Table 1, with the metre units in the original having been transformed to millimetre units for consistency with other standards discussed in this report. This standard is not often used to assess construction noise as it takes a long temporal averaging time (16 hours) to obtain the final result. Other more appropriate indices for assessing construction vibration are discussed in the following paragraphs of this report.

Table 3.4 Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings

Place and time	Low probability of adverse comment $m.s^{-1.75}$ (1)	Adverse comment possible $m.s^{-1.75}$	Adverse comment probable $m.s^{-1.75}$ (2)
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

NOTE For offices and workshops, multiplying factors of 2 and 4 respectively should be applied to the above vibration dose value ranges for a 16 h day.
1) Below these ranges adverse comment is not expected.
2) Above these ranges adverse comment is very likely.

Part 2: Advice Concerning of Noise & Vibration from Construction Activities

BS5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 1 Noise

3.31 The standard recognises the need of persons living and working in the vicinity of and those working on construction and open sites from noise and vibration, which can disturb and inconvenience those in proximity to the construction activities. The standard provides a method of predicting construction noise and recommendations for noise control.

3.32 The standard advises that a pragmatic approach needs to be taken to determining the significance of noise effects. There are two approaches to determining significance;

- Fixed noise limit – typically 75 dBA between 07:00 – 19:00 hours.
- Noise change – the ABC method or the 5dB change method.

BS5228-2:2009 Code of practice for noise and vibration control on construction and open sites - Part 2 Vibration

3.33 Human beings are very sensitive to vibration, with a typical perception threshold in the PPV range of 0.14 mm.s-1 to 0.3mm.s-1. Above these values, vibration can disturb startle, cause annoyance or interfere with work activities. This is particularly relevant to the highly skilled artists, performers and engineers working in Air Studios. At higher levels they can be described as unpleasant or even painful. In residential accommodation, vibration can promote anxiety that structural mishap may occur.

3.34 BS6472 sets down vibration levels at which minimal adverse comment is likely to be provoked from the occupants of the premises being subjected to vibration. It is not concerned primarily with short term health hazards or working efficiently. Generally, vertical vibrations are more perceptible than horizontal ones, but at very low frequencies this tendency is reversed. However, for construction it is considered more appropriate to provide guidance in terms of PPV, as this parameter is likely to be more routinely measured. Furthermore, as many empirical vibration predictors yield a result in PPV, it is necessary to understand what the consequences may be of any predicted levels in terms of human perception and disturbance. Table 3.5 below provides guidance on the effects

Table 3.5 Guidance on the effects of various vibration levels

Vibration Level (PPV)	Effect
0.14mm.s-1	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3mm.s-1	Vibration might be just perceptible in residential environments.
1.0mm.s-1	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10mm.s-1	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

(Source: BS5228-2:2009, Table B.1 guidance on effects of Vibration Levels)

3.35 The response of a building to ground borne vibration is affected by the type of foundation, underlying ground conditions, building structure and condition. BS5228-2:2009 presents limits for transient vibration, above which cosmetic damage could occur which are taken from the advice contained in BS7385-2:1993, particularly Table 1 of the standard which is reproduced as Table 3.1 in this report.

Control of Pollution Act 1974

3.36 Section 60 of the CoPA 1974 empowers the Local Authority to serve a notice on those carrying out works (that include demolition, ground works and construction) to control noise (and vibration). The notice can perform the following functions:

- Specify the plant or machinery to be used
- Specify hours during which construction activity can occur.
- Specify level of noise and vibration that can be emitted
- provide for change of circumstances – e.g. if ground conditions change and there is a need to switch to alternative methods.

3.37 The Local Authority's notice must ensure that the best practicable means are employed to minimize noise and vibration and other types of plant or machinery that might be equally effective in minimizing noise and vibration.

3.38 Under section 61 of the CoPA 1974, the contractor/developer can apply to the local authority for consent to carry out the work. Once a consent has been granted, a local authority cannot take action under section 60 of the Act or section 80 of the 1990 Environmental protection act providing the consent remains in force and the contactor complies with its terms. Action against nuisance can be taken under section 82 of the EPA or under common law.

