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TRANSPORT AND WORKS (APPLICATIONS AND OBJECTIONS PROCEDURE) (ENGLAND AND WALES) RULES 2006

NORTHUMBERLAND LINE

REBUTTAL PROOF OF EVIDENCE OF RICHARD HINTON BSc (Hons) MIOA ON BEHALF OF THE BERNICIA GROUP (OBJ 25)

2nd NOVEMBER 2021

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1 Introduction

1.1 This Rebuttal supplements my original Proof of Evidence, which was submitted to the Inquiry by the deadline of 12th October 2021.

1.2 It is noted that no noise evidence has been provided by the Applicant. To that extent there is limited noise evidence requiring rebuttal. However, some additional clarification was provided by the Applicant shortly before the deadline for submission of proofs of evidence. Bernicia Group's initial evidence expressly reserved its position in respect of that further material, not having had time to address it properly by the proof deadline. This rebuttal revisits and updates the position set out in my proof of evidence in the light of that later information.

1.3 Bernicia Group's main concerns remain largely unaltered in light of the recent information provided by the Applicant.

1.4 If the Applicant were to now produce rebuttal noise evidence in response to my proof of evidence, which I understand may well be the case, such evidence would comprise new as opposed to rebuttal evidence. I reserve the right, with the leave of the Inspector, to respond to any such new noise evidence.

1.5 My evidence, as a whole, examines the technical impacts of the proposals, how the impacts compare to guidance, and the extent to which noise mitigation can be achieved.

1.6 Some noise mitigation requires windows to remain closed which has other impacts on the amenity of residents. I have been made aware that residents like to have windows open. I attach a schedule of photographs (Appendix H) that was taken by Liz McLoughlin of Sanderson Weatherall LLP on a site visit on 24th June 2021 and by Jeff Boyd of Bernicia on 28th October 2021 which shows the extent to which windows were open on that day. My evidence, however, does not deal with such impacts although they plainly are relevant to whether the noise and consequent amenity impacts are acceptable overall. That is a judgment for Bernicia Group in the first place and, ultimately, for the decision-maker.

1.7 The Applicant has offered Bernicia Group some assurances. However, these are in large part by way of pointing to proposed planning conditions in relation to the Bedlington Station planning permission which as drafted require schemes for noise mitigation to be submitted and approved. The draft planning conditions do not provide adequate assurance in that they provide no clarity as to the levels of noise to be achieved. They effectively defer the identification of an acceptable level of noise until a later date and after the grant of planning permission. That is not appropriate, especially where, as here, the residents are vulnerable.

1.8 Without the clarity of identified noise limits, Bernicia Group has to continue to object to protect their residents and properties.

1.9 No works are currently proposed to Sleekburn House as part of the planning application submitted for Bedlington Station. Sleekburn House is not owned by or controlled by applicant. It will be essential that any conditions do not allow the development to go ahead until any necessary mitigation works to Sleekburn House; are in place.

2 Summary of Proof of Evidence dated 12th October 2021

2.1 My main Proof of Evidence noted the following main issues:

1. **Public Address system**: I concluded that the assessment of the potential noise impact from the Public Address system was inadequate and inappropriate. Based on the current proposals and predicted noise levels there is a high risk of a significant adverse impact on the residents of Sleekburn House. No quantitative evidence is presented to demonstrate the measures are sufficiently robust to avoid an adverse impact on the residents of Sleekburn House.
2. **Noise from additional train movements**: The predicted increase in noise levels due to train movements is likely to result in residents of Sleekburn House having to keep windows closed to mitigate against the noise impact. This has ramifications to both the ventilation strategy and the loss of amenity to residents who can currently enjoy a connection to the outside world via an open window. No information is provided on the proposed ventilation treatment measures, or quantitative assessment to demonstrate the proposed ventilation treatment is sufficiently robust to avoid an adverse impact on the residents of Sleekburn House.
3. **Construction noise**: No quantitative assessment has been presented for the potential noise impact from construction activities, which are understood to include night-time operations. Hence, it is not possible to properly understand if or what mitigation measures are required.

3 Additional information

3.1 The following additional information pertinent to potential noise impacts has been received:

- Northumberland County Council Memo, Ref: SRU150709, dated 27th September 2021 (updated 18th October 2021), Planning Ref: 21/01106/CCD, downloaded from NCC planning Portal 20th October 2021.
- Drawing 60601435-ACM-06-PL-DRG-ECV-000004 Rev P02, Bedlington Existing and Proposed Platform Sections Sheet 1 of 2, AECOM received 8th October 2021 from Pinsent Masons.
- Drawing 60601435-ACM-06-ZZ-SKT-LEP-000001, Rev P01.2, Sleekburn House Bedlington Revised Land Holding, AECOM, received 21st October from Pinsent Masons.

- Bedlington Station Noise Impact Assessment Sensitivity Test, Ref: 60628487, AECOM, dated 15th October 2021, received 15th October 2021 from Pinsent Masons.
- Bernicia – letter of assurances, received 21st October 2021 from Pinsent Masons.

4 Guidance and proposed assessment criteria

4.1 Noise impact can be assessed in a variety of ways, using different noise level metrics, depending on the context of the assessment.

4.2 The main noise level metrics typically used in environmental noise assessments are:

- $L_{Aeq,T}$ – the equivalent continuous A-weighted[1] sound pressure level, over a time period, T. This is an average of the sound level over a defined period of time. A fluctuating noise level over the defined time period would have the same $L_{Aeq,T}$ as a steady continuous noise at the same level. Some standards (i.e. BS 8233, as discussed below) define the daytime and night-time periods as 07:00 hours to 23:00 hours and 23:00 hours to 07:00 hours respectively. The daytime and night-time periods are 16 hours and 8 hours long respectively, and the sound level over these periods would then be denoted as xx dB $L_{Aeq,16hrs}$ (daytime) and xx dB $L_{Aeq,8hrs}$ (night-time). Shorter time periods may be used where appropriate for assessing a particular noise. For example, if the context of an assessment includes a very short term significant noise event which lasted for 1 minute, once over the defined night-time period, the $L_{Aeq,8hrs}$ would average this event out over the entire 8 hour period and would result in a relatively low dB value. Where a shorter reference time period is used (e.g. 15 minutes with 1 no. 1 minute noise event), the $L_{Aeq,15min}$ dB value would be significantly greater.
- L_{AFmax} – the A-weighted maximum fast-weighted sound level. This is used to measure the peak magnitude of a noise event, and is a particularly useful metric when assessing short-term noise events. The A-weighting is a frequency correction to mimic the response of human hearing. The fast weighting refers to the time response of the sound level meter.

4.3 I note that there is no direct relation or correlation between the $L_{Aeq,T}$ and L_{AFmax} metrics.

[1] A-weighting of noise levels is an adjustment of the levels at different frequencies intended to mimic the response of human hearing. Human hearing does not respond equally to noise events of the same energy at different frequencies, e.g. we do not perceive low frequency ("bass") noise the same as mid-frequency (e.g. human voice) even when the acoustic energy is equal.

4.4 **BS 8233:2014: Guidance on sound insulation and noise reduction for buildings (Appendix L)**

4.5 Table 4 of BS 8233 gives guideline internal noise level limits for dwellings.

4.6 Table 4 is shown below for ease of reference:

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	—
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	—
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

4.7 Above Table 4, BS 8233 states that the limits given apply to noise sources "*without a specific character*" and adds "*Noise has a specific character if it contains features such as a distinguishable and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.*".

4.8 Note 2 to Table 4 in BS 8233 also notes that shorter time periods may be used where noise sources or conditions do not follow typical diurnal patterns.

4.9 Note 4 to Table 4 of BS 8233 states "*Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night.*". I note that the descriptor $L_{Amax,F}$ is the same as L_{AFmax} which I described above.

4.10 **World Health Organisation Guidelines for Community Noise (Appendix P)**

4.11 The World Health Organisation (WHO) Guidelines for Community Noise is a review of international research and guidance on the effects of noise sources including transportation (road, rail and aircraft), industry, construction and the neighbourhood, on people in the community.

4.12 An excerpt from Table 1 of WHO which gives guideline noise level limits for various situations is shown below:

Specific environment	Critical health effect(s)	L_{Aeq} [dB(A)]	Time base [hours]	L_{Amax} fast [dB]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16	
Inside bedrooms	Sleep disturbance, night-time	30	8	45

4.13 The daytime and night-time $L_{Aeq,16hr}$ and $L_{Aeq,8hr}$ (respectively) levels given in WHO are the same as those in BS 8233 for noise sources without specific characteristics.

4.14 The WHO guidelines do not provide any guidance or methodology for instances where noise has specific characteristics.

4.15 WHO also states that noise levels greater than 45 dB L_{AFmax} cause sleep disturbance.

4.16 **BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise**

4.17 BS 5228 is referenced in the AECOM noise impact assessment report and is a standard that amongst other things, provides guidance on noise limits from construction activities (which are dependent on the pre-existing noise levels during the daytime and night-time) and provides example guidance on when noise insulation might be provided to affected noise sensitive properties and when temporary rehousing may be offered.

4.18 The AECOM noise impact refers to BS 5228 and acknowledges that as a details programme of construction works is not available at the time of writing, an assessment of predicted noise levels from construction works is not undertaken.

4.19 I am satisfied that the AECOM noise impact assessment determines suitable construction noise threshold levels with reference to the methodology of BS 5228.

4.20 These construction threshold noise limits are as follows:

- 65 dB L_{Aeq} 07:00 hrs to 19:00 hrs Monday to Friday
- 65 dB L_{Aeq} 07:00 hrs to 13:00 hrs Saturdays
- 55 dB L_{Aeq} 19:00 hrs to 23:00 hrs Monday to Friday
- 55 dB L_{Aeq} 13:00 hrs to 23:00 hrs Saturdays
- 55 dB L_{Aeq} 07:00 hrs to 23:00 hrs Sundays
- 50 dB L_{Aeq} at all other times, i.e. including the night-time

4.21 BS 5228 states that where the site (construction) noise exceeds the threshold values, then a significant effect is indicated.

4.22 An excerpt from Section 8.4 of BS 5228 regarding the requirement for noise monitoring is shown in Figure 1 below.

Monitoring of noise at sites where noise is an issue should be regarded as essential. Measurement may be carried out for a number of reasons, including the following:

a) to allow the performance of noise control measures to be assessed;

b) to ascertain noise from items of plant for planning purposes;

c) to provide confirmation that planning requirements have been complied with.

Monitoring positions should reflect the purpose for which monitoring is carried out.

Monitoring to ascertain whether an item of plant or particular process is meeting an anticipated noise criterion or if noise control methods are working, might require measurements to be carried out close to the plant or process to avoid undue interference from other noise sources.

Monitoring to confirm that planning conditions imposed to protect local occupants have been met may be undertaken at NSPs or at the site boundary, with a correction applied. The choice of noise measurement locations to be included in the planning conditions should reflect the requirement to accurately assess the noise.

Monitoring is the responsibility of the site operator and should be carried out by suitably trained personnel.

Figure 1: Excerpt from BS 5228

4.23 Section E.4 of BS 5228 determines trigger noise levels for which noise insulation measures should be offered when exceeded; an excerpt from BS 5228 indicating the noise levels and associated time periods is shown in Figure 2.

Time	Relevant time period	Averaging time, *T*	Noise insulation trigger level dB $L_{Aeq,T}$ [A)]
Monday to Friday	07.00 – 08.00	1 h	70
	08.00 – 18.00	10 h	75
	18.00 – 19.00	1 h	70
	19.00 – 22.00	3 h	65
	22.00 – 07.00	1 h	55
Saturday	07.00 – 08.00	1 h	70
	08.00 – 13.00	5 h	75
	13.00 – 14.00	1 h	70
	14.00 – 22.00	3 h	65
	22.00 – 07.00	1 h	55
Sunday and Public Holidays	07.00 – 21.00	1 h	65
	21.00 – 07.00	1 h	55

[A)] All noise levels are predicted or measured at a point 1 m in front of the most exposed of any windows and doors in any façade of any eligible dwelling.

Figure 2: Noise insulation trigger levels from BS 5228

4.24 Noise insulation should be offered when the noise insulation trigger levels are exceeded for:

- a period of 10 or more days of working in any 15 consecutive days, or
- a total number of days exceeding 40 in any 6 consecutive months

4.25 With regards to temporary rehousing, BS 5228 states that this (or the reasonable costs thereof) will be offered when construction noise:

- exceeds the noise insulation trigger levels by 10 dB, or
- is 10 dB greater than the pre-construction ambient noise level for the corresponding times of the day

and for:

- a period of 10 or more days of working in any 15 consecutive days, or
- a total number of days exceeding 40 in any 6 consecutive months

4.26 As BS 5228 assessment has not been undertaken, there is no way of understanding whether the threshold values are likely to be exceeded, and whether noise insulation (including ventilation) or temporary re-housing is required.

4.27 Any Planning Conditions must define time limits and threshold values, and require noise monitoring during all night-time works to determine whether the threshold values are being exceeded in practice.

4.28 **Noise surveys**

4.29 My colleagues have carried out noise level measurements at Sleekburn House both within rooms and externally.

4.30 The initial surveys included internal noise level measurements over a period of 3 days within the first floor guest room overlooking the rail line with the window open; the survey methodology and results are detailed in my main Proof of Evidence.

4.31 Further internal noise level measurements have been made over a circa. 24 hour period within the first floor guest room with the window closed and trickle vent open.

4.32 The survey methodology and results are detailed in Appendix Q.

4.33 Table 1 shows the minimum $L_{Aeq,1hr}$ within the room with windows open and closed during the daytime and night-time periods.

Period	Minimum measured level	
	Windows closed	Windows open
Daytime	23 dB $L_{Aeq,1hr}$	33 dB $L_{Aeq,1hr}$
Night-time	21 dB $L_{Aeq,1hr}$	26 dB $L_{Aeq,1hr}$

Table 1: Summary of minimum measured internal noise levels

4.34 The 1 hour $L_{Aeq,T}$ levels have been determined during both the daytime and night-time periods, as I consider that assessing the impact of the short-term PA noise events against the 16 hour daytime or 8 hour night-time $L_{Aeq,T}$ to result in an unrepresentative assessment.

4.35 The significance of the PA noise impact will be dependent on the ambient noise level at the time. As this varies throughout the course of the daytime and night-time, any assessment of the PA impact, given the character of the noise and how distinctive the announcements are against the existing noise environment which is a result of road and rail traffic, should be assessed to the minimum level, as there is the future potential for an increase in passenger trains and PA announcements at any time.

4.36 **Proposed internal noise level limits**

4.37 The noise impact from passenger trains is assessed in the AECOM noise impact assessment. The daytime $L_{Aeq,16hrs}$ is predicted to increase by 4 dB immediately outside of the ground floor windows; this is assessed as a "Medium" impact according to the guidance referenced in the AECOM report.

4.38 No assessment has been undertaken to show the potential impact from the peak or maximum noise events associated with the passenger train movements.

4.39 As discussed above, the L_{AFmax} metric is suitable for assessing the likelihood of sleep disturbance, and is considered the relevant metric by the Northumberland County Council Environmental Protection officer, as discussed in detail below.

4.40 The residents of Sleekburn House are typically elderly, over half have care packages, and it is not untypical for them rarely to leave their accommodation.

4.41 I understand that they may often rest during the daytime period and as such should be protected from the significant intensification of noise events associated with the passenger trains.

4.42 Hence, to afford protection to the residents of Sleekburn House I propose that the noise levels from passenger trains should not exceed 45 dB L_{AFmax} within their rooms, so they may continue to rest during the daytime period.

4.43 Although I note that the freight train movements currently exceed 45 dB L_{AFmax} within rooms, this occurs between 6 and 7 times during the daytime period, the current

proposal includes a further 60 passenger trains during the daytime period (i.e. about 10 times the amount), significantly reducing the period of time between trains when residents may enjoy peaceful rest without significant disturbance.

4.44 I believe that the noise from announcements via the PA has the potential to cause a significant adverse impact on the residents.

4.45 The announcements have a specific character and are readily distinctive against the existing noise environment.

4.46 In the AECOM noise impact assessment, noise from the announcements via the PA are predicted as an averaged level across the defined daytime period (16 hours between 07:00 hours and 23:00 hours).

4.47 This methodology fails to take into account the actual noise level of the announcements as they are occurring.

4.48 As the announcements a relatively short-term events, I consider that assessing them over a 10 second period is reasonable to capture the potential duration of such an event as it is occurring.

4.49 To reduce the risk of causing significant disturbance to residents of Sleekburn House, I consider that the announcement noise level, defined as $L_{Aeq,10sec}$ should be no greater than the existing internal noise level, defined as $L_{Aeq,1hr}$, during the daytime period, and no greater than a level 5 dB below the existing internal ambient noise level during the night-time period.

4.50 Based on the guidance above, the noise limits set out in Table 2 below would be appropriate to protect the amenity and health of the residents of Sleekburn House.

4.51 Ideally, these internal noise levels should be achieved with open windows, allowing the residents, some of whom rarely leave the care home, a connection with the outside world.

4.52 Open windows are also used for purge ventilation which is defined in Approved Document F of the Building Regulations as “ventilation of rooms at a relatively high rate to rapidly dilute pollutants and/or water vapour.” I understand that some residents regularly open windows while drying clothes in their rooms.

4.53 Approved Document F defines the purge ventilation rate as 4 no. air changes per hour.

4.54 Open windows are also used to control overheating during hotter summer months. Overheating is a significant risk for elderly residents such as those at Sleekburn House.

4.55 Based on the orientation of the building, and its geographical location, I consider it likely that the ventilation rate of 4 no. air changes per hour is also likely to be suitable

for controlling overheating, although this cannot be definitively determined without conducting an overheating assessment.

4.56 As there are no further forms of noise mitigation available (an acoustic barrier is already proposed, the proposal does not offer the opportunity to put the line / station in a cutting), mitigation via closed windows with other means of ventilation is considered to be the only practicable option where the internal noise level limits cannot be achieved with open windows.

Noise source	**Proposed noise level limit(s)**	**Notes**
Passenger trains – daytime	Internally within rooms: 35 dB $L_{Aeq,16hrs}$ 45 dB L_{AFmax}	The $L_{Aeq,16\ hrs}$ value is as per BS 8233 and WHO. I understand that the residents of Sleekburn House are typically elderly and may often rest and sleep during the daytime period. In these circumstances, my view is that the L_{AFmax} limit is appropriate. Both the $L_{Aeq,T}$ and L_{AFmax} values should be applicable
Passenger trains – night-time	Internally within rooms: 30 dB $L_{Aeq,8hrs}$ 45 dB L_{AFmax}	The $L_{Aeq,8\ hrs}$ value is as per BS 8233 and WHO. The L_{AFmax} value is as per WHO. Both the $L_{Aeq,T}$ and L_{AFmax} values should be applicable.
PA System – daytime	Where windows are open, externally outside the window: 47 dB $L_{Aeq,10sec}$ Where windows are required to be closed, internally within rooms: 23 dB $L_{Aeq,10sec}$	Announcements through the PA system have a distinctive character – they are intended to be noticed and audible. Spoken word noise source is entirely different and distinguishable from the existing sound environment, and should be assessed accordingly. Hence, I propose that the noise from announcements *as they are occurring* should be:

Noise source	Proposed noise level limit(s)	Notes
PA System – night-time	Where windows are open, externally outside the window: 35 dB $L_{Aeq,10sec}$ Where windows are required to be closed, internally within rooms: 16 dB $L_{Aeq,10sec}$	1. Less than the guideline values given in BS 8233, as per the guidance of BS 8233 for noise sources with specific character, and 2. no greater than the existing internal noise levels experienced in rooms at Sleekburn House during the daytime, and 5 dB lower during the night-time A reference time period of 10 seconds is proposed to capture the impact of the PA announcements as they are occurring.
Construction noise – daytime	65 dB $L_{Aeq,12hrs}$ 07:00 hrs to 19:00 hrs Monday to Friday 65 dB $L_{Aeq,6hrs}$ 07:00 hrs to 13:00 hrs Saturdays 55 dB $L_{Aeq,4hrs}$ 19:00 hrs to 23:00 hrs Monday to Friday 55 dB $L_{Aeq,10hrs}$ 13:00 hrs to 23:00 hrs Saturdays 55 dB $L_{Aeq,16\ hrs}$ 07:00 hrs to 23:00 hrs Sundays	Proposed construction noise limits are as per the AECOM noise impact assessment. The requirement for noise insulation measures or temporary re-housing shall be assessed according to the criteria of section E.4 of BS 5228. A noise impact assessment following the guidance of BS 5228 should be completed and form part of the Construction Noise Management Plan to predict the likely noise levels and durations affecting Sleekburn House. Noise monitoring shall be carried out during the construction works to show compliance with the limits and noise insulation trigger levels.
Construction noise – night-time	50 dB $L_{Aeq,8hrs}$	

Table 2: Proposed noise level criteria

5 NCC Environmental Protection Officer memo (Appendix J)

5.1 The consultee response memo from Gary Park, Environmental Protection Officer at Northumberland County Council to Gordon Halliday, Consultant Planner at Northumberland County Council, initially dated 27th September 2021 was updated on 18th October 2021.

5.2 The memo is the consultee response to the noise assessment (amongst other submitted information) issued to the Planning Case Officer and describes their review of the AECOM noise assessment and the noise impact on residents potentially affected by noise from Bedlington Station and the activities and operations associated with this i.e. construction, trains, PA system and vehicles using the car park.

5.3 The memo includes recommendation for planning conditions associated with (amongst other things) noise impact from the proposed station.

5.4 The purpose of the memo is to inform the Northumberland County Council Planning Officer of noise issues, risks and recommendations in areas beyond the Planning Officer's area of expertise.

5.5 The main points and text from this memo are referenced and repeated in the Northumberland County Council Strategic Planning Committee report dated 2nd November 2021 (Appendix P).

5.6 **Noise from proposed passenger trains**

5.7 The memo summarises some of the main points regarding the predicted daytime noise levels averaged over the 16 hour daytime period ($L_{Aeq,16hrs}$) and notes that the 57 dB $L_{Aeq,16hrs}$ noise level calculated to be incident on the first floor windows at Sleekburn House with the mitigation afforded by the acoustic barrier is 4 dB greater than the existing measured daytime level.

5.8 According to the guidance referenced in the AECOM report, this results in a "Medium" impact, although no further qualitative description is given as to what the effects or ramifications of a "Medium" impact might be.

5.9 The memo notes that the AECOM assessment does not present any noise impact for the first floor receptors or show the impact from L_{AFmax} events.

5.10 L_{AFmax} levels are typically limited when new homes are proposed near to noise sources, as they are understood to be a good metric for assessing the likelihood for sleep disturbance above researched threshold levels.

5.11 Hence, as the L_{AFmax} limit given in the WHO guidance is with reference to sleep disturbance, I consider it appropriate to use this assessment methodology in this case.

5.12 The memo notes that "*the acoustician has used library data for similar rail traffic in similar situations to inform the prediction of noise levels at the first floor of Sleekburn House.*"

5.13 No prediction, assessment, or reporting, of L_{AFmax} levels are given in the AECOM reports; hence, I do not understand where the information in the memo has come from, nor the validity of the library data from where it is described to have been sources from.

5.14 The memo reports that the external L_{AFmax} levels incident on Sleekburn House and the predicted internal levels with both open and closed windows based on the assumed reductions in noise level of 15 dB and 30 dB respectively. The noise levels reported in the memo are shown in Table 3 below for ease of reference.

Floor	**Predicted external level**	**Predicted Internal levels**	
		Closed windows	**Open windows**
Ground	63 dB L_{AFmax}	33 dB L_{AFmax}	48 dB L_{AFmax}
First	71 dB L_{AFmax}	41 dB L_{AFmax}	56 dB L_{AFmax}

Table 3: Predicted L_{AFmax} noise levels as per the NCC Environmental Protection Officer Memo

5.15 As per my main Proof of Evidence, the sound reduction through an open window at Sleekburn House has been tested to be 11 dB for free field noise incident on a first floor window and 13 dB for a ground floor window.

5.16 Hence, based on the predicted external L_{AFmax} levels shown above, the internal levels with an open window would be 60 dB L_{AFmax} in a first floor room and 50 dB L_{AFmax} in a ground floor room; these levels are significantly greater than the 45 dB L_{AFmax} guidance limit from WHO above which sleep disturbance occurs.

5.17 I note that based on the noise level measurements that Apex Acoustics have undertaken, that the freight train movements currently result in the proposed L_{AFmax} limit of 45 dB being exceeded.

5.18 However, these freight train movements occur relatively infrequently (e.g. up to 7 trains during the daytime, and up to 2 during the night-time), the proposed introduction of passenger trains either moving along the line or stopping at and leaving the station I consider to be a significant intensification of noise events.

5.19 The memo states that "*Sleekburn House is a "care home" (in a general description) and within BS 8233 there is a relaxation for these alongwith hotels etc., which gives an internal night-time noise limit of 35 dB LAeq.*".

5.20 There is no reference to a relaxation of the internal noise level guidance in BS 8233 for care homes.

5.21 Although BS 8233 gives a range of internal noise levels for hotel rooms which are deemed suitable by hotel operators, the upper value for night-time noise levels given is 35 dB $L_{Aeq,1hr}$ (i.e. the average noise level during any 1 hour period of the night-time), it is not stated or implied in the standard that this level is acceptable for care homes or other types of rooms for residential purposes.

5.22 The memo notes that the applicant is intending to install trickle vents to the rooms at Sleekburn House which with closed windows will allow internal L_{AFmax} levels to be below the limit of 45 dB suggested in the WHO guidance.

5.23 The AECOM assessment does not state that trickle vents may be installed at Sleekburn House, but that alternate means of ventilation may be provided where windows are required to be kept closed whilst achieving internal noise level limits. The ramifications of this are discussed further in Section 7 below.

5.24 I would note that in the experience of Apex Acoustics, NCC typically require internal noise level limits to be achieved with windows open for residential properties (see examples in Appendix K).

5.25 As noted above the residents of Sleekburn House are typically elderly and spend much of the daytime in their rooms.

5.26 Hence, to afford protection to the residents of Sleekburn House I propose that the noise levels from passenger trains should not exceed 45 dB L_{AFmax} within their rooms, so they may continue to rest during the daytime period.

5.27 Although I note that the freight train movements currently exceed 45 dB L_{AFmax} within rooms, this occurs between 6 and 7 times during the daytime period, the current proposal includes a further 60 passenger trains during the daytime, significantly reducing the period of time between trains when residents may enjoy peaceful rest without significant disturbance.

5.28 **Public Address system**

5.29 Appropriate noise level limits within apartments at Sleekburn House for the PA are set out in Section 4 above; these are shown in Table 4 below for ease of reference.

Noise source	Proposed noise level limit(s)	Notes
PA System – daytime	Where windows are open, externally outside the window: 47 dB $L_{Aeq,10sec}$ Where windows are required to be closed, internally within rooms: 23 dB $L_{Aeq,10sec}$	Announcements through the PA system have a distinctive character – they are intended to be noticed and audible. Spoken word noise source is entirely different and distinguishable from the existing sound environment, and should be assessed accordingly. Hence, I propose that the noise from announcements *as they are occurring* should be: 1. Less than the guideline values given in BS 8233, as per the guidance of BS 8233 for noise sources with specific character, and 2. no greater than the existing internal noise levels experienced in rooms at Sleekburn House during the daytime, and 5 dB lower during the night-time A reference time period of 10 seconds is proposed to capture the impact of the PA announcements as they are occurring.
PA System – night-time	Where windows are open, externally outside the window: 35 dB $L_{Aeq,10sec}$ Where windows are required to be closed, internally within rooms: 16 dB $L_{Aeq,10sec}$	

Table 4: PA system proposed noise level limits

5.30 The memo states that *"the noise impact is expected to be 45 dB LAeq at the receptors on three of the receptors, significantly below the existing ambient noise level of 53 dB LAeq during the day, even at night this would meet the internal limit in BS 8233 of 30 dB LAeq (accounting for 15 dB of attenuation through an open windows) and below the existing background level at night of 48 dB LAeq."*

5.31 I note that in the AECOM report the PA system noise level, averaged over the 16 hour daytime period, is predicted to be 46 dB $L_{Aeq,16hrs}$ at Sleekburn House.

5.32 Where relatively short term noise events such as the PA announcements are averaged over a significantly greater time period (i.e. 16 hours), the resultant noise level value is significantly lower than the actual absolute noise level during the short-term PA announcement event.

5.33 The actual noise level from announcements through the PA system as they are occurring is predicted to be 10dB greater, therefore 56 dB $L_{Aeq,T}$, at first floor level of Sleekburn House (see main Proof of Evidence, para. 5.17), the AECOM assessment assumes a 5 dB reduction for the PA noise due to the proposed 3.5 m acoustic barrier.

5.34 As determined in my original Proof of Evidence, the measured attenuation through an open window at Sleekburn House is approximately 11 dB, resulting in an internal noise level of 45 dB $L_{Aeq,T}$.

5.35 The above statement from the memo notes that the night-time noise level limit in a bedroom from BS 8233 is 30 dB $L_{Aeq,8hrs}$; I note that the daytime limit in a living room or bedroom is given as 35 dB $L_{Aeq,16hrs}$ in BS 8233.

5.36 However, BS 8233 states that the limits given apply to noise sources "*without a specific character*" and adds "*Noise has a specific character if it contains features such as a distinguishable and continuous tone, is irregular enough to attract attention, or has strong low-frequency content., in which case lower noise limits might be appropriate.*"

5.37 I consider that noise from announcements through the PA system have a specific character in accordance with this guidance.

5.38 Note 2 to Table 4 (which defines the dwelling guideline internal noise level limits) in BS 8233 also notes that shorter time periods may be used where noise sources or conditions do not follow typical diurnal patterns.

5.39 Hence, based on the guidance from BS 8233 above, I consider it entirely reasonable to assess the PA announcement noise against lower limits than those given in Table 4 of BS 8233, and to use a shorter time period.

5.40 I would recommend that to avoid a significant adverse impact on the residents at Sleekburn House, the internal noise level limit from announcements through the PA system should be:

- below those given in Table 4 of BS 8233, and
- no greater than any pre-existing $L_{Aeq,1hr}$ within the bedrooms or living spaces during the daytime, and
- at least 5 dB below any pre-existing $L_{Aeq,1hr}$ within the bedrooms during the night-time

5.41 Based on the measured internal noise levels with open and closed windows, and the points discussed above, this would result in the limits shown in Table 4.

5.42 To achieve this, windows may be required to be closed and other means of ventilation provided, including the means to achieve purge ventilation and ventilation to control overheating during summer months.

5.43 Approved Document F states that purge ventilation requires 4 no. air changes per hour.

5.44 This can only be achieved by mechanical means whilst keeping windows closed and maintaining the acoustic requirements.

5.45 If the windows are required to be closed to achieve the internal noise level limits, as well as an alternative ventilation provision, the existing glazing may need to be replaced with a higher sound reduction performance glazing.

5.46 An assessment should be undertaken to determine whether the existing glazing will provide the required attenuation.

5.47 **Construction noise**

5.48 The memo notes that noisy construction works should be undertaken during the day and not during the evening or night.

5.49 This is not reflected in the main AECOM assessment which indicates that construction will take place throughout a 79 hour period from Thursdays at 22:00 hours through to Mondays at 05:00 hours over a period between October 2022 to February 2023.

5.50 This equates to construction works being undertaken during the course of every Thursday, Friday and Saturday night for a period of 5 months.

5.51 There is no quantitative assessment of construction noise, hence any potential mitigating measures or impact cannot be commented upon.

6 Bedlington Station Noise Impact Assessment Sensitivity Test, AECOM

6.1 AECOM issued the Bedlington Station Noise Impact Assessment Sensitivity Test document (Sensitivity Test) on 15th October 2021, after the submission of proofs of evidence for the inquiry.

6.2 The Sensitivity Test reviews the mapping data used in the main AECOM assessment, Appendix A, as reviewed in my main Proof of Evidence and identifies the discrepancies between different datasets used to determine the location of Sleekburn House and the proposed noise barrier relative to each other, and relative to the proposed Bedlington Station, incorporating the rail lines.

6.3 The Sensitivity test confirms that there is no material difference in the predicted noise impact from passenger trains whether the Ordnance Survey or drone mapping data is used in the noise impact calculations.

6.4 I am in agreement with this conclusion.

6.5 **Noise from proposed passenger trains**

6.6 Table 1 of the Sensitivity Test indicates that there is only a marginal difference in predicted noise levels due to passenger train movements at the first floor level of Sleekburn House than reported in the main AECOM assessment.

6.7 I understand that the main AECOM noise assessment gives predicted noise level results for a single receiver at Sleekburn House, whilst Table 1 of the Sensitivity Test gives predicted noise level values for 7 no. receiver positions along the façade of Sleekburn House. It is not understood which of those 7 no. position relates to the single point considered in the main AECOM assessment.

6.8 Table 1 of the Sensitivity Test shows that the difference in predicted noise levels due to the final mapping datasets and those used in the main AECOM assessment are relatively minor (between 0.1 dB and 1.1 dB difference).

6.9 **Noise from Public Address**

6.10 The predicted noise levels from announcements via the PA system shown in Table 2 of the Sensitivity test are averaged over the 16 hour daytime period.

6.11 As discussed above and in my Proof of Evidence, I do not consider this to be an appropriate assessment methodology as it has the potential to significantly under-estimate the significance of the noise impact on the residents of Sleekburn House.

7 Potential mitigation

7.1 **Train noise**

7.2 Based on the documents reviewed above, and my Proof of Evidence, to achieve appropriate internal noise levels for identified train noise sources may necessitate the use of closed windows]

7.3 However, potentially, in order to achieve the above proposed passenger train internal noise level would additionally require the existing glazing to be replaced with a glazing system with a higher sound reduction performance.

7.4 Where windows are required to be closed to achieve the internal noise levels, an alternative means of ventilation is required, as discussed and defined above.

7.5 **PA noise**

7.6 Noise impact from the PA to achieve the proposed limits may be achieved by a combination of the following:

- placement of the PA loudspeakers, in terms of both height and distance from Sleekburn House
- orientation and directivity of the loudspeakers
- sound level output of the of the loudspeakers

7.7 Where the above mitigation is unable to achieve the proposed criteria with open windows, the existing glazing at Sleekburn house should be assessed to ascertain

whether the sound reduction via this element is capable of achieving the proposed internal noise levels in combination with an alternative ventilation system.

7.8 Where the sound reduction of the existing glazing is considered insufficient, the glazing should be replaced with a higher sound reduction performing system capable of achieving the required internal noise levels.

7.9 Trickle vents are not an appropriate method of achieving the ventilation rates required to control overheating or to provide purge ventilation.

7.10 A mechanical ventilation system would need to be to be implemented which is not only attenuated to mitigate the external noise sources, but also designed and attenuated such that noise from the ventilation system itself does not cause disturbance to residents.

7.11 Any such ventilation system should meet the ventilation rates and noise levels defined above.

7.12 **Construction noise**

7.13 As no quantitative assessment of construction noise has been presented, potential mitigation measures cannot be assessed for suitability.

7.14 The lack of quantitative assessment of construction noise impact on sensitive receptors is considered a material omission.

8 Proposed Planning Conditions

8.1 **Letter of Assurances**

8.2 The Draft Letter of Assurances (Appendix R) proposed planning conditions, some of which are pertinent to protecting residents of Sleekburn House from an adverse noise impact.

8.3 Proposed Planning Condition nos. 4 and 20 both require an assessment of construction noise and vibration.

8.4 I would note that as Condition 4 includes a requirement for an assessment of construction noise and vibration, Condition 20 is not necessary.

8.5 Proposed Planning Condition 21 states:

"*The development shall not be brought into use until a scheme for the mitigation of rail noise at Sleekburn House has been submitted to and approved in writing by the Local Planning Authority. The approved noise mitigation scheme shall be implemented in accordance with the approved details before the development is brought into use.*"

8.6 The Condition refers only to rail noise and does not include or refer to noise from announcements via the PA system.

8.7 **Northumberland County Council Strategic Planning Committee**

8.8 The Strategic Planning Committee report (Appendix P) has a number of Planning Conditions which relate to noise impact from the proposed station, and the construction thereof.

8.9 Planning Condition 4 repeats that given in Condition 4 of the Draft Letter of Assurance and includes the requirement for an assessment of construction noise management plan.

8.10 Planning Condition 28 requires details of the tannoy (Public Address) system to be submitted, including details of how noise impact will be minimised.

8.11 Planning Condition 29 requires details of the acoustic barrier to be submitted.

8.12 Planning condition 30 repeats the requirements of Condition 20 of the Draft Letter of Assurance and requires a construction noise management plan to be submitted.

8.13 Planning Condition 31 requires details of a scheme for mitigation of rail noise affecting Sleekburn House to be submitted.

8.14 None of the proposed Planning Conditions quantify noise level limits to be achieved to avoid an adverse, or significant adverse, impact on the residents of Sleekburn House, to satisfy Northumberland County Council, Bernicia, or the existing and future residents.

8.15 Therefore I consider that the Planning Conditions don't give sufficient detail to achieve their objective.

8.16 Based on my discussion above, I would recommend that Planning Conditions be included, or the existing Conditions revised, which limits noise from the identified noise sources to those proposed in Table 2. Ward Hadaway wrote to Northumberland County Council in advance of the Strategic Planning Committee on 2 November 2021 (see Appendix S) requesting that the below conditions be applied but I understand that on the advice of officers the Committee declined to do so.

8.17 Such conditions could be worded as follows:

Condition A

No development shall take place, including any works of demolition, until a Noise Attenuation Management Plan, including a post-implementation monitoring plan, has been submitted to, and approved in writing by the local planning authority.

The Noise Attenuation Management Plan shall meet the following criteria:

(a) The level of noise emitted from the announcements or alerts via a Public Address system (or other) on the site shall not (except in the case of emergency) exceed a level of 47 dB $L_{Aeq,10sec}$ between 0700 and 2300

Monday to Sunday, and a level of 35 dB $L_{Aeq,10sec}$ at any other time, as measured at a distance of 1 m from any first floor window of Sleekburn House; or, if it has been demonstrate to the satisfaction of the Local Planning Authority that the Open Window Scenario cannot be achieved;

(b) The level of noise emitted from announcements or alerts via a Public Address system (or other) on the site shall not (except in the case of emergency) exceed a level of 23 dB $L_{Aeq,10sec}$ between 0700 and 2300 Monday to Sunday and a level of 16 dB $L_{Aeq,10sec}$ at any other time, as measured within any first floor room of Sleekburn House with windows closed and an alternative attenuated means of ventilation provided. The alternative ventilation must be capable of achieving a ventilation rate of not less than 4 air changes per hour whilst not exceeding a noise level of 30 dB $L_{Aeq,1hr}$, and not exceeding a noise level of 25 dB $L_{Aeq,1hr}$ when providing ventilation at the minimum whole dwelling rates as defined in AD-F. Ventilation and announcement noise levels should be measured in accordance with the most recent revision of the Association of Noise Consultants Measurement of Sound Levels in Buildings, or its successor.

Noise levels from passenger trains should not exceed a level of 45 dB L_{AFmax} at any time within any first floor room of Sleekburn House. Where this requires windows to be closed, an alternative means of ventilation must be provided which meets the specifications and criteria outlined above.

The development shall not be brought into use until all measures required by the approved Noise Attenuation Management Plan have been installed and become fully operational.

The measures required by the approved Noise Attenuation Management Plan shall thereafter be maintained and monitored.

Condition B

Construction work, including demolition, shall not take place until a scheme for protecting Sleekburn House from noise from the construction work shall have been submitted to and approved in writing by the local planning authority.

The level of construction noise emitted from the site shall not exceed:

- 65 dB $L_{Aeq,12hrs}$ 07:00 hrs to 19:00 hrs Monday to Friday
- 65 dB $L_{Aeq,6hrs}$ 07:00 hrs to 13:00 hrs Saturdays
- 55 dB $L_{Aeq,4hrs}$ 19:00 hrs to 23:00 hrs Monday to Friday
- 55 dB $L_{Aeq,10hrs}$ 13:00 hrs to 23:00 hrs Saturdays

- 55 dB $L_{Aeq,16hrs}$ 07:00 hrs to 23:00 hrs Sundays
- 50 dB $L_{Aeq,8hrs}$ at all other times, i.e. including the night-time

as measured at a distance of 1 m from any window of Sleekburn House.

Where the predicted noise levels exceed the criteria stipulated in section E.4 of BS 5228, then noise insulation measures, temporary re-housing (or the reasonable costs thereof) shall be provided.

Noise monitoring must be undertaken during the construction period to show compliance with the criteria above.

9 Statement of truth

9.1 I hereby declare as follows:

- This proof of evidence includes all facts which I regard as being relevant to the opinions that I have expressed and that the inquiry's attention has been drawn to any matter which would affect the validity of that opinion;
- I believe the facts that I have stated in this proof of evidence are true and that the opinions I have expressed are correct; and
- I understand my duty to the inquiry to help it with matters within my expertise and I have complied with that duty.

Richard Hinton

2nd November 2021

Richard Hinton

Northumberland Line TWAO – Rebuttal

Appendices

Appendix H Site photographs taken on 24th June 2021

Photo 1 (24th June 2021) Corner of North east elevation looking towards railway line showing window open

Photo 2 (24th June 2021) North east elevation looking north showing a number of flats with windows open

Photo 3 (24th June 2021) North east elevation showing a number of flats with open windows and extensive landscaping adjacent to existing railway line

Photo 4 (24th June 2021) North east elevation looking south towards Station Road showing a number of flats with windows open

Photo 5 (24th June 2021) North east elevation looking south towards Station Road showing a number of windows open

Photo 6 (28th October 2021) showing a number of flats with windows open

Photo 7 (28th October 2021) showing a flat with windows open

Appendix I AECOM Noise Impact Sensitivity Test

AECOM

AECOM Limited
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T: +44 131 301 8600
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Project name:
Northumberland Line Upgrades

Project ref:
60628487

To:
Gordon Halliday
Northumberland County Council

From:
Seckin Basturk

CC:
Matt Smedley
AECOM

Date:
15 October 2021

Bedlington Station Noise Impact Assessment Sensitivity Test

AECOM undertook a noise and vibration impact assessment ('the Noise Assessment') (December 2020) to accompany the application for planning permission for the proposed new railway station in Bedlington ('the Development') (planning application reference 21/01106/CCD).

It is understood that stakeholders have raised concerns regarding potential mapping discrepancies relating to the design of the proposed Bedlington Station. These concerns were focused mainly on the location of the proposed noise barrier along the western edge of the proposed station platform and its relative position to the Sleekburn House.

The Noise Assessment used Ordnance Survey (OS) mapping to locate Sleekburn House relative to the boundary and the station.

The purpose of this technical note is to provide a sensitivity test to establish whether potential mapping discrepancies have a material impact upon the conclusions of the Noise Assessment.

Mapping data used in the Noise Assessment

The Noise Assessment used the following mapping data to predict operational noise levels from the Development at worst-affected facades of nearby noise sensitive receptors:

- Topographical survey of the rail corridor used to construct a digital terrain model within the computational noise model;
- Drone survey data for land beyond (up to approx. 200m in the area of the proposed Bedlington Station) the rail corridor to extend the digital terrain model in noise model;
- OS mapping and AddressBasePlus data to build a 3D model of the built environment, including Sleekburn House, within the computational noise model; and
- Station design drawings which are based on above mentioned drone survey data were used to include the proposed Development in the noise model.

Further details on the input datasets employed were provided in Appendix C of the Noise Assessment report.

The noise model extended up to 400m from the rail corridor and therefore required a combined use of the above mapping data. In order to maintain consistency across the noise model area and to be able to use context related information provided in AddressBasePlus dataset, the building footprints within the noise model, including the Sleekburn House, were sourced from OS mapping.

Sensitivity Test

Following the concerns raised, a correction has been made to the location of the noise barrier and the drone survey data has been compared to OS mapping data. The location of the north-east façade (facing the proposed railway station hence worst-affected by noise from the Development) of the Sleekburn House as provided in OS mapping differs from the location provided in drone survey. The location provided in drone survey is between 0.24m to 0.95m closer (the difference varies along the façade) to the railway. Sections where these differences have been measured are shown in the below figure.

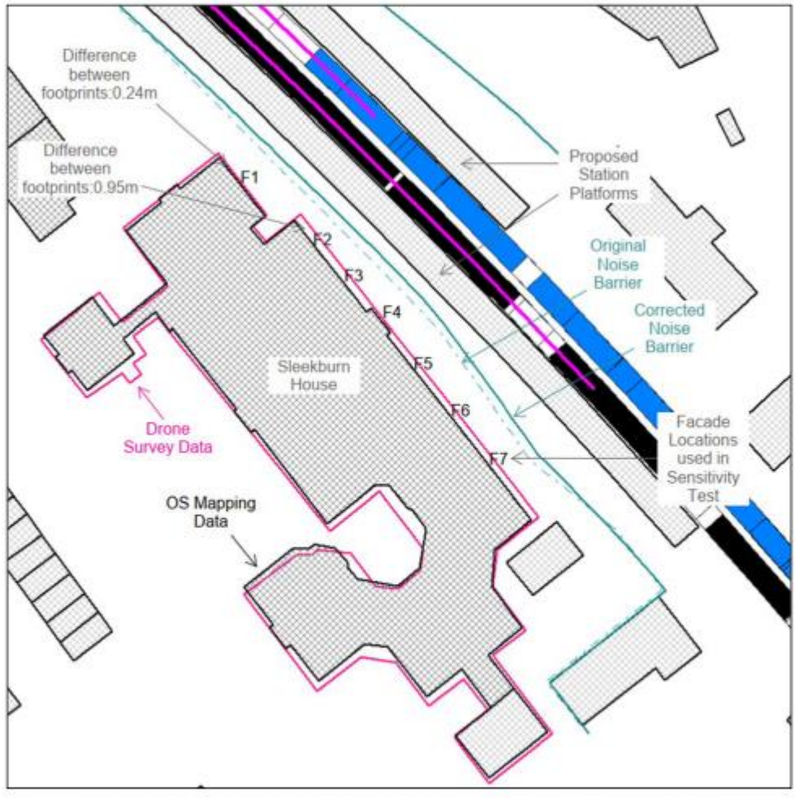


Figure 1. Comparison of Drone Survey Data and OS Mapping Data for Sleekburn House

The terrain level within 1m of the north-east façade of the Sleekburn House is constant, therefore the height of the assumed first-floor level (i.e. 4m above terrain, worst-case floor level in terms of noise received from the Development) receptor relative to the railway corridor is maintained if drone survey data were used.

It is understood that the differences between two mapping datasets may be related to the roof overhang of Sleekburn House; drone survey data is likely to show the outermost edge of the roof whilst OS mapping is likely to show the building façade. Hence these two sets of data are not always exactly aligned.

It is important to note that when impacts at first and above floor levels are studied, the level of the sound incident on windows would provide a more appropriate estimate of what is perceived by residents of that floor. Therefore, usually, the use of building façade for definition of noise sensitive locations is considered a more appropriate approach.

Nonetheless, following a conservative approach, the computational noise model[1] used for the Noise Assessment has been updated using the drone survey data to account for the differences identified above. This update has resulted in façade assessment locations to be repositioned up to 0.95m closer to the railway. The predicted daytime operational Development sound levels using the updated model have been compared to the outputs from of the original model in Table 1 below.

Table 1. Predicted Daytime Passenger Train Noise, $L_{Aeq,16h}$ (dB) free-field

Prediction Scenario	Along North East Façade of Sleekburn House at 1st Floor Level						
	F1	F2	F3	F4	F5	F6	F7
Façade located from OS Mapping (as reported in the Noise Assessment)	57.1	57.4	56.0	56.2	54.3	53.4	53.1
As above, with corrected fence location	56.8	56.2	54.9	54.8	53.4	52.7	52.4
Façade located from drone survey (including corrected barrier location)	57.2	57.2	56.3	55.1	54.3	53.6	52.7
Difference	0.1	-0.2	0.3	-1.1	0	0.2	-0.4

As shown in Table 1, the predicted daytime passenger train noise levels under drone survey prediction scenario differ between -1.1dB and 0.3dB from those reported in the Noise Assessment, for the two positions of the north eastern façade of Sleekburn House.

For completeness of the sensitivity test, at the worst-affected façade location, i.e. F1 (being closest to the railway tracks), the overall noise assessment has also been updated using the overall prediction results from the drone survey prediction scenario at ground and first floor levels, as shown in Table 2 below.

Table 2 shows that at ground floor level the use of drone survey façade location results in a slight increase in passenger train noise levels. However, this does not change the overall assessment result; future ambient sound level remains at 55 dB $L_{Aeq,16h}$ hence within the adopted noise criterion, and the identified magnitude of impact remains classified as “low”.

At the first floor level, a reduction of 1 dB in future freight train noise level has been predicted due to the use of drone survey façade location. However, as freight train noise levels have been provided only for information (see Section 6.2 of the Noise Assessment report), these do not change neither the future ambient noise level nor the magnitude of impact reported.

Considering the above, the use of the drone survey data for location of the north eastern façade of the Sleekburn House has no material impact on the overall results of the Noise Assessment issued to support the application for planning permission for the proposed new railway station in Bedlington.

Quality Information

Prepared by	Checked by	Verified by	Approved by
Seckin Basturk PhD, MIOA Senior Acoustic Consultant	James Block BSc, MIOA Associate Acoustic Consultant	James Block BSc, MIOA Associate Acoustic Consultant	Matthew Smedley BA (Hons), Dip TP, MRTPI Associate Planner

Table 2. Predicted future free-field sound levels at Sleekburn House – Drone Survey prediction scenario

NSR	Floor Level	Freight Train $L_{Aeq,16h}$ (dB)	Proposed Car Park and Access Road $L_{Aeq,16h}$ (dB)	Proposed Passenger Train $L_{Aeq,16h}$ (dB)	Proposed PA System $L_{Aeq,16h}$ (dB)	Overall Development Sound $L_{Aeq,16h}$ (dB)	Future Ambient Sound $L_{Aeq,16h}$ (dB)	Change from Measured $L_{Aeq,16h}$ (dB)	Magnitude of Impact
R1	Ground	40	20	50	46	51	55	2.2	Low
	First	47	26	57	46	58	59	N/a	N/a

Appendix J NCC Memo

Northumberland
County Council

MEMO

To:	Gordon Halliday - Consultant Planner, Planning, Corporate Resources - Planning & Economy
From:	Gary Park - Environmental Protection Officer, Environmental Protection Team, Public Health Protection Unit
Date:	27/09/2021 (updated 18/10/2021)
Our Ref:	SRU150709
Planning Ref:	21/01106/CCD (reconsultation)
Subject:	Construction of a two-platform railway station including: ramped pedestrian access, new highway access; modifications to existing highways including pedestrian footways; provision of parking for cars, electric vehicles, motorcycles, cycles, and taxis and other associated works. Construction of facilities ancillary to the station including, lighting, soft and hard landscaping, surface and subsurface drainage, utilities and other services, boundary treatment and other associated works.
Location:	Bedlington Railway Station Station Street Bedlington Northumberland NE22 5UZ.

I refer to your consultation dated 30 July 2021.

Submitted documents reviewed on the 27 September 2021.

Opinion

The Environmental Protection Team do not object to the proposed development.

We also recommend to the Local Planning Authority that the following conditions and informatives be included in any decision notice.

Proposal

The proposal is for the reinstatement of a passenger train service with associated infrastructure from the Benton Junction on the East Coast Main Line to Ashington.

This application is for the reinstatement of a railway station at Bedlington Station, at the location of the original station location and all associated infrastructure.

Commentary

General

The main issues which the Environmental Protection Team have considered for this application are:

- Noise and Vibration.
- Land Contamination Assessment
- Air Quality Impacts.
- Artificial Lighting.

Most of these issues have been addressed already by the applicant and the Environmental Protection Team have provided commentary and reviewed supporting documents at a pre-application stage and before.

Local Noise Sensitive Receptors

The main residential receptors for the new Bedlington Station are 1 Sleekburn House, 14-21 / 22 / 23 / 24 and 26-32 Blenheim Drive, Clayton Arms, 5A / 8A and 9 Station Street, 2A / 4A and 7A Ravensworth Terrace, 1-3 / 4-6 and 7 Park Terrace, The Gables, 3 / 18-23 / 24-29 and 30 West View.

These dwellings are already receptors to noise from the current mineral rail traffic on this line. Currently, there are up to 4/5 trains per day carrying biomass to Lynemouth Power Station through Bedlington Station and returning the same way and a few alumina trains to North Blyth each week (these depart from the Ashington branch at West Sleekburn).

Proposed train movements for the passenger service will be every half hour between 05:51 (empty to Ashington) and 23:11 (empty to Heaton/Newcastle), a total of 32 per day in both directions.

Operational Noise

Rail Traffic Noise - Daytime

The line is still an operational one and is currently used for freight traffic to and from Lynemouth Power Station and Battleship Wharf (North Blyth/Cambois). It is understood that this currently has up to 30 train movements per week with some of these being early morning.

Noise from trains is transitory, however at stations the period of impact will be greater while passengers disembark and board (estimated at one minute in the noise assessment).

It is understood that the current plan is to use diesel railcars/railbuses and there is no intention to electrify the line. Therefore, most train engines will be located under the chassis of the railcar and a certain amount of noise attenuation will be provided at stations from the platform acting as a barrier.

The noise from the railcars at the station is predicted to be 41 to 63dB LAeq (without mitigation), this is between 12dB below and 10dB over the measured baseline daytime level at present.

Six of the closest receptors to the station have been identified which would benefit from an acoustic barrier on the platform on the original down line (west platform). With this mitigation they would experience noise from railcars predicted to be 44 to 57dB LAeq (with mitigation), this is between 9dB below and 4dB over the measured baseline daytime level at present.

Rail Traffic Noise – Night-time

The Environmental Protection Team sought further information on first floor receptors (particularly Sleekburn House) as the noise assessment had not presented any noise impacts for these during the night period (2300-0700) or shown the LAMax impacts.

Whilst it is appreciated that this railtrack has an existing lawful use and the number and types of train movements do not have to be approved by any planning authority, to assess the impact of the proposed reintroduction of passenger trains and the reuse of Bedlington Station only, it was felt that the Environmental Protection Team had to consider this impact in isolation.

Currently there are proposed to be three empty trains passing Bedlington Station and three stopping trains in the night period, these are:

- Three empty trains passing Bedlington Station at 0551 and 0615 (both northbound) and 2311 (southbound), and;

- Three stopping trains at the station at 0611 and 0638 (both southbound) and 0654 (northbound).

The acoustician has used library data for similar rail traffic in similar situations to inform the prediction of noise levels at the first floor of Sleekburn House. The summarised information below is for passing trains only – stopping trains are approximately 3-4dB lower for both metrics, so this represents a "worst case scenario".

This has shown that at Sleekburn House the external façade noise levels at night will be will be:

LAeq, 8-hour = 41dB (ground floor) and 50dB (first floor)

LAMax = 63dB (ground floor) and 71dB (first floor)

With windows open in the rooms of Sleekburn House (and allowing for 15dB of attenuation through an open window) this would translate to internal levels of:

LAeq, 8-hour = 26dB (ground floor) and 35dB (first floor)

LAMax = 48dB (ground floor) and 56dB (first floor)

The applicant is intending to install trickle vents in room at Sleekburn House which alongwith closed windows would achieve internal levels of:

LAeq, 8-hour = 11dB (ground floor) and 20dB (first floor)

LAMax = 33dB (ground floor) and 41dB (first floor)

Whilst the purpose of this exercise was to assess the impact of the reintroduction of the passenger service and the reuse of Bedlington Station in isolation from all other noise sources, the station is in a town centre location which will already experience a degree of road, rail and other noise sources in these same time periods.

Sleekburn House is a "care home" (in a general description) and within BS 8233 there is a relaxation for these alongwith hotels etc., which gives an internal night-time noise limit of 35dB LAeq. Whilst there is no specific relaxation of the night-time limit for LAMax it might be expected that existing residents of this building are partially desensitised to rail traffic noise being exposed to is on a regular basis.

The existing freight trains were until recent years coal trains travelling north to Lynemouth Station and coal trains south from Battleship Wharf to coal-fired power stations in the UK, all the coal trains have now ceased and the ones to Lynemouth Power Station have been replaced by up to 27 trains per week carrying biomass fuel to the converted power station. There are also a smaller number of trains (approximately two per week) carrying alumina from North Blyth to Lochaber. Some of these trains pass Bedlington Station early morning.

Additionally, these proposed train movement in the night-time principally impact the 0600 to 0700 period, a period in which there are much heavier freight trains with a greater number of wagons over the three railcar (DMU) unit in combination proposed for the passenger use.

Given the limited number of passenger traffic movements (passing and stopping) in a small proportion of the night period, the predicted night-time noise impacts are expected to be in the Lowest Observed Adverse Effect Level (LOAEL) when taken against the existing rail traffic (principally).

It should be noted that this situation is not expected at the other proposed stations as there are no other receptors in such close proximity to the railtrack without distance or natural barriers attenuating noise.

Proposed Noise Mitigation for Sleekburn House

A condition has been proposed for the applicant to agree upon and carry out any required noise mitigation to Sleekburn House.

Tannoy Systems

Final details of the tannoy system and how it will be managed, especially between 0600 and 0700 are yet to be determined. There are proposals that the noise emitted from the tannoy system can possibly be "managed" in some way.

However, the noise impact is expected to 45dB LAeq at the receptors on three of the receptors, significantly below the existing ambient noise level of 53dB LAeq during the day, even at night this would meet the internal limit in BS 8233 of 30dB LAeq (accounting for 15dB of attenuation through an open windows) and below the existing background level at night of 48dB LAeq.

This is acceptable for the daytime operation if the tannoy system. However, it would still be expected that noise from the tannoy system is managed in the same way it will be at other stations (ie Ashington) in the night period.

A condition has been recommended for the applicant to submit final details of the tannoy system and how noise will be managed and controlled during the night period.

Car Parks

The noise levels at the nearest receptors from the operational noise from the use of the car park is predicted to be 15 to 44dB LAeq at the nearest receptors.

This in isolation from the other operational noise impacts is below the measured daytime background levels of 53dB LAeq at these receptors.

The most impacted will be those residential dwellings on (opposite the station) but even at the most affected the predicted level is some 12dB below the current ambient noise level.

Most of the use of the car park for the station use will be during the acoustic daytime period, although it is likely there will be cars arriving before the first train at 0615.

Cumulative Operational Noise Impact

The predicted cumulative daytime noise impact at receptors close to the station is between 0.1 and 0.6 decibels (dB) over existing ambient noise levels of 53dB LAeq (ie 54.3dB to 64.1dB LAeq).

Because of the low predicted impact, no noise attenuation is proposed at this station.

Operational Vibration

The line is still an operational one and is currently used for freight traffic to and from Lynemouth Power Station and Battleship Wharf (North Blyth/Cambois). It is understood that these freight trains can be up to 30 movements per week with some of these being early morning.

Given the weight and length of railcars (diesel multiple units - DMUs) the degree and duration of vibration is likely to be minimal, especially when compared to heavier and longer freight trains already using the line.

The noise assessment has assessed existing freight train passes to generate:

The typical sound exposure level (LAE) of a freight train passby is 83 dB and a typical VDV (Vibration Dose Value) of 0.003 $ms^{-1.75}$.

It has been assumed that the passenger railcars will generate the same level of vibration as the freight trains, this is likely to be a significant overestimate.

Guidance on human annoyance from vibration presented in in BS 6472-1 has the lowest vibration levels 0.2 - 0.4 $ms^{-1.75}$ (day) and 0.1 - 0.2 $ms^{-1.75}$ (night) which would likely to be noticeable in receptors.

It is clear that the predicted vibration levels from the train passes are significantly below levels at which it would be noticeable in nearby dwellings.

Construction Noise and Vibration

Construction Noise

The construction of the station platforms, car park and associated infrastructure would appear to be limited compared to a large commercial development with structure(s).

It is expected that any noisy works should be carried out during the day and not at night (or evening).

It might be sufficient to limit the days and times of noisy works and a condition has been recommended to address this.

The applicant has indicated that the works could be given "prior consent" through Section 60/61 of The Control of Pollution Act 1974. Details of this can be found on the following webpage under "Construction sites information & advice":

https://www.northumberland.gov.uk/Protection/Pollution/Pollution.aspx

Final details of the construction schedule and plant to be used is yet to be finalised, the applicant has included a qualitative assessment.

The draft construction environmental management plan has proposed that a final CEMP will include an assessment of construction noise and vibration once final schedule of works and plant is known.

A condition has been recommended to the Local Planning Authority to secure this.

Construction Vibration

Final details of the construction schedule and plant to be used is yet to be finalised, the applicant has included a qualitative assessment.

The draft construction environmental management plan has proposed that a final CEMP will include an assessment of construction noise and vibration once final schedule of works and plant is known.

A condition has been recommended to the Local Planning Authority to secure this.

Land Contamination

The proposal is for a currently operational railway line to be used for passenger traffic and this proposal would not appear to place any vulnerable receptors in any form of pathway to any potential contamination source.

The applicant has submitted a Phase 1 (desk top study) for the site and has recommended the following intrusive investigations at the site to be carried out to determine:

- Ground conditions and groundwater regime at the site;
- Depth, composition, strength, compressibility of any Made Ground present;
- Depth, composition, strength and compressibility of the natural Glacial Till soils below the site;
- Depth to bedrock and determine its type and strength;
- Determine the presence or absence of mine workings below the site;
- Minimum of 10m of competent rock and determine the Coal Measures succession (including seams), and;

- Identify residual contamination from past historical land uses located on or close to the site (e.g. live railway, former colliery and spoil heap, backfilled opencast to the east of the A189).

The site investigations are to be phased and the exact detail and scope of these investigation have yet to be finalised.

Conditions have been recommended to secure some aspects of these investigations – principally the last bullet-point.

Where existing buildings or structures (ie stations or platforms) are to be reused then an asbestos survey should be carried out and any suspected Asbestos Containing Materials (ACMs) removed by a licensed contractor.

PLEASE NOTE: If materials are to be reused onsite (or removed offsite) then The Definition of Waste: Development Industry Code of Practice (CL:AIRE Version 2 March 2011) would may apply and needs to be a consideration by the applicant.

Air Quality - Operational

Rail Traffic

The proposed trains to be used will be railcars (DMUs) which generally consist of three diesel engine powered units (or multiples of this arrangement).

The engines are similar to one which would be used to drive a large HGV truck. Given, that and the frequency of passes and station stops proposed in the current timetable, it is considered that the air quality impact from the operation of the passenger service will be minimal.

This would be equivalent to additional road traffic (LDV and HGV) in the vicinity of the station and receptors.

The trains are estimated to be stationary at stations for approximately one minute.

The air quality assessment has followed the criteria in DEFRA (2018); Local Air Quality Management Technical Guidance (TG16) which states that a detailed air quality assessment must be carried out if stations are to have station, running trains for 15 minutes or more on three or more occasions during the day. The air quality report states that:

"*Given the maximum proposed short wait time (one minute), it is extremely unlikely that a diesel locomotive will be stationary at the station platform for periods of 15 minutes or more, at least three times a day*"

Therefore, no assessment of air quality impacts from the proposed timetable of trains is not required under current guidance.

Road Traffic Associated with Stations

Detailed air quality modelling has not been undertaken at this site as the air quality report has concluded that:

"*The majority of traffic flows are predicted to remain broadly at the same levels as a result of the Proposed Development, when compared to the DM. The criteria given in the guidance to suggest the potential need for a detailed assessment of road traffic emissions impacts is therefore not exceeded.*"

And;

"*As such, detailed consideration of operational road traffic emissions impacts has been screened out of this assessment and the impact of such limited emissions would not contribute to a significant effect on local air quality.*"

The car parking associated with the development is dispersed over three sites with one being brought under a separate planning application (21/03060/CCD), one of the car parks is directly north of the station platform.

This is acceptable as the site is within a relatively busy town centre with an existing traffic load on the surrounding roads.

External Artificial Lighting

The external lighting on the platform and car park is some 25 metres from the nearest receptor, at this distance any modern streetlighting should be below guidance limits for light trespass through windows.

Any fixed, external lighting (principally station and car park floodlighting) installed as part of this development should have regard for the ILP Guidance on the Reduction of Obtrusive Light, 2012:

https://www.theilp.org.uk/documents/obtrusive-light/

The applicant should ensure that lighting does not cause annoyance to any nearby receptors.

Experience of lighting installations has shown that complaints about floodlighting normally arise from poorly designed or installed lighting schemes. It is recommended that the applicant ensures the lighting contractor installs the proposed lighting scheme in line with submitted proposals and that the ILP guidance is adhered to minimise the impact of lighting as part of this development.

Legacy Coal Mining

Issues of ground stability relating to historic underground mining lies outside any remit for the Environmental Protection Team and should be addressed by the applicant and the Coal Authority.

No further information is required by the Environmental Protection Team on this issue.

Ground/Mine Gases

It is understood that there is no intention to use the existing buildings on the station at present and therefore gas protection does not need to be currently considered for these buildings.

Given that no enclosed, occupiable buildings are proposed there would not appear to be any risk of ground/mine gas accumulation within any of the proposed "open" structures.

No further information is required by the Environmental Protection Team on this issue.

Dust - Construction Phase

The applicant has submitted a dust management plan as part of a CEMP which is acceptable.

Recommended Conditions

If the LPA grant this application then the Environmental Protection Team recommend the following conditions:

1. Station Tannoy System Details

Prior to any amplified voice or tannoy system becoming operational, full details of the system shall be provided to the Local Planning Authority to show how the system will be operated and managed to minimise noise impacts to local noise sensitive receptors.

The proposed system shall be installed, operated and maintained to the satisfaction of the Local Planning Authority in accordance with the details submitted to and approved in writing by the Local Planning Authority.

Reason: To protect residential amenity and provide a commensurate level of protection against noise.

2. Acoustic Barrier Details

Prior to the development being brought into use or continuing in use, the applicant shall provide full details of the acoustic barrier(s) as outlined in the noise assessment (Bedlington Railway Station Noise Impact Assessment produced by AECOM Limited, Project number: 60628487, Revision 1 dated 18/01/21) and agreed through the LPA, including location, specification, design and performance, to the local planning authority for written approval. The approved scheme shall be implemented in full and retained for the lifetime of the development.

Reason: To protect residential amenity and provide a commensurate level of protection against noise.

3. Construction Noise and Vibration Assessment

No development shall take place, including any works of demolition, until a noise and vibration assessment and management plan has first been submitted to the Local Planning Authority and agreed in writing. The plan shall detail measures for the control and reduction of noise and vibration emissions associated with demolition, earthworks and construction. The development shall be carried out in accordance with the plan so agreed.

Reason: To protect residential amenity and provide a commensurate level of protection against noise and vibration.

4. Noise Mitigation for Sleekburn House

The development shall not be brought into use until a scheme for the mitigation of rail noise at Sleekburn House has been submitted to and approved in writing by the Local Planning Authority. The approved noise mitigation scheme shall be implemented in accordance with the approved details before the development is brought into use.

Reason: To protect the amenity of residents of Sleekburn House.

5. Identification of Enabling Works

No development shall take place, including any works of demolition, until a full programme of works has been established which allows the identification of "enabling works" separate for the main demolition and construction works which should also include the main groundworks (ie soil stripping).

Reason: To provide an identifiable separation of works which will allow the imposition of conditions aimed only at the main demolition and construction works.

6. Potentially Contaminated Land

No development shall take place beyond the enabling works identified under **Condition 5*** until an appropriate scheme of assessments, investigations and remediation have been carried out as detailed below, unless those assessments and investigations demonstrate that remediation is not required, and the Local Planning Authority dispenses with any such requirement in writing:

a) Further site investigations are recommended in the Phase 1: Desk Study (The Northumberland Line – Preliminary Sources Study Report – Blyth Bedlington Station Appendix 05 produced by AECOM Limited, Project number: 60601435 ref: 60601435-ACM-06-ZZ-REP-EGE-000001 and dated 26 February 2021) and shall

be carried out to fully and effectively characterise the nature and extent of any land contamination and or pollution of controlled waters. It shall specifically include a risk assessment that adopts the Source-Pathway-Receptor principle. In order that any potential risks are adequately assessed taking into account the sites existing status and proposed new use. Two full copies of the site investigation and findings shall be forwarded to the Local Planning Authority without delay upon completion.

b) Thereafter, a written Method Statement (or Remediation Strategy) detailing the remediation requirements for the land contamination and/or pollution of controlled waters affecting the site shall be submitted and approved by the Local Planning Authority, and all requirements shall be implemented and completed to the satisfaction of the Local Planning Authority. No deviation shall be made from this scheme without express written agreement of the Local Planning Authority.

*** As numbered in this consultation response.**

Reason: To ensure that risks from land contamination to the future users of the land and dwellings are minimised and to ensure that the development can be carried out safely without unacceptable risks to any future occupants.

7. Contaminated Land Verification

The development hereby permitted shall not be brought into use or continue in use until two full copies of a full closure (Verification Report) report shall be submitted to and approved by the Local Planning Authority. The report shall provide verification that the required works regarding contamination have been carried out in accordance with the approved Method Statement(s). Post remediation sampling and monitoring results shall be included in the closure report to demonstrate that the required remediation has been fully met.

Reason: To ensure that risks from land contamination to the future users of the land and dwellings are minimised and to ensure that the development can be carried out safely without unacceptable risks to any future occupants.

8. Unexpected Contamination if Found During Development

If during redevelopment contamination not previously considered is identified, then an additional written Method Statement regarding this material shall be submitted to and approved in writing by the Local Planning Authority. No building shall be occupied until a method statement has been submitted to and approved in writing by the Local Planning Authority, and measures proposed to deal with the contamination have been carried out. Should no contamination be found during development then the applicant shall submit a signed statement indicating this to discharge this condition.

Reason: To ensure that risks from land contamination to the future users of the land and dwellings are minimised and to ensure that the development can be carried out safely without unacceptable risks to any future occupants.

9. Construction Delivery / Collection Hours

Deliveries to and collections from the demolition and/or construction phase of the development shall only be permitted between the hours:

Monday to Friday - 08:00 to 18:00

Saturday - 08:00 to 13:00

With no deliveries or collections on a Sunday or Bank Holiday, unless agreed in writing with the LPA.

Reason: To protect residential amenity and provide a commensurate level of protection against noise.

[**NOTE**: All recommended conditions above should be subject to confirmation by Development Services Legal Team, to ensure they are enforceable].

Informatives

Electric Vehicle Charging Points

The current provision proposed for electric car charging points is 5.2 per cent (4 spaces out of a total of 77). This is below the national electric vehicle ownership of 6.6 per cent in 2020, although it is likely there are large regional variations.

However, including the three spaces in the Ravensworth Street car park (being applied for under 21/03060/CCD) this raises the percentage of electric car charging points to 6.5 per cent (7 spaces out of a total of 108).

The applicant should consider and make plans for increasing this number as an when the take up of electric vehicles increases in the UK.

Statutory Nuisance

The Environmental Protection Team would advise that the prevention of nuisance is the responsibility of the developer and their professional advisors. Developers should, therefore, fully appreciate the importance of professional advice. Failure to address issues of noise, dust and light at the development stage does not preclude action by the Council under Section 79 of The Environment Protection Act 1990 in respect of statutory nuisance.

Burning Materials Onsite

There shall be no burning of any material associated with the construction phase on the site.

	Name	Signature
Prepared by	Gary Park	[redacted]
Checked by	Gillian Plaice	

Appendix K NCC Public Protection examples of internal noise level requirements

K.1 The following memo is the planning consultation response from the Environmental Protection Officer to the Planning Case Officer with regards to a planning application for new residential dwellings in Stannington, Northumberland, which have the potential to be affected by noise from road traffic.

K.2 The memo includes proposed planning conditions; condition 8 requires that the guidance internal noise levels are not exceeded in the master bedrooms and living room with open windows.

K.3 The guidance internal noise levels are as per reported in BS 8233 and WHO.

Northumberland
County Council

MEMO

To: Mrs Tamsin Wood, Senior Planning Officer.

From: Paul Proctor, Environmental Protection Team.

Date: 21st May 2019

Our Ref: SRU 129556

Planning Ref: 19/01031/OUT

Subject: Proposal Erection of 3 no. dwellinghouses (C3 use) plus new access road.

Location: Land East Of 21 Station Road Station Road Stannington Northumberland

I refer to your consultation dated 25th April 2019 and attachments:

- Planning Statement, Dated March 2019, No Reference, Prepared By JT Planning.
- Preliminary Contamination & Mining Risk Assessment, Dated 8th Nov 2018, Ref: 35340R01, Prepared By FWS Consultants Ltd.
- Site Location Plan, No Date, Ref: P/1819/013/001, PreparedBy JT Planning.
- Proposed Site Plan, No Date, Ref: P/1819/013/003, Prepared By J T Planning.

Opinion

In principle this Service is in agreement with this proposal subject to the imposition of recommended conditions.

Comments

Construction Works

- Public Health Protection Unit (PHPU) have concerns regarding construction noise, dust and floodlighting which have the potential to cause loss of amenity to residential premises which are in close proximity to the proposed site.

Potential Land Contamination
PHPU concur with the Preliminary Contamination & Mining Risk Assessment, Dated 8th Nov 2018, Ref: 35340R01, Which states that further investigation is required. This is to ensure that any contaminants within the site are dealt with in an appropriate manner to afford protection to the end user.
Please note as the development site lies within The Coal Authority Standing Advice Area; therefore within the application site and surrounding area there are coal mining features and hazards which need to be considered in relation to the determination of this planning application. PHPU have concerns with regard to mine gases, which may potentially be prejudicial to the health & amenity of the future occupants of the proposed dwellings. For this development PHPU will dispose on the need for gas monitoring and recommend that mine gas protection be installed to the proposed dwellings.

Loss of Amenity due to the Potential Impact of roadway traffic noise (Stannington Station Road). PHPU have concerns with regard to the noise impact upon the proposed residential development from noise associated with traffic noise which has the potential to cause loss of amenity to future occupiers of the proposed development.

These issues must form a material consideration in planning terms.

If members are minded to grant planning permission the following conditions are recommended:

Recommended Conditions.

1. Noisy Working – During Construction Periods.
During the construction period, there should be no noisy activity, i.e. audible at the site boundary, on Sundays or Bank Holidays or outside the hours: Monday - Friday - 0800 - 1800, Saturday 0800-1300. Any repeatedly noisy activity at any time may render the developer liable to complaints which could result in investigation as to whether a statutory nuisance is being caused

Reason: To safeguard the amenity of neighbouring residential properties.