3.39 The application must contain 'particulars' about the works, the method by which they are to be carried out and the steps proposed to be taken to minimise noise resulting from the works.

3.40 The "particulars" that must be provided in an application are sufficiently broadly specified that they might include the whole monitoring regime on the basis that it can be seen as one of the steps proposed to minimise noise from the works. The local authority clearly has the power to impose standards. The developer intends to propose a regime of noise and vibration action levels and limits, and a protocol to monitor and enforce them which the Council can consent to. No doubt the appeal procedure provided in the section would be invoked if it did not.

3.41 With regard to vibration, the CoCP places a duty on contractors to ensure that residents and people at work are protected from nuisance and harm and buildings are protected from structural damage. It states that the contractor will comply with BS6472:1992. The vibration levels permitted are established by agreement with the Council on a site by site basis.

3.42 The permitted hours of work for any works audible at the site boundary are 8.00am to 6pm Monday – Friday and 8.00am – 1.00pm on Saturdays although it notes that individual site requirements which differ from these hours will be considered on a site by site basis.

3.43 Like most councils, Camden have their guidance on the assessment and control of construction noise and vibration which is based on the factors previously discussed for the CoPA. Camden Planning Policy CPG4, Basements and Lightwells specifically deals with Basement Impact Assessments (BIM) and planning development. Noise and vibration are mentioned although no particular criteria are recommended.

Re-Radiated Noise and Vibration Criteria

3.44 There are no particular standards related to re-radiated noise from construction affecting studios but guidance can be taken from other planning development schemes such as Crossrail where construction of the tunnels below a number of studios and theatres needed to be assessed. The Technical report included in the DS10 documentation, 'Assessment of Noise and Vibration Impacts' produced for Crossrail in February 2015 presented some agreed re-radiated noise guidelines. These values are also applied to the HS2 construction project. These noise levels are shown in the table below.

Table 3.6 – Re-Radiated Noise from Underground Sources – Threshold of Significant Impacts

Building	Noise Level, $L_{Amax,S}$
Theatre	25dB
Large Auditorium/Concert Hall	25dB
Studios	30dB
Churches	35dB
Courts, Lecture Theatres	35dB
Small Auditoria/halls	35dB
School Colleges	40dB

3.45 From this table, it is recommended that for Air studios, the target LAmax.S level should be 25dB.

4 Review of Application Proposals

Introduction

4.1 We have reviewed the documents submitted under planning application reference 2015/2089/P, in particular;

- Planning Application form
- Design and Access, Planning and Heritage Statement
- Outline Construction Management Plan
- Plant noise report
- Plant noise assessment
- Basement impact assessment
- Related drawings and plans

These documents are discussed below in relation to the potential noise and vibration impacts Air Studios.

Construction Management Plan

4.2 The so-called construction management plan described in the Camden Planning portal is not a Construction Management plan but a report dealing solely with the traffic impact and traffic management. There is no discussion or assessment of the noise or vibration impacts and no control procedures. No further construction noise and vibration information is contained within the other documents and we therefore consider the application to be flawed.

4.3 The construction management plan in respect of noise and vibration should provide details of:-

- The sensitivity of nearby properties, especially in respect of the Air recording studios being the closest to the applicants site.
- The noise and vibration criteria affecting all nearby adjoining properties based on relevant standards, guidelines and other schemes of a similar nature.
- The methodology for predicting noise and vibration levels from the construction activities.

- The predicted levels and an assessment against the relevant criteria for noise and vibration.
- The management and control of the noise and vibration.
- The monitoring and control procedures (target and action levels) to be adopted throughout the construction phase.

4.4 We would expect there to be a full review of the construction noise and vibration criteria and standards as described in section 3 of this report. With the lack of such information, we propose the following target levels (Table 4.1) based on the guidance, measurements and details provided on standards in section 3 of this report:-

Table 4.1 Guideline Internal Noise levels

Construction Effect	Maximum Level not to be exceeded in all the studios
Internal noise	NR 20
Re-radiated noise	25dB LAmax,s
Vibration for occupiers	0.5mm.s^{-1}
Structural vibration	3.0 mm.s^{-1}

Comments on the Cole Jarman Plant Noise Reports

4.5 There are two noise reports submitted in support of the Planning Application for the extension works to 11 Rosslyn Hill, NW3. The first report (Ref: 14/0692/R1) produced in January 2014 provides detail of a background noise survey (carried out in December 2014 – we deduce that the report is dated incorrectly) and suggests appropriate offsite noise limits for the proposed plant based on published 'Camden Council's Noise Standards'.

4.6 The second report (Ref: 14/0692/R2-1) produced in March 2015 relies on the information provided by the first report and sets out the noise limits and any required mitigation measures to achieve compliance with the recommendations of the first report.

Plant Noise Report (14/0692/R1)

4.7 This report is incomplete as whilst Air Studios is mentioned in the Section 2 – Site Description, it does not acknowledge that Air Studios is a noise sensitive receptor so no assessment is carried out at this location.

4.8 Vanguardia's further concerns with their report are:

- There is only one measurement position for the survey which is located in an area chosen to be representative of the identified noise sensitive receptors. This location is not wholly suitable for Air Studios to the North of the development.
- The microphone was located at a height of 4m above ground. There is no explanation for this when measurements are normally made at 1.2m from the ground.
- There seems to be an arbitrary choice of noise limit chosen from Table E in the 'Camden Council Noise Standards' document of 5dB(A) < L90 without explanation. This assumes that none of the plant will have a tonal component but no supporting evidence is provided for this decision.
- The assessment is performed at their 'nearest' noise sensitive receptors/worst affected. Air Studios is not included in the assessment. The identified area for the location of the plant does not include the area later identified in the second report for the 'A/C Condenser Unit and 2 Air Source Heat Pumps', so does not provide a complete assessment.

Plant Noise Assessment (14/0692/R2-1)

4.9 This report also raises concern as it relies on the information provided in the previous report which is inadequate. All of the bullet points above apply to this report. Again Air Studios is overlooked as a potential noise sensitive receptor.

4.10 Section 5 of the report itemises the Mechanical Services Installation and refers to Appendix 14/0692/PNS1 for the details of sound pressure/power levels of proposed plant and equipment.

- The assessment ignores Air Studios even though plant is identified as being nearer to the Studios than the noise sensitive receptors used in the report. The A/C Condenser and 2 Air Source Heat Pumps are closer to Air Studios than the properties on Rosslyn Hill and Belsize Lane

- The data provided in the Appendix suggests that some items of plant will be tonal but despite this the noise limits are not amended to account for this. We believe that the limit to be applied should be 10dB(A) < LA90 as specified in Camden's Noise Standards.

- Given our concerns raised for the initial assessment, the suggested mitigation is also likely to be wrongly specified. The design criterion is incorrect.

5 Conclusions

5.1 Vanguardia Consulting has been appointed by Air Studios to complete a detailed review of the supporting information accompanying the planning application for extensive building works at 11 Rosslyn Hill, London which is adjacent to the studios. Advice has been given on appropriate noise, vibration and re-radiated noise guidelines applicable to construction and operational activities from the application site. The advice has been supported by baseline sound level measurements made in the studio. Recommended criteria, should the application be granted, have also been provided.

5.2 Air Studios is a world-class recording facility comprising of state-of-the-art recording equipment. The facility is renowned for producing some of the finest film scores, classical and rock music. Air Studios operates 24 hours a day and with the high demand for its use, the studios cannot be comprised by construction or operational noise and vibration from 11 Rosslyn Hill.

5.3 The effect of construction noise and vibration is of particular concern to the studios as it can pose an unacceptable impact in terms of:_

- The highly sensitive recording equipment,
- the artists and musicians performing in the studios
- the staff and engineers working in the facility.

5.4 Noise and vibration can be picked up by the recording microphones and recorded along with the intended musical or vocal performance. This kind of unwanted noise in the recording is not acceptable to producers and artistes who may not be able to use the recorded material to create the end product such as a film score or music album. This effect can render the facility completely unusable if construction noise is audible in the relevant rooms.

5.5 The effect of intrusive noise and vibration can have both short term and long term effects on the recording studio business. In the short term recording contracts may have to be cancelled due to the impact of the potential noise and vibration and in the long run the reputation of the business may suffer.