2. Dusty Working –During Construction.
No development shall take place until an emergency contact telephone numbers in the event of a dust complaint being received and a scheme specifying (Dust Management Plan) the provision to control/mitigate dust emanating from the site, shall be submitted to the Local Planning Authority. The agreed scheme shall be implemented in full and maintained until the construction process has been completed.
(Guidance on the assessment of dust from demolition and construction can be found at the following: www.iaqm.co.uk).

Reason: To Safeguard the amenity of neighbouring residential properties.

3. Floodlighting – During Construction Works.
No flood lighting shall be installed unless details have first been submitted to and approved in writing by the Local Planning Authority. The floodlighting shall thereafter be installed and operated fully in accordance with the approved scheme.

Reason: To retain control over floodlighting in the interests of visual amenity.

4. Potentially Contaminated Land
The development hereby permitted shall not be commenced until a scheme to deal with any contamination of land or pollution of controlled waters has been submitted to and approved in writing by the Local Planning Authority and until the measures approved in that scheme have been implemented. The scheme shall include all of the following measures unless the Local Planning Authority dispenses with any such requirement in writing:
As identified and recommended in the Preliminary Contamination & Mining Risk Assessment, Dated 8th Nov 2018, Ref: 35340R01,
A) site investigation shall be carried out to fully and effectively characterise the nature and extent of any land contamination and/ or pollution of controlled waters. It shall specifically include a risk assessment that adopts the Source-Pathway-Receptor principle, in order that any potential risks are adequately assessed taking into account the sites existing status and proposed new use. Two full copies of the site investigation and findings shall be forwarded to the Local Planning Authority without delay upon completion.
B) Thereafter, a written method statement detailing the remediation requirements for the land contamination and/ or pollution of controlled waters affecting the site shall be submitted and approved by the Local Planning Authority, and all requirements shall be implemented and completed to the satisfaction of the Local Planning Authority. No deviation shall be made from this scheme without express written agreement of the Local Planning Authority.
C) Two full copies of a full closure report shall be submitted to and approved by the Local Planning Authority. The report shall provide verification that the required works regarding contamination have been carried out in accordance with the approved Method Statement(s). Post remediation sampling and monitoring results shall be included in the closure report to demonstrate that the required remediation has been fully met.

Reason: To ensure that any contaminants within the site are dealt with in an appropriate manner to afford protection to the public, the buildings and the environment.

5. Contamination not previously discovered.
If during development contamination not previously considered is identified, then an additional method statement regarding this material shall be submitted to and approved in writing by the Local Planning Authority. No building shall be occupied until the method statement has been submitted to

and approved in writing by the Local Planning Authority, and measures proposed to deal with the contamination have been carried out.
[Should no contamination be found during development then the applicant shall submit a signed statement indicating this to discharge this condition].

Reason: To ensure that any contaminants not previously considered within the site are dealt with in an appropriate manner to afford protection to the end user.

6. Ground Gases Protection Measures.
No buildings shall be constructed until a report detailing the protective measures to prevent the ingress of ground gases, including depleted Oxygen (<19%), to the CS2 standard specified in BS8485:2015 (Code of Practice for the design of protective measures for Methane and Carbon Dioxide ground gases for new buildings), have been submitted to and approved in writing by the Local Planning Authority.
The report shall contain full details of the validation and verification assessment to be undertaken on the installed ground gas protection, as detailed in CIRIA C735 (Good practice on the testing and verification of protection systems for buildings against hazardous ground gases)

Reason:
In order to prevent any accumulation of ground gas, which may potentially be prejudicial to the health & amenity of the occupants of the respective properties

7. Validation and Verification of Ground Gas Protection.
The development shall not be brought into use until the applicant has submitted a validation and verification report to the approved methodology in Condition 6*, which has been approved in writing by the LPA.
*In this list of conditions

Reason: In order to prevent any accumulation of ground gases, which may potentially be prejudicial to the health of the future occupiers.

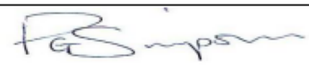
8. Condition - Acoustic / Orientation:
No dwelling shall be constructed until an acoustic design scheme has been submitted to and approved in writing by the Local Planning Authority. The scheme shall demonstrate that internal noise level of 35dB LAeq during the day and 30dB LAeq and 45dB LAMax during the night can be achieved in habitable rooms. Habitable rooms on the façade facing away from the **Stannington Station Road** , shall have windows which are not restricted from opening. The scheme shall include internal room layouts to show that the main habitable rooms# shall have access to a window which can be opened

without causing the ingress of obtrusive noise above guidance levels. Thereafter, the approved acoustic design scheme shall be implemented in full before the occupation of the dwelling it relates to and retained in perpetuity.

#Main habitable rooms shall be taken to mean living rooms (07:00 - 23:00) and the master bedrooms (23:00 - 07:00)

Reason:
To protect residential amenity and provide a commensurate level of protection against noise.

All recommended conditions above should be subject to confirmation by Development Services Legal Team, to ensure they are enforceable.

	Name	Signature
Prepared by	Paul Proctor	
Checked by	Peter Simpson	

K.4 The following memo is the pre-application (planning) consultation response from the Environmental Protection Officer to the Planning Case Officer with regards to a proposed residential development in Berwick-upon-Tweed, Northumberland, which have the potential to be affected by noise from road and rail traffic.

K.5 The memo stipulates that proposed guidance internal noise levels are not exceeded in the master bedrooms and living room with open windows.

K.6 The proposed external noise level limits are based on a 15 dB reduction through an open window to achieve the internal noise level limits as given in BS 8233 and WHO.

Northumberland
County Council

MEMO

To:	James Bellis - Senior Planning Officer, Communities & Infrastructure, Corporate Resources - Planning & Economy
From:	Gary Park - Environmental Protection Officer, Environmental Protection Team, Public Health Protection Unit
Date:	31/03/2021
Our Ref:	SRU145800
Planning Ref:	21/00152/PREAPP
Subject:	The construction of 63No affordable homes.
Location:	Land At Seton Hall Ord Road Tweedmouth Berwick-Upon-Tweed Northumberland TD15 2UT.

I refer to your consultation dated 08 March 2021 and attachments:

- Pre-application enquiry form completed by or on behalf of the applicant and dated 17/2/2021.
- Proposed Site Plan produced by ID Partnership, Project / Drawing No. N81:2797 / 001 (Rev D5) dated Nov 2020.
- Pre-Application Design Document produced by ID Partnership, Revision A and dated February 2021.
- Letter entitled "Preapplication Enquiry – Land at Seaton Hall, Berwick", ref: 62601/01/MHE/JE/19438422V1 dated 15 February 2021.

Proposal

The proposal is for the construction of 63 affordable homes to the north-west of Ord Road, west of the East Coast Main Line railway and north and north-west of Berwick fire station and the Allan Brothers factory.

Commentary

General

Please see the Public Health Protection Unit's full set of pre-application and application guidance for developers (in the "related documents for environmental protection in development" section):

http://www.northumberland.gov.uk/Protection/Pollution/Advice.aspx

Commentary

The Public Health Protection Unit would normally consider a number of aspects in any application such as this, they would include:

- Noise
- Contaminated Land
- Ground / Radon Gas

Noise

It would be expected that noise impacts from the following sources will have been assessed and presented in a noise report to support any subsequent planning application:

- Industrial noise from surrounding industrial processes, especially Alan Brothers.
- Rail traffic noise from the East Coast Main Line (ECML) which is elevated on a viaduct at this location.
- Road traffic noise from the A698 road at the east of the site.
- Noise from Berwick Fire Station.

The assessment shall include day and night noise measurements of the main metrics (LAeq, LAMax and LA90) following relevant guidance.

Measurements should be taken at locations representative of each noise source(s).

Where any of the following is exceeded at the site then noise mitigation should be proposed:

- 50dB LAeq external during daytime in garden/amenity areas.
- 45dB* LAeq at night at the façade of the nearest dwellings to the noise source(s).
- 60dB* LAMax at night at the façade of the nearest dwellings to the noise source(s).

* Assuming 15dB of attenuation through an open window.

The approach that the Public Health Protection Unit has in respect of noise impacts upon newly proposed residential developments is that the future occupants should be able to use and enjoy their properties with windows open and still meet internal noise criteria, especially in the main habitable rooms (main living room and master bedroom(s)).

Therefore, it is likely a condition would be placed on any subsequent planning application for the applicant to demonstrate how the layout, design and orientation of the proposed dwellings has been informed by any noise assessment. For a noise impacted dwelling where there is a "protected façade" not impacted by a noise source, then it would be expected to place the main habitable rooms on the "protected façade".

Failure to submit a noise assessment report with any subsequent planning application may result in the Public Health Protection Unit objecting to any proposed development on the site.

Land Contamination

Although the Public Health Protection Unit are unaware of any historic, potentially contaminative uses on the site (with the exception of agriculture) given the sensitive end use of residential with gardens any subsequent planning application should be supported with a minimum of a Phase 1 desk top study as required under Paragraph 178 of the National Planning Policy Framework (NPPF) which makes it clear that:

a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising

from natural hazards or former activities such as mining, and proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);

b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and

c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.

Please refer to our guidance (Development on Land Affected by Contamination - Technical Guidance for Developers, Landowners and Consultants) which can be found at:

http://www.northumberland.gov.uk/Protection/Pollution/Contaminated.aspx

Should the Phase 1 identify a medium to high risk then the applicant will need to undertake a Phase 2 intrusive investigation and submit this in support of the application.

It would be expected that any subsequent full or outline planning application is supported with a minimum of a Phase 1 desk top study report.

Failure to submit a Phase 1 report with any subsequent planning application may result in the Public Health Protection Unit objecting to any proposed development on the site.

Ground Gases

The site lies outside of any Coal Authority reporting area and therefore does not require any gas protection because of any risks from mine gases.

However, the proposed Plots 62 and 63 fall within an area predicted to be impacted by radon gas (10-30 per cent of dwellings at or above the radon "action level") requiring full radon gas protection.

It would be normal to treat a development site as a whole and expect full radon gas protection in all proposed dwellings, for any subsequent application the applicant should clarify their position on this matter.

Details of the technical requirements of full radon protection can be found in section 5.2 of Building Research Establishment publication BR 211 Radon Guidance on Protective Measures for New Buildings (2015)

https://www.bre.co.uk/page.jsp?id=3139

Which could comprise:

- A radon specific gas membrane.

And;

- A suspended floor with a passively ventilated sub-floor void (with the option to add an external pump later if required). In this design, the radon membrane is placed in the floor above the void.

Or;

- A suspended floor with a sub-floor void and a second "floor" at the bottom of the void with a radon sump (vented to atmosphere) below this. In this design, the radon membrane is placed upon sand blinding directly on the ground and screed placed on top of the membrane with the void above this and the floor above the void.

Or;

- A ground-bearing raft/slab incorporating a radon gas membrane with a sub-floor depressurisation pipe vented to atmosphere.

It would be expected that any radon gas protection should include how the protection works will be validated and verified. BR 211 does not provide a methodology for this, so we would expect that the works will be verified in accordance with those for ground gases generally.

General guidance and what a gas protection proposal should include (Appendix 2) and how it will be verified/validated (Appendix 3) is contained within our adopted guidance on gas protection; YALPAG Technical Guidance Verification Requirements for Gas Protection Systems (Version 1.1 – December 2016), which is available under the related documents section at:

https://www.northumberland.gov.uk/Protection/Pollution/Advice.aspx

In any subsequent application, the applicant should acknowledge the requirement and extent of radon gas protection upon which the Public Health Protection Unit can recommend conditions to the Local Planning Authority.

	Name	Signature
Prepared by	Gary Park	
Checked by	David Lathan	

K.7 The following memo is the pre-application (planning) consultation response from the Environmental Protection Officer to the Planning Case Officer with regards to a proposed residential development in Consett, Northumberland, which have the potential to be affected by noise from road traffic.

K.8 The memo stipulates that proposed guidance internal noise levels are not exceeded in the master bedrooms and living room with open windows.

K.9 The memo directly references the internal noise level limits given in BS 8233 and WHO.

Northumberland
County Council

MEMO
To: Planningcomments@northumberland.gov.uk
From: Paul Proctor, Environmental Protection Team.
Date: 13th May 2020
Our Ref: SRU 138480
Planning Ref: 20/00326/PREAPP
Subject: Farmstead:: conversion of some farm buildings to dwellings and demolition and replacement of some buildings with dwellings.
Location: Whittonstall Hall Farm Newlands Stocksfield Consett Northumberland DH8 9JL

I refer to your consultation, Dated 5th May 2020 and attachments:

- Site Location Plan, May 2020, Drawing No. PL01, Prepared By OAD Architects.

(*Public Health Protection Unit (PHPU) has reviewed the applicant's pre application information. If a subsequent outline or full application is submitted with supporting information with regard to contaminated land, artificial lighting, environmental noise and the impact of odour upon local amenity and sensitive receptors then PHPU reserves the right to recommend further planning material considerations (conditions) to the Local Planning Authority).*

Commentary

1. Potential Contaminated Land from Past Industrial Uses.
The proposed site has a past historical farming and agricultural uses, the applicant would be prudent to submit the following reports

A Phase 1- Preliminary Risk Assessment, (Phase 2-Site investigation and risk assessment, Phase 3-Remediation and Phase 4-Verification If required) contaminated land assessment will be required in support of the application. Contaminated land Investigations should be carried out in accordance with relevant British Standards and current Guidance e.g. BS10175, BS5930 and the Land Contamination; Risk Management:
https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks

Contaminated land Investigations should be carried out by a competent and experienced person / organisation in accordance with relevant British

Standards and current Guidancdance e.g. BS10175, BS5930 and the CLR11 (Environment Agency, 2004).

If the Phase 1- Preliminary Risk Assessment indicated that development is located within the Northumberland Coalfield as defined by the Coal Authority Data, then ground gas protection to a minimum standard of CS2 will need to be installed into the proposed developments.

Further information of ground gas protection can be found at:
https://www.northumberland.gov.uk/NorthumberlandCountyCouncil/media/Public-Protection/Pollution/YALPAG-Technical-Guidance-Verification-Requirements-for-Gas-Protection-Systems-Version-1-1-%E2%80%93-December-2016.pdf

To ensure that the proposed development site is dealt with in an appropriate manner to afford protection to future end users.

Permitted Development Rights:
Public Protection often asks that the Local Planning Authority remove all permitted development rights for these sites with ground gas protection in the coal field areas. This is to ensure no other buildings (extensions, porches, conservatories etc.) are built in relation to the proposed dwellings to ensure that the proposed gas protection measures are not compromised.

2 Potential Road Traffic Noise impact upon the proposed development
PHPU Notes that the proposed development site lies adjacent to the B6309 Roadway. Noise emanating from Road Traffic (B6309) has the potential to cause loss of amenity to future occupiers.

Potential Road Traffic Noise (B6309)
Calculating Noise from Existing Roads Traffic
Calculating and assessment the impact of road traffic noise on existing or new properties and to determine the need for noise insulation where roads are altered or a new one proposed should be based on

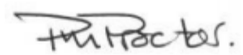
- Road Traffic Noise (CRTN) 1988.
- Sound Insulation and Noise Reduction for Building - Code of Practice BS 8233;2014
- World Health Organisation (WHO) publication "Community Noise Noise" 1999

Http://whqlibdoc.who.int/hq/1999/a68672.pdf

If the noise assessment of road traffic noise indicates that the development requires noise mitigation measures the applicant should submit an acoustic design scheme shall to the Local Planning Authority. The scheme shall demonstrate that noise levels can comply with BS8233:2014 and the WHO Guidelines for Community Noise for the following metris, LAeq (16 hour), LAew 8(hour) and LAmax. Habitable rooms on the façade facing away from the station Road shall have windows which are not restricted from opening. The scheme shall include internal room layouts to show that the main habitable rooms* shall have access to a window which can be opened without causing the ingress of obtrusive noise above guidance levels. Thereafter, the approved acoustic design scheme shall be implemented in full before the occupation of the dwelling it relates to and retained in perpetuity.
*Main habitable rooms shall be taken to mean living rooms (07:00 - 23:00) and the master bedrooms (23:00 - 07:00)
To protect the amenity of future occupiers of the proposed development.

PHPU would advise the applicant that the above information must be provided upfront to allow a robust assessment of the application to ensure that any of the above validation requirements are satisfied in order to protect the residential amenity of existing receptors.
Should these reports not be submitted then PHPU will not be able to fully appraise the development and are likely to ask that it is refused due to lack of information.

Informative
The effectiveness of the development's design in ensuring that a nuisance is not created, is the responsibility of the applicant / developer and their professional advisors / consultants. Applicants / Developers should, therefore, fully appreciate the importance of obtaining competent professional advice. In all cases, the Council retains its rights under Section 79 of the Environment Protection Act 1990, in respect of the enforcement of Statutory Nuisance.

	Name	Signature
Prepared by	Paul Proctor	
Checked by	David Lathan	

Appendix L BS 8233

BS 8233:2014

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 28 February 2014. It was prepared by Technical Committee B/564, *Noise control on building sites*, and Subcommittee EH/1/6, *Building acoustics*. A list of organizations represented on these committees can be obtained on request to their secretaries.

Supersession

This British Standard supersedes BS 8233:1999, which is withdrawn.

Information about this document

This British Standard draws on the results of research and experience to provide information on the design of buildings that have internal acoustic environments appropriate to their functions. It deals with control of noise from outside the building, noise from plant and services within it, and room acoustics for non-critical situations. This document is intended for use by non-specialist designers and constructors of buildings and those concerned with building control, planning and environmental health.

This is a full revision of the standard. The principal changes have been made to reflect:

- changes to the legislative framework since publication of the 1999 edition;
- revisions to Building Regulations Approved Document E [1];
- the publication of specialist documents for specific sectors, such as healthcare and education;
- the publication in England of the National Planning Policy Framework [2] in March 2012, with the concurrent withdrawal of numerous individual planning guidance and policy statement documents, including those specifically relating to noise;
- a reappraisal of the tabular content with respect to setting targets for various classes of living space in the light of research findings; and
- the need to transfer some of the more detailed information from the main text to annexes.

BS 8233:1999 was, like its predecessor CP3 Chapter III:1972, published as a code of practice. However, it was decided to publish this edition as a guide because the text largely comprises guidance that does not support claims of compliance.

Use of this document

As a guide, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it.

Presentational conventions

The guidance in this standard is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

0 Introduction

Noise control in and around buildings is discussed in this British Standard guide on an objective and quantifiable basis as far as is currently possible. For many common situations, this guide suggests criteria, such as suitable sleeping/resting conditions, and proposes noise levels that normally satisfy these criteria for most people. However, it is necessary to remember that people vary widely in their sensitivity to noise, and the levels suggested might need to be adjusted to suit local circumstances. Moreover, noise levels refer only to the physical characteristics of sound and cannot differentiate between pleasant and unpleasant sounds. Important though psychological factors are, it is not practicable to consider them in this guide.

NOTE The standard is intended to be used routinely where noise sources are brought to existing noise-sensitive buildings.

Attention is drawn to the fact that measures taken to control sound might also impinge on fire precautions and other health and safety requirements. All such requirements need to be considered together at an early stage of the design.

1 Scope

This British Standard provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building.

This British Standard does not cover:

a) specialist applications, such as auditoria and cinemas (for cinemas, see BS ISO 9568);

b) vibration control, except where it is evident in the form of radiated sound; or

c) noise that breaks out from the building that might affect external receptors.

NOTE Annex A describes some of the simpler types of noise calculation. A method of rating noise is described in Annex B. Methods of measurement of sound insulation are described in Annex C. Annex D outlines some special problems requiring expert advice. Annex E describes airborne and impact sound insulation. Annex F sets out the legislative framework applicable to noise producing developments. Annex G provides example calculations for resolving a typical design problem. Examples of design criteria adopted by various hotel groups are included for reference in Annex H.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 4142, *Methods for rating and assessing industrial and commercial sound* [1)]

BS 5502-32, *Buildings and structures for agriculture – Part 32: Guide to noise attenuation*

BS EN 20354, *Acoustics – Measurement of sound absorption in a reverberation room*

[1)] Revision in preparation.

BS EN 60942, *Electroacoustics – Sound calibrators*

BS EN 61672-1, *Electroacoustics – Sound level meters – Part 1: Specifications*

BS EN 61672-2, *Electroacoustics – Sound level meters – Part 2: Pattern evaluation tests*

BS EN ISO 140, *Acoustics – Measurement of sound insulation in buildings and of building elements*

BS EN ISO 140-4, *Acoustics – Measurement of sound insulation in buildings and of building elements – Part 4: Field measurements of airborne sound insulation between rooms*

BS EN ISO 140-7, *Acoustics – Measurement of sound insulation in buildings and of building elements – Part 7: Field measurements of impact sound insulation of floors*

BS EN ISO 10140-1, *Acoustics – Laboratory measurement of sound insulation of building elements – Part 1: Application rules for specific products*

BS EN ISO 10140-2, *Acoustics – Laboratory measurement of sound insulation of building elements – Part 2: Measurement of airborne sound insulation*

BS EN ISO 10140-3, *Acoustics – Laboratory measurement of sound insulation of building elements – Part 3: Measurement of impact sound insulation*

BS EN ISO 10140-4, *Acoustics – Laboratory measurement of sound insulation of building elements – Part 4: Measurement procedures and requirements*

BS EN ISO 10140-5, *Acoustics – Laboratory measurement of sound insulation of building elements – Part 5: Requirements for test facilities and equipment*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

3.1.1 A-weighted sound pressure

p_A

value of overall sound pressure, measured in pascals (Pa), after the electrical signal derived from a microphone has been passed through an A-weighting network

NOTE The A-weighting network modifies the electrical response of a sound level meter with frequency in approximately the same way as the sensitivity of the human hearing system.

3.1.2 A-weighted sound pressure level

L_{pA}

quantity of A-weighted sound pressure given by the following formula in decibels (dBA)

$$L_{pA} = 10 \log_{10} (p_A/p_0)^2$$

where:

p_A is the A-weighted sound pressure in pascals (Pa);

p_0 is the reference sound pressure (20 μPa)

*NOTE Measurements of A-weighted sound pressure level can be made with a meter and correlate roughly with subjective assessments of loudness. They are usually made to assist in judging the effects of noise on people. The size of A-weighting, in 1/3 octave bands, is shown in Annex A (see **A.5**). An increase or decrease in level of 10 dBA corresponds roughly to a doubling or halving of loudness.*

3.1.3 background sound
underlying level of sound over a period, *T*, which might in part be an indication of relative quietness at a given location

3.1.4 break-in
noise transmission into a structure from outside

3.1.5 break-out
noise transmission from inside a structure to the outside

3.1.6 cross-talk
noise transmission between one room and another room or space via a duct or other path

3.1.7 C_{tr}
correction term applied against the sound insulation single-number values (R_w, D_w, and $D_{nT,w}$) to provide a weighting against low frequency performance

NOTE The reference values used within the C_{tr} calculation are based on urban traffic noise.

3.1.8 equivalent continuous A-weighted sound pressure level
$L_{Aeq,T}$

value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, *T*, has the same mean-squared sound pressure as the sound under consideration that varies with time

NOTE 1 This is given by the following formula.

$$L_{\mathrm{Aeq},T} = 10\log_{10}\left[\frac{1}{T}\int_0^T \frac{p_{\mathrm{A}}{}^2(\mathrm{t})}{p_0{}^2}\,\mathrm{d}t\right]$$

where:

$p_A(t)$ *is the instantaneous A-weighted sound pressure in pascals (Pa);*

p_0 *is the reference sound pressure (20 μPa).*

NOTE 2 Equivalent continuous A-weighted sound pressure level is mainly used for the assessment of environmental noise and occupational noise exposure.

3.1.9 equivalent sound absorption area of a room
A

hypothetical area of a totally absorbing surface without diffraction effects, expressed in square metres (m²), which, if it were the only absorbing element in the room, would give the same reverberation time as the room under consideration

3.1.10 facade level
sound pressure level 1 m in front of the facade

NOTE Facade level measurements of L_{pA} are typically 1 dB to 2 dB higher than corresponding free-field measurements because of the reflection from the facade.

3.1.11 free-field level
sound pressure level away from reflecting surfaces

NOTE Measurements made 1.2 m to 1.5 m above the ground and at least 3.5 m away from other reflecting surfaces are usually regarded as free-field. To minimize the effect of reflections the measuring position has to be at least 3.5 m to the side of the reflecting surface (i.e. not 3.5 m from the reflecting surface in the direction of the source). Estimates of noise from aircraft overhead usually include a correction of 2 dB to allow for reflections from the ground.

3.1.12 impact sound pressure level
L_i

average sound pressure level in a specific frequency band in a room below a floor when it is excited by a standard tapping machine or equivalent

NOTE For additional information on impact sound pressure level and the standard tapping machine see Annex C and BS EN ISO 140-7.

3.1.13 indoor ambient noise
noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants

NOTE The location(s) within the room at which the ambient indoor noise is to be measured or calculated ought to be considered.

3.1.14 noise criteria
numerical indices used to define design goals in a given space

3.1.15 noise rating
NR

graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves

NOTE Noise rating is described in Annex B.

3.1.16 normalized impact sound pressure level
L_n

impact sound pressure level normalized for a standard absorption area in the receiving room

NOTE Normalized impact sound pressure level is usually used to characterize the insulation of a floor in a laboratory against impact sound in a stated frequency band (see Annex C and BS EN ISO 140-7).

3.1.17 octave band
band of frequencies in which the upper limit of the band is twice the frequency of the lower limit

3.1.18 percentile level
$L_{AN,T}$

A-weighted sound pressure level obtained using time-weighting "F", which is exceeded for N% of a specified time interval

EXAMPLE

$L_{A90,1h}$ is the A-weighted level exceeded for 90% of 1 h.

NOTE Percentile levels determined over a certain time interval cannot accurately be extrapolated to other time intervals. Time-weighting "F" or "S" can be selected on most modern measuring instruments and used to determine the speed at which the instrument responds to changes in the amplitude of the signal. Time-weighting "F" is shorter than "S" and so its use can lead to different values when rapidly changing signals are measured.

3.1.19 rating level

$L_{Ar,Tr}$

equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise

NOTE This is used in BS 7445 and BS 4142 for rating industrial noise, where the noise is the specific noise from the source under investigation.

3.1.20 reverberation time

T

time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped

NOTE Reverberation time is usually measured in octave or third octave bands. It is not necessary to measure the decay over the full 60 dB range. The decay measured over the range 5 dB to 35 dB below the initial level is denoted by T_{30}, and over the range 5 dB to 25 dB below the initial level by T_{20}.

3.1.21 sound exposure level

L_{AE}

level of a sound, of 1 s duration, that has the same sound energy as the actual noise event considered

NOTE 1 The L_{AE} of a discrete noise event is given by the formula:

$$L_{\mathrm{AE}} = 10 \log_{10} \left[\frac{1}{\mathrm{t}_0} \int_{t_1}^{t_2} \frac{{p_{\mathrm{A}}}^2(\mathrm{t})}{{p_0}^2} \, \mathrm{d}t \right]$$

where:

- $p_A(t)$ *is the instantaneous A-weighted sound pressure in pascals (Pa);*
- $t_2 - t_1$ *is a stated time interval in seconds (s) long enough to encompass all significant sound energy of the event;*
- p_0 *is the reference sound pressure (20 μPa);*
- t_0 *is the reference time interval (1 s).*

NOTE 2 L_{AE} is also known as L_{AX} (single-event noise exposure level).

3.1.22 sound level difference

D

difference between the sound pressure level in the source room and the sound pressure level in the receiving room

NOTE D is given by the following formula.

$$D = L1 - L2$$

where:

- *L1* *is the average sound pressure level in the source room;*
- *L2* *is the average sound pressure level in the receiving room.*

3.1.23 sound pressure
p

root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound

3.1.24 sound pressure level
L_p

quantity of sound pressure, in decibels (dB), given by the formula:

$$L_p = 10\log_{10}\left(p / p_0\right)^2$$

where:

p is the root-mean-square sound pressure in pascals (Pa);

p_0 is the reference sound pressure (20 μPa)

NOTE The range of sound pressures for ordinary sounds is very wide. The use of decibels gives a smaller, more convenient range of numbers. For example, sound pressure levels ranging from 40 dB to 94 dB correspond to sound pressures ranging from 0.002 Pa to 1 Pa. A doubling of sound energy corresponds to an increase in level of 3 dB.

3.1.25 sound reduction index
R

laboratory measure of the sound insulating properties of a material or building element in a stated frequency band

NOTE For further information, see Annex C and BS EN ISO 10140-2.

3.1.26 standardized impact sound pressure level
L'_{nT}

impact sound pressure level normalized to a reverberation time in the receiving room of 0.5 s

NOTE Standardized impact sound pressure level is used to characterize the insulation of floors in buildings against impact sounds in a stated frequency band (see Annex C and BS EN ISO 140-7).

3.1.27 standardized level difference
D_{nT}

difference in sound level between a pair of rooms, in a stated frequency band, normalized to a reference reverberation time of 0.5 s for dwellings

NOTE Standardized level difference takes account of all sound transmission paths between the rooms (see Annex C and BS EN ISO 140-4).

3.1.28 Groundborne and structure-borne noise

NOTE When elements of a structure vibrate they radiate noise and, if the vibration is high enough, this noise can be audible. Groundborne and structure-borne noise are rarely an issue outside buildings or structures.

3.1.28.1 groundborne noise

audible noise caused by the vibration of elements of a structure, for which the vibration propagation path from the source is partially or wholly through the ground

NOTE Common sources of groundborne noise include railways and heavy construction work on adjacent construction sites.

3.1.28.2 structure-borne noise
audible noise caused by the vibration of elements of a structure, the source of which is within a building or structure with common elements

NOTE Common sources of structure-borne noise include building services plant, manufacturing machinery and construction or demolition of the structure.

3.1.29 third octave band
band of frequencies in which the upper limit of the band is $2^{1/3}$ times the frequency of the lower limit

3.1.30 weighted level difference
D_w

single-number quantity that characterizes airborne sound insulation between rooms, but which is not adjusted to reference conditions

NOTE Weighted level difference is used to characterize the insulation between rooms in a building as they are. Values cannot normally be compared with measurements made under other conditions (see BS EN ISO 717-1).

3.1.31 weighted normalized impact sound pressure level
$L'_{n,w}$

single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies

NOTE Weighted normalized impact sound pressure level is usually used to characterize the insulation of floors tested in a laboratory (see Annex C and BS EN ISO 717-2).

3.1.32 weighted sound reduction index
R_w

single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies

NOTE The weighted sound reduction index is used to characterize the insulation of a material or product that has been measured in a laboratory (see Annex C and BS EN ISO 717-1).

3.1.33 weighted standardized impact sound pressure level
$L'_{nT,w}$

single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies

NOTE Weighted standardized impact sound pressure level is used to characterize the insulation of floors in buildings (see Annex C and BS EN ISO 717-2).

3.1.34 weighted standardized level difference
$D_{nT,w}$

single-number quantity that characterizes the airborne sound insulation between rooms

NOTE Weighted standardized level difference is used to characterize the insulation between rooms in a building (see Annex C and BS EN ISO 717-1).

3.2 Symbols

For the purposes of this British Standard the following symbols apply.

A	Equivalent sound absorption area (m^2)
D	Sound level difference (dB)
D_w	Weighted level difference (dB)

D_{nT} Standardized level difference (dB)

$D_{nT,w}$ Weighted standardized level difference (dB)

L_{Amax} Maximum noise level (dB)

$L_{Ar,Tr}$ Rating level (dB)

L_i Impact sound pressure level (dB)

L_n Normalized impact sound pressure level (dB)

L'_{nT} Standardized impact sound pressure level (dB)

$L'_{nT,w}$ Weighted standardized impact sound pressure level (dB)

$L'_{n,w}$ Weighted normalized impact sound pressure level (dB)

L_p Sound pressure level (dB)

L_{pA} A-weighted sound pressure level (dB)

$L_{AN,T}$ Percentile level (dB)

L_{AE} Sound exposure level (dB)

$L_{Aeq,T}$ Equivalent continuous A-weighted sound pressure level (dB)

p Sound pressure (Pa)

p_A A-weighted sound pressure (dB)

$p_A(t)$ Instantaneous A-weighted sound pressure (Pa)

p_0 Reference sound pressure (Pa)

R Sound reduction index (dB)

R_w Weighted sound reduction index (dB)

T Time interval (also used for reverberation time) (s)

t_0 Reference time interval (s)

4 Measuring equipment and accuracy

The equipment to be used for measuring noise levels should:

a) conform to the accuracy requirements specified in BS EN ISO 140, BS EN ISO 10140 or BS 4142, as applicable; or

b) if not stated, meet Class 2 or better (see BS EN 61672-1, BS EN 61672-2 and BS EN 60942).

In critical situations, for example, where the measurements are to confirm that a specification has been met or for the resolution of a dispute, the appropriate guidelines for the building use should also be followed.

*NOTE 1 Quantification of measurement uncertainty is generally described in the relevant British or International standard and specific guidance, such as that supporting the Building Regulations (see, for example, **7.7.3.1**), healthcare design technical manuals and schools building bulletins (see, for example, **7.7.8**).*

NOTE 2 Where there are no specific measurement requirements for a building use, the guidelines published by the Association of Noise Consultants [3] or other professional bodies may be followed.

5 Planning and design

5.1 Sequence of stages

The recommended sequence of stages in the planning and early design stages of a development is as follows.

a) Assess the site, identify significant existing and potential noise sources, measure or estimate noise levels (see Clause **6**), and evaluate layout options (see **5.2**).

b) Determine design noise levels for spaces in and around the building(s) (see **5.3** and Clause **7**).

c) Determine sound insulation of the building envelope, including the ventilation strategy (see **5.4.5** and Clause **6**).

d) Identify internal sound insulation requirements (see **5.3** and Clause **8**).

e) Identify and design appropriate noise control measures (see **5.4**).

f) Establish quality control and ensure good quality workmanship (see **5.5**).

Although this British Standard does not cover the impacts on external receptors of noise that breaks out from the building, it might be necessary to address this within the overall design and planning process.

The same sequence [a) to f)] can be applied where a new noise-making development is to be introduced near an existing noise-sensitive development, such as housing.

5.2 Assessing the building or site

5.2.1 Need for noise assessment

When planning permission is sought for a new building or for a change of use to an existing building, the local planning authority may:

a) refuse permission if the site is too noisy for the proposed use and local or national noise policies will not be met; or

b) refuse permission if the proposed use is likely to cause noise disturbance to the occupants of existing buildings such that local or national noise policies will not be met; or

c) grant permission, with or without conditions regarding noise levels, so that local or national noise policies are met.

NOTE 1 The local planning authority needs to take account of the following government publications:

- *in England: the National Planning Policy Framework published by the Department for Communities and Local Government (March 2012) [2], relevant National Policy Statements and the Noise Policy Statement for England [4];*
- *in Wales: the Welsh Government publications "Planning Policy Wales" [5] and Technical Advice Note (TAN) 11: Noise [6];*
- *in Scotland: the Scottish Government's Planning Advice Note 1/2011: Planning and Noise [7] and the accompanying Technical Advice Note [8];*
- *in Northern Ireland: where appropriate, the relevant Planning Policy Statement [9] or relevant Development Control Advice Note [10]; and*
- *any noise action plans published under the relevant Environmental Noise Regulations [11, 12, 13, 14].*

It is therefore important that, even when a full environmental assessment is not mandatory, proposals for developments on noisy sites, or sites which generate noise, should take account of noise, and an assessment should be made of the possible effects of:

1) noise generated outside the site that might enter any building on site;
2) noise generated inside the site or a building on site that could affect people outside the site/building;

   NOTE 2 The noise in item 2) is outside the scope of this British Standard.

3) the effect of the proposed development on the existing ambient noise outside the site.

Some noise sources (e.g. airports) might not always be active, or might change their mode of operation under different weather conditions and/or at certain times of day or night. Furthermore, buildings might not necessarily be occupied when the outside environment is noisy. It is therefore essential to make a full assessment of the site before considering the need for, and extent of, noise control.

5.2.2 Noise generated inside or outside the building

5.2.2.1 Noise generated inside the building

For noise generated and heard within the building, the design guidance in Clause **8** for sound insulation within the building should be followed.

The existing and expected noise source(s) should first be identified and the designer should apply the following procedures.

a) Select metrics to use for measuring or predicting noise levels (e.g. $L_{Aeq,T}$, or L_p in octave or third octave bands).
b) Assess effects of topography and other features, such as noise screens or reflecting surfaces.
c) Measure or predict noise levels at strategic points. In some complex situations it might be worth drawing a contour map of external noise levels.
d) If appropriate, assess noise levels due to user activities around the buildings and site.

The levels of existing noise and noise expected in the foreseeable future should be based on measurement where practicable, or may be predicted if there is reliable information.

5.2.2.2 Noise generated outside the building

For noise sources outside the building, the initial appraisal should take account of the options for:

a) location of the site in relation to the noise source(s);
b) reduction of noise at source;
c) positioning of buildings on site;
d) orientation of buildings on site;
e) provision of barriers;
f) increasing the sound insulation of the building envelope; and
g) re-planning the interior layout of the building.

These options might also be applicable to protecting neighbouring buildings that are likely to be disturbed by noise generated within the building.

5.3 Design and noise criteria: noise levels

The designer should establish the intended use, including noise activity, noise sensitivity and privacy, of the proposed rooms and other spaces.

To achieve satisfactory sound insulation inside the building, it is necessary to know how each space is to be used so that appropriate noise criteria can be chosen. The designer can then decide which noise criteria are appropriate for the relevant parts of the proposed building, and select appropriate noise levels (see **7.2** and **7.3**).

*NOTE Advice on indoor ambient noise criteria for various building types is given in **7.3**.*

The designer should also:

a) compare external noise levels with internal design criteria;

b) calculate the noise reduction required between the exterior and interior;

c) if appropriate, assess internal noise sources;

d) calculate the noise reduction required between internal user areas and, if necessary, the noise reduction required to reduce noise from internal sources to the level required outside the building; and

e) identify which noise control measures would be appropriate to deliver this noise reduction (see **5.4**).

5.4 Noise control measures

5.4.1 General approach

All reasonable noise control measures should be designed and implemented to ensure that the noise levels are met, along with local or national noise management policies, as appropriate.

NOTE Effective design for noise control requires a good understanding of the behaviour of sound. While the general approach is explained in this subclause, practical information on the transmission of sound within buildings and propagation across the ground is given in the Building Research Establishment document BR 238/CIRIA report 127 [15]. Specialist advice is required for more complex situations, such as those listed in Annex D.

In determining the appropriate noise control measures, the designer should take the following steps, which may be iterative.

a) Check the feasibility of reducing noise levels and/or relocating noise sources.

b) Consider options for planning the site or building layout.

c) Consider the orientation of proposed building(s).

d) Select construction types and methods for meeting building performance requirements (see **5.4.4**).

e) Examine the effects of noise control measures on the requirements for ventilation, fire regulation, health and safety, cost, CDM (construction, design and management), etc.

f) Assess the viability of alternative solutions.

The designer should then decide which of the following options can be applied to reduce noise levels.

1) Quietening or removing the source of noise (**5.4.2**).

2) Attenuating the sound on its path to the receiver (**5.4.3**).

3) Obstructing the sound path between source and receiver (**5.4.4**).

4) Improving the sound insulation of the building envelope (**5.4.5**).

5) Using agreements to manage noise (**5.4.6**).

5.4.2 Quietening the source

Reducing the noise at source should always be considered because the number of people benefiting might be large and it can be the most cost-effective method.

5.4.3 Attenuating the noise

Noise is attenuated as it travels through the air because it:

a) spreads out;

b) is affected by nearby surfaces, such as grass-covered ground; and

c) is partly absorbed by the air itself.

These mechanisms for attenuating noise become more effective as the distance between the source and the receiver increases. Spreading is usually the most important effect. For small sources, the reduction is up to approximately 6 dB for each doubling of distance between source and receiver. For extended sources, there is a smaller reduction with distance. For example, the noise level from dense road traffic diminishes at approximately 3 dB for each doubling of distance.

In some circumstances, the noise might not attenuate at expected rates, with poor attenuation occurring with traffic in city streets with high buildings on both sides. In this situation, the noise level diminishes vertically very slowly as the storey height increases because of multiple reflections between the facades (canyon effect).

Ground attenuation is negligible for hard ground and water surfaces. For grassland and other types of ground considered "soft", the attenuation varies with frequency.

5.4.4 Obstructing the sound

Complete enclosure of the noise source or receiver is the most effective form of barrier, provided it is impervious and sufficiently heavy. The walls and roof of a building usually perform this function (see Clause **8**). Their effectiveness as a sound insulator is reduced by weaknesses in the envelope (e.g. ventilation openings, thin glazing and doorways), especially when windows are opened. It is therefore important that the effectiveness of measures for obstructing sound is determined.

Barriers that are not complete enclosures (e.g. screens) are normally most effective when tall, long, sound-absorbent, and close to either the source or the receiver.

Solid fences, walls, earth bunds or buildings should extend to the ground.

Whilst neither of the national methods for calculating noise from road traffic or from railways provides for any reduction in noise due to the presence of vegetation, other available guidance suggests that appreciable attenuation can be expected under certain conditions. ISO 9613-2 includes procedures for estimating the attenuation from foliage (trees and shrubs) in each octave band as a function of the total propagation distance that the sound travels through the foliage.

In the context of promoting sustainable methods for reducing road traffic noise, the HOSANNA (Holistic and Sustainable Abatement of Noise by Optimised Combinations of Natural and Artificial Means) Research Project (see Note), funded by the European Union Seventh Framework Programme, was tasked with investigating the theoretical performance of different forms and configurations of vegetation-based noise mitigation, including trees (rows and belts), shrubs and bushes. The study reports that, through an optimized combination of scattering, dispersion, absorption and diffraction effects, appreciable reductions in traffic noise can be expected from compositions of vegetation elements (such as twigs, leaves, stems and trunks).

*NOTE To calculate the attenuation for road and rail traffic noise and construction noise, see the references given in Clause **6**. Attenuation values of approximately 10 dB are common, but a barrier can reduce the benefit of any ground absorption.*

5.4.5 Sound insulation of the building envelope

5.4.5.1 General

Where the designer proposes a form of construction that is intended to obstruct noise, and which might take into account cost and other constraints, the proposed design should be examined and calculations carried out to determine whether the target noise reduction is likely to be achieved. The results indicate whether a higher standard of noise reduction might be necessary or whether a lower standard is adequate. If the need for a change in the design is indicated, further calculations should be carried out and the process repeated until a satisfactory result is obtained. In a situation where a low standard suffices it might be prudent to consider future uses of the building.

When the sound insulation of the building envelope is not known, this may be calculated using one of the methods given in **5.4.5.2** (see also BS EN 12354).

5.4.5.2 Calculations

5.4.5.2.1 General

The required sound insulation should be determined on the basis of the assessment of:

a) the level and characteristics of the noise outside the building (see **5.2** and Clause **6**);

b) the design noise levels in the rooms and other spaces of the building (see **5.3** and Clause **7**).

The sound insulation required can then be determined.

5.4.5.2.2 Initial estimates

Initial estimates may be obtained using calculations based on single-figure data such as the following.

a) The level of the noise at a key position, such as the equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$) at the location of the nearest facade of the proposed building. The time period, T, should be chosen to cover the normal operation of the source, or particular occupational requirements of the building if more appropriate. If the source level varies, the maximum level having an appreciable duration should be chosen.

b) The sound reduction of appropriate parts of the building envelope, e.g. estimated from values of R_w (see Clause **8** and Annex E).

NOTE Annex A contains a method for estimating the sound insulation of a non-uniform facade comprising windows, ventilation openings and cladding.

c) The design sound level at the receiver (e.g. $L_{Aeq,T}$). If the source operates at night, it might be appropriate to have separate design noise levels for day and night periods.

It is important to understand that there is no simple relationship connecting these single-figure data and that the results are approximate (see Clause **6**).

5.4.5.2.3 Detailed calculations

For detailed calculations, knowledge of the following is required.

a) Frequency characteristics of the noise source(s).

b) Frequency characteristics of the sound reducing elements.

c) Surface area of the common construction separating the two areas.

d) Reverberation time of the receiving space.

Generally, frequency data should be for contiguous octave bands.

5.4.6 Agreements

For certain types of building, it might be possible to assist the management of noise by express provisions in agreements. For example, a contract specification might set noise limits, a tenancy agreement can restrict the use of musical instruments, providing the restriction is sufficiently specific to be enforceable, or a noise management plan might require monitoring of noise levels and actions if limits are exceeded.

5.5 Quality control and workmanship

Quality control and workmanship should always be considered very carefully. Noise control measures can fail to perform adequately if they are not built as the designer intended. Such variations might appear to be unimportant, but often have serious implications for noise control, e.g. a slight warp in a window frame can reduce the effectiveness of the seals. To establish good quality control and workmanship the following aspects should be considered by the designer and discussed with the builder.

a) Detailed specifications.

b) The standards of materials and workmanship.

c) Performance specification in the contract documentation.

d) Checking and testing procedures that are to be used to demonstrate the standard of workmanship during construction.

e) Checking and testing procedures that are to be used to assess the building performance.

6 External noise sources

6.1 Introduction

Noise from common sources in the environment is dealt with in **6.2** to **6.7**. In each case, information is given on the characteristics of the noise and guidance is given as to how levels can be determined and controlled for each specific source. Example calculations for resolving a typical design problem are given in Annex G.

6.2 Noise from road traffic

6.2.1 General

Road traffic noise generation depends upon a number of factors, including:

a) traffic flow, which can vary considerably within and between days of the week;

b) type of vehicles, i.e. proportion of heavy or light;

c) mode of operation, i.e. on level or inclined road;

d) surface texture of the road; and

e) traffic speed and whether flow is continuous or interrupted.

NOTE Weather conditions, e.g. surface water on road, can also affect noise generation.

As with other types of noise the propagation depends upon meteorological conditions, topographical features and ground cover characteristics.

For a typical urban situation where road speed is below 60 km/h, sound energy is concentrated in the low frequency end of the spectrum because of high levels of exhaust noise, particularly from diesel commercial vehicles. At greater speeds (i.e. 80 km/h or higher), more energy is present at higher frequencies due to the road/tyre surface interaction and aerodynamic noise. This difference in spectral characteristics can affect the nature of the noise heard within a building, and should be considered when different noise control measures are being examined.

For initial design purposes, typical noise levels for three common situations are given in Table 1.

Table 1 **Typical traffic noise levels measured approximately 1 m from the facade**

Situation	**dB** $L_{Aeq,16h}$
At 20 m from the edge of a busy motorway carrying many heavy vehicles; average traffic speed 100 km/h; intervening ground turfed	78
At 20 m from the edge of a busy main road through a residential area; average traffic speed 50 km/h; intervening ground paved	68
On a residential road parallel to a busy main road and screened by the houses from the main road traffic; free flowing traffic	58

NOTE Values are for dry road.

A typical noise spectrum for assessing sound reduction near roads is given in BS EN 1793-3. For more complex situations, detailed calculations or measurements should be undertaken.

6.2.2 Modelling traffic noise

The noise from road traffic can be calculated for a specified range of situations using the method in *Calculation of Road Traffic Noise* (CRTN) [16]. This method predicts the $L_{A10,18h}$ for the period 06:00 to 24:00 or the $L_{A10,1h}$ for roads carrying more than 1 000 vehicles per 18 h day or 50 vehicles per hour. It is the recognized national method for calculating road traffic noise levels, but has been augmented by additional guidance published by the Highways Agency (*Design Manual for Roads and Bridges*, Volume 11, Section 3, Part 7, HD 213/11 – Revision 1) [17]. This additional guidance includes updated advice on calculating night-time noise levels, determining the extent of the study area, vehicle classification, corrections for contemporary road surfaces, speed data, and other approaches to modelling certain specific situations. It is usual to make flow rate forecasts 15 years ahead.

The method takes the following factors into account.

a) Hourly or 18-hourly traffic flow rate.

b) Mean traffic speed.

c) Percentage of heavy vehicles.

Other information required for the calculation includes:

1) road surface and gradient;

2) ground type;

3) height of receiver;

4) shielding by barriers and cuttings;

5) reflections at facades and from nearby buildings; and

6) angle of view of the road.

The method can be used to draw noise contours on a site plan, and this is now usually implemented through a number of proprietary noise prediction models which implement the calculation procedure in CRTN [16]. However, where traffic conditions are complex or unusual it might be necessary to measure noise levels on site, and procedures for measurements are contained within CRTN [16].

A Defra-commissioned study, prepared by TRL and entitled "*Method for Converting the UK Road Traffic Noise Index $L_{A10,18h}$ to the EU Noise Indices for Road Noise Mapping*" [18], is the source of the method promulgated in Highways Agency document HD 213/11 [17] for estimating night-time noise levels from the calculated or measured $L_{A10,18h}$.

This study, however, also provides methods for the conversion of $L_{A10,18h}$ index to other indices, including various period $L_{Aeq,T}$ values. Whilst these conversions have been developed primarily for compliance with strategic EU noise mapping requirements, they provide one potential approach to estimating the range of noise indicators which are relevant to modelling traffic noise.

Otherwise, conversion of L_{A10} to L_{Aeq} can be achieved by the (approximate) relationship: $L_{Aeq,16h} = L_{A10,18h} - 2$ dB. This is generally correct with a 95% confidence interval of ±2 dB for moderate and heavy traffic flows.

6.3 Noise from aircraft

6.3.1 General

For most airports, the airport operator is responsible for the noise management, which has to be designed to align with Government policy. The exceptions are Heathrow, Gatwick and Stansted, for which the Department of Transport has noise management responsibility. Airports covered by Directive 2002/49/EC [19] have published Noise Action Plans which describe their noise management, including information about flight paths, hours of operation, the planning conditions under which they operate and other noise mitigation practices.

Aircraft noise can be controlled by voluntary noise abatement procedures, which can include:

a) the adoption of noise preferential routes; and

b) restrictions on the number of movements and/or classes of aircraft.

Aerodromes used for commercial air transport of passengers and for training in aircraft above certain total maximum total weights are licensed by the Civil Aviation Authority (CAA). Many aerodromes, including general aviation (private and recreational flying and aviation work), do not require a licence for their operation, but the CAA remains responsible for all matters affecting the safety of aircraft and provides guidance on noise consideration at general aviation aerodromes [20].

Planning conditions and legally binding agreements between local planning authorities and landowners can also impose restrictions on aircraft types and operating times, and number of movements, to control noise.

Military aircraft operate under the control of the Military Aviation Authority (MAA).

6.3.2 Prediction of noise from aircraft

Prediction of noise from aircraft or airports is complex, though aircraft noise modelling software packages are available. Many airports periodically produce contours showing the noise exposure around the airport. Care is needed in interpreting these contours as they tend to show average exposure, taking account of different modes of airport operation. This means that, on a particular day, the noise exposure at a particular location might be higher than implied by the contours, and consideration should be given to designing the building envelope for those operational days.

These contours show the noise of aircraft departing from and arriving at an airport without the presence of any shielding effects from buildings or topographical features. They also do not include the noise from ground operations such as taxiing, auxiliary or ground power units or engine testing. Where appropriate, these sources need to be considered separately.

Where it appears that sound insulation treatment is necessary, noise exposure data should be obtained by on-site noise measurements, taking account of wind direction and runway usage. The survey duration of on-site measurements should be sufficient to take account of the various permutations of runway use that can occur, as certain flight paths might only be used under certain wind direction conditions. Where treatment of the building envelope is required to achieve internal design standards then site-specific measurements should be recorded, including provision for the frequency content of the noise (predominantly low frequency noise). It should be noted that for a jet aircraft the frequency content of noise when landing is generally different from that when departing. Typically, landing jet aircraft produce relatively higher levels of high-frequency noise and departing jet aircraft produce relatively higher levels of low-frequency noise.

6.4 Noise from railways

6.4.1 General

Noise from passing trains is characterized in two ways.

a) The passage of trains over the day and night periods, which is dependent upon timetabling. Passenger trains follow strict daily timetables; freight train passage is less predictable and often occurs at night when passenger services have ceased.

b) The specific characteristic associated with the passage of each train type, but this is generally characterized by short periods of high noise levels dependent upon speed, locomotive type, power type (electric/diesel), etc.

6.4.2 Prediction of airborne noise from railways

The recognized national calculation method for airborne noise from railways is given in *Calculation of Railway Noise (CRN)* [21], with additional source terms given in *Additional railway noise source terms for "Calculation of Railway Noise 1995"* [22]. The method begins with the calculation of a reference sound exposure level (SEL or L_{AE}) for rolling noise at 25 m, which is speed-based. The calculated value is then corrected for vehicle type/description which takes into account number of axles and brake type. The procedure enables calculation of two $L_{Aeq,T}$ values:

a) day $L_{Aeq,16h}$ (07.00 to 23.00); and

b) night $L_{Aeq,8h}$ (23.00 to 07.00).

This method takes into consideration the following factors for each type of train.

1) SEL (or L_{AE}) of the train(s).

2) Number and times of train movements.

3) Distance from track.

4) Air absorption.

5) Ground type.

6) Track bed type.

7) Screening.

8) Angle of view.

9) Reflection and facade effects.

6.5 Noise from industry

6.5.1 General

Industrial noise can originate from specific processes, either internal or external to buildings, or from related transport operations, such as loading/unloading vehicles or activities involving other plant such as fork lift trucks.

NOTE Normal traffic movements on site may be assessed using the measures in ***6.2****.*

6.5.2 Assessment of industrial noise

Where industrial noise affects residential or mixed residential areas, the methods for rating the noise in BS 4142 should be applied. BS 4142 describes methods for determining, at the outside of a building:

a) noise levels from factories, industrial premises or fixed installations, or sources of an industrial nature in commercial premises; and

b) background noise level.

6.6 Noise from construction and open sites

6.6.1 General

Noise from construction and open sites can disturb occupants of nearby buildings, whether in residential or other uses. Noise at night can cause sleep disturbance. On this basis, it is commonly accepted that controls are necessary for many construction and open sites, unless they are sufficiently remote from occupied buildings. BS 5228-1 gives recommendations for basic methods of noise control for construction and open sites where work/activities/operations, including demolition, generate significant noise levels. Industry-specific guidance is also included. The legislative background to noise control is described and recommendations are given for establishing effective liaison between developers, site operators and local authorities. Guidance is also given on methods of predicting and measuring noise and assessing its impact on those exposed to it.

6.6.2 Noise effects and community reaction

The main factors that affect the acceptability of noise arising from construction sites are:

a) site location;

b) existing ambient noise levels;

c) duration of site operations;

d) hours of work;

e) attitude of the site operator, e.g. if the site operator communicates with affected residents on a regular basis as to when and for how long noisy events are planned to occur, the expected noise is perceived as less annoying than unexpected noise of an unknown duration;

f) noise characteristics; and

g) whether additional mitigation has been provided in the form of sound insulation or temporary or permanent rehousing.

BS 5228-1 describes methods for noise control and for determining the significance of noise effects. Several example assessment methods are provided from various significant projects. However, one of the key elements is the provision in BS 5228-1:2009, Annex F, of methods for estimating noise from sites, which is assisted by the inclusion of a large data set of source terms for plant and activities.

6.6.3 Prediction of construction site noise

Noise from construction sites arises from a wide range of plant and activities with many different characteristics. BS 5228-1:2009, Annex F, provides methods for estimating the $L_{Aeq,T}$ levels, taking into account:

a) sound power outputs of processes and plant;

b) periods of operation of processes and plant;

c) distances from sources to receivers;

d) presence of screening by barriers;

e) reflection of sound; and

f) soft ground attenuation.

The levels from the range of equipment used are combined to give an overall $L_{Aeq,T}$ level.

NOTE Slightly different procedures exist for stationary and mobile plant, and these are described in a flowchart in BS 5228-1:2009, Figure F.1.

6.7 Noise from wind farms

6.7.1 General

Wind turbines vary in size and power output, from those just a few metres in diameter to large turbines of around 90 m in diameter. As the turbine blades rotate, aerodynamic noise is generated, which sounds like a swishing noise. Many modern pitch-regulated turbines achieve a maximum level of noise emission at or around the wind speed at which they reach their maximum power generation capacity, which then remains constant, or in some cases declines, as wind speed increases. Mechanical noise from the gearbox (when fitted) and, to a lesser extent, the generator is not usually significant, except in small or older turbine designs. The hub is isolated from the tower and the blade assembly to prevent significant structure-borne noise occurring, which in turn prevents any significant vibrations being transmitted to the ground.

6.7.2 Assessment of wind farm noise

The design, size and rotational speed of a turbine influences the character of the noise generated. The quantification of the noise emissions of medium to large wind turbines is set out in BS EN 61400-11. A particular feature of aerodynamic noise, which is often cited as an adverse feature of medium to large wind turbines, is that of amplitude modulation (AM), which is the modulation or rhythmic swish. Excess AM can sometimes occur. However, it cannot be predicted at the planning stage with the current state of the art. Within the UK, ETSU-R-97 [23] may be used to assess and rate the noise from wind farms. ETSU requires wind farms to achieve defined noise limits in order to preserve day time outdoor amenity and sleep quality at night.

In comparison, small turbines generally have a lower noise emission level, but generate higher frequencies since the blades rotate at greater speeds. Thus the noise impact from these turbines is relatively localized. Offshore turbines might only influence the design and construction of buildings when there is nearby onshore infrastructure, such as electrical substations and converter stations.

6.7.3 Prediction of wind turbine noise

Reliable estimates of wind turbine noise can be made using the procedures in the Institute of Acoustics' *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* [24], which provides accepted methods of noise prediction. Following these procedures permits calculation of reliable noise levels at varying distances and locations for a range of operational wind speeds (typically 4 m/s to12 m/s).

6.8 External noise sources: Meteorological effects

Whether noise levels are measured or predicted, wind gradients, temperature gradients and turbulence affect the level of received sound and audibility over short periods. The magnitude of these effects, i.e. variations in noise level and audibility, increases with increasing distance between source and receptor. The effects are asymmetrical and, for distances of 500 m to 1 000 m, typically range from increasing the level by typically 2 dB downwind to reducing it by typically 10 dB upwind. It is not usually practicable to use these factors in design, but the prevailing wind direction should be considered when planning building orientation.

Noise from wind and precipitation, including the wind-generated noise from trees, can also affect noise measurements.

6.9 Other sources of noise

Other noise sources exist, many of which originate from leisure activities, e.g. model aircraft, sports and entertainment.

Codes of practice give guidance on likely noise levels, assessment and frequency of occurrences for most of these noise sources [for example, 25, 26, 27]. Specialist advice might be required.

NOTE Codes produced by the Government can normally be obtained from The Stationery Office, and additional advice might be available from local authority environmental health departments.

Noise from natural sources, such as rivers, streams, waves, birdsong, wind in trees or rain, also contributes to the acoustic environment and could affect noise assessments.

7 Specific types of building

7.1 General

Guidance is given in **7.2** to **7.6** on acoustic criteria and noise levels appropriate for various types of space that have different functions. In addition, attention is drawn to special features requiring consideration. Where the acoustic performance of spaces or systems is critical [e.g. auditoria or complex heating, ventilating and air conditioning (HVAC) systems], specialist advice should be sought (see Annex D).

It is not practical to give detailed guidance on all types of building. Many types of building include spaces having different functions. For example, a factory may include workshops, offices and meeting rooms. Appropriate guidance is given in **7.7**.

7.2 Design considerations

To control internal ambient noise from sources such as traffic and mechanical services, the designer should, at the outset, decide which of the following are appropriate for all or different parts of the proposed building.

a) Industrial working conditions.

b) Speech and telephone communications.

c) Acoustic privacy.

d) Conditions for study and work requiring concentration.

e) Listening conditions.

f) Resting/sleeping conditions.

The designer should establish noise activity levels, noise sensitivity and privacy levels for the relevant spaces.

7.3 Indoor ambient noise criteria

For each space there might be a range of noise levels that are considered acceptable. The designer should select a level appropriate for the particular circumstances. In noise-making workshops, etc., the activity noise is dominant and so the internal ambient noise level is not critical. In most other situations internal ambient noise is important.

NOTE Guidance on indoor ambient noise levels is given in Table 2, Table 3, Table 4, Table 5 and Table 6 for various types of room.

Normally, only the maximum desirable noise level needs to be decided (see Table 4 and Table 5). In some cases, such as open-plan offices and restaurants, a moderate noise level might provide masking for acoustic privacy in shared spaces without causing disturbance, so upper and lower noise levels should be considered (see Table 2).

Table 2 **Indoor ambient noise levels in spaces when they are unoccupied and privacy is also important**

Objective	Typical situations	Design range $L_{Aeq,T}$ dB
Typical noise levels for acoustic privacy in shared spaces	Restaurant	40 – 55
	Open plan office	45 – 50
	Night club, public house	40 – 45
	Ballroom, banqueting hall	35 – 40
	Living room	35 – 40

NOTE See Noise control in building services [28] and BS EN ISO 3382.

Noise levels generally apply to steady sources, such as those due to road traffic, mechanical services or continuously running plant, and should be the noise level in the space during normal hours of occupation but excluding any noise produced by the occupants and their activities. The time period, *T*, should be appropriate for the activity involved (e.g. 23.00 to 07.00 for bedrooms, 30 min for schools). If the noise is fairly steady, it might not be necessary to measure for the whole of the relevant time period to establish the typical outdoor level.

*NOTE Guidelines for the measurement of noise in buildings can be obtained from The Association of Noise Consultants (http://www.association-of-noise-consultants.co.uk/index.php?*p=pubguide).*

7.4 Noise indices

The noise rating (NR) system, a graphical method described in Annex B, is in common use for rating noise from ventilation systems. Although there is no direct relationship between dBA and NR, the following approximate relation applies in the absence of strong low frequency noise.

$$NR \approx dBA - 6$$

Although the NR system is currently a widely used method for rating noise from mechanical ventilation systems in the UK, other methods are also available that are more sensitive to noise at low frequencies [29]. Low frequency noise can be disturbing or fatiguing to occupants, but might have little effect on the dBA or NR value.

7.5 Internal sound insulation

In addition to controlling exterior noise and internal services noise, sound from adjacent spaces can affect the intended use, depending on the noise activity, noise sensitivity and privacy requirement. A matrix may be used to determine the sound insulation requirement of separating partitions once the noise activity, noise sensitivity and privacy requirements for each room and space are established (see **7.2**). An example matrix, which can be adapted according to the specific building use, is given in Table 3. Each room may be both a source and a receiving room. Where adjacent rooms have different uses, the worst case sound insulation should be specified.

Table 3 **Example on-site sound insulation matrix (dB $D_{nT,w}$)**

Privacy requirement	Activity noise of source room	Noise sensitivity of receiving rooms		
		Low sensitivity	Medium sensitivity	Sensitive
Confidential	Very high	47	52	57 [A)]
	High	47	47	52
	Typical	47	47	47
	Low	42	42	47
Moderate	Very high	47	52	57 [A)]
	High	37	42	47
	Typical	37	37	42
	Low	No rating	No rating	37
Not private	Very high	47	52	57 [A)]
	High	37	42	47
	Typical	No rating	37	42
	Low	No rating	No rating	37

*NOTE Background noise can also influence privacy. See also **7.7.6.3**.*

[A)] $D_{nT,w}$ 55 dB or greater is difficult to obtain on site and room adjacencies requiring these levels should be avoided wherever practical.

7.6 Limits for reverberation time

As well as internal ambient noise level, the reverberation time, *T*, measured in seconds (s), should also be considered because it affects the noise level in the space, and also affects the clarity of speech and the warmth of music. Even where good speech conditions are not paramount, an excessively long reverberation time accentuates the background noise and can reduce the clarity of public address announcements.

General guidance on designing rooms for speech (e.g. meeting rooms) is given in **7.7.10**, although the acoustic design of auditoria is a specialized subject and is beyond the scope of this British Standard.

NOTE BS EN ISO 3382 covers the measurement of reverberation time in various room types.

7.7 Specific types of building

7.7.1 Dwelling houses, flats and rooms in residential use (when unoccupied)

This subclause applies to external noise as it affects the internal acoustic environment from sources without a specific character, previously termed "anonymous noise". Occupants are usually more tolerant of noise without a specific character than, for example, that from neighbours which can trigger complex emotional reactions. For simplicity, only noise without character is considered in Table 4. For dwellings, the main considerations are:

a) for bedrooms, the acoustic effect on sleep; and

b) for other rooms, the acoustic effect on resting, listening and communicating.

NOTE Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.

7.7.2 Internal ambient noise levels for dwellings

In general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values in Table 4.

Table 4 **Indoor ambient noise levels for dwellings**

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	—
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	—
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

NOTE 1 Table 4 provides recommended levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Groundborne noise is assessed separately and is not included as part of these targets, as human response to groundborne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

NOTE 2 The levels shown in Table 4 are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the levels recommended in Table 4.

NOTE 3 These levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

NOTE 4 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$ depending on the character and number of events per night. Sporadic noise events could require separate values.

NOTE 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the facade insulation or the resulting noise level.

If applicable, any room should have adequate ventilation (e.g. trickle ventilators should be open) during assessment.

NOTE 6 Attention is drawn to the Building Regulations [30, 31, 32].

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

If there is noise from a mechanical ventilation system, the internal ambient noise levels should be reported separately with the system operating and with it switched off. If the room contains items such as fridges, freezers, cookers and water heaters, these should be turned off during measurement. Shorter measurement periods such as $L_{Aeq,\ 1\ hour}$ may be used by agreement, provided the selected shorter measurement period is shown to be representative of the entire night or day period.

7.7.3 Living accommodation

7.7.3.1 Regulatory framework

The sound insulation between adjoining dwellings is controlled by the Building Regulations [30, 31, 32], which require reasonable standards of insulation for certain walls, floors, and stairs. As the Building Regulations have been devolved in Scotland, Wales and Northern Ireland, the appropriate national regulations should be consulted, together with their supporting documents:

- England: Approved Document E [1];
- Wales: Approved Document E [1];
- Scotland: Section 5 of the Technical Handbook [33];
- Northern Ireland: Technical Booklets G and G1 [34].

7.7.3.2 Design criteria for external noise

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.

7.7.3.3 Internal planning

To minimize disturbance from internally generated noise:

a) services should be kept away from bedrooms;

b) special attention should be given when locating stairs next to noise-sensitive rooms, such as bedrooms, to prevent disturbance by footsteps;

c) special attention should be given when locating bedrooms near the lift and circulation areas, with less sensitive rooms being used as buffers.

NOTE Compatibility between rooms of adjacent dwellings can be assisted by handing and stacking identical dwelling plans.

Where it is necessary to locate bedrooms adjacent to stairs (other than stairs used for fire escape) or lifts, precautions should be taken where practical to minimize noise transfer.

7.7.3.4 Noise levels from lifts in living accommodation

7.7.3.4.1 General

The maximum recommended noise levels within the living accommodation due to lift operation should not exceed the values given in Table 5. These criteria relate to the highest noise levels during any part of the lift cycle and with any occupancy level between zero and the recommended maximum number of people in a car.

The values in Table 5 should be regarded as upper guideline values and every effort should be made in the design of the lift systems and components to minimize noise and vibration at source such that lower levels result in practice.

Table 5 **Noise levels from lifts in living accommodation**

Room	Maximum noise level (dB $L_{Amax,F}$)
Bedroom	25
Living room	30
Other areas	35

NOTE These figures relate solely to lift noise levels and do not account for any other noise sources. These values include noise from the lifts irrespective of the transmission mechanism, i.e. they include both airborne and structure-borne noise.

The lift motor and associated equipment should be installed on suitable anti-vibration mountings to prevent the transmission of excessive vibration and/or structure-borne noise to any parts of the living accommodation.

Lifts should be positioned such as to minimize noise disturbance from the operation of the control gear. Lift doors should operate quietly, and acoustic signals to herald lift arrival should not be audible within dwellings.

7.7.3.4.2 Lift lobbies

Lift operation noise during any part of the lift cycle, including announcements, and with any occupancy level should not normally exceed 55 dB $L_{Amax,F}$ when measured in the lift lobby.

7.7.3.5 Other precautions

Any partition separating a WC from a noise-sensitive room should have an airborne sound insulation of at least 40 dB R_w.

In an apartment building, sound-absorbing materials should be applied to the ceiling surfaces of communal corridors and stairwells to reduce propagation of noise through the building. Such materials need to be applied carefully, only where necessary and as agreed with building control.

Resilient floor coverings, such as carpet with underlay, can be used to minimize noise from footsteps on stair treads, corridors and landings. Noise is reduced at the same floor level and to rooms below the floor or stair. The quietest types of sanitary, heating and plumbing equipment (e.g. WCs, ball valves, refuse chutes) should be used, though their location is more important than their detailed design.

Structure-borne noise should be controlled by isolating the heating pipework from the building structure, at least near the pump. This may be achieved using flexible pipe connectors and resilient fixings on pipe runs. Where pipework penetrates walls and floors, air gaps should be sealed to reduce airborne noise transmission in such a way that structure-borne noise is not transmitted. This may be achieved by packing the gap with mineral wool, and sealing the faces with non-hardening mastic. Building Regulations guidance for fire safety [35, 36, 37] needs to be taken into account. Ventilation fans and similar equipment should be installed on resilient mountings where structure-borne noise would otherwise be a problem.

NOTE For additional guidance see [15].

7.7.4 Spaces in non-domestic buildings when they are unoccupied

The ambient noise levels in non-domestic buildings should not normally exceed the design ranges given in Table 6.

It is advisable to consult a specialist acoustician for guidance on the design of specialist spaces such as recording studios, cinemas, concert halls and opera houses.

*NOTE For schools and hospitals, see **7.7.8**.*

Table 6 **Typical noise levels in non-domestic buildings**

Activity	Location	Design range dB $L_{Aeq,\ T}$
Speech or telephone communications	Department store Cafeteria, canteen, kitchen	50 – 55
	Concourse Corridor, circulation space	45 – 55
Study and work requiring concentration	Library, gallery, museum	40 – 50
	Staff/meeting room, training room	35 – 45
	Executive office	35 – 40
Listening	Place of worship, counselling, meditation, relaxation	30 – 35

7.7.5 Hotels and rooms for residential purposes

7.7.5.1 Design criteria for intrusive external noise

7.7.5.1.1 General

The recommendations for ambient noise in hotel bedrooms are similar to those for living accommodation (see **7.7.2**).

NOTE 1 In addition to hotels, rooms for residential purposes include, among others, student halls of residence, school boarding houses, hostels, hospices and residential care homes. Approved Document E to the Building Regulations [1] might not be applicable to such premises as they are to dwellings. Occupants of rooms for residential purposes, although transitory rather than permanent, might typically reside for longer periods than hotel guests.

In hotels and other multi-occupancy premises containing rooms for residential purposes, it is desirable to avoid intrusive noise, both airborne and impact, in bedrooms, especially when occupants are sleeping (typically assumed to be at night-time).

Intrusive noise can arise from other rooms or uses within the building, from external sources through facades and from internal building services, including heating, ventilation and air conditioning plant.

Consideration should be given to adjacencies, both horizontal and vertical, between bedrooms, and between bedrooms and rooms used for other purposes. Particular attention should be paid to noise from corridors, door closers, adjoining bathrooms, stairwells, lifts and lift lobbies.

NOTE 2 Several large chains of hotels have developed their own criteria for insulating rooms against intrusive noise. Examples of design criteria adopted by various hotel groups are included for reference in Annex H. These examples reflect commercial judgements dependent on the nature of the accommodation provided, e.g. budget or luxury. They are included in this British Standard not as recommendations but as preliminary guidance and, where appropriate, specialist advice ought to be sought.

7.7.6 Offices

7.7.6.1 General

General acoustic guidance for offices is available from the British Council for Offices [38, 39] and the Association of Interior Specialists [40].

Complaints from office workers can arise from the intrusion of external noise, high internal noise levels from services, low background noise and excessive reflections from room surfaces. Inadequate sound insulation between offices is also a frequent source of complaint from those who require privacy for telephone conversations and interviews.

Privacy between offices and between an office and an occupied space requires effective insulation and moderate background noise to mask intruding speech. In order to achieve unintelligible speech from another office, the minimum sound insulation between two offices needs to be approximately D_w = 38 dB. Where privacy is important the minimum sound insulation should be D_w = 48 dB. It is possible that voices can be heard, but the conversation is not usually understood. Where the internal ambient noise level is low it might be necessary to design for higher insulation values (see Table 3 and **7.7.6.3**).

NOTE If a partition does not run from true slab to soffit, it is unlikely that a high level of privacy can be achieved, due to flanking transmission.

7.7.6.2 Controlling noise in open-plan offices

In open-plan offices, the maximum reduction that can be expected between screened workstations separated by 2.5 m to 3.0 m is 15 dB to 25 dB, but the cumulative noise of equipment and people might provide a masking background level which makes this adequate for general needs. The screening should be absorbent-faced and at least 1.5 m high. Low ceilings and absorbent ceilings can assist in reducing sound transmission between workstations. Where ceilings are higher than 3 m, it is more difficult to provide acceptable acoustic conditions in open-plan offices with absorption coverage lower than Class A. Where exposed soffits are used additional absorption might be required. Carpet having good sound-absorbent properties is a desirable floor finish. It should be noted that if the width of the room is small, reflections from the side walls might reduce the effectiveness of the arrangement.

NOTE BS EN ISO 3382-3 specifies methods for the measurement of room acoustic properties in open-plan offices with furnishing.

As some office equipment (e.g. photocopying machines) is noisy, large installations should be contained in a well-screened area or separate room. This could also simplify control of ventilation noise in mechanically-ventilated buildings. Additional speech privacy can be gained by considering spatial planning and the internal ergonomics of the users.

7.7.6.3 Speech privacy in offices

The guidance in this subclause does not apply to amplified speech (e.g. two adjacent video conference rooms), which requires special consideration.

When considering the sound insulation of a partition between two areas, the following factors should be taken into account.

a) The required function of the two rooms. Is conversation required to be inaudible in one room or is some audible speech acceptable, not intrusive or intelligible?

b) The background sound level present in the critical area due to the air conditioning systems and other sources. The intelligibility of speech and the perception of extraneous noise are controlled by the masking created by this background sound level. The higher the background sound level, the more effective it is in masking unwanted sounds. However, the background noise should not become intrusive in itself, so a balance should be achieved between the background sound level and the partition sound reduction.

7.7.7 Industrial buildings

7.7.7.1 Selecting design criteria

The design criteria for inside the building should include provision of reasonable industrial working conditions and reasonable speech and telephone communications. Other acoustic requirements often include limiting the noise emitted from the building and controlling noise from activities outside the building (e.g. vehicle movements) to minimize disturbance to neighbours.

7.7.7.2 Noise inside workshops

As hearing damage is covered by the Control of Noise at Work Regulations [41], special precautions should be taken and management procedures implemented where it is known that noisy processes are taking place.