5.6 Furthermore, whilst the studios are built with a ‘box-within a box’ construction to isolate most forms of external noise, the hall is not isolated in this way due to its size and historic building constraints. This recording facility in particular, therefore, is the most sensitive and vulnerable to noise and vibration impact.

5.7 Vanguardia's background noise measurements made in the studios with no recording in progress, show extremely low baseline sound levels (NR15). These low levels over the complete audio frequency range, facilitate the environment for exceptional recordings with high dynamic range. Noise rating levels of NR15 were consistently recorded in various locations in the hall and studios. This indicates that any low level airborne noise or re-radiated noise from outside construction works will be readily noticed and be a potential source of disturbance in such a quiet environment.

5.8 The review of the supporting information is summarised as follows:-

- There is no recognition of the sensitive nature of Air Studios in respect of the potential noise and vibration impact of the construction works.
- The Outline Construction Logistic Plan is flawed as it falls far short of a construction plan as it deals solely with transport related issues.
- There are no recommended noise or vibration criteria for the construction works in relation to the effect on the studios.
- There are no predictions of airborne noise, re-radiated groundborne noise and vibration levels from the construction works. These are critical to assess the potential impact on the operation of the studios.
- There are no mitigation or management plans provided with the application to minimise any risk from noise and vibration disturbance.
- There is no noise impact assessment for the proposed external plant at the nearest noise sensitive receptor which is Air Studios.
- Concern is raised regarding the criteria adopted for the plant noise which ignores the tonal characteristics of the units.

5.9 The review and measurements have shown that the studios are a highly sensitive receptor that need to be protected against any risk of potential noise and vibration impacts. Given the extent of the construction works in very close proximity to Lyndhurst Hall, it is highly unlikely that such works can be completed whilst not causing some considerable disturbance to the staff, artists and recording facilities at Air Studios.

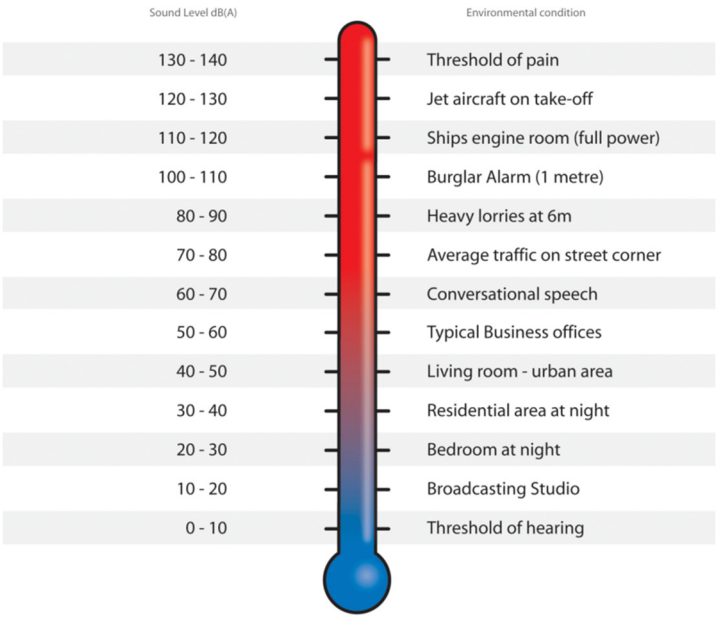
Appendix A / Glossary of Terms

A.1 Noise is defined as unwanted sound. The range of audible sound is from 0dB to 140dB, which is taken to be the threshold of pain. The sound pressure detected by the human ear covers an extremely wide range. The decibel (dB) is used to condense this range into a manageable scale by taking the logarithm of the ratio of the sound pressure and a reference sound pressure.

A.2 The frequency response of the ear is usually taken to be about 18Hz (number of oscillations per second) to 18,000Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than at the lower and higher frequencies, and because of this, the low and high frequency component of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most used and which correlates best with the subjective response to noise is the dB(A) weighting. This is an internationally accepted standard for noise measurements.

A.3 The ear can just distinguish a difference in loudness between two noise sources when there is a 3dB(A) difference between them. Also when two sound sources of the same noise level are combined the resultant level is 3dB(A) higher than the single source. When two sounds differ by 10dB(A) one is said to be twice as loud as the other.

A.4 The subjective response to a noise is dependent not only upon the sound pressure level and its frequency, but also its intermittency. Various indices have been developed to try and correlate annoyances with the noise level and its fluctuations. The parameter used for this measure is Equivalent Continuous Sound Pressure Level (L_{Aeq}). The A-weighted sound pressure level of a steady sound that has, over a given period, the same energy as the fluctuating sound under investigation. It is in effect the energy average level over the specified measurement period (T) and is the most widely used indicator for environmental noise. A few examples of noise of various levels are given right:



Displacement, Velocity, Acceleration

A.5 The precise position of a body in simple harmonic motion - the simplest form of vibration - can be described by its displacement from rest, its instantaneous velocity (rate of change of displacement) or its instantaneous acceleration (rate of change of velocity).

A.6 The 'strength' or magnitude of a vibration can also be described by any one of these parameters. When describing ground vibration or vibration in a structure the term 'particle' velocity or acceleration is used to describe the motion of a nominal particle on the surface in question. Displacement is not usually used in describing environmental or building vibration.

Peak, rms, rmq

A.7 Each of the three related descriptors: displacement, velocity and acceleration, varies from a maximum in the positive direction to a maximum in the negative direction through zero during one cycle of motion. To measure a vibration level requires a definition of where in the cycle to take the value. The maximum or peak value in either positive or negative direction can be adopted (peak particle velocity (ppv), peak particle acceleration (ppa)), the peak to peak value can be useful, but most environmental vibration is constantly variable and an average over some time interval would be more useful for assessing its effect on people than a single momentary peak value.

A.8 The most commonly used averaging process is 'root mean square' or rms averaging. Since a vibration has positive and negative components, the two cancel out if an attempt is made to average the magnitude of motion in the normal way and the average approaches zero. If the whole wave is squared, so that there is no negative component, the average of the squared values across a time interval can be taken and then square rooted to yield a root mean square magnitude which can be related to peoples' experience of the vibration.

A.9 Similarly, a signal can be averaged by 'root mean quad'. This is exactly the same as rms averaging except that the wave is raised to the power of 4 and then quad rooted to obtain the average value over a period of time. The rmq process emphasises short term peaks and jolts and has been found to better represent peoples' responses to intermittent vibrations.

Frequency weighting

A.10 Peoples' sensitivity to whole-body vibration is frequency dependent. The body is significantly more sensitive to vibration along its head to foot axis (denoted z) than along its front to back (x)

or side to side (y) axes. The frequency dependency differs between the z and x/y axes. At the order of magnitude of most environmental and building vibrations the body is most sensitive to motion at less than 10Hz, the sensitivity falling away as the frequency of motion increases to 80Hz which is the upper limit addressed in BS6472 or reduces below 1Hz, the lower limit.

A.11 In order to take the frequency-dependency of the body into account when assessing vibration it is necessary to apply a frequency weighting to the measured signal. This is exactly the same principle as is commonplace in noise measurements where 'A-weighting' is universally applied to take into account the frequency-dependency of the auditory system. In vibration assessment, however, different weightings must be used to assess motion affecting people along their z axis or their x/y axis. Usually the measurement is made relative to a building and people's z-axis may be vertical relative to the building during the day and horizontal at night. The weightings must be applied as appropriate to the orientation of the subject relative to the building.