Table 7 contains maximum noise levels for reliable speech communication. Even where speech communication is not important, it is important that audible warnings and information announcements can be heard clearly (see, for example, BS 5839-8).

The noise control measures discussed in **7.7.6** should be applied to offices outside production areas.

Table 7 **Maximum steady noise levels for reliable speech communication**

Distances between talker and listener m	**Noise level** dBA	
	Normal voice	**Raised voice**
1	57	62
2	51	56
4	45	50
8	39	44

7.7.7.3 Noise emitted by factories

Where a proposed factory development is to be situated in the vicinity of noise-sensitive buildings, the local planning authority usually sets planning conditions that take account of any predicted increase in noise due to the factory (see Clause **5**). Extensive noise control measures might be required, especially if the noise is impulsive, has a strong tonal character, or is otherwise of a distinguishable nature.

On an industrial estate, the noisier factories should be sited furthest from houses, with warehouses and quieter production areas used as buffers between the noisier factories and dwellings outside the industrial estate. Careful site planning can give some protection to noise-sensitive activities on the estate.

Common causes of complaint, which should be taken into consideration, are noise from:

a) industrial processes;

b) external generators, etc.;

c) calling systems;

d) end-of-shift indicators;

e) vehicle movements; and

f) night-time working.

7.7.7.4 Controlling noise in production areas

A factory divided into a number of smaller workshops is likely to provide a better working environment than one that consists of a single uninterrupted area. As permanent and solid divisions to the full height of the workshop are often not possible, partial enclosures or screens in conjunction with absorbent treatments are useful, both between departments and around individual machines. However, these enclosures or screens should be located so as not to obstruct the flow of work or they could be removed.

Acoustically absorbent materials should be used to reduce the amount of reflected sound within a space. These reduce the noise exposure of people not exposed to the direct sound from a noisy machine or activity, although the absorbent material has little or no effect on the noise level in the immediate vicinity of the noisy machines, etc. These materials can be applied to wall and ceiling surfaces or hung freely in the space (functional absorbers).

NOTE The Health and Safety Executive has published practical examples of noise control measures [42].

7.7.8 Schools and hospitals

Detailed guidance on the design of schools is available from the Department for Education in England [43] and the corresponding departments in the devolved administrations, and detailed guidance on the design of hospitals is available from the Department for Health in England [44] and the corresponding departments in the devolved administrations.

7.7.9 Agricultural buildings

For buildings and structures for agricultural use noise attenuation should be in accordance with BS 5502-32.

7.7.10 Rooms for speech

7.7.10.1 General

Lecture theatres, classrooms and meeting/conference rooms require good acoustic conditions for speakers and listeners. This should be recognized at an early stage of the design as room size and shape influence the acoustic conditions, as much as the selection and distribution of finishes. Although room acoustics is a specialized subject beyond the scope of this British Standard, general guidance on common situations is given in **7.7.10.5** to **7.7.10.7**.

7.7.10.2 Design criteria for intrusive external noise

The design objective for internal ambient noise level is reasonable listening conditions (see Table 4). This requires a low level of background noise and a fairly short reverberation time (see Annex A). However, other requirements should also be fulfilled to ensure the acoustic conditions are good. The main parameters are discussed in **7.7.10.3** and **7.7.10.4**.

7.7.10.3 Design for good speech communication

The sound that arrives at the listener's ears can be considered to have the following three components.

a) Direct sound. This is sound carried by waves that travel directly from the source (e.g. the speaker) to the listener. It should be the strongest component, and all listeners should have an unobstructed view of the source. The distance between the source and the most distant listener should be kept to a minimum. If this distance exceeds approximately 20 m an electro-acoustic sound reinforcement system might be required.

b) Early reflected sound. Shortly after the direct sound arrives, the listener

hears a series of wave fronts, which have been reflected once or a small number of times from the walls, ceiling or other hard surfaces. As these have taken a longer path than the direct sound, they arrive later. Sound travels at approximately 340 m/s so, for the simpler paths, the delay can be estimated. Reflections that arrive within approximately 35 ms of the direct sound reinforce it, and so are beneficial. Longer delays generally reduce intelligibility, and delays greater than approximately 50 ms should be avoided. Longer delays can be perceived as echoes.

c) Reverberant sound. Sound waves emitted by a source in a room are repeatedly reflected by the room surfaces, and grow weaker because of absorption by the surfaces at each reflection. The reverberation time, *T*, is a measure of how long a sound takes to decay after the source has stopped. *T* affects the level of sound in a space and gives an indication of the clarity of speech and the warmth of music. It is proportional to the room volume, and inversely proportional to the total absorption, and so can be estimated if the absorption coefficients of the main surfaces and features in the room are known (see Annex A). The optimum *T* for a space depends on whether it is to be used mainly for speech or music, the type of music and the volume of the space.

The optimum values for reverberation time also vary with frequency (pitch) of the sound. Guide values of *T* for rooms of different volume can be found in standard texts, e.g. *Noise control in building services* [28]. Guidance on the calculation of reverberation time in enclosed spaces generally is given in BS EN 12354-6, while BS EN ISO 3382-2 gives guidance for calculation in ordinary rooms and BS EN ISO 3382-1 gives guidance for calculation in larger (performance) spaces.

7.7.10.4 Sound-absorbing materials

Sound-absorbing materials and devices dissipate sound energy as heat, instead of reflecting sound energy back into the source room. Most types of absorber do not provide high values of sound insulation. Porous materials provide absorption over a reasonably wide range of frequencies, depending mainly on their structure and thickness, and they usually perform better at middle and high frequencies. Tuned devices are available which absorb over a limited range of frequencies.

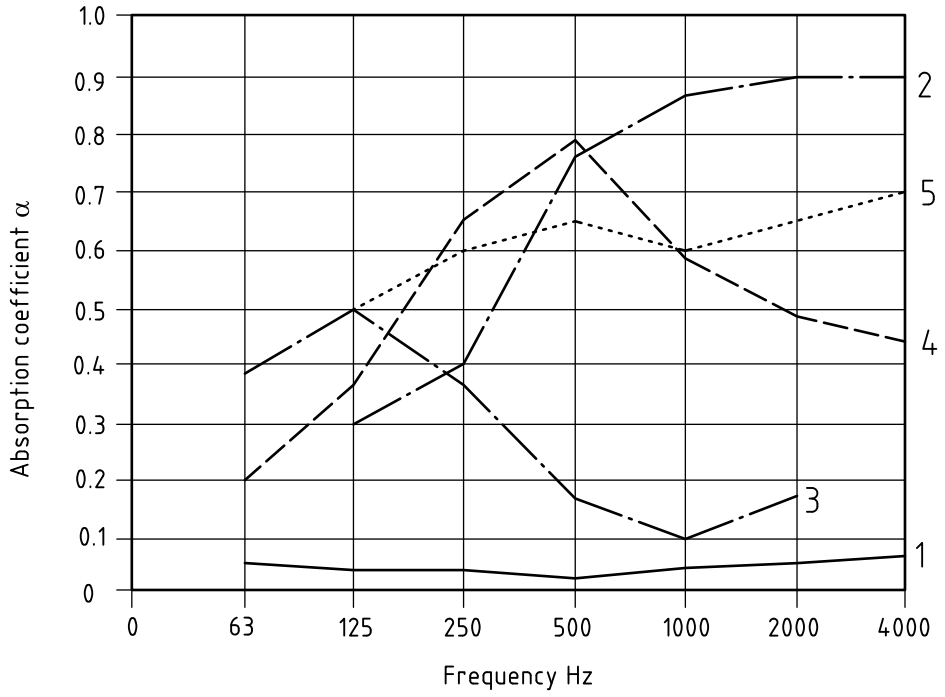
NOTE 1 Typical characteristics of different types of absorber are shown in Figure 1.

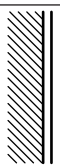
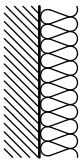
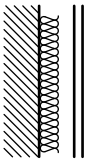
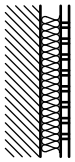
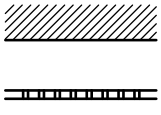
Sound absorbers are used to make acoustic corrections to rooms and spaces by changing the reverberation time (see Annex A). They are commonly used in rooms designed for music or speech, for general noise reduction in rooms (but with minimal benefit close to the source), and for preventing the spread of noise over large rooms or along corridors, ventilation ducts, etc. The type chosen should be influenced by a number of factors, such as acoustic characteristics, appearance, wearing qualities, maintenance, fire spread and other health and safety considerations.

The performance of a porous sound-absorbing material is given by the sound absorption coefficient α. The coefficient varies with the frequency of the sound and is commonly quoted for frequencies at the following octave intervals: 125 Hz, 250 Hz, 500 Hz, 1 000 Hz, 2 000 Hz and 4 000 Hz. Tests should be carried out in accordance with BS EN 20354 to obtain the coefficient in each frequency band.

NOTE 2 A method for assigning a single-number rating for porous absorbers is given in BS EN ISO 11654.

Figure 1 **Characteristics of sound-absorbing materials**



1		Hard finish: Plaster on solid backing
2		Porous absorber: 50 mm mineral fibre 50 kg/m^3 Performance is not significantly affected if protected by a perforated panel with at least 30% open area
3		Panel absorber: 9 mm ply, 50 mm cavity containing 25 mm mineral fibre
4		Perforated panel: 14% perforations, 25 mm cavity containing mineral fibre
5		Perforated gypsum ceiling tile/board: 13 mm gypsum tile/board, 16% perforations, suspended with 200 mm plenum

7.7.10.5 Committee/meeting rooms

Seats may be arranged in a circle or oval, rather than in parallel rows facing each other. The ceiling may be acoustically hard and low (not more than 3 m), at least over the table area, to reflect speech. A resilient floor covering minimizes noise from chair and foot movements, and reverberation should be controlled by absorbent materials on the walls. Noise from chair/table movement can also be controlled by rubber feet/castors. Appropriate wall treatments should be used to control the effects of flutter echo. Folding partitions can be provided in large rooms so the size is reduced when it is not fully occupied. The sound insulation of partitions is considered separately in **7.7.6.3**.

7.7.10.6 Lecture theatres

Human speakers project sound predominantly in the forward direction, so all listeners should have a reasonable view of the speaker's face. To facilitate this, the seating may be splayed in a fan shape around the lecturer's dais, extending approximately 70° either side of the centre line. The direct sound reaching the rear of the audience is weakened if the speaker-listener path passes over the heads of intervening listeners at a shallow angle. The effect can be minimized by raising the speaker on a podium or, better, by raking the audience seating at an angle of at least 20°. To reflect the speaker's voice the wall behind the speaker may be reflective. For the same reason, the ceiling may be reflective and horizontal for simplicity. Carpets should be used, and in large rooms the seats should be absorbent to control reverberation when unoccupied. Absorbent material on the rear wall and on the rear side walls should be considered if further measures to control reverberation are required.

Door lobbies can be used where it is necessary to minimize noise from people outside the theatre (see **8.4.4**).

7.7.10.7 Community halls

Although community halls are used for events that involve speech and music, they should normally be designed for speech. The reverberation time could be increased a little above 500 Hz if there are expected to be frequent unamplified musical events (see *Noise control in building services* [28]).

The need for a level floor means that direct sound from the stage is attenuated as it passes over rows of the audience. A reflective wall behind the stage and an angled reflector over it helps to project sound to the back of the room. Making the hall as wide as sight lines allow, rather than long and thin, also helps. In large halls, high-level loudspeakers by the stage might be required to reinforce the sound. The rear wall (i.e. behind the last row of the audience) and the rear side walls may be covered in sound-absorbing material, if necessary, to control reverberation and slap back. If the hall has to be long and thin, smooth, flat side walls should be avoided to prevent sound undergoing repeated reflections between them, giving rise to a flutter echo. Flutter can be controlled by having random indents and projections and/or patches of absorption on the side walls.

As musical events such as discos involve high noise levels, noise emanating from the building should be controlled to prevent this causing a nuisance to local residents, as well as to prevent external noise affecting events in the hall.

Although the designer has no control over the level at which music is played in the room, it would be prudent to inform the client that exposure to high noise levels can be harmful to hearing.

Electronic sound limiting equipment can be used to control the level of amplified music.

8 Sound insulation in a building

8.1 Factors affecting sound insulation

The main factors determining the sound insulation of a building element (wall, floor or facade) are mass, air-tightness and the isolation between elements (e.g. between the leaves of a cavity wall). Other factors which influence the sound transmission through a building are the characteristics of materials used for construction, the standard of workmanship, and the layout and detailing of the building. Sound transmission in buildings occurs through direct and flanking transmission paths, for which the resulting sound insulation can be predicted using theory, measurements or a combination of both [45].

NOTE Some of these factors are discussed in Annex E, which also lists typical sound insulation values of common constructions.

8.2 Flanking transmission

The sound insulation between rooms in a building is not only influenced by the sound insulation of the separating element, but also by transmission via adjoining elements and air paths through or round the element, known as flanking transmission (see Annex E). To control flanking transmission, careful design and high standards of site supervision and workmanship are essential. In addition to obvious air paths, hidden paths might be contained in materials themselves due to porosity and permeability: materials having a high permeability provide sound insulation considerably lower than an impervious material of similar mass per unit area. Applying a sealing finish, such as plaster or cementitious paint, can make a substantial improvement to the performance of a permeable material.

The degree of flanking transmission depends on the overall design of a building, and in some cases flanking transmission can exceed direct sound transmission. It is often a limiting factor where high performance is required. Some factors which should be considered are:

a) junction detail between the separating wall/floor and the flanking wall;

b) mass of flanking elements;

c) transmission through floor voids, loft spaces, service ducts, mullions and similar paths.

It is not practicable to consider the sound insulation of all possible combinations of the elements that might form a building. In the initial stages of a design, individual elements are often considered as though they behaved independently of each other, but later in the design process possible interactions between the elements should be considered and the design modified or refined as necessary.

*NOTE The characteristics of common types of building element are discussed in **8.4**.*

8.3 Sound insulation tests

Standard laboratory measurements of airborne sound insulation in accordance with BS EN ISO 10140-2 and impact sound insulation in accordance with BS EN ISO 10140-3 do not take account of flanking transmission, and so should only be regarded as a guide to the performance of an element in the field. The performance of the completed construction can be checked by tests carried out in accordance with BS EN ISO 140-4 and BS EN ISO 140-7. From these measurements, single-number ratings can be calculated according to BS EN ISO 717-1, for airborne insulation, and BS EN ISO 717-2, for impact insulation (see Annex C).

8.4 Sound insulation characteristics of common building elements

8.4.1 Masonry partitions

8.4.1.1 Single-leaf masonry walls

The main parameter which determines sound insulation is mass, and a rough guide to performance can be obtained from the mass law (see Annex E). Different materials sometimes have different empirical mass laws because the mass law approach does not account for stiffness, damping and airflow resistivity. However, all materials have a characteristic reduction in sound insulation due to the coincidence effect at their critical frequency (see Annex E), the position of which is mainly dependent on the mass and stiffness of the wall. The reduction in sound insulation in this frequency region depends on the amount of damping present, and for common materials the insulation at the critical frequency is often 5 dB to 10 dB below the trend at lower frequencies and remains low for an octave above the critical frequency. A typical 225 mm solid, dense masonry wall might show coincidence effects in the 125 Hz octave band, while 100 mm solid lightweight concrete might show the effects in the 500 Hz octave band.

8.4.1.2 Double-leaf masonry cavity walls

With masonry double-leaf walls, sound energy is transmitted from one leaf to the other through the air in the cavity which separates them, and in the form of mechanical vibrations through any ties or structural links between the two leaves. A wide cavity assists in providing good sound insulation. A high degree of structural isolation between the two leaves also assists in reducing structure-borne sound transmission. To this end, ties between the two leaves should be as few as possible and be flexible whilst maintaining structural stability. Butterfly pattern ties are better in this respect than most other types, which degrade acoustic performance. Type A ties need to have a measured dynamic stiffness of <4.8 MN/m^3 for the specified minimum cavity, at a standard density.

Because of unavoidable structural links, masonry cavity walls seldom attain their potential acoustic performance. Each leaf of double-leaf walls is subject to coincidence effects and, in addition, double-leaf constructions exhibit a mass-air-mass resonance (see Annex E) which reduces the insulation at low frequencies.

8.4.2 Lightweight partitions

8.4.2.1 Double-leaf stud walls

Single-frame and twin-frame lightweight partitions are often used to divide a large floor area into separate rooms, for example, in large office blocks. The effects described in **8.4.1.2** are particularly marked where sheet materials such as plasterboard are used. However, the reduction in insulation can be minimized if there is a high degree of mechanical discontinuity between the leaves.

The frames of the lightweight partitions can be made from timber or metal studs. For single-frame partitions the improvement in mechanical discontinuity can be made by use of resilient bar on one or both sides of either timber or metal frames. Mechanical discontinuity can also be improved by use of acoustic versions of the metal studs. Single-frame lightweight partitions can achieve R_w performances ranging from 30 dB to 65 dB.

A higher degree of mechanical discontinuity can be achieved with a twin-frame construction using separate support frames for each leaf, again made from metal or timber studs. Mechanical discontinuity of twin frames can also be improved by use of acoustic versions of studs or by increasing the cavity width. Twin-frame lightweight partitions can achieve R_w performances ranging from 55 dB to 75+ dB.

For both single-frame and twin-frame constructions, sound-absorbing infill such as mineral wool batts or quilt is beneficial. Well-designed, lightweight, double-leaf partitions can provide good performance with much lower mass than a masonry construction of comparable acoustic performance.

NOTE Low frequency performance can be different between lightweight and masonry partition walls.

Particular care should be taken to avoid any significant loss of sound insulation through indirect sound transmission routes. For example, where a partition wall is butted to a suspended ceiling, a continuous barrier should be provided in the space above it.

8.4.2.2 Pre-fabricated walls

To permit flexible room planning and quick installation there are numerous proprietary systems of prefabricated, lightweight, demountable partitions that are easily assembled using dry methods. These partitions seldom exceed approximately 40 kg/m^2 and employ room height units approximately 1 m wide, usually constructed with skins approximately 50 mm apart and with mineral wool or other lightweight cavity filling materials. Various methods are used to fix the panels to the structure and to fasten them together. However, for maximum sound insulation the partition should be fitted to the soffit of the structural slab and sealed around all edges.

Because of their lightness, and the inevitable small gaps around them, the insulation of prefabricated office partitions usually lies in the range 30 dB R_w to 40 dB R_w, occasionally extending up to 45 dB R_w.

8.4.2.3 Operable walls and moveable partitions

Folding and sliding partitions generally provide approximately 30 dB R_w, but better performance can be achieved with careful design and installation. Operable walls and moveable partitions can provide flexibility, for example, to allow meeting or training rooms to be separated or combined. However, where a high degree of acoustic privacy is required between separated spaces, the partitions can be expensive and require specialist maintenance to maintain the acoustic performance. Careful design is also required to avoid flanking paths and to provide structural support for the partition.

8.4.3 Construction details

The following recommendations should be closely followed to maximize sound insulation. They are particularly applicable to masonry separating walls between dwellings.

a) Avoid forming recesses in the separating wall, but, if it is necessary to recess electrical sockets in the wall, they should not be placed back-to-back to avoid the risk of complete penetration.

b) Complete filling of mortar joints, particularly perpends, is important. In brick walls, if the bricks have frogs they should be laid frog up so that the frogs are filled with mortar.

c) In the case of walls formed from permeable materials, the wall surface should be sealed with cementitious paint or render unless it is to have a plaster finish. Ideally, this sealing should include the wall surface where it passes through a suspended timber floor.

d) The minimum number of connections between the leaves of masonry cavity separating walls consistent with structural stability should be used. Butterfly or similar low stiffness ties are recommended. Further information is given in the Building Regulations [30, 31, 32].

e) Care should be taken to ensure that mortar droppings or other foreign matter do not bridge cavities.

f) A cavity separating wall construction should continue right through the roof space.

g) Air paths through or round a separating wall, even in the loft space, should be kept to the minimum possible by careful sealing around any necessary penetration of the wall. Joists should preferably run parallel to a separating wall, but if they are perpendicular joist hangers should be used, or if they are built in all air paths should be filled.

h) The reveals of windows should be well sealed to prevent sound getting into the wall cavity. At the junction with the separating wall it is good practice to stop the external wall cavity with a flexible closer, such as mineral wool, to reduce sound transmission along the cavity. If the cavity is to be filled or partially filled for thermal insulation, additional stopping is not necessary.

i) Masonry separating walls should be rigidly bonded or tied to the inner leaf of a cavity wall or only leaf of a solid external masonry wall.

8.4.4 Doors

The main factors determining the sound insulation of a single door set are the mass of the door and the gaps around the edges; usually, the latter are critical. For good sound insulation, the door should form airtight joints with the frame when closed and the joints between frame and wall should be sealed. A threshold seal is essential, and even keyhole covers should be fitted in critical situations.

A nomogram is given in Annex A for estimating the insulation of elements comprising two components having different values of sound insulation, such as a partition containing a door.

Single door sets providing a sound insulation greater than 35 dB R_w are specialist products and are normally supplied as complete door sets. High performance seals might make the door hard to open and close. The most effective solution, where space is available, is to use two well-sealed doors separated by a lobby lined with absorbing material. Such sound lobbies are particularly useful where uninterrupted sound insulation is required (e.g. audiometric examination rooms) because one door can be closed before the other is opened. Well-constructed lobbies can be expected to provide sound insulation of 45 dB to 60 dB, although the higher figure can only be achieved if the whole construction is carefully designed.

Where infrequent access to a space is required, a removable panel may be installed in place of a door.

8.4.5 Windows

8.4.5.1 General

BS EN 12758 gives values for the sound insulation of windows.

NOTE Further information is given in BS 6262, [46] and [47]. Figure A.1 can be used to estimate the insulation of a wall containing a window.

The full sound insulation value of any window cannot be realized if there are air gaps. These commonly occur around frames due to insecure fixing, shrinkage of wood and poor maintenance, and between frames and opening lights.

Glass often shows a pronounced dip in insulation at its critical frequency (see Annex E). For 6 mm glass this is around 2 000 Hz. Laminated glass performs better because the increased damping reduces the effect.

When adjoining rooms have their windows open the sound reduction from one to the other is limited to approximately 30 dB if there are other buildings close to the windows to reflect the sound back. When the window is closed in one of the rooms, a reduction of over 50 dB between the rooms should be obtainable and, with both windows closed, this flanking path should not limit the insulation provided by normal separating elements.

8.4.5.2 Double-glazed units

A double-glazed unit is unlikely to perform better than a single pane of mass equivalent to the thicker pane of the sealed unit, and should be used in a frame with good seals to realize its full insulating potential.

8.4.5.3 Secondary windows

In addition to the need for good sealing, the following recommendations apply for double windows.

a) The air space should be at least 100 mm, although for good performance over the main frequency range of interest, a cavity of approximately 300 mm is desirable.

b) The sides and top of the reveal should be lined with sound-absorbing material (the bottom should be left clear to avoid staining due to condensation).

c) The best results are obtained if both windows are sealed, but this has obvious difficulties for cleaning (and means of escape where appropriate). When opening lights are used some loss of insulation occurs, but this can be minimized by good quality fittings and weather stripping.

d) The outer pane can be a double-glazed unit to improve thermal performance and reduce condensation.

8.4.5.4 Ventilation

The Building Regulations' supporting documents on ventilation [48, 49, 50] recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice.

Alternatively, acoustic ventilation units (see **7.7.2**) are available for insertion in external walls. These can provide sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans.

8.4.6 Floors and ceilings

8.4.6.1 General

Airborne sound insulation is mainly considered for intermediate floors between spaces containing either noise sources or noise-sensitive occupants. For a ground or basement floor where there is neither an appreciable noise source nor a noise-sensitive occupant below the floor, the floor is only of interest if it could contribute to flanking transmission.

Separating floors suitable for use in dwellings, which are described in the technical documents that support the appropriate Building Regulations [1, 33, 34], fall into the following three broad categories for new buildings:

a) a concrete base with a soft covering;

b) a concrete base with a floating layer; and

c) a timber base with a floating layer.

Guidance on upgrading existing floors is also provided. The technical documents contain details of points to consider, and should be consulted for work in dwellings. As the gaps between precast units in beam and block floors are difficult to seal well, a bonded screed is strongly recommended.

Dwellings that adjoin other buildings with activities that generate noise levels greater than normal domestic activities might require constructions offering better performance than those described in the documents that support the appropriate Building Regulations [1, 33, 34].

8.4.6.2 Partitions on floating floors

It is generally better to build partitions on the structural base rather than on top of a floating floor. This is because a partition built on a floating floor might overload the resilient layer and reduce its isolation properties, and movement of the floating floor could cause cracking in the partitions. A partition built on a floating layer might also provide a flanking path between the floor and the walls. The isolation between the floating floor and the partition should be maintained. Specialist advice should be sought for floating floors.

8.4.6.3 Pipes and conduits in floating floors

It is often necessary for services, such as electrical conduits and gas and water pipes, to run across a concrete floor. Whenever possible these pipes should be accommodated within the thickness of the floor slab or levelling screed, but sometimes they have to be laid on top of the slab and contained within the depth of the floating layer. Pipes or conduits are less likely to damage floating floors, providing they do not extend more than approximately 25 mm above the base, are properly fixed so as not to move while the floating floor is being laid, and are haunched up with mortar on each side to give continuous support to the resilient quilt. When two pipes cross, one of them should be sunk into the base slab. The resilient quilt should be carried right over the pipes.

NOTE Although channel systems have been devised to allow access to pipes in concrete and timber floors, the acoustic performance of these is not well documented.

8.4.6.4 Squeaking floor boards

Floating floors of timber or similar materials might squeak when walked on. To minimize the risk for boarding or panels, deep battens and long nails or screws may be used. For softwood tongued and grooved boards, latex adhesive between boards and on joists may be used, while for tongued and grooved chipboard sheets, a polyvinyl acetate emulsion adhesive is more suitable.

NOTE Further information is given in [51].

Timber joists made from reconstituted wood are available and can also be used to help minimize squeaking.

8.4.7 Roofs and mansards

Roofs and mansards generally have lower sound insulation than masonry facade walls, but in many cases they are required to reduce noise from external sources such as aircraft or road traffic. The performance of various roof types is indicated in Table 8. As rainfall noise can be a problem with lightweight roofs and skylights, these should be avoided in critical situations. Laminated glass is likely to transmit slightly less noise than an equivalent solid pane, but the manufacturer's advice should be sought.

Table 8 **The sound insulation of roofs**

Roof type	**Weighted sound reduction index R_w** dB
Tiles on felt, pitched roof with 100 mm mineral wool on plasterboard ceiling	43
100 mm flat concrete roof (230 kg/m^2)	52
Flat timber joist roof, asphalt on boarding, 12 mm plasterboard ceiling, thermal insulation	45
Single-skin galvanized steel cladding	22
50 mm sandwich panel, galvanized steel panels with thermal foam infill	26
Double-skin galvanized steel cladding with mineral fibre infill	38

9 Noise from building services

9.1 General

Detailed building services design advice is beyond the scope of this British Standard and it might be necessary to seek advice from an acoustic consultant. Several useful texts are available, which provide guidance on noise from mechanical services [28] and [52].

The general principles are discussed in **9.2** to **9.6**.

9.2 Main components

The components of a heating, ventilating and air conditioning (HVAC) system move air, water or refrigerant, as appropriate, around the system. The following contain advice on control of noise from the components of a typical air conditioning system, from intake to outlet.

a) *Intakes*. There should be sufficient ducting distance between intake grilles and fans to enable fan noise travelling back to the opening to be reduced. Common methods of attenuation are splitter attenuators and sound-absorbing lined ducts. However, fibrous absorbent materials should be used with caution as these can damage health.

b) *Fans*. The type and size of fans are influenced by noise control needs. In general, larger and slower fans are quieter, for a given volume and pressure duty. The casing, fan and drive motors commonly require vibration isolating mountings to reduce structural vibration. It is often essential that the fan casing is isolated from ducting using flexible connectors, and the ducting may need to be supported from resilient hangers.

c) *Chillers*. Chillers create high levels of noise and vibration and so should be located in an enclosure if situated near sensitive areas. Careful attention should be paid to air gaps allowing noise to escape. Resilient mountings are usually necessary. It is essential that all pipework leading to and from the

chillers is held by isolating clips or hangers (or is fixed to joists that can be isolated), and passes through the enclosure in sleeves lined with a resilient material.

d) *Ducts*. Ducts might have fan noise propagating inside them, or turbulence noise generated in them by fast-moving air or by drumming of the duct walls. Noise generated in one room can be transmitted to a neighbouring room by a common duct, resulting in poor sound insulation (cross-talk). Noise can escape from inside a duct to the outside (break-out). Consequently, ducts that pass close to sensitive areas might need to be lagged with noise insulating material. Conversely, if a duct passes through a noisy area, noise can break in and be transmitted down the duct. This is most likely to occur in a plant room where, for example, a silencer has been located close to a fan and the silenced duct runs through the plant room. The silencer should be located at the position where the duct penetrates the plant room wall.

e) *Outlets*. Air movement through diffuser grilles can be the source of significant levels of noise (known as regenerated noise). Reduction of the velocity of the air or removal of any obstructions can significantly reduce the regenerated noise from the grilles. In some cases where background noise is needed, noisier grilles can be useful, but to achieve a steady noise level the velocity of the air from the grille should be constant.

9.3 Frequency characteristics of noise

The frequency ranges of noise from the components can be generalized as follows.

a) Fan instability, air turbulence, structure-borne noise: 10 Hz to 80 Hz perceived as throb and rumble.

b) Fan and pump noise: 50 Hz to 500 Hz perceived as rumble and roar.

c) Variable air volume (VAV) unit noise: 125 Hz to 2 500 Hz, perceived as roar and whistle or whirr.

d) Chiller noise: 250 Hz to 1 000 Hz, perceived as roar and whistle or whirr.

e) Outlet (or diffuser) noise: 800 Hz to 4 000 Hz, perceived as whistle or whirr and hiss.

Many types of silencer are available, which can work over a wide frequency range (broad band) or be tuned to a particular frequency band.

NOTE For more information about silencers see BS EN ISO 14163.

9.4 Rating noise from services

Continuous ventilation noise is commonly rated in the UK using either dBA levels or noise rating (NR) curves based on an octave band analysis of the noise (see Annex B). Noise criteria curves are also used and are broadly similar to NR curves (see Annex B). CIBSE Guide B5 [52] provides further rating systems and information.

9.5 Sound-absorbing treatment

The reduction in noise within a room where the source is outside the room is limited to approximately 3 dB for each doubling of total sound absorption within the room. Increasing absorption is therefore not usually an alternative to improving sound insulation. This approach is most effective in factory buildings. Sound-absorbing materials are also used to control noise in ducts, taking into account health and safety considerations.

9.6 Quality control and workmanship

Experience has shown that effective sound insulation and noise control require careful detailing on the part of the designer and a high standard of workmanship on the part of the contractor. Correct execution of the detailing should be checked on site, and the completed building should be fully commissioned before handover.

Noise control is only one aspect of environmental design and designers should be aware that the solution to a noise problem can cause difficulties elsewhere, e.g. thermal insulation, cold bridging, solar gain, ventilation and condensation. Much information on the environment in and around buildings is available and should be considered at an early stage of the design process.

Annex A (informative) Noise calculations

A.1 General

Some of the simpler types of noise calculation are described in this annex. For methods of predicting noise from road and rail traffic, see Clause **6**.

A.2 Addition of two noise levels

To determine the combined sound pressure level (L_c) resulting from the sound pressure levels of two or more noise sources (L_1, L_2, etc.), it is necessary to calculate and add the mean-square values of their individual sound pressures and convert this back to a sound pressure level. This can be achieved using the following formula.

$$L_c = 10\lg\left(10^{\frac{L_1}{10}} + 10^{\frac{L_2}{10}}\right)$$

As the individual sound pressure levels are logarithms of the mean-square sound pressures, they cannot simply be added arithmetically.

A.3 Subtraction of two noise levels

When measuring noise from a source, the true noise level of the source alone is less than that shown by the meter if the level of background sound is less than approximately 10 dB below the total noise level. This is given by the following equation.

$$L_s = 10\lg\left(10^{\frac{L_m}{10}} - 10^{\frac{L_b}{10}}\right)$$

where:

L_s is the source sound level;

L_m is the measured sound level;

L_b is the background sound level.

A.4 Non-uniform facades comprising windows and cladding

Figure A.1 shows how to calculate the overall sound insulation of a non-uniform facade comprising a window and cladding. It may also be used to give an indication of the effect of gaps or holes in a partition by assigning a sound insulation value of 0 dB to the aperture.

A.5 A-weighting calculations

The equivalent A-weighted level is often required when data on a noise source are available as a set of octave band or one-third octave band levels. The conversion can be performed manually, using the standard A-weighting values (see Table A.1). For all but the simplest situations it is more convenient to use a computer spreadsheet to do the conversion.

A.6 Reverberation time calculation

An estimate of the reverberation time, T, of a room can be obtained using the model in BS EN 12354-6.

Figure A.1 **Sound insulation of non-uniform facades comprising windows and cladding**

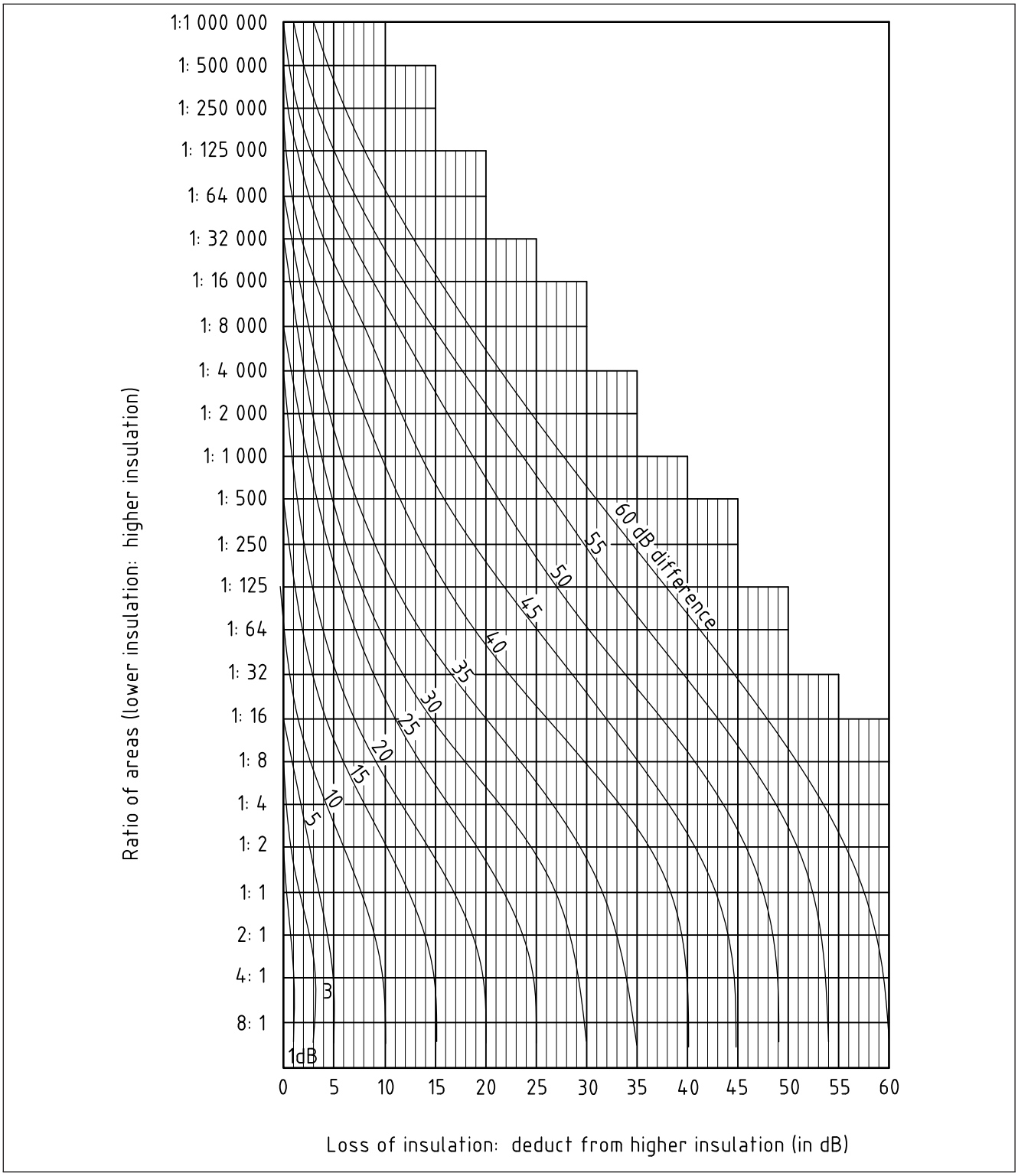


Table A.1 **Standard A-weighting values (dB)**

Third octave band centre frequency Hz	Octave band centre frequency Hz	A-weighting dB	Third octave band centre frequency Hz	Octave band centre frequency Hz	A-weighting dB
10		–70.4	500	500	–3.2
12.5		–63.4	630		–1.9
16	16	–56.7	800		–0.8
20		–50.5	1 000	1 000	0
25		–44.7	1 250		0.6
31.5	31.5	–39.4	1 600		1.0
40		–34.6	2 000	2 000	1.2
50		–30.2	2 500		1.3
63	63	–26.2	3 150		1.2
80		–22.5	4 000	4 000	1.0
100		–19.1	5 000		0.6
125	125	–16.1	6 300		–0.1
160		–13.4	8 000	8 000	–1.1
200		–10.9	10 000		–2.5
250	250	–8.6	12 500		–4.3
315		–6.6	16 000	16 000	–6.6
400		–4.8	20 000		–9.3

Annex B (informative)

Noise rating

Noise rating (NR) is a graphical method for assigning a single-number rating to a noise spectrum. It can be used to specify the maximum acceptable level in each octave band of a frequency spectrum, or to assess the acceptability of a noise spectrum for a particular application. The method was originally proposed for use in assessing environmental noise, but it is now used in the UK mainly for describing noise from mechanical ventilation systems in buildings. To obtain a rating, the noise spectrum is superposed on a family of NR contours. The NR of the spectrum corresponds to the value of the first NR contour that is entirely above the spectrum. The values at intervals of NR 5 (from NR 0 to NR 75) are shown in Table B.1 for the frequency range 31.5 Hz to 8 kHz.