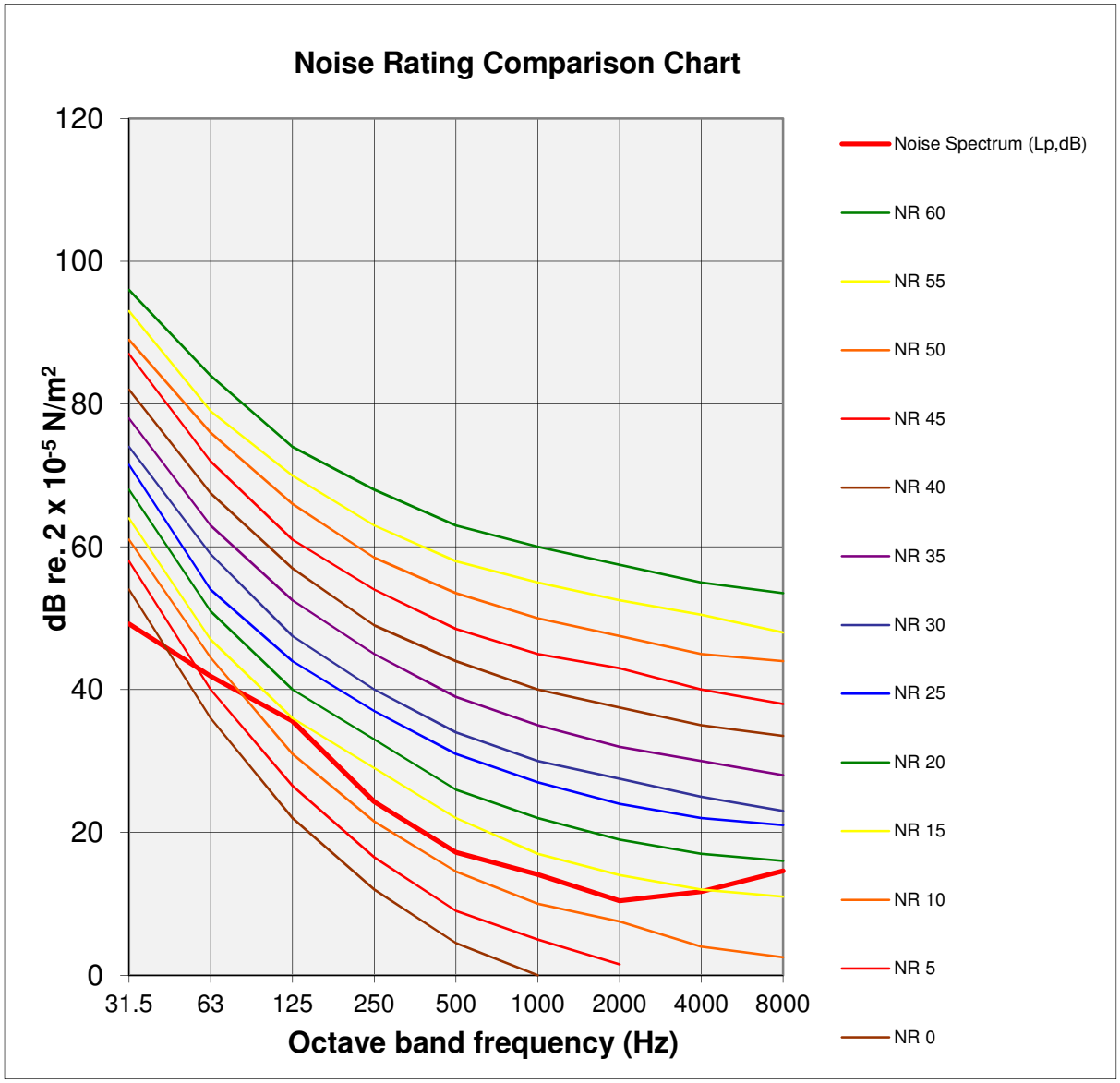
A.12 BS6472 directs that the vibration should be weighted according to linear approximations to curves presented more precisely in BS6841. The linear approximation for z-axis motion equates with the 'b' weighting specified (and denoted 'W_b') in BS6841. The linear approximation for x/y axis motion equates with BS6841 W_d weighting.

VDV

A.13 BS6472 provides guidance on the likelihood that vibration will provoke 'adverse comment' by reference to Vibration Dose Value, VDV. VDV is a compound index incorporating the magnitude, frequency components and duration of vibration exposure per day or night.