Measured or calculated noise levels should be determined to not more than one decimal place.

NR values may be determined in each octave band by the following equation, rounded to the nearest single decimal place.

$$L = a + bN$$

where:

L is the octave band sound pressure level corresponding to NR level N;

a and b are constants for each frequency band, as given in Table B.2.

NOTE NR values cannot be converted directly to dBA values, but the following approximate relationship applies.

$$NR \approx dBA - 6.$$

The NR level is that entirely above the spectral levels calculated.

For example, if a spectrum contains a noise level of 48.6 dB at 500 Hz, the NR level would be at least NR 46.

Although the NR system is currently a widely-used method for rating noise from mechanical ventilation systems in the UK, other methods which are more sensitive to noise at low frequencies are available [28], but they are not yet widely accepted in the UK. Low-frequency noise can be disturbing or fatiguing to occupants, but might have little effect on the dBA or NR value.

Table B.1 **Noise rating values**

Noise rating	**Octave band centre frequency** Hz								
	31.5	**63**	**125**	**250**	**500**	**1 000**	**2 000**	**4 000**	**8 000**
NR75	106.5	94.7	87.2	81.7	77.9	75	72.6	70.8	69.2
NR70	103.1	90.8	82.9	77.1	73.0	70	67.5	65.7	64.1
NR65	99.7	86.8	78.5	72.4	68.1	65	62.5	60.5	58.9
NR60	96.3	82.9	74.2	67.8	63.2	60	57.4	55.4	53.8
NR55	92.9	78.99	69.8	63.1	58.4	55	52.3	50.3	48.6
NR50	89.4	75.0	65.5	58.5	53.5	50	47.2	45.2	43.5
NR45	86.0	71.0	61.1	53.6	48.6	45	42.2	40.0	38.3
NR40	82.6	67.1	56.8	49.2	43.8	40	37.1	34.9	33.2
NR35	79.2	63.1	52.4	44.5	38.9	35	32.0	29.8	28.0
NR30	75.8	59.2	48.1	39.9	34.0	30	26.9	24.7	22.9
NR25	72.4	55.2	43.7	35.2	29.2	25	21.9	19.5	17.7
NR20	69.0	51.3	39.4	30.6	24.3	20	16.8	14.4	12.6
NR15	65.6	47.3	35.0	25.9	19.4	15	11.7	9.3	7.4
NR10	62.2	43.4	30.7	21.3	14.5	10	6.6	4.2	2.3
NR5	58.8	39.4	26.3	16.6	9.7	5	1.6	–1	–2.8
NR0	55.4	35.5	22.0	12.0	4.8	0	–3.5	–6.1	–8

Table B.2 **Values of a and b**

Octave band centre frequency Hz	a	b
31.5	55.4	0.681
63	35.4	0.790
125	22.0	0.870
250	12.0	0.930
500	4.2	0.980
1 000	0.0	1.000
2 000	–3.5	1.015
4 000	–6.1	1.025
8 000	–8.0	1.030

Annex C (informative) Specification of sound insulation

C.1 General

Sound insulating elements work mainly by reflecting sound energy back into the source room, not by absorbing it. The methods of measurement and the terms used are described in **C.2** to **C.4**.

C.2 Insulation against airborne sound

In the tests specified in BS EN ISO 10140-2 and BS EN ISO 140-4 the insulation between a pair of rooms is measured, either:

a) in third octave bands having centre frequencies which cover at least the range 100 Hz to 3 150 Hz; or

b) in octave bands which cover at least the range 125 Hz to 2 000 Hz.

The noise is produced by a loudspeaker in one of the rooms (called the source room) and at each frequency the average noise levels are measured in the source room (L_S) and in the adjacent receiving room (L_R). The difference between these two levels (D) is a measure of the sound insulation between the rooms, regardless of the transmission path(s) the sound energy followed to travel between the rooms. The equation is as follows.

$$D = L_S - L_R$$

The actual level in the receiving room depends on:

- the sound insulation of the separating wall or floor;
- the area of the separating wall or floor;
- the volume of the receiving room;
- the flanking transmission, i.e. the importance of transmission paths other than the separating wall or floor; and
- the amount of absorbing material (e.g. furniture) in the receiving room.

For field measurements, apart from the amount of absorption, these factors are a property of the building and need to be taken into account by the measurement procedure. As the amount of absorbing material (e.g. soft furniture) in the room at the time of measurement is arbitrary, it has to be allowed for separately. This is achieved by measuring the reverberation time, *T*, of the room in seconds (s), which is a measure of how long it takes a sound to die away after the source has been switched off. As the sound energy is dissipated as heat in the absorbing material, *T* is related to the total amount of absorption in the room. The receiving room level can be corrected to the level it would be if the room has a standard reverberation time, T_o, which is typical of bedrooms, and is taken to be 0.5 s. The corrected level difference is known as the standardized level difference, D_{nT}, and is calculated using the following equation.

$$D_{nT} = L_S - L_R + 10 \log_{10} (T/T_o)$$

For laboratory measurements the insulation of the separating wall or floor being tested is assessed in a way that is independent of the actual measuring laboratory. For this reason, laboratories are designed to have minimal flanking transmission and a different correction is applied to account for the other factors.

This correction is $10 \log_{10} (S/A)$, where:

S is the common area of the separating wall or floor in square metres (m^2);

A is the equivalent absorption area in the receiving room in square metres (m^2).

The laboratory corrected level difference at each frequency is known as the sound reduction index, *R*, and is calculated using the following equation.

$$R = L_S - L_R + 10 \log_{10} (S/A)$$

If the test wall or floor is mounted in a realistic way in the laboratory and flanking transmission is low in the field, the sound reduction index may be used to predict its performance in the field. The relationship between D_{nT} and *R* is:

$$D_{nT} = R - 10 \log_{10} (3S/V)$$

where:

S is the area of the separating wall or floor in the field in square metres (m^2);

V is the volume of the receiving room in the field in cubic metres (m^3).

This equation shows that, if the source and receiving rooms have different volumes, D_{nT} depends on which is used as the source room. Using the larger room as the source room gives the lower value.

C.3 Insulation against impact sound

The procedure for measuring the impact insulation of floors is rather different (see BS EN ISO 10140-3 and BS EN ISO 140-7). Instead of a loudspeaker, a machine containing five small hammers is placed on the floor. While the hammers strike the floor at a rate of ten blows a second, the resulting noise level, L_i, is measured in the receiving room below at each of the same frequency bands used for airborne insulation. In the field, the receiving room levels are again "corrected" to a standard reverberation time, T_o, of 0.5 s to give the standardized impact sound pressure level, L'_{nT}, which is calculated as follows.

$$L'_{nT} = L_i - 10 \log_{10} (T/T_o)$$

In the laboratory, the noise level depends mainly on the characteristics of the floor being tested and the amount of absorption, A (m^2), in the laboratory. It is therefore appropriate to correct the noise level to a standard area of absorption. The area used is 10 m^2. The resulting normalized impact sound pressure level, L_n, is calculated as follows.

$$L_n = L_i + 10 \log_{10} (A/10)$$

C.4 Rating sound insulation

Measurements of insulation against both airborne and impact sounds yield values in a number of frequency bands. To make this information more manageable, rating methods such as those in BS EN ISO 717-1 and BS EN ISO 717-2 are used to reduce the frequency band values to single-figure ratings. These single-figure ratings are generally good predictors of subjective assessments of insulation of similar constructions. However, this is not always the case for different constructions, for example the low-frequency performance of a lightweight partition might be significantly different from that of a masonry partition with the same single-number rating, so it is prudent to examine the full measurement data in critical situations.

The more common indices used to describe sound insulation are summarized in Table C.1 and Table C.2.

NOTE 1 Further guidance on rating sound insulation is given in BS EN ISO 717-1 and BS EN ISO 717-2. The terminology shown in Table C.1 is used, but with additional spectrum adaptation terms (C).

EXAMPLE

R_w (C; C_{tr}) = 41(0; –5) dB.

Here, C (value 0) is the correction needed to convert R_w to a dB insulation value against a pink noise spectrum; C_{tr} (–5) is the correction needed to convert R_w to a dB insulation value against a standardized road traffic noise spectrum. In this case the dB insulation is 41 – 5 = 36 dB.

NOTE 2 Pink noise has the same sound pressure level in adjacent frequency bands, and is used to represent general activity noise.

It is essential that the difference between the sound insulation value obtained for a single building element in the laboratory and the value for a completed construction in the field environment is understood. A common mistake is to expect to obtain values of a weighted sound reduction index, R_w, from a completed building. To clarify this, different indices are used to indicate sound insulation performance in the different environments. Table C.1 and Table C.2 show the different indices that apply to the laboratory or field environment respectively.

Due to the flanking transmission paths and a difference in the calculation method, a laboratory test value for sound insulation might not be obtained in the field, even if all elements of the construction have been specified and built correctly.

Table C.1 **Common indices used to describe laboratory airborne and impact sound insulation**

Airborne (*A*) or impact (*I*)	**Measured values**		**Single number quantity**	
	Name	Symbol	Name	Symbol
A	Sound reduction index	R	Weighted sound reduction index	R_w
A	Spectrum adaptation term	C	Spectrum adaptation term	C
A	Spectrum adaptation term	C_{tr}	Spectrum adaptation term	C_{tr}
I	Normalized impact sound pressure level	L'_n	Weighted normalized impact sound pressure level	$L'_{n,w}$

Table C.2 **Common indices used to describe field airborne and impact sound insulation**

Airborne (*A*) or impact (*I*)	**Measured values**		**Single number quantity**	
	Name	Symbol	Name	Symbol
A	Standardized level difference	D_{nT}	Weighted standardized level difference	$D_{nT,w}$
A	Spectrum adaptation term	C	Spectrum adaptation term	C
A	Spectrum adaptation term	C_{tr}	Spectrum adaptation term	C_{tr}
I	Standardized impact sound pressure level	L'_{nT}	Weighted standardized impact sound pressure level	$L'_{nT,w}$
A	Apparent sound reduction index	R	Weighted sound reduction index (dB)	R'_w

Annex D (informative) Special problems requiring expert advice: Guidance for specific applications

D.1 General

Certain design problems require reliable advice of a kind that is not easy to find in published material. The advice of an expert is necessary for these kinds of problems, some examples of which are given in **D.2** to **D.9**.

D.2 Acoustic test rooms

The design of rooms in which acoustic measurements are carried out, such as reverberation chambers, free-field rooms and audiometric test rooms, might need to conform to national or international standards and usually requires the advice of an expert.

D.3 Performing spaces

The design of theatres, opera houses, concert halls and similar performing spaces usually requires expertise in room acoustics and noise control. The intrusion of relatively low levels of noise can seriously interfere with the enjoyment of the performance and distract the performers. The requirements for low noise levels often mean that more room has to be allocated for low velocity ventilation ductwork and the impact on the design of the ventilation system is often substantial.

D.4 Broadcasting and recording studios

Broadcasting and recording studios have requirements similar to those of performing spaces (see **D.3**). For some infrequent intrusive noises, the requirements are sometimes relaxed on the grounds that a retake is possible, but this can result in higher operating costs.

D.5 Aircraft noise

As there are many variables affecting the level of aircraft noise heard on the ground, expert advice is almost always required. Contours of daytime $L_{Aeq,T}$ levels are available from most major airports and helipads. Where measurements of facade insulation are necessary a test method is described in BS EN ISO 140-5.

D.6 Groundborne noise

Projects involving groundborne noise from underground trains, plant or industrial sources usually require expert advice.

D.7 Low-frequency noise

Projects involving low-frequency noise usually require expert advice as accurate measurement is difficult and there is a shortage of reliable data below 100 Hz.

D.8 Active noise control

Active noise control is the reduction of noise by cancellation with a similar noise (anti-noise) generated by electro-acoustic means. Commercial systems are available which successfully reduce low frequency noise from mechanical ventilation systems.

D.9 Noise surveys

Noise surveys are carried out for a variety of reasons, for example:

a) before construction, to establish the existing noise climate at the site of a proposed development where reliable prediction is impracticable, as an aid to the design of the building envelope, either to protect against external noise or contain internally produced noise;

b) during construction, to monitor noise from building activity, either to assess the likely nuisance to the local community or the risk of hearing damage to the workforce;

c) at the end of a building contract to check the insulation of the building envelope or the noise levels produced by the services;

d) as part of a planning requirement;

e) to provide objective evidence to support or defend a legal action.

Surveys ought to be carried out by competent persons and the interpretation of survey results might require expert advice.

Annex E (informative) Airborne and impact sound insulation

E.1 General

Airborne sound refers to noise produced by sources that directly set the air around them into vibration. Impact sound refers to noise caused by sources which produce impulsive mechanical excitation of part of a building (e.g. footsteps, electric light switches, slamming doors). Many sources of impact sound also produce significant levels of airborne sound. The term structure-borne sound has no very precise meaning as the structure can be excited by both airborne and impact sources; it is often used to refer to sound that travels for long distances via the structure, especially in connection with vibrating machinery linked directly to the structure.

E.2 Direct and indirect transmission

Figure E.1 shows diagrammatically a pair of rooms in a house where the construction consists of solid walls, etc., bonded together. Sound travelling from Room 1 to Room 2 can travel via the direct path a-a and by the many indirect, or flanking, paths shown. The term flanking transmission is usually used to mean transmission paths involving the structure, while the term indirect transmission includes flanking paths and airborne paths through gaps and ducts, etc. The indirect paths can limit the sound insulation attainable no matter how much the direct sound is reduced by the separating wall or floor. The indirect transmission can be reduced by measures such as the following.

- Increasing the mass of the flanking walls.
- Increasing the mass of the partition.
- Introducing discontinuities in the indirect paths.
- Erecting independent wall linings adjacent to the flanking walls to prevent energy entering the flanking construction.
- Sealing any air gaps and paths through ducts.

Figure E.2 shows a number of indirect paths that have been found in offices.

It is important to remember that standard test laboratories are designed to minimize transmission by all paths other than the direct path. This makes it difficult to relate the results of laboratory measurements to those likely to be obtained in the field.

E.3 Airborne sound insulation

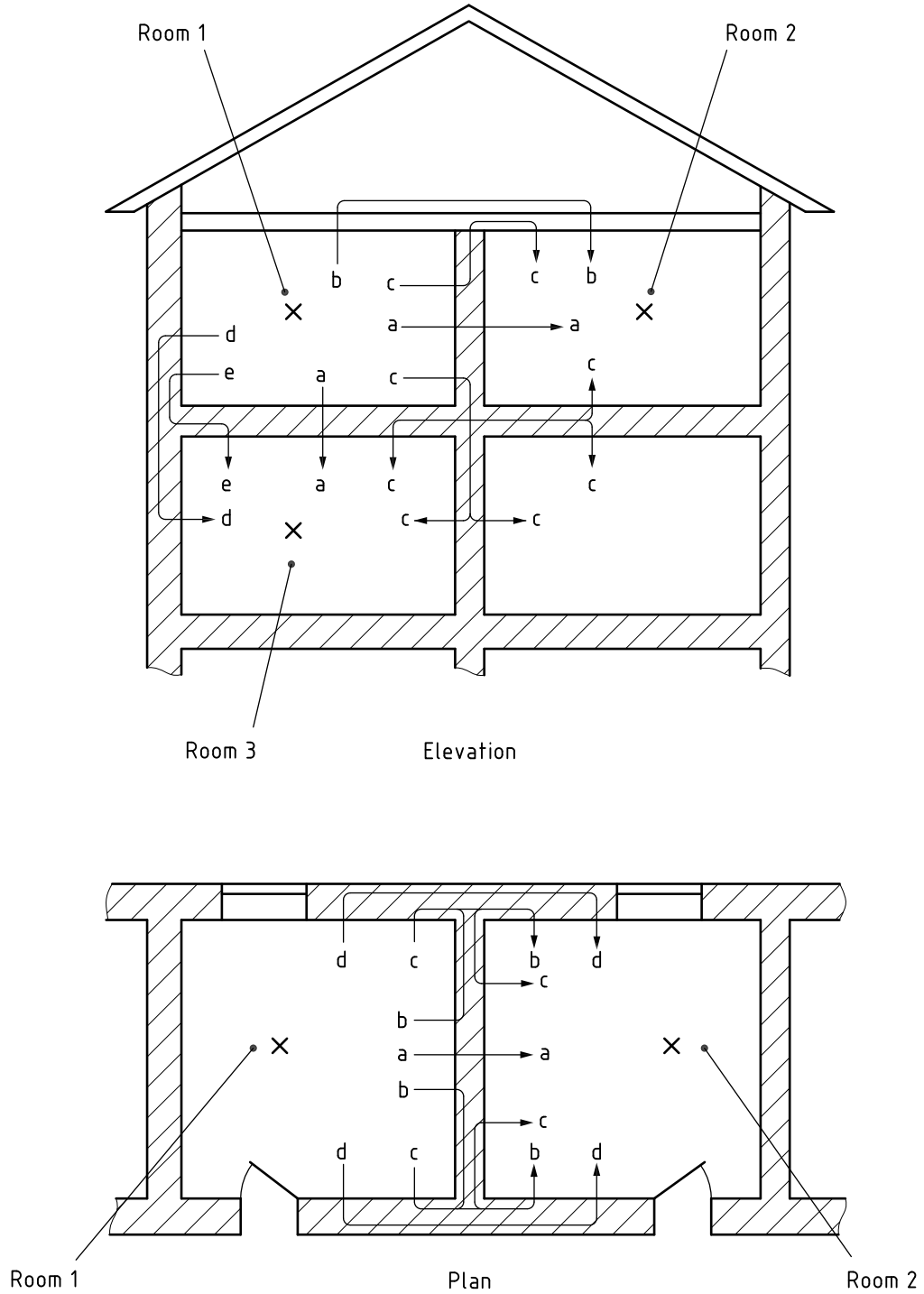
E.3.1 General

The sound insulation of structural elements, such as walls and floors, always varies with frequency, the insulation rising in general as the frequency rises.

E.3.2 Mass law

An approximate empirical relationship has been established between sound insulation and mass for single-leaf constructions, as shown in Figure E.3. This so-called "mass law" gives a useful first approximation to the behaviour of a single sheet or plate. In practice, the sound insulation predicted by the mass law might not be attained because of factors such as the coincidence effect, which is outlined in **E.3.3**. Results for specific materials vary around the value given by the mass law relationship, and so measured data are to be used when available. Table E.1 gives a list of materials and indicates the sound insulation of a single, imperforate sheet when fixed to a suitable wood or metal framework. These values are useful, for example, when assessing existing structures.

Figure E.1 **Transmission paths (via the structure) of noise originating in Room 1 (diagrammatic)**



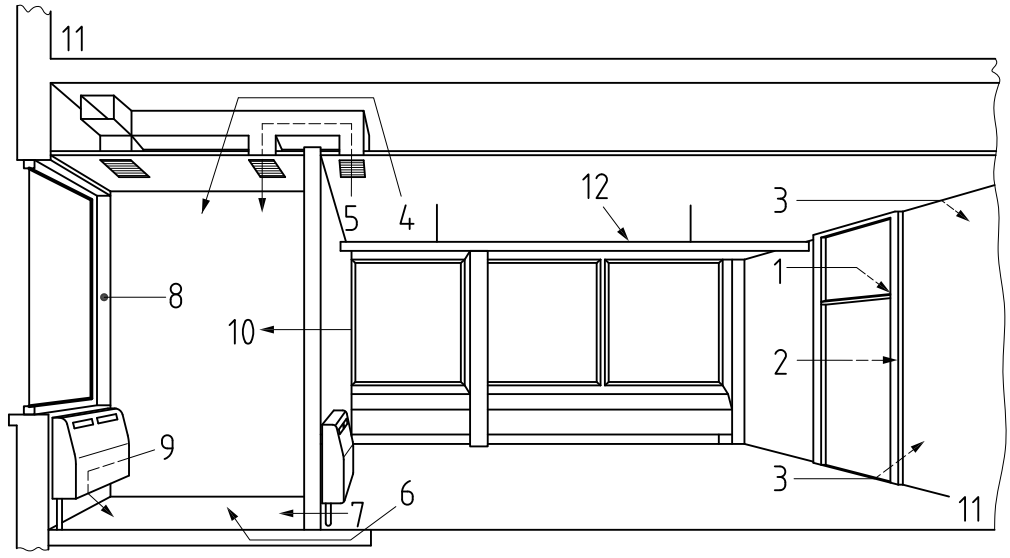
Room 1: Source room

Room 2: Horizontal receiver

Room 3: Vertical receiver

NOTE The arrows indicate the direction of transmission of sound from letter X *in the source room to the same letter* X *in the receiving room.*

Figure E.2 **Indirect sound leakage paths**



Key

1	Lightweight panels above doors	7	Electrical outlets and service pipes
2	Doors	8	Lightweight mullions or mullion/partition closers
3	Air leaks through gaps, cracks or holes	9	Continuous sill line heating
4	Sound transmission via suspended ceilings/partitions	10	Partition performance
5	Common ventilation system without silencers	11	Appliances
6	Common floor duct	12	Continuous lighting fittings

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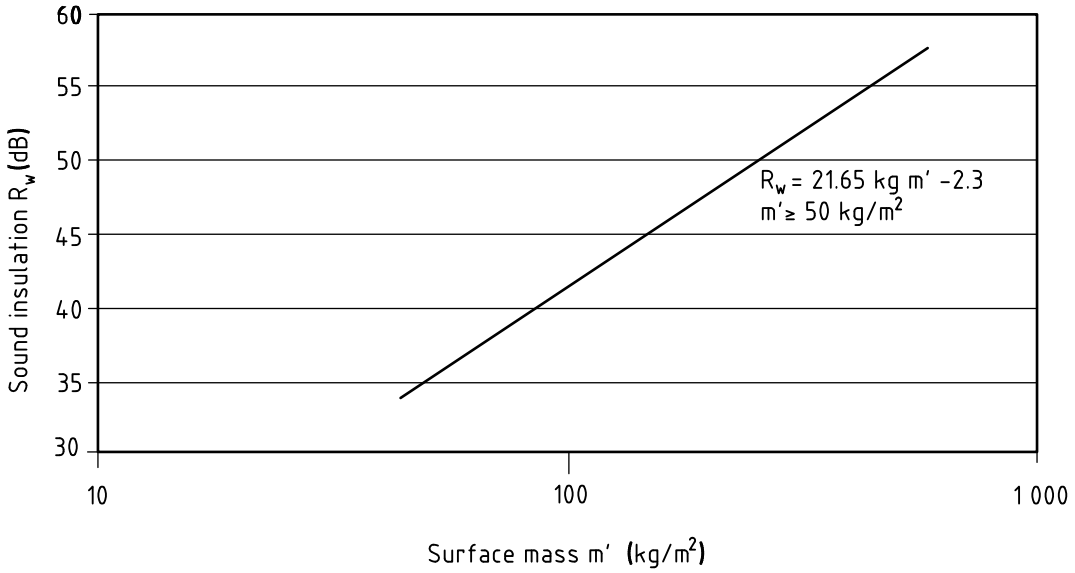
Figure E.3 **Mass law curve**



E.3.3 The coincidence effect

The coincidence effect occurs when the wavelength of the wave impressed on the panel by the incident sound wave is close to the wavelength of free bending waves in the panel. The effect of coincidence is to lower the sound insulation of a construction by as much as 10 dB below the level expected from its mass per unit area over a limited frequency range. The coincidence effect can be pronounced with thin lightweight partitions, resulting in loss of insulation at middle and high frequencies. Reducing the stiffness without a corresponding reduction of mass can raise the critical frequency above 3 150 Hz, and so improve the insulation over the important 100 Hz to 3 150 Hz range. An increase of stiffness has the reverse effect.

It is possible to design lightweight stud partitions so that they perform to their maximum effect in the speech frequency region between 250 Hz and 2 000 Hz, i.e. between the mass-spring-mass and coincidence regions respectively. The worst coincidence dips occur in materials such as plate glass and rigid metal sheets. Heavily damped materials such as lead sheets are least affected.

E.3.4 Mass-spring-mass frequency

A double-leaf wall can perform better than a single-leaf wall of similar mass because the sound has to pass through two barriers. If the two leaves are not connected to each other, the insulation values of the two leaves can be added together. However, in practice, the leaves are often connected by ties or studs, and the full insulation cannot be achieved. Even where the two leaves are isolated from each other, the full benefit can only be obtained above a certain frequency that depends on the cavity width. This is because the air in the cavity behaves like a spring connecting the leaves together, and causes a resonance at the mass-spring-mass frequency. Below this frequency, the two leaves behave more like an equivalent single leaf.

Making the cavity wide can reduce the mass-spring-mass frequency, as in the case of sound insulating secondary glazing. The mass-spring-mass frequency (F_0) can be estimated from the following equation.

$$F_0 = 59.6\sqrt{\frac{1}{d}\left(\frac{1}{m_1}+\frac{1}{m_2}\right)}$$

where:

m_1 and m_2 are the surface masses of the two leaves in kilograms per square metre (kg/m^2);

d is the cavity width in metres (m).

E.3.5 Impact sound control

A structure that receives an impact or has a vibrating source in contact with it behaves more like an extension of the source rather than an intervening element between source and listener. For this reason, a relatively small amount of impact energy can produce a loud sound and, if the structure is continuous, the sound can travel a long distance. Control is usually obtained by inserting a resilient surface at the point of contact with the source (e.g. laying a carpet) or by introducing a structural discontinuity.

Floating floors, which are an example of the latter approach, are a common method of controlling impact sound from footsteps. However, an effective floating floor might result in increased sound from impacts on the source side of the floor. The conventional forms of floating floor might be unsatisfactory if protection against the low-frequency content of impact noise is required (e.g. a dance floor over a restaurant).

E.4 Airborne insulation values of walls and airborne and impact insulation values of floors

Table E.1 and Table E.2 give examples of common types of wall and floor construction with sound insulation in the ranges shown. The insulation indices are for laboratory and field measurements assessed in accordance with BS EN ISO 717-1 and BS EN ISO 717-2. The insulation values given are necessarily approximate since examples of nominally identical constructions might show variations of several decibels. Variation in the amount of indirect transmission can affect significantly the insulation between two rooms separated by a given barrier. For example, the sound insulation of some types of floor could be reduced by indirect transmission along the walls supporting them, particularly if these walls are of lightweight masonry and carried past the floor.

In many cases, simple solid partitions give insulation values according to their mass (see **E.3.2**). Moreover, with partitions of this type there is usually little variation between field and laboratory test results unless the laboratory insulation exceeds 45 dB. Exceptions can occur in buildings that have not been specially designed to minimize common cavities and strongly coupled elements in lightweight panelling. The examples given are not exhaustive. Flanking structures are not listed since these can vary widely and are often dependent upon other factors, such as thermal insulation, which are outside the scope of this British Standard.

Table E.1 and Table E.2 give general, non-exhaustive guidance on the potential sound insulation performance of generic constructions. Manufacturers' products and systems are continually being developed. Additional information on the most up-to-date specifications available ought to be obtained directly from the manufacturers. When considering separating partitions above 50 R_w or $D_{nT,w} + C_{tr}$, expert advice might be required.

Table E.1A **Laboratory airborne sound insulation of walls and partitions**

Sound insulation R_w dB	**Type of wall or partition**
26 to 33	a) 1 mm steel sheet panels fixed to steel frame members to form demountable partition units 50 mm overall thickness. Mineral wool cavity insulation.
	b) Plywood or wood fibre board 12 mm thick nailed both sides of (50 × 50) mm timber framing members spaced at 400 mm centres.
	c) Paper faced strawboard or wood wool 50 mm thick panels plastered both sides.
	d) Chipboard hollow panels 50 mm thick tongued and grooved edges, hardboard faced. Joints covered with wood trim.
33 to 37	a) Lightweight masonry blockwork. Plaster or drylining on at least one side. Overall mass per unit area not less than 50 kg/m^2.
	b) Timber stud partitions any size timbers greater than (50 × 350) mm, 400 mm centres, cross noggins, 9.5 mm plasterboard lining on both sides, any suitable finish.
	c) Metal stud partition, 50 mm studs 600 mm centres, clad both sides with 12.5 mm plasterboard, joints filled and perimeters sealed. Approximate mass per unit area 18 kg/m^2.
	d) 50 mm lightweight masonry blockwork, plastered both sides to 12 mm thickness or drylined with 9.5 mm plasterboard.
37 to 43	a) Lightweight masonry blockwork, plaster or dry lining on at least one side. Overall mass per unit area not less than 75 kg/m^2.
	b) Either 75 mm or (100 × 50) mm timber studs (no noggins) spaced 600 mm apart, 50 mm mineral fibre quilt in stud cavity. Frame-lined on both sides with one layer 12.5 mm plasterboard. Approximate mass per unit area 19 kg/m^2.
	c) Metal stud partition, 50 mm studs 600 mm centres, clad both sides with 15 mm plasterboard, joints filled and perimeters sealed. Approximate mass per unit area 26 kg/m^2.
43 to 50	a) Masonry wall, joints well filled. Either plaster or dry lining on both sides. Overall mass per unit area not less than 150 kg/m^2.
	b) 100 mm metal stud partition, "C" section studs not greater than 600 mm spacing, not less than nominal 50 mm web depth. Clad on both sides with two layers of plasterboard of not less than 22 mm combined thickness. Mineral fibre quilt hung between studs. Approximate mass per unit area 35 kg/m^2.
	c) (75 × 50) mm timber framing using stagged studs at 300 mm spacing with 25 mm stagger forward and back. Frame clad with two layers of 12.5 mm of plasterboard on both sides. Mineral fibre quilt hung between studs. Approximate mass per unit area 36 kg/m^2.
	d) (50 × 25) mm timber stud partition to form a 25 mm cavity, clad on both sides with minimum 38 mm wood wool slabs having their outer faces screeded or plastered.
	e) Solid autoclaved aerated concrete blocks, 215 mm thick plaster or dry-lined finish on both sides, blockwork joints well filled. Overall mass per unit area not less than 160 kg/m^2.
50 to 54	a) Two separate frames of timber studs not less than (89 × 38) mm, or boxed metal studwork with 50 mm minimum web depth. Studs at 600 mm maximum centres. A 25 mm mineral wool quilt suspended between frames. Frames spaced to give a minimum 200 mm overall cavity. Clad on outside of each frame with a minimum of 30 mm plasterboard layers (e.g. 19 mm plus 12.5 thickness). Approximate mass per unit area 54 kg/m^2.
	b) Either in situ or precast concrete wall panel not less than 175 mm thick and not less than 415 kg/m^2. All joints well filled.

Table E.1A **Laboratory airborne sound insulation of walls and partitions**

Sound insulation R_w dB	Type of wall or partition
	c) Brick laid frogs up, wall nominal 200 mm thickness, weight (including plaster) not less than 380 kg/m^2. Plaster or dry-lined finish both sides. Brickwork joints well filled.
	d) "No fines" concrete 225 mm thickness, weight (including plaster) not less than 415 kg/m^2. Plaster or dry-lined finish both sides.
	e) Cavity lightweight aggregate block (maximum density of block 1 600 kg/m^3) with 75 mm cavity and wall ties of the butterfly wire type. Dry-lined finish on both sides. Joints in blockwork well filled. Overall mass per unit area not less than 300 kg/m^2.
	f) Dense aggregate concrete block cavity wall with 50 mm cavity and wall ties of the butterfly wire type. Dry-lined finish on both sides. Joints in blockwork well filled. Overall mass per unit area not less than 415 kg/m^2.
	g) Autoclaved aerated concrete block cavity wall consisting of two leaves, 100 mm blocks not less than 75 mm apart, with wall ties of the butterfly type. Plaster or dry-line finish on both sides. Joints in blockwork well filled. Overall mass per unit area not less than 150 kg/m^2.
	h) Metal stud partition, 70 mm acoustic studs 600 mm centres, clad both sides with 15 mm plasterboard, joints filled and perimeters sealed. Mineral fibre within cavity. Approximate mass per unit area 26 kg/m^2.
54 to 60	a) Two separate frames of timber studs not less than (100 × 50) mm, spaced at 600 mm maximum centres. A 50 mm mineral wool quilt in each frame between studs. Frames spaced to give a minimum 300 mm overall cavity. Each frame clad on outside with three layers of 12.5 mm plasterboard nailed to framing. Approximate mass per unit area: 51 kg/m^2.
	b) Metal stud partition, 146 mm acoustic studs 600 mm centres, clad both sides with a double layer 15 mm plasterboard, joints filled and perimeters sealed. Approximate mass per unit area: 51 kg/m^2.
	c) Solid masonry with an overall mass per unit area of not less than 700 kg/m^2, fully sealed both sides.
	d) Dense aggregate concrete block solid wall 215 mm thick plaster finish to both surfaces. Overall mass per unit area not less than 415 kg/m^2.
	e) Cavity lightweight aggregate block (maximum density of block 1 600 kg/m^3) with 75 mm cavity and wall ties of the butterfly wire type. Plaster finish on both sides. Joints in blockwork well filled. Overall mass per unit area not less than 300 kg/m^2.
	f) Dense aggregate concrete block cavity wall with 50 mm cavity and wall ties of the butterfly wire type. Plaster finish on both sides. Joints in blockwork well filled. Overall mass per unit area not less than 415 kg/m^2.
	g) Metal stud partition, 146 mm acoustic studs 600 mm centres, clad both sides with a double layer 15 mm plasterboard, joints filled and perimeters sealed. Mineral fibre within cavity. Approximate mass per unit area 52 kg/m^2.
60+	a) Two separate frames of metal 48 mm "C" studs 600 mm centres, clad both sides with a double layer 15 mm plasterboard, joints filled and perimeters sealed. Minimum overall width of 200 mm. Mineral fibre within cavity. Approximate mass per unit area 55 kg/m^2.

NOTE 1 Construction details and workmanship are important if the levels of sound insulation indicated are to be achieved.

NOTE 2 Constructions might not achieve these laboratory performances in the field, even if correctly specified and correctly built, due to flanking transmission paths.

Table E.1B **Field airborne sound insulation of walls and partitions**

Sound insulation $D_{nT,w} + C_{tr}$ dB	**Type of wall or partition capable of achieving required performance**
40 - 44	a) Metal stud partition of overall nominal width of 208 mm. 146 mm metal "C" studs at 600 mm centres, 50 mm mineral wool insulation in the cavity, double layer of 15 mm plasterboard each side (minimum plasterboard density 25 kg/m^2 each side).
	b) Metal stud partition of overall nominal width of 138 mm. 70 mm metal "C" studs at 600 mm centres with resilient bars at 600 mm centres fixed to one side of the stud framework, 50 mm mineral wool insulation positioned in the cavity, double layer of 15 mm plasterboard each side (minimum plasterboard density 22 kg/m^2 each side).
45 - 49	a) Metal stud partition of overall nominal width of 208 mm. 146 mm metal acoustic studs at 600 mm centres, 50 mm insulation in the cavity, double layer of 15 mm plasterboard each side (minimum plasterboard density 25 kg/m^2 each side).
	b) Metal stud partition of overall nominal width of 200 mm. Two frames of 48 mm metal "C" studs at 600 mm centres, cross-braced at 1 200 mm centres. Cavity width of 140 mm. 50 mm mineral wool insulation positioned between the frames. Double layer of 15 mm plasterboard each side (minimum plasterboard density 25 kg/m^2 each side).
50 - 52	a) Aggregate block cavity wall, minimum 100 mm blocks (minimum density 1 350 kg/m^3), minimum 75 mm cavity between leaves, finished with 13 mm plaster.
	b) Aggregate block cavity wall, minimum 100 mm blocks (minimum density 1 350 kg/m^3), minimum 75 mm cavity between leaves, finished with nominal 8 mm (minimum 6 mm) gypsum parge coat, 12.5 mm plasterboard (minimum plasterboard density 8 kg/m^2).
	c) Metal stud partition of overall nominal width of 250 mm. Two frames of minimum 60 mm metal "I" studs at 600 mm centres (no bracing between leaves). Minimum cavity width of 190 mm. 100 mm mineral wool insulation positioned between the frames. Double layer of 15 mm plasterboard each side (minimum plasterboard density 25 kg/m^2 each side).
	d) Timber stud partition of overall nominal width of 300 mm. Two frames of timber studs at 600 mm centres (no bracing between leaves). Minimum cavity width of 240 mm. 90 mm mineral wool insulation positioned between the studs in each timber frame. Double layer of 15 mm plasterboard each side (minimum plasterboard density 25 kg/m^2 each side).
53+	a) Aggregate block cavity wall, minimum 100 mm blocks (minimum density 1 350 kg/m^3), minimum 100 mm cavity between leaves, 100 mm mineral wool insulation in the cavity, finished with plasterboard (minimum plasterboard density 10 kg/m^2).
	b) Metal stud partition of overall nominal width of 300 mm. Two frames of minimum 60 mm metal "I" studs at 600 mm centres (no bracing between leaves). Minimum cavity width of 240 mm. 100 mm mineral wool insulation positioned between the frames. Double layer of 15 mm plasterboard each side (minimum plasterboard density 25 kg/m^2 each side).

NOTE 1 Construction details and workmanship are important if the levels of sound insulation indicated are to be achieved.

NOTE 2 These constructions might perform better than the field values given above if tested in a laboratory where flanking paths are idealized.

Table E.1C **Typical performance measured in the field of walls built to Robust Details generic systems**

dB $D_{nT,w}$ Mean	dB $D_{nT,w}+C_{tr}$ Mean	Type of wall [A)]
59	53	E-WM-1 - cavity masonry – dense aggregate blockwork (wet plaster)
59	53	E-WM-2 - cavity masonry – lightweight aggregate blockwork (wet plaster)
60	54	E-WM-3 - cavity masonry – dense aggregate blockwork (render and gypsum-based board)
59	53	E-WM-4 - cavity masonry – lightweight aggregate blockwork (render and gypsum-based board)
58	52	E-WM-6 - cavity masonry – aircrete blockwork (render and gypsum-based board)
55	50	E-WM-9 - solid masonry – solid dense aggregate blockwork (render and gypsum-based board)
62	55	E-WM-11 - cavity masonry – lightweight aggregate blockwork (render and gypsum-based board) with 100 mm minimum cavity [For Scotland: V-WM-11]
62	55	E-WM-16 - cavity masonry – dense aggregate blockwork (render and gypsum-based board) with 100 mm minimum cavity
60	53	E-WM-18 - cavity masonry – dense aggregate blockwork (wet plaster) with 100 mm minimum cavity
62	56	E-WM-21 - cavity masonry – lightweight aggregate blockwork (wet plaster) with 100 mm minimum cavity [For Scotland: V-WM-11]
63	55	E-WT-1 – twin-leaf timber frame – without sheathing board [For Scotland: V-WT-1]
63	54	E-WT-2 – twin-leaf timber frame – with sheathing board [For Scotland: V-WT-2]
58	51	E-WS-1 - steel frame – twin metal frame

[A)] See the Robust Details (RD) Handbook [53] or, for Scotland, [54] for full specification details, including flanking requirements.

Table E.2A **Laboratory airborne sound insulation of floor constructions**

Sound insulation R_w dB	**Type of floor construction**
Below 43	Timber joist floor consisting of 22 mm tongued and grooved floor boarding or equivalent fixed directly to floor joists. Ceiling of 12.5 mm plasterboard and skim with no floor covering.
Above 43	a) A concrete floor having mass per unit area not less than 365 kg/m^2, including any screed or ceiling finish directly bonded to the floor slab, together with a floating floor or resilient floor covering equivalent to rubber or sponge rubber underlay or thick cork tile (e.g. carpet and underlay or sponge rubber backed vinyl flooring).
	b) A solid floor consisting of: • a solid slab; or • concrete beams and infilling blocks; or • hollow concrete planks, together with a floating floor. A ceiling finish is required for a beam and block floor. In each case the slab is to have a mass per unit area of at least 300 kg/m^2, including any screed or ceiling finish directly bonded to it. Where a floating floor is laid over a floor of beams and hollow infill blocks or hollow beams along the top of the structural floor, the latter is to be sealed and levelled before the resilient layer is put down. It is also essential to have due regard for conduits and pipework to be be laid and covered so as to prevent any short circuit of the floor's isolating properties. If precast units are used as a structural floor it is essential that the joints are filled to ensure that the sound insulation performance is maintained. The resilient material is laid to cover completely the structural floor and turned up against the surrounding wall along all edges. The resilient layer is usually of mineral fibre, or a special grade of expanded polystyrene. When the screed is laid, it is important that none of the mix finds its way through the resilient layer to the structural floor, as this short-circuits the isolation between the two decks and significantly reduces the sound insulation.
	c) A floor consisting of boarding nailed to battens laid to float upon an isolating layer of mineral fibre capable of retaining its resilience under imposed loading. With battens running along the joists, a dense fibre layer can be used in strips. The ceiling below to be of metal lath and plaster not less than 29 mm thick, with pugging on the ceiling such that the combined mass per unit area of the floor, ceiling and pugging is not less than 120 kg/m^2.
	d) A floor consisting of 18 mm tongued and grooved chipboard on 19 mm plasterboard, laid on battens running parallel to the joists and supported on 25 mm thick mineral wool of approximately 90 kg/m^3 to 140 kg/m^3 density; 100 mm of fibre absorbent (as used for insulation in roof spaces) laid between the joists on top of the plasterboard ceiling. The ceiling can be 19 mm plus 12.5 mm plasterboard. It is imperative that the resilient layer is not punctured by nails.
	e) A floor consisting of 18 mm tongued and grooved chipboard on 19 mm plasterboard floating on a 25 mm thick mineral wool layer of approximately 60 kg/m^3 to 80 kg/m^3 density; this on a 12.5 mm plywood platform; 100 mm of fibre absorbent laid between the joists on top of the plasterboard ceiling. The ceiling can be 19 mm plus 12.5 mm plasterboard. It is imperative that the resilient layer is not punctured by nails.

NOTE 1 Construction details and workmanship are important if the levels of sound insulation indicated are to be achieved.

NOTE 2 Constructions might not achieve these laboratory performances in the field, even if correctly specified and correctly built, due to flanking transmission paths.

Table E.2B **Typical performance measured in the field of floors built to Robust Details generic systems**

dB $D_{nT,w}$ Mean	dB $D_{nT,w}+C_{tr}$ Mean	dB $L'_{nT,w}$ Mean	Type of floor [A)]
54	50	51	E-FC-1 - precast concrete plank with directly applied screed and floating floor treatment
62	56	44	E-FC-2 – in situ concrete slab and floating floor treatment
60	52	52	E-FT-1 - timber I-joists and floating floor treatment [For Scotland, V-FT-1]
60	52	52	E-FT-2 - timber solid joists and floating floor treatment [For Scotland, V-FT-2]
64	56	37	E-FS-1 - steel deck and in situ concrete and floating floor treatment [For Scotland, V-FS-1]

[A)] See the Robust Details (RD) Handbook [53] or, for Scotland, [54] for full specification details, including flanking requirements.

Annex F (informative)

Legislative framework and guidance

*NOTE Much of the advice already given in **5.1** to **5.5** can also be applied to a new noise producing development. As the local planning authority might require noise control measures, and failure to implement these properly could result in widespread annoyance and legal action, it is necessary to consider the legislative framework.*

F.1 Legislative framework

For many projects involving buildings, there is usually a need to carry out some form of noise impact assessment in order to satisfy local and national noise management and planning policies. The scope of the assessment needs to include all phases of the proposed development including construction and operation.

Certain types of project that meet specific criteria require either a full environmental impact assessment (EIA) [55] to be carried out, an important part of which is often noise, or a more specific noise assessment process to be followed. In all cases, it is prudent to consult, at an early stage, with:

a) the relevant local planning authority;

b) the relevant local authority environmental health department;

c) the relevant building control authority.

F.2 Construction noise

Sections 60 and 61 of the Control of Pollution Act 1974, as amended [56], provide the legislative basis for controlling construction noise, including local authority powers. Useful advice on controlling construction noise is given in BS 5228-1.

F.3 Noise from other sources

A local authority can take legal action to prevent or stop a noise from fixed premises, including land, which it considers prejudicial to health or a nuisance. Any new noise source of that nature has the potential to be a statutory nuisance. Furthermore, an existing noise source can become susceptible to nuisance legislation if residential premises are introduced into its vicinity. Useful advice on the assessment of sources of an industrial nature can be found in BS 4142.

In England, Wales and Scotland, a local authority's power is primarily to be found in section 80 of the Environmental Protection Act 1990 [57] and, in Northern Ireland, Article 70 The Clean Neighbourhoods and Environmental Act (Northern Ireland) 2011 [58]. These Acts also make provision for private individuals to take complaints directly to a magistrate's court (or Sheriff's court in Scotland).

The main principles established under these Acts are as follows.

a) There is no prescribed level above which a noise automatically becomes a statutory nuisance. Each case is considered on its merits taking account of a range of factors, including the likely reaction of a typical person.

b) Where the noisemaker is operating from industrial, trade or business premises, it is a defence to show that the best practicable means to control noise have been used.

F.4 Civil action

Civil action can be taken against the perpetrator of noise that is felt to be a nuisance and, again, each case is assessed on its merits. The criterion for a civil action is how the noise affects the individual, compared with the ordinary inconvenience suffered by the public at large, or how it affects land in which the individual has an interest. The defence of best practicable means is not available.

Annex G (informative) Typical design problem

G.1 Typical design problem: Simple calculation

A small housing development is to be situated 55 m from the edge of an existing road. The average traffic speed is 50 km/h, and the intervening ground is paved.

To establish the noise exposure of the site, the $L_{A10,18h}$ could be calculated or measured for a typical unit near the road. This has been calculated from CRTN [16] to be 65 dB free-field. This is approximately 63 dB $L_{Aeq,16h}$. The local planning authority has requested noise control measures; in this case to reduce the noise level inside the bedrooms to 35 dB $L_{Aeq,16h}$ during the day and 30 dB $L_{Aeq,8h}$ at night.

To reduce the noise exposure inside the houses, attention needs to be given to the sound insulation of both the roof and facade. A traditional pitched roof with concrete tiles and a 9 mm plasterboard ceiling, covered in thermal insulating material, has an insulation of approximately 43 dB R_w (see Clause **8**).

The windows, and any trickle ventilators, are normally the weakest part of a brick and block facade. Insulating glass units have an insulation of approximately 33 dB R_w and, assuming suitable sound attenuating trickle ventilators [2)] are used, the resulting internal noise level, roughly 30 dB, ought to be determined by the windows. This level is acceptable with the windows closed and attenuated background ventilation, even with the correction for first floor level. If partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB [3)], resulting in the target levels being exceeded. However, windows may still be openable for rapid or purge ventilation, or occupant's choice.

[2)] Note that, where more than one ventilator is used to meet the ventilation requirement, the overall ventilator attenuation needs to be suitable (see **G.2.1**, Note 5). Where the glazing exceeds the required attenuation, the ventilation is usually the weakest part of the facade.

[3)] Note that the level difference through a window partially open for ventilation can

This calculation ought to be repeated for night-time traffic conditions, and the design needs to satisfy both sets of requirements. Strictly, the insulation values used here relate to a pink noise spectrum, and actual values achieved are lower for traffic noise. Furthermore, the method does not take account of the absorption (e.g. furnishings) in the room. However, the R_w values suffice for a rough calculation, although it is likely to underestimate the level in the room by up to 5 dBA. Where the estimate is within 5 dBA of the target noise level, a more rigorous calculation needs to be carried out using octave bands, as explained in **G.2**.

G.2 Typical design problem: More rigorous calculation

G.2.1 Calculation method

This calculation method is based on that given in BS EN 12354-3.

NOTE 1 This method is applicable for simple facades without balconies. The calculation is different for external noise intrusion from a point source, e.g. an item of construction plant, and that for a line source. The external noise is assumed to irradiate the external facade at random incidence, whereas for a point source there is irradiation from a single direction of incidence, with a cosθ factor being applied to account for various incident angles. BS EN 12354-3, which in any case is more difficult to follow than the example given here, does not distinguish between point and line source cases.

NOTE 2 Measurement methods for the insulation of facade elements are given in BS EN ISO 10140-2.

The following equation, which gives the equivalent sound pressure level in a room, $L_{eq,2}$, needs to be evaluated for each frequency band of interest.

$$L_{eq,2} = L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3 \quad \text{(G.1)}$$

where:

$L_{eq,ff}$ is the equivalent continuous sound pressure level outside the room elements under consideration;

NOTE 3 It is the free-field sound level (i.e. in the absence of the facade), measured or estimated at the intended position of the element under consideration. It is related to the level $L_{eq,1}$ measured within a few millimetres of the actual facade by the relation $L_{eq,ff} \approx L_{eq,1} - 6$, and to the level $L_{eq,2m}$ measured 2 m away from the facade by the relation $L_{eq,ff} \approx L_{eq,2m} - 3$.

NOTE 4 The calculation method assumes the source is traffic noise and a facade shape correction factor is not required. BS EN 12354-3 provides a more detailed calculation method where these assumptions are not valid.

A_0 is a reference absorption area of 10 m^2 and is independent of frequency;

S_f is the total facade area in square metres (m^2) of the room in question;

S_{wi} is the area in square metres (m^2) of the windows of the room;

vary significantly depending on the window type and the frequency content of the external noise. If the specific details of the window and external noise are known the value for insulation may be adjusted accordingly.

S_{ew}	is the area in square metres (m^2) of the external wall of the room;
S_{rr}	is the area in square metres (m^2) of the ceiling of the room;
S	is the total area in square metres (m^2) of elements through which sound enters the room, i.e. $S_f + S_{rr}$;
$D_{n,e}$	is the insulation of the trickle ventilator measured according to BS EN ISO 10140;
	NOTE 5 Where more than one ventilation unit is required to achieve the background ventilation, the $D_{n,e}$ of the combined ventilators should be used in the calculation.
R_{wi}	is the sound reduction index (octave band value) of the window (see Annex C);
R_{ew}	is the sound reduction index (octave band value) of the external wall (see Annex C);
R_{rr}	is the sound reduction index (octave band values) of the roof/ceiling (see Annex C);
A	is the equivalent absorption area of the receiving room being considered (see Annex C);
3	is a correction factor.

Values of L_{eq}, $D_{n,e}$, R and A are frequency dependent, and the calculation of $L_{eq,2}$ has to be repeated using values for each octave band of interest. If the dBA level in the room ($L_{Aeq,2}$) is to be estimated, the resulting values of $L_{eq,2}$ ought to be A-weighted (to give $L_{Aeq,125}$ in the 125 Hz octave band, etc.) and summed logarithmically (see Annex A). The equation for summing the levels in each frequency is as follows.

$$L_{Aeq,2} = 10\log_{10}\left(10^{\frac{L_{Aeq,125}}{10}} + 10^{\frac{L_{Aeq,250}}{10}} + \ldots + \right) \quad \text{(G.2)}$$

G.2.2 The calculation of the noise level inside a room

The calculation for this example is conducted most easily on a spreadsheet, using the data in Table G.1. Each term in the equation is evaluated for each frequency band, as shown in Table G.2.

In this example the exposure of the roof and all facade elements is the same. Where this is not the case the calculation has to be undertaken on an element-by-element basis and the resulting internal levels summed using equation (G.2).

The calculated noise level is above the target of 35 dBA, and Table G.2 shows that the main contribution comes from the window (row C), although the roof (row E) dominates at low frequencies. A better product ought to be selected and the procedure repeated until it has no significant effect on the insulation. The revised value may be compared with the rough estimate of 34 dBA. This procedure needs to be repeated for night-time conditions and the design has to satisfy both sets of requirements. The rapid ventilation problem still needs to be tackled.

In this calculation the trickle ventilators were not an important transmission path, but this might not always be the case.

Although this calculation is more rigorous than the simple example, the method still makes assumptions, and it is likely that the estimated levels differ from measured values. It does, however, indicate the relative performance of each element in each octave band and allows iterative changes. Facade calculations are also covered in [15].

Table G.1 **Data used in the calculation of the noise level inside a room**

Terms that are frequency dependent

Term	Description	Single-figure rating	Octave band centre frequency Hz					A-weighted level
			125	250	500	1 000	2 000	
$L_{eq,ff}$	—	—	70	66	63	61	61	67
$D_{n,e}$	Sound attenuated trickle ventilator	—	37	36	35	36	34	—
R_{wi}	6-12-6 insulated glass unit	33	26	29	33	28	24	—
R_{ew}	Brick and block external wall	50	40	44	45	51	56	—
R_{rr}	See Table G.2	43	28	34	40	45	49	—
A	—	—	11	14	16	16	15	—

Terms that are not frequency dependent

Term	Derivation	Value m^2
S_f	Facade area (including window)	10
S_r	Roof area (exposed side)	40
S_{wi}	Window area	1.5
S_{ew}	$S_f - S_{wi}$	8.5
S_{rr}	Area of ceiling	15
S	$S_f + S_{rr}$	25
A_0	Reference absorption area given in BS EN ISO 10140-2	10

NOTE The expected precision of this calculation is ±2 dB.

Table G.2 **The calculation of the noise level inside a room**

Term from equation (G.1)	Reference letter of result	Octave band centre frequency Hz				
		125	250	500	1 000	2 000
$L_{eq,ff}$	A	70	66	63	61	61
$D_{n,e}$		37	36	35	36	34
$\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}}$	B	0.000 08	0.000 10	0.000 13	0.000 10	0.000 16
R_{wi}		26	29	33	28	24
$\frac{S_{wi}}{S_f}10^{\frac{-R_{wi}}{10}}$	C	0.000 15	0.000 08	0.000 03	0.000 10	0.000 24
R_{ew}		40	44	45	51	56
$\frac{S_{ew}}{S_f}10^{\frac{-R_{ew}}{10}}$	D	0.000 03	0.000 01	0.000 01	0.000 00	0.000 00
R_{rr}		28	34	40	45	49
$\frac{S_{rr}}{S_f}10^{\frac{-R_{rr}}{10}}$	E	0.000 95	0.000 24	0.000 06	0.000 02	0.000 01
$10\log_{10}(B+C+D+E)$	F	–29.2	–33.7	–36.4	–36.6	–33.9
A (furnished)		11	14	16	16	15
$10 \log \frac{S}{A}$	G	3.6	2.5	1.9	1.9	2.2
$L_{eq,2}$	A + F + G + 3	47.4	37.8	31.5	29.3	32.3
A-weighting dB		–16	–9	–3	0	1
$L_{eq,2}$ + A-weighting	$L_{Aeq,125}$ etc.	31.4	28.8	28.5	29.3	33.3

$L_{Aeq,2}$ is obtained by combining these values using equation (G.2).
A-weighted level in the room $L_{Aeq,2}$ is 37.7 dB

Annex H (informative) Examples of design criteria adopted by hotel groups

H.1 General

Airborne sound insulation between spaces is not to be less than the values given in Table H.1, when measured in accordance with BS EN ISO 140-4 and rated in accordance with BS EN ISO 717-1.

Table H.1 **Airborne sound insulation**

Room areas	Performance
Bedroom – Bedroom Bedroom – Bathroom (different rooms) Bathroom – Bathroom	Walls: 43 dB $D_{nT,w} + C_{tr}$ Floors: 45 dB $D_{nT,w} + C_{tr}$
Bedroom – Restaurant/bar	60 dB $D_{nT,w}$
Bedroom – Kitchen	60 dB $D_{nT,w}$
Bedroom – Other tenancies	65 dB $D_{nT,w}$
Bedroom – Corridor	Walls: 43 dB $D_{nT,w} + C_{tr}$
Bathroom – Corridor	45 dB $D_{nT,w}$
Bedroom – Laundry	43 dB $D_{nT,w} + C_{tr}$
Bedroom – Plant room	60 dB $D_{nT,w}$

NOTE It might be important to take account of the purpose of the room.

Internal wall constructions within bedrooms (but not to en suite bathrooms) are to have a sound insulation performance of not less than 40 dB R_w. Doors to bedrooms are to have a sound insulation performance of not less than 29 dB R_w, when measured in accordance with BS EN ISO 10140-2 and rated in accordance with BS EN ISO 717-1. Interconnecting doors should maintain the required room-to-room sound insulation performance of the total wall as identified in accordance with **H.2**.

Where moveable walls are to be installed between meeting rooms and between function rooms, the entire wall, including cupboards for parking the wall panels and the wall above and beneath the ceiling or floor, is, in its entirety, to achieve a minimum installed performance of 48 dB $D_{nT,w}$.

H.2 Impact sound insulation

Impact sound insulation between spaces is not to exceed the values given in Table H.2, when measured in accordance with BS EN ISO 140-7 and rated in accordance with BS EN ISO 717-2.

Table H.2 **Impact sound insulation for hotels**

Room areas	Performance
Bedroom – Bedroom	62 dB $L'_{nT,w}$
Bathroom – Bedroom	62 dB $L'_{nT,w}$
Corridor – Bedroom	62 dB $L'_{nT,w}$

NOTE The applicable Building Regulations [30, 31, 32] might require more stringent standards than those given in this table.

All separating floor systems need to be free from "squeaks" and "creaks" from footsteps (see **8.4.6.4**). All doorsets should include seals on the sides, head and threshold in order to meet the necessary acoustic requirements. Smooth-closing doors are to be installed in order to minimize noise disturbance from occupant movement.

H.3 Sound absorption in common parts

Sound absorption is to be provided for corridors, staircases and hallways in accordance with Clause **8**. The applicable Building Regulations [30, 31, 32] contain provisions for sound absorption that is necessary in corridors, staircases and hallways.

H.4 Internal noise levels from external sources

The noise level in any hotel bedroom, with windows closed, from all external sources, including road, rail and air traffic and noise from activities outside the hotel and any adjacent premises, are to be within the range of average noise levels in Table H.3.

Table H.3 **Indoor ambient noise level ranges for hotel bedrooms**

Period	Noise level
Daytime (07:00 – 23:00 hrs)	30 – 40 dB $L_{Aeq,1hour}$
Night-time (23:00 – 07:00 hrs)	25 – 35 dB $L_{Aeq,1hour}$
Night-time (23.00 – 07.00 hrs)	45 – 55 dB L_{Amax}

NOTE Some hotels may set lower noise levels, depending on location.

Music and patron noise intrusion from inside any adjacent, neighbouring or connected bar/restaurant or nightclub into the guest bedrooms is to be controlled such that it is unlikely to cause disturbance.

In hotels, other commercial factors could influence the criteria adopted for the break-in to bedrooms of building services noise from adjacent rooms or spaces.

External facade constructions and components, such as brise soleil, grilles, ventilators, curtain walling systems or other architectural features, are not to give rise to intrusive whistling, creaking, rattling or other noises as a result of wind or other climatic effects.

H.5 Background noise levels: Internal sources

The background noise level in any hotel bedroom arising from comfort cooling room units serving the bedroom is not to exceed NR25 L_{eq} when the units are operating at their design duty. Comfort cooling systems installed in bedrooms are to have the facility to be operated at quieter duties and to be switched off by room occupants.

The background noise level in any hotel bedroom as a result of constant minimum fresh air ventilation systems serving the bedroom or other parts of the development is not to exceed NR20 L_{eq} when the systems are operating at their design duty.

The background noise level in any hotel bedroom arising from any other building services systems serving the bedroom or any other parts of the development is not to exceed NR20 L_{eq} within the bedroom.

The building services noise in other areas of the hotel is not to exceed the levels given in Table H.4.

Table H.4 **Building services noise in hotels**

Area	Noise level
En suite bathrooms	NR35 to NR 45 $L_{eq,\ 1hr}$
Corridors/lobbies	NR40 $L_{eq,\ 1hr}$
Restaurants	NR35 to NR 45 $L_{eq,\ 1hr}$
Public toilets	NR40 $L_{eq,\ 1hr}$
Staff rooms	NR40 $L_{eq,\ 1hr}$

Noise emission from hydraulic systems, including domestic hot and cold water services, refrigerant pipework, and soil and waste pipes serving other bedrooms, is not to cause disturbance in normal use.

Noise from the operation of lifts is not to cause disturbance in hotel bedrooms (see **7.7.3.4**).

H.6 Noise control measures for bedrooms, corridors and stairwells

The air conditioning system is to be designed to conform to Table H.4, and to avoid compromising sound insulation between rooms. Bedrooms are not to be located next to lift shafts, plant rooms or other areas where there are high noise levels. Effective protection against indoor noise is necessary, and partitions and floors between rooms are required to meet the appropriate Building Regulations [30, 31, 32].

To avoid unnecessary transmission of airborne noise between adjoining rooms by way of open windows, windows are not to open in such a way as to direct sound immediately from one room into the next. Where possible, bedrooms are not to overlook courtyards, or to be over kitchens or service vehicle areas that are frequently noisy in the early morning.

Door openings on opposite sides of corridors may be staggered and fitted with acoustic seals on all four edges to reduce noise transmission (but without making it necessary to slam the doors closed). Doors may have quiet-action latches. Corridors can be fitted with carpeted floors. Sound-absorbing ceilings are beneficial, though not always essential if a carpet is fitted in the corridor. Staircases and lift halls may be separated from the corridors by means of doors that can open and close quietly (such as swing doors) and, where possible, isolated from bedrooms by linen stores and similar rooms. If bedroom doors have to be located close to lift doors, acoustic lift signals are not to be audible in the bedrooms. Except within the same suite, bathrooms are not be planned next to bedrooms. In all cases, the types of sanitary fittings chosen ought ideally to be quiet in operation and the plumbing system designed to minimize noise by avoiding sharp bends and restrictions of flow.

H.7 Function rooms

Large hotels often have ballrooms, banqueting rooms and meeting rooms, which are hired out separately for public and private functions. Proceedings might go on well into the night and it is essential, therefore, that these rooms can be effectively isolated from bedrooms, with all noise paths suitably insulated. For example, a ballroom in an internal court does not sufficiently insulate from bedrooms in higher storeys if it has windows opening into the well of the court, or a lightweight roof construction. To minimize disturbance the roof is to be of concrete or other solid construction, and any top lights or windows are to be double-glazed and sealed, with a separate air conditioning system if necessary.

The insulation between the public rooms themselves also needs to be considered. In rooms in which dancing could take place on one side of a division wall and speech-making on the other, a wall of less than 60 dB R_w insulation might not provide adequate protection. Folding partitions are not normally sufficient to separate rooms where disparate activities take place.

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Appendix M Guidelines for Community Noise (Executive Summary), World Health Organisation, 1999

GUIDELINES

FOR

COMMUNITY NOISE

Edited by

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Thomas Lindvall
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This WHO document on the *Guidelines for Community Noise* is the outcome of the WHO- expert task force meeting held in London, United Kingdom, in April 1999. It bases on the document entitled "Community Noise" that was prepared for the World Health Organization and published in 1995 by the Stockholm University and Karolinska Institute.

World Health Organization, Geneva
Cluster of Sustainable Development and Healthy Environment (SDE)
Department of the Protection of the Human Environment (PHE)
Occupational and Environmental Health (OEH)

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Foreword

Noise has always been an important environmental problem for man. In ancient Rome, rules existed as to the noise emitted from the ironed wheels of wagons which battered the stones on the pavement, causing disruption of sleep and annoyance to the Romans. In Medieval Europe, horse carriages and horse back riding were not allowed during night time in certain cities to ensure a peaceful sleep for the inhabitants. However, the noise problems of the past are incomparable with those of modern society. An immense number of cars regularly cross our cities and the countryside. There are heavily laden lorries with diesel engines, badly silenced both for engine and exhaust noise, in cities and on highways day and night. Aircraft and trains add to the environmental noise scenario. In industry, machinery emits high noise levels and amusement centres and pleasure vehicles distract leisure time relaxation.

In comparison to other pollutants, the control of environmental noise has been hampered by insufficient knowledge of its effects on humans and of dose-response relationships as well as a lack of defined criteria. While it has been suggested that noise pollution is primarily a "luxury" problem for developed countries, one cannot ignore that the exposure is often higher in developing countries, due to bad planning and poor construction of buildings. The effects of the noise are just as widespread and the long term consequences for health are the same. In this perspective, practical action to limit and control the exposure to environmental noise are essential. Such action must be based upon proper scientific evaluation of available data on effects, and particularly dose-response relationships. The basis for this is the
process of risk assessment and risk management.

The extent of the noise problem is large. In the European Union countries about 40 % of the population are exposed to road traffic noise with an equivalent sound pressure level exceeding 55 dB(A) daytime and 20 % are exposed to levels exceeding 65 dB(A). Taking all exposure to transportation noise together about half of the European Union citizens are estimated to live in zones which do not ensure acoustical comfort to residents. More than 30 % are exposed at night to equivalent sound pressure levels exceeding 55 dB(A) which are disturbing to sleep. The noise pollution problem is also severe in cities of developing countries and caused mainly by traffic. Data collected alongside densely travelled roads were found to have equivalent sound pressure levels for 24 hours of 75 to 80 dB(A).

The scope of WHO's effort to derive guidelines for community noise is to consolidate actual scientific knowledge on the health impacts of community noise and to provide guidance to environmental health authorities and professional trying to protect people from the harmful effects of noise in non-industrial environments. Guidance on the health effects of noise exposure of the population has already been given in an early publication of the series of Environmental Health Criteria. The health risk to humans from exposure to environmental noise was evaluated and guidelines values derived. The issue of noise control and health protection was briefly addressed.
At a WHO/EURO Task Force Meeting in Düsseldorf, Germany, in 1992, the health criteria and guideline values were revised and it was agreed upon updated guidelines in consensus. The essentials of the deliberations of the Task Force were published by Stockholm University and Karolinska Institute in 1995. In a recent Expert Task Force Meeting convened in April 1999 in London, United Kingdom, the Guidelines for Community Noise were extended to provide global coverage and applicability, and the issues of noise assessment and control were addressed in more detail. This document is the outcome of the consensus deliberations of the WHO Expert Task Force.

Dr Richard Helmer
Director, Department of Protection of the Human Environment
Cluster Sustainable Development and Healthy Environments

Preface

Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic, industries, construction and public work, and the neighbourhood. The main indoor sources of noise are ventilation systems, office machines, home appliances and neighbours. Typical neighbourhood noise comes from premises and installations related to the catering trade (restaurant, cafeterias, discotheques, etc.); from live or recorded music; sport events including motor sports; playgrounds; car parks; and domestic animals such as barking dogs. Many countries have regulated community noise from road and rail traffic, construction machines and industrial plants by applying emission standards, and by regulating the acoustical properties of buildings. In contrast, few countries have regulations on community noise from the neighbourhood, probably due to the lack of methods to define and measure it, and to the difficulty of controlling it. In large cities throughout the world, the general population is increasingly exposed to community due to the sources mentioned above and the health effects of these exposures are considered to be a more and more important public health problem. Specific effects to be considered when setting community noise guidelines include: interference with communication; noise-induced hearing loss; sleep disturbance effects; cardiovascular and psycho-physiological effects; performance reduction effects; annoyance responses; and effects on social behaviour.

Since 1980, the World Health Organization (WHO) has addressed the problem of community noise. Health-based guidelines on community noise can serve as the basis for deriving noise standards within a framework of noise management. Key issues of noise management include abatement options; models for forecasting and for assessing source control action; setting noise emission standards for existing and planned sources; noise exposure assessment; and testing the compliance of noise exposure with noise immission standards. In 1992, the WHO Regional Office for Europe convened a task force meeting which set up guidelines for community noise. A preliminary publication of the Karolinska Institute, Stockholm, on behalf of WHO, appeared in 1995. This publication served as the basis for the globally applicable *Guidelines for Community Noise* presented in this document. An expert task force meeting was convened by WHO in March 1999 in London, United Kingdom, to finalize the guidelines.

The *Guidelines for Community Noise* have been prepared as a practical response to the need for action on community noise at the local level, as well as the need for improved legislation, management and guidance at the national and regional levels. WHO will be pleased to see that these guidelines are used widely. Continuing efforts will be made to improve its content and structure. It would be appreciated if the users of the *Guidelines* provide feedback from its use and their own experiences. Please send your comments and suggestions on the WHO *Guidelines for Community Noise – Guideline document* to the Department of the Protection of the Human Environment, Occupational and Environmental Health, World Health Organization, Geneva, Switzerland (Fax: +41 22-791 4123, e-mail: schwelad@who.int).

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Particular thanks are due to the Ministry of Environment of Germany, which provided the funding to convene the WHO expert task force meeting in London, United Kingdom, in March 1999 to produce the Guidelines for Community Noise.

Executive Summary

1. Introduction

Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic; industries; construction and public work; and the neighbourhood. The main indoor noise sources are ventilation systems, office machines, home appliances and neighbours.

In the European Union about 40% of the population is exposed to road traffic noise with an equivalent sound pressure level exceeding 55 dB(A) daytime, and 20% are exposed to levels exceeding 65 dB(A). When all transportation noise is considered, more than half of all European Union citizens is estimated to live in zones that do not ensure acoustical comfort to residents. At night, more than 30% are exposed to equivalent sound pressure levels exceeding 55 dB(A), which are disturbing to sleep. Noise pollution is also severe in cities of developing countries. It is caused mainly by traffic and alongside densely-travelled roads equivalent sound pressure levels for 24 hours can reach 75–80 dB(A).

In contrast to many other environmental problems, noise pollution continues to grow and it is accompanied by an increasing number of complaints from people exposed to the noise. The growth in noise pollution is unsustainable because it involves direct, as well as cumulative, adverse health effects. It also adversely affects future generations, and has socio-cultural, esthetic and economic effects.

2. Noise sources and measurement

Physically, there is no distinction between sound and noise. Sound is a sensory perception and the complex pattern of sound waves is labeled noise, music, speech etc. Noise is thus defined as unwanted sound.

Most environmental noises can be approximately described by several simple measures. All measures consider the frequency content of the sounds, the overall sound pressure levels and the variation of these levels with time. Sound pressure is a basic measure of the vibrations of air that make up sound. Because the range of sound pressures that human listeners can detect is very wide, these levels are measured on a logarithmic scale with units of decibels. Consequently, sound pressure levels cannot be added or averaged arithmetically. Also, the sound levels of most noises vary with time, and when sound pressure levels are calculated, the instantaneous pressure fluctuations must be integrated over some time interval.

Most environmental sounds are made up of a complex mix of many different frequencies. Frequency refers to the number of vibrations per second of the air in which the sound is propagating and it is measured in Hertz (Hz). The audible frequency range is normally considered to be 20–20 000 Hz for younger listeners with unimpaired hearing. However, our hearing systems are not equally sensitive to all sound frequencies, and to compensate for this various types of filters or frequency weighting have been used to determine the relative strengths of frequency components making up a particular environmental noise. The A-weighting is most commonly used and weights lower frequencies as less important than mid- and higher-frequencies. It is intended to approximate the frequency response of our hearing system.

The effect of a combination of noise events is related to the combined sound energy of those events (the equal energy principle). The sum of the total energy over some time period gives a level equivalent to the average sound energy over that period. Thus, LAeq,T is the energy average equivalent level of the A-weighted sound over a period T. LAeq,T should be used to measure continuing sounds, such as road traffic noise or types of more-or-less continuous industrial noises. However, when there are distinct events to the noise, as with aircraft or railway noise, measures of individual events such as the maximum

noise level (LAmax), or the weighted sound exposure level (SEL), should also be obtained in addition to LAeq,T. Time-varying environmental sound levels have also been described in terms of percentile levels.

Currently, the recommended practice is to assume that the equal energy principle is approximately valid for most types of noise and that a simple LAeq,T measure will indicate the expected effects of the noise reasonably well. When the noise consists of a small number of discrete events, the A-weighted maximum level (LAmax) is a better indicator of the disturbance to sleep and other activities. In most cases, however, the A-weighted sound exposure level (SEL) provides a more consistent measure of single-noise events because it is based on integration over the complete noise event. In combining day and night LAeq,T values, night-time weightings are often added. Night-time weightings are intended to reflect the expected increased sensitivity to annoyance at night, but they do not protect people from sleep disturbance.

Where there are no clear reasons for using other measures, it is recommended that LAeq,T be used to evaluate more-or-less continuous environmental noises. Where the noise is principally composed of a small number of discrete events, the additional use of LAmax or SEL is recommended. There are definite limitations to these simple measures, but there are also many practical advantages, including economy and the benefits of a standardized approach.

3. Adverse health effects of noise

The health significance of noise pollution is given in chapter 3 of the *Guidelines* under separate headings according to the specific effects: noise-induced hearing impairment; interference with speech communication; disturbance of rest and sleep; psychophysiological, mental-health and performance effects; effects on residential behaviour and annoyance; and interference with intended activities. This chapter also considers vulnerable groups and the combined effects of mixed noise sources.

Hearing impairment is typically defined as an increase in the threshold of hearing. Hearing deficits may be accompanied by tinnitus (ringing in the ears). Noise-induced hearing impairment occurs predominantly in the higher frequency range of 3 000–6 000 Hz, with the largest effect at 4 000 Hz. But with increasing LAeq,8h and increasing exposure time, noise-induced hearing impairment occurs even at frequencies as low as 2 000 Hz. However, hearing impairment is not expected to occur at LAeq,8h levels of 75 dB(A) or below, even for prolonged occupational noise exposure.

Worldwide, noise-induced hearing impairment is the most prevalent irreversible occupational hazard and it is estimated that 120 million people worldwide have disabling hearing difficulties. In developing countries, not only occupational noise but also environmental noise is an increasing risk factor for hearing impairment. Hearing damage can also be caused by certain diseases, some industrial chemicals, ototoxic drugs, blows to the head, accidents and hereditary origins. Hearing deterioration is also associated with the ageing process itself (presbyacusis).

The extent of hearing impairment in populations exposed to occupational noise depends on the value of LAeq,8h, the number of noise-exposed years, and on individual susceptibility. Men and women are equally at risk for noise-induced hearing impairment. It is expected that environmental and leisure-time noise with a LAeq,24h of 70 dB(A) or below will not cause hearing impairment in the large majority of people, even after a lifetime exposure. For adults exposed to impulse noise at the workplace, the noise limit is set at peak sound pressure levels of 140 dB, and the same limit is assumed to be appropriate for environmental and leisure-time noise. In the case of children, however, taking into account their habits while playing with noisy toys, the peak sound pressure should never exceed 120 dB. For shooting noise with LAeq,24h levels greater than 80 dB(A), there may be an increased risk for noise-induced hearing impairment.

The main social consequence of hearing impairment is the inability to understand speech in daily living conditions, and this is considered to be a severe social handicap. Even small values of hearing impairment (10 dB averaged over 2 000 and 4 000 Hz and over both ears) may adversely affect speech comprehension.

Speech intelligibility is adversely affected by noise. Most of the acoustical energy of speech is in the frequency range of 100–6 000 Hz, with the most important cue-bearing energy being between 300–3 000 Hz. Speech interference is basically a masking process, in which simultaneous interfering noise renders speech incapable of being understood. Environmental noise may also mask other acoustical signals that are important for daily life, such as door bells, telephone signals, alarm clocks, fire alarms and other warning signals, and music.

Speech intelligibility in everyday living conditions is influenced by speech level; speech pronunciation; talker-to-listener distance; sound level and other characteristics of the interfering noise; hearing acuity; and by the level of attention. Indoors, speech communication is also affected by the reverberation characteristics of the room. Reverberation times over 1 s produce loss in speech discrimination and make speech perception more difficult and straining. For full sentence intelligibility in listeners with normal hearing, the signal-to-noise ratio (i.e. the difference between the speech level and the sound level of the interfering noise) should be at least 15 dB(A). Since the sound pressure level of normal speech is about 50 dB(A), noise with sound levels of 35 dB(A) or more interferes with the intelligibility of speech in smaller rooms. For vulnerable groups even lower background levels are needed, and a reverberation time below 0.6 s is desirable for adequate speech intelligibility, even in a quiet environment.

The inability to understand speech results in a large number of personal handicaps and behavioural changes. Particularly vulnerable are the hearing impaired, the elderly, children in the process of language and reading acquisition, and individuals who are not familiar with the spoken language.

Sleep disturbance is a major effect of environmental noise. It may cause primary effects during sleep, and secondary effects that can be assessed the day after night-time noise exposure. Uninterrupted sleep is a prerequisite for good physiological and mental functioning, and the primary effects of sleep disturbance are: difficulty in falling asleep; awakenings and alterations of sleep stages or depth; increased blood pressure, heart rate and finger pulse amplitude; vasoconstriction; changes in respiration; cardiac arrhythmia; and increased body movements. The difference between the sound levels of a noise event and background sound levels, rather than the absolute noise level, may determine the reaction probability. The probability of being awakened increases with the number of noise events per night. The secondary, or after-effects, the following morning or day(s) are: reduced perceived sleep quality; increased fatigue; depressed mood or well-being; and decreased performance.

For a good night's sleep, the equivalent sound level should not exceed 30 dB(A) for continuous background noise, and individual noise events exceeding 45 dB(A) should be avoided. In setting limits for single night-time noise exposures, the intermittent character of the noise has to be taken into account. This can be achieved, for example, by measuring the number of noise events, as well as the difference between the maximum sound level and the background sound level. Special attention should also be given to: noise sources in an environment with low background sound levels; combinations of noise and vibrations; and to noise sources with low-frequency components.

Physiological Functions. In workers exposed to noise, and in people living near airports, industries and noisy streets, noise exposure may have a large temporary, as well as permanent, impact on physiological functions. After prolonged exposure, susceptible individuals in the general population may develop permanent effects, such as hypertension and ischaemic heart disease associated with exposure to high sound levels. The magnitude and duration of the effects are determined in part by individual characteristics, lifestyle behaviours and environmental conditions. Sounds also evoke reflex responses, particularly when they are unfamiliar and have a sudden onset.

Workers exposed to high levels of industrial noise for 5–30 years may show increased blood pressure and an increased risk for hypertension. Cardiovascular effects have also been demonstrated after long-term exposure to air- and road-traffic with LAeq,24h values of 65–70 dB(A). Although the associations are weak, the effect is somewhat stronger for ischaemic heart disease than for hypertension. Still, these small risk increments are important because a large number of people are exposed.

Mental Illness. Environmental noise is not believed to cause mental illness directly, but it is assumed that it can accelerate and intensify the development of latent mental disorders. Exposure to high levels of occupational noise has been associated with development of neurosis, but the findings on environmental noise and mental-health effects are inconclusive. Nevertheless, studies on the use of drugs such as tranquillizers and sleeping pills, on psychiatric symptoms and on mental hospital admission rates, suggest that community noise may have adverse effects on mental health.

Performance. It has been shown, mainly in workers and children, that noise can adversely affect performance of cognitive tasks. Although noise-induced arousal may produce better performance in simple tasks in the short term, cognitive performance substantially deteriorates for more complex tasks. Reading, attention, problem solving and memorization are among the cognitive effects most strongly affected by noise. Noise can also act as a distracting stimulus and impulsive noise events may produce disruptive effects as a result of startle responses.

Noise exposure may also produce after-effects that negatively affect performance. In schools around airports, children chronically exposed to aircraft noise under-perform in proof reading, in persistence on challenging puzzles, in tests of reading acquisition and in motivational capabilities. It is crucial to recognize that some of the adaptation strategies to aircraft noise, and the effort necessary to maintain task performance, come at a price. Children from noisier areas have heightened sympathetic arousal, as indicated by increased stress hormone levels, and elevated resting blood pressure. Noise may also produce impairments and increase in errors at work, and some accidents may be an indicator of performance deficits.

Social and Behavioural Effects of Noise; Annoyance. Noise can produce a number of social and behavioural effects as well as annoyance. These effects are often complex, subtle and indirect and many effects are assumed to result from the interaction of a number of non-auditory variables. The effect of community noise on annoyance can be evaluated by questionnaires or by assessing the disturbance of specific activities. However, it should be recognized that equal levels of different traffic and industrial noises cause different magnitudes of annoyance. This is because annoyance in populations varies not only with the characteristics of the noise, including the noise source, but also depends to a large degree on many non-acoustical factors of a social, psychological, or economic nature. The correlation between noise exposure and general annoyance is much higher at group level than at individual level. Noise above 80 dB(A) may also reduce helping behaviour and increase aggressive behaviour. There is particular concern that high-level continuous noise exposures may increase the susceptibility of schoolchildren to feelings of helplessness.

Stronger reactions have been observed when noise is accompanied by vibrations and contains low-frequency components, or when the noise contains impulses, such as with shooting noise. Temporary, stronger reactions occur when the noise exposure increases over time, compared to a constant noise exposure. In most cases, LAeq,24h and L_{dn} are acceptable approximations of noise exposure related to annoyance. However, there is growing concern that all the component parameters should be individually assessed in noise exposure investigations, at least in the complex cases. There is no consensus on a model for total annoyance due to a combination of environmental noise sources.

Combined Effects on Health of Noise from Mixed Sources. Many acoustical environments consist of sounds from more than one source, i.e. there are mixed sources, and some combinations of effects are common. For example, noise may interfere with speech in the day and create sleep disturbance at night.

These conditions certainly apply to residential areas heavily polluted with noise. Therefore, it is important that the total adverse health load of noise be considered over 24 hours, and that the precautionary principle for sustainable development be applied.

Vulnerable Subgroups. Vulnerable subgroups of the general population should be considered when recommending noise protection or noise regulations. The types of noise effects, specific environments and specific lifestyles are all factors that should be addressed for these subgroups. Examples of vulnerable subgroups are: people with particular diseases or medical problems (e.g. high blood pressure); people in hospitals or rehabilitating at home; people dealing with complex cognitive tasks; the blind; people with hearing impairment; fetuses, babies and young children; and the elderly in general. People with impaired hearing are the most adversely affected with respect to speech intelligibility. Even slight hearing impairments in the high-frequency sound range may cause problems with speech perception in a noisy environment. A majority of the population belongs to the subgroup that is vulnerable to speech interference.

4. Guideline values

In chapter 4, guideline values are given for specific health effects of noise and for specific environments.

Specific health effects.

Interference with Speech Perception. A majority of the population is susceptible to speech interference by noise and belongs to a vulnerable subgroup. Most sensitive are the elderly and persons with impaired hearing. Even slight hearing impairments in the high-frequency range may cause problems with speech perception in a noisy environment. From about 40 years of age, the ability of people to interpret difficult, spoken messages with low linguistic redundancy is impaired compared to people 20–30 years old. It has also been shown that high noise levels and long reverberation times have more adverse effects in children, who have not completed language acquisition, than in young adults.

When listening to complicated messages (at school, foreign languages, telephone conversation) the signal-to-noise ratio should be at least 15 dB with a voice level of 50 dB(A). This sound level corresponds on average to a casual voice level in both women and men at 1 m distance. Consequently, for clear speech perception the background noise level should not exceed 35 dB(A). In classrooms or conference rooms, where speech perception is of paramount importance, or for sensitive groups, background noise levels should be as low as possible. Reverberation times below 1 s are also necessary for good speech intelligibility in smaller rooms. For sensitive groups, such as the elderly, a reverberation time below 0.6 s is desirable for adequate speech intelligibility even in a quiet environment.

Hearing Impairment. Noise that gives rise to hearing impairment is by no means restricted to occupational situations. High noise levels can also occur in open air concerts, discotheques, motor sports, shooting ranges, in dwellings from loudspeakers, or from leisure activities. Other important sources of loud noise are headphones, as well as toys and fireworks which can emit impulse noise. The ISO standard 1999 gives a method for estimating noise-induced hearing impairment in populations exposed to all types of noise (continuous, intermittent, impulse) during working hours. However, the evidence strongly suggests that this method should also be used to calculate hearing impairment due to noise exposure from environmental and leisure time activities. The ISO standard 1999 implies that long-term exposure to LAeq,24h noise levels of up to 70 dB(A) will not result in hearing impairment. To avoid hearing loss from impulse noise exposure, peak sound pressures should never exceed 140 dB for adults, and 120 dB for children.

Sleep Disturbance. Measurable effects of noise on sleep begin at LAeq levels of about 30 dB. However, the more intense the background noise, the more disturbing is its effect on sleep. Sensitive groups mainly include the elderly, shift workers, people with physical or mental disorders and other individuals who have difficulty sleeping.

Sleep disturbance from intermittent noise events increases with the maximum noise level. Even if the total equivalent noise level is fairly low, a small number of noise events with a high maximum sound pressure level will affect sleep. Therefore, to avoid sleep disturbance, guidelines for community noise should be expressed in terms of the equivalent sound level of the noise, as well as in terms of maximum noise levels and the number of noise events. It should be noted that low-frequency noise, for example, from ventilation systems, can disturb rest and sleep even at low sound pressure levels.

When noise is continuous, the equivalent sound pressure level should not exceed 30 dB(A) indoors, if negative effects on sleep are to be avoided. For noise with a large proportion of low-frequency sound a still lower guideline value is recommended. When the background noise is low, noise exceeding 45 dB LAmax should be limited, if possible, and for sensitive persons an even lower limit is preferred. Noise mitigation targeted to the first part of the night is believed to be an effective means for helping people fall asleep. It should be noted that the adverse effect of noise partly depends on the nature of the source. A special situation is for newborns in incubators, for which the noise can cause sleep disturbance and other health effects.

Reading Acquisition. Chronic exposure to noise during early childhood appears to impair reading acquisition and reduces motivational capabilities. Evidence indicates that the longer the exposure, the greater the damage. Of recent concern are the concomitant psychophysiological changes (blood pressure and stress hormone levels). There is insufficient information on these effects to set specific guideline values. It is clear, however, that daycare centres and schools should not be located near major noise sources, such as highways, airports, and industrial sites.

Annoyance. The capacity of a noise to induce annoyance depends upon its physical characteristics, including the sound pressure level, spectral characteristics and variations of these properties with time. During daytime, few people are highly annoyed at LAeq levels below 55 dB(A), and few are moderately annoyed at LAeq levels below 50 dB(A). Sound levels during the evening and night should be 5–10 dB lower than during the day. Noise with low-frequency components require lower guideline values. For intermittent noise, it is emphasized that it is necessary to take into account both the maximum sound pressure level and the number of noise events. Guidelines or noise abatement measures should also take into account residential outdoor activities.

Social Behaviour. The effects of environmental noise may be evaluated by assessing its interference with social behavior and other activities. For many community noises, interference with rest/recreation/watching television seem to be the most important effects. There is fairly consistent evidence that noise above 80 dB(A) causes reduced helping behavior, and that loud noise also increases aggressive behavior in individuals predisposed to aggressiveness. In schoolchildren, there is also concern that high levels of chronic noise contribute to feelings of helplessness. Guidelines on this issue, together with cardiovascular and mental effects, must await further research.

Specific environments.

A noise measure based only on energy summation and expressed as the conventional equivalent measure, LAeq, is not enough to characterize most noise environments. It is equally important to measure the maximum values of noise fluctuations, preferably combined with a measure of the number of noise events. If the noise includes a large proportion of low-frequency components, still lower values than the guideline values below will be needed. When prominent low-frequency components are present, noise

measures based on A-weighting are inappropriate. The difference between dB(C) and dB(A) will give crude information about the presence of low-frequency components in noise, but if the difference is more than 10 dB, it is recommended that a frequency analysis of the noise be performed. It should be noted that a large proportion of low-frequency components in noise may increase considerably the adverse effects on health.

In Dwellings. 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 30 dB LAeq for continuous noise and 45 dB LAmax for single sound events. Lower noise levels may be disturbing depending on the nature of the noise source. At night-time, outside sound levels about 1 metre from facades of living spaces should not exceed 45 dB 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 15 dB. To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35 dB LAeq. The maximum sound pressure level should be measured with the sound pressure meter set at "Fast".

To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB 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 50 dB LAeq. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development.

In Schools and Preschools. For schools, the critical effects of noise are speech interference, disturbance of information extraction (e.g. comprehension and reading acquisition), message communication and annoyance. To be able to hear and understand spoken messages in class rooms, the background sound level should not exceed 35 dB LAeq during teaching sessions. For hearing impaired children, a still lower sound level may be needed. The reverberation time in the classroom should be about 0.6 s, and preferably lower for hearing impaired children. For assembly halls and cafeterias in school buildings, the reverberation time should be less than 1 s. For outdoor playgrounds the sound level of the noise from external sources should not exceed 55 dB LAeq, the same value given for outdoor residential areas in daytime.

For preschools, the same critical effects and guideline values apply as for schools. In bedrooms in preschools during sleeping hours, the guideline values for bedrooms in dwellings should be used.

In Hospitals. For most spaces in hospitals, the critical effects are sleep disturbance, annoyance, and communication interference, including warning signals. The LAmax of sound events during the night should not exceed 40 dB(A) indoors. For ward rooms in hospitals, the guideline values indoors are 30dB LAeq, together with 40 dB LAmax during night. During the day and evening the guideline value indoors is 30 dB LAeq. The maximum level should be measured with the sound pressure instrument set at "Fast".

Since patients have less ability to cope with stress, the LAeq level should not exceed 35 dB in most rooms in which patients are being treated or observed. Attention should be given to the sound levels in intensive care units and operating theaters. Sound inside incubators may result in health problems for neonates, including sleep disturbance, and may also lead to hearing impairment. Guideline values for sound levels in incubators must await future research.

Ceremonies, Festivals and Entertainment Events. In many countries, there are regular ceremonies, festivals and entertainment events to celebrate life periods. Such events typically produce loud sounds, including music and impulsive sounds. There is widespread concern about the effect of loud music and impulsive sounds on young people who frequently attend concerts, discotheques, video arcades, cinemas, amusement parks and spectator events. At these events, the sound level typically exceeds 100 dB LAeq. Such noise exposure could lead to significant hearing impairment after frequent attendances.

Noise exposure for employees of these venues should be controlled by established occupational standards; and at the very least, the same standards should apply to the patrons of these premises. Patrons should not be exposed to sound levels greater than 100 dB LAeq during a four-hour period more than four times per year. To avoid acute hearing impairment the LAmax should always be below 110 dB.

Headphones. To avoid hearing impairment from music played back in headphones, in both adults and children, the equivalent sound level over 24 hours should not exceed 70 dB(A). This implies that for a daily one hour exposure the LAeq level should not exceed 85 dB(A). To avoid acute hearing impairment LAmax should always be below 110 dB(A). The exposures are expressed in free-field equivalent sound level.

Toys, Fireworks and Firearms. To avoid acute mechanical damage to the inner ear from impulsive sounds from toys, fireworks and firearms, adults should never be exposed to more than 140 dB(lin) peak sound pressure level. To account for the vulnerability in children when playing, the peak sound pressure produced by toys should not exceed 120 dB(lin), measured close to the ears (100 mm). To avoid acute hearing impairment LAmax should always be below 110 dB(A).

Parkland and Conservation Areas. Existing large quiet outdoor areas should be preserved and the signal-to-noise ratio kept low.

Table 1 presents the WHO guideline values arranged according to specific environments and critical health effects. The guideline values consider all identified adverse health effects for the specific environment. An adverse effect of noise refers to any temporary or long-term impairment of physical, psychological or social functioning that is associated with noise exposure. Specific noise limits have been set for each health effect, using the lowest noise level that produces an adverse health effect (i.e. the critical health effect). Although the guideline values refer to sound levels impacting the most exposed receiver at the listed environments, they are applicable to the general population. The time base for LAeq for “daytime” and “night-time” is 12–16 hours and 8 hours, respectively. No time base is given for evenings, but typically the guideline value should be 5–10 dB lower than in the daytime. Other time bases are recommended for schools, preschools and playgrounds, depending on activity.

It is not enough to characterize the noise environment in terms of noise measures or indices based only on energy summation (e.g., LAeq), because different critical health effects require different descriptions. It is equally important to display the maximum values of the noise fluctuations, preferably combined with a measure of the number of noise events. A separate characterization of night-time noise exposures is also necessary. For indoor environments, reverberation time is also an important factor for things such as speech intelligibility. If the noise includes a large proportion of low-frequency components, still lower guideline values should be applied. Supplementary to the guideline values given in Table 1, precautions should be taken for vulnerable groups and for noise of certain character (e.g. low-frequency components, low background noise).

Table 1: Guideline values for community noise in specific environments.

Specific environment	Critical health effect(s)	L_{Aeq} [dB(A)]	Time base [hours]	L_{Amax} fast [dB]
Outdoor living area	Serious annoyance, daytime and evening Moderate annoyance, daytime and evening	55 50	16 16	- -
Dwelling, indoors Inside bedrooms	Speech intelligibility & moderate annoyance, daytime & evening Sleep disturbance, night-time	35 30	16 8	 45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School class rooms & pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
Pre-school bedrooms, indoor	Sleep disturbance	30	sleeping-time	45
School, playground outdoor	Annoyance (external source)	55	during play	-
Hospital, ward rooms, indoors	Sleep disturbance, night-time Sleep disturbance, daytime and evenings	30 30	8 16	40 -
Hospitals, treatment rooms, indoors	Interference with rest and recovery	#1		
Industrial, commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Music and other sounds through headphones/ earphones	Hearing impairment (free-field value)	85 #4	1	110
Impulse sounds from toys, fireworks and firearms	Hearing impairment (adults) Hearing impairment (children)	- -	- -	140 #2 120 #2
Outdoors in parkland and conservations areas	Disruption of tranquillity	#3		

#1: As low as possible.

#2: Peak sound pressure (not LAF, max) measured 100 mm from the ear.
#3: Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low.
#4: Under headphones, adapted to free-field values.

5. Noise Management

Chapter 5 is devoted to noise management with discussions on: strategies and priorities in managing indoor noise levels; noise policies and legislation; the impact of environmental noise; and on the enforcement of regulatory standards.

The fundamental goals of noise management are to develop criteria for deriving safe noise exposure levels and to promote noise assessment and control as part of environmental health programmes. These basic goals should guide both international and national policies for noise management. The United Nation's Agenda 21 supports a number of environmental management principles on which government policies, including noise management policies, can be based: the principle of precaution; the "polluter pays" principle; and noise prevention. In all cases, noise should be reduced to the lowest level achievable in the particular situation. When there is a reasonable possibility that the public health will be endangered, even though scientific proof may be lacking, action should be taken to protect the public health, without awaiting the full scientific proof. The full costs associated with noise pollution (including monitoring, management, lowering levels and supervision) should be met by those responsible for the source of noise. Action should be taken where possible to reduce noise at the source.

A legal framework is needed to provide a context for noise management. National noise standards can usually be based on a consideration of international guidelines, such as these *Guidelines for Community Noise*, as well as national criteria documents, which consider dose-response relationships for the effects of noise on human health. National standards take into account the technological, social, economic and political factors within the country. A staged program of noise abatement should also be implemented to achieve the optimum health protection levels over the long term.

Other components of a noise management plan include: noise level monitoring; noise exposure mapping; exposure modeling; noise control approaches (such as mitigation and precautionary measures); and evaluation of control options. Many of the problems associated with high noise levels can be prevented at low cost, if governments develop and implement an integrated strategy for the indoor environment, in concert with all social and economic partners. Governments should establish a "National Plan for a Sustainable Noise Indoor Environment" that applies both to new construction as well as to existing buildings.

The actual priorities in rational noise management will differ for each country. Priority setting in noise management refers to prioritizing the health risks to be avoided and concentrating on the most important sources of noise. Different countries have adopted a range of approaches to noise control, using different policies and regulations. A number of these are outlined in chapter 5 and Appendix 2, as examples. It is evident that noise emission standards have proven insufficient and that the trends in noise pollution are unsustainable.

The concept of environmental an environmental noise impact analysis is central to the philosophy of managing environmental noise. Such an analysis should be required before implementing any project that would significantly increase the level of environmental noise in a community (typically, greater than a 5 dB increase). The analysis should include: a baseline description of the existing noise environment; the

expected level of noise from the new source; an assessment of the adverse health effects; an estimation of the population at risk; the calculation of exposure-response relationships; an assessment of risks and their acceptability; and a cost-benefit analysis.

Noise management should:

1. Start monitoring human exposures to noise.
2. Have health control require mitigation of noise immissions, and not just of noise source emissions. The following should be taken into consideration:
    - specific environments such as schools, playgrounds, homes, hospitals.
    - environments with multiple noise sources, or which may amplify the effects of noise.
    - sensitive time periods such as evenings, nights and holidays.
    - groups at high risk, such as children and the hearing impaired.
3. Consider the noise consequences when planning transport systems and land use.
4. Introduce surveillance systems for noise-related adverse health effects.
5. Assess the effectiveness of noise policies in reducing adverse health effects and exposure, and in improving supportive "soundscapes".
6. Adopt these *Guidelines for Community Noise* as intermediary targets for improving human health.
7. Adopt precautionary actions for a sustainable development of the acoustical environments.

Conclusions and recommendations

In chapter 6 are discussed: the implementation of the guidelines; further WHO work on noise; and research needs are recommended.

Implementation. For implementation of the guidelines it is recommended that:

- Governments should protection the population from community noise and consider it an integral part of their policy of environmental protection.
- Governments should consider implementing action plans with short-term, medium-term and long-term objectives for reducing noise levels.
- Governments should adopt the *Health Guidelines for Community Noise* values as targets to be achieved in the long-term.
- Governments should include noise as an important public health issue in environmental impact assessments.
- Legislation should be put in place to allow for the reduction of sound levels.
- Existing legislation should be enforced.
- Municipalities should develop low noise implementation plans.
- Cost-effectiveness and cost-benefit analyses should be considered potential instruments for meaningful management decisions.
- Governments should support more policy-relevant research.

Future Work. The Expert Task Force worked out several suggestions for future work for the WHO in the field of community noise. WHO should:

- Provide leadership and technical direction in defining future noise research priorities.
- Organize workshops on how to apply the guidelines.

- Provide leadership and coordinate international efforts to develop techniques for designing supportive sound environments (e.g. "soundscapes").
- Provide leadership for programs to assess the effectiveness of health-related noise policies and regulations.
- Provide leadership and technical direction for the development of sound methodologies for environmental and health impact plans.
- Encourage further investigation into using noise exposure as an indicator of environmental deterioration (e.g. black spots in cities).
- Provide leadership and technical support, and advise developing countries to facilitate development of noise policies and noise management.

Research and Development. A major step forward in raising the awareness of both the public and of decision makers is the recommendation to concentrate more research and development on variables which have monetary consequences. This means that research should consider not only dose-response relationships between sound levels, but also politically relevant variables, such as noise-induced social handicap; reduced productivity; decreased performance in learning; workplace and school absenteeism; increased drug use; and accidents.

In Appendices 1–6 are given: bibliographic references; examples of regional noise situations (African Region, American Region, Eastern Mediterranean Region, South East Asian Region, Western Pacific Region); a glossary; a list of acronyms; and a list of participants.

Introduction

Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources, except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic, industries, construction and public work, and the neighbourhood. Typical neighbourhood noise comes from premises and installations related to the catering trade (restaurant, cafeterias, discotheques, etc.); from live or recorded music; from sporting events including motor sports; from playgrounds and car parks; and from domestic animals such as barking dogs. The main indoor sources are ventilation systems, office machines, home appliances and neighbours. Although many countries have regulations on community noise from road, rail and air traffic, and from construction and industrial plants, few have regulations on neighbourhood noise. This is probably due to the lack of methods to define and measure it, and to the difficulty of controlling it. In developed countries, too, monitoring of compliance with, and enforcement of, noise regulations are weak for lower levels of urban noise that correspond to occupationally controlled levels (>85 dB LAeq,8h; Frank 1998). Recommended guideline values based on the health effects of noise, other than occupationally-induced effects, are often not taken into account.

The extent of the community noise problem is large. In the European Union about 40% of the population is exposed to road traffic noise with an equivalent sound pressure level exceeding 55 dBA daytime; and 20% is exposed to levels exceeding 65 dBA (Lambert & Vallet 19 1994). When all transportation noise is considered, about half of all European Union citizens live in zones that do not ensure acoustical comfort to residents. At night, it is estimated that more than 30% is exposed to equivalent sound pressure levels exceeding 55 dBA, which are disturbing to sleep. The noise pollution problem is also severe in the cities of developing countries and is caused mainly by traffic. Data collected alongside densely traveled roads were found to have equivalent sound pressure levels for 24 hours of 75–80 dBA (e.g. National Environment Board Thailand 19 1990; Mage & Walsh 19 1998).

(a) In contrast to many other environmental problems, noise pollution continues to grow, accompanied by an increasing number of complaints from affected individuals. Most people are typically exposed to several noise sources, with road traffic noise being a dominant source (OECD-ECMT 19 1995). Population growth, urbanization and to a large extent technological development are the main driving forces, and future enlargements of highway systems, international airports and railway systems will only increase the noise problem. Viewed globally, the growth in urban environmental noise pollution is unsustainable, because it involves not simply the direct and cumulative adverse effects on health. It also adversely affects future generations by degrading residential, social and learning environments, with corresponding economical losses (Berglund 1998). Thus, noise is not simply a local problem, but a global issue that affects everyone (Lang 1999; Sandberg 1999) and calls for precautionary action in any environmental planning situation.

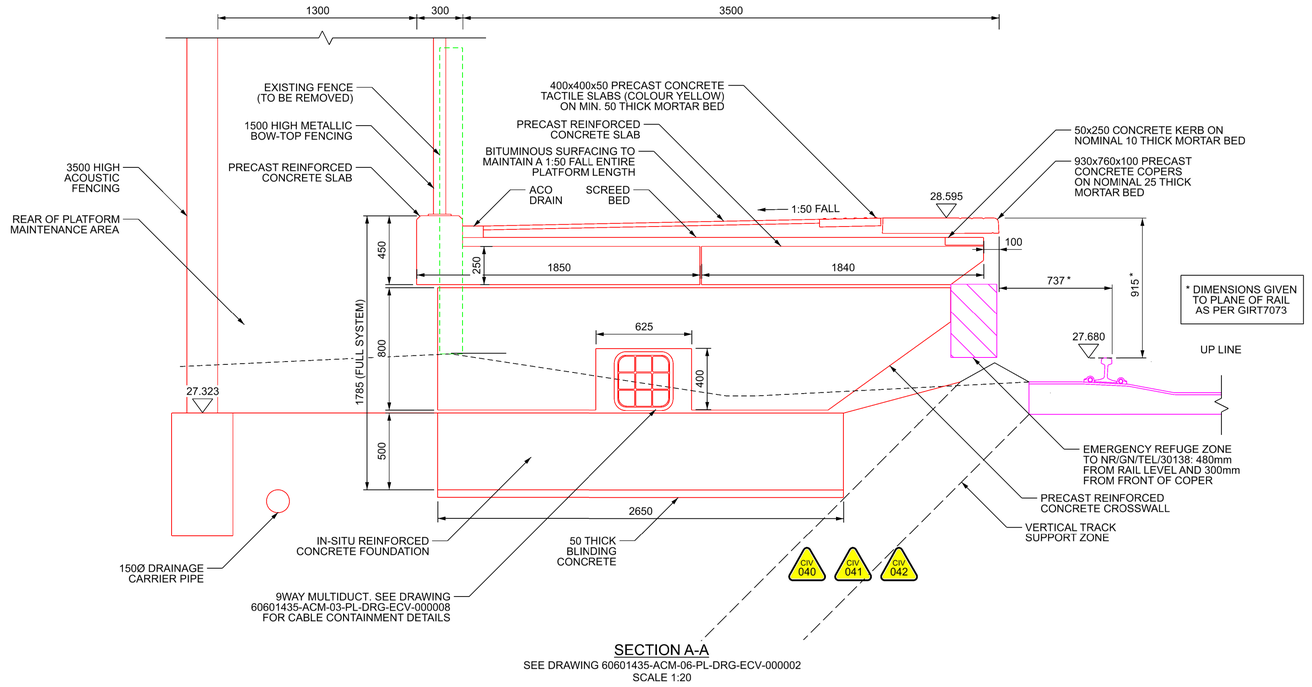
The objective of the World Health Organization (WHO) is the attainment by all peoples of the highest possible level of health. As the first principle of the WHO Constitution the definition of ‘health’ is given as: “A state of complete physical, mental and social well-

being and not merely the absence of disease or infirmity". This broad definition of health embraces the concept of well-being and, thereby, renders noise impacts such as population annoyance, interference with communication, and impaired task performance as 'health' issues. In 1992, a WHO Task Force also identified the following specific health effects for the general population that may result from community noise: interference with communication; annoyance responses; effects on sleep, and on the cardiovascular and psychophysiological systems; effects on performance, productivity, and social behavior; and noise-induced hearing impairment (WHO 1993; Berglund & Lindvall 1995; *cf*. WHO 1980). Hearing damage is expected to result from both occupational and environmental noise, especially in developing countries, where compliance with noise regulation is known to be weak (Smith 1998).

Noise is likely to continue as a major issue well into the next century, both in developed and in developing countries. Therefore, strategic action is urgently required, including continued noise control at the source and in local areas. Most importantly, joint efforts among countries are necessary at a system level, in regard to the access and use of land, airspace and seawaters, and in regard to the various modes of transportation. Certainly, mankind would benefit from societal reorganization towards healthy transport. To understand noise we must understand the different types of noise and how we measure it, where noise comes from and the effects of noise on human beings. Furthermore, noise mitigation, including noise management, has to be actively introduced and in each case the policy implications have to be evaluated for efficiency.

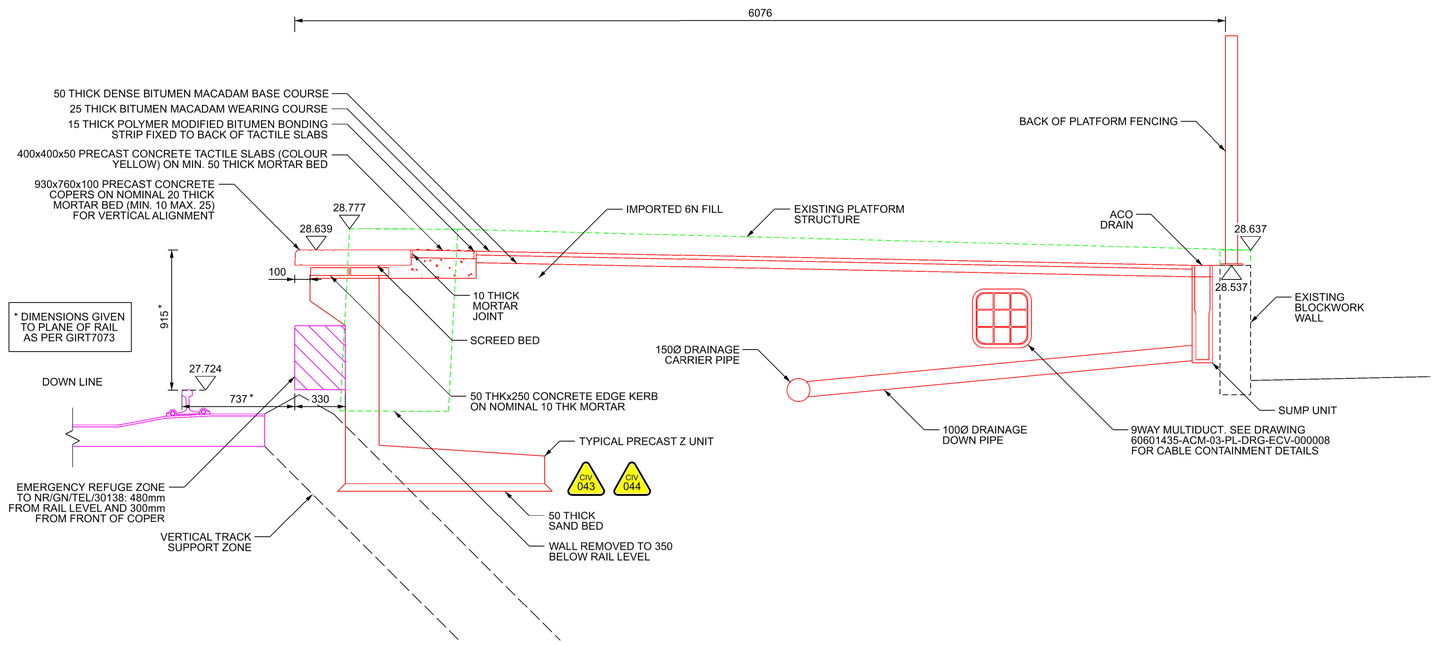
This document is organized as follows. In Chapter 2 noise sources and measurement are discussed, including the basic aspects of source characteristics, sound propagation and transmission. In Chapter 3 the adverse health effects of noise are characterized. These include noise-induced hearing impairment, interference with speech communication, sleep disturbance, cardiovascular and physiological effects, mental health effects, performance effects, and annoyance reactions. This chapter is rounded out by a consideration of combined noise sources and their effects, and a discussion of vulnerable groups. In Chapter 4 the Guideline values are presented. Chapter 5 is devoted to noise management. Included are discussions of: strategies and priorities in the management of indoor noise levels; noise policies and legislation; environmental noise impact; and enforcement of regulatory standards. In Chapter 6 implementation of the WHO Guidelines is discussed, as well as future WHO work on noise and its research needs. In Appendices 1–6 are given: bibliographic references; examples of regional noise situations (African Region, American Region, Eastern Mediterranean Region, South East Asian Region, Western Pacific Region); a glossary; a list of acronyms; and a list of participants.

Appendix N Drawing 60601435-ACM-06-PL-DRG-ECV-000004 Rev P02, Bedlington Existing and Proposed Platform Sections Sheet 1 of 2



SECTION A-A

SEE DRAWING 60601435-ACM-06-PL-DRG-ECV-000002
SCALE 1:20



SECTION B-B

SEE DRAWING 60601435-ACM-05-PL-DRG-ECV-000002
SCALE 1:20

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

NOTES BELOW ARE ADDITIONAL TO HAZARDS/RISKS NORMALLY ASSOCIATED WITH THIS TYPE OF WORK:

CIV040. OPEN EXCAVATIONS. RISK OF PERSONNEL FALLING IN DURING CONSTRUCTION OF CROSSWALL FOUNDATIONS

CIV041. UNKNOWN AVAILABLE CABLE SLACK IN EXISTING LINESIDE TELECOMS CABLE.

CIV042. RISK OF STRIKING FORMER MINES & COAL SEAMS CAUSING COLLAPSE OR FIRE.

CIV043. RISK OF COLLAPSE OF EXISTING PLATFORM DURING MODIFICATION WORKS.

CIV044. EXCAVATIONS WITHIN THE TRACK SUPPORT ZONE HAVE THE POTENTIAL TO CAUSE LOCALISED TRACK BUCKLING DUE TO THE CRITICAL TEMPERATURE.

THESE NOTES ARE BASED ON THE USE OF EXPERIENCED AND COMPETENT CONTRACTORS CARRYING OUT THE WORK USING AN APPROVED SAFE METHOD OF WORKING.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

IT IS ASSUMED THAT WORKS ON THIS DRAWING WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROPRIATE METHOD STATEMENT

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

Notes

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. ALL CHAINAGE AND LEVELS ARE IN METRES.
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH:

   - 60601435-ACM-06-ZZ-DRG-EHW-060001
   AND ALL DRAWINGS LISTED THEREON.
4. RAILWAY PLATFORM SPECIFIC DRAWINGS ARE:

   - 60601435-ACM-06-PL-DRG-ECV-000001
   - 60601435-ACM-06-PL-DRG