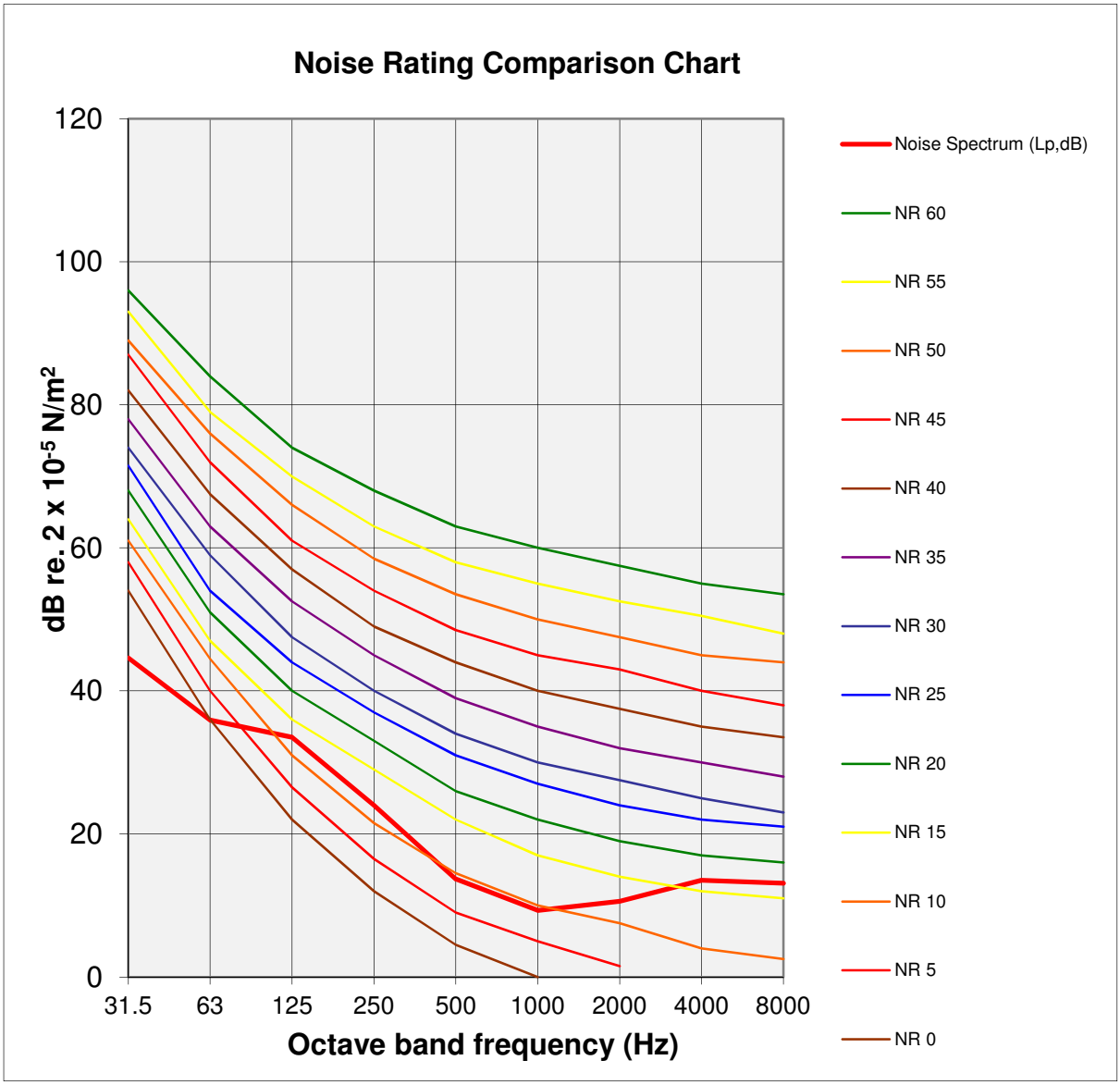
A.14 VDV is defined mathematically as the integral over time of the fourth power of the frequency-weighted, time varying vibration acceleration magnitude multiplied by the duration, all to the fourth root.

Appendix B / Noise Measurements in Hall



Note:
This is NR15 apart from the last three measurements which are affected by the self noise of the measurement equipment.
i.e. values represent the noise floor the measurement equipment

Appendix C / Noise Measurements in Studio 3



Note:
This is NR15 apart from the last three measurements which are affected by the self noise of the measurement equipment.
i.e. values represent the noise floor the measurement equipment

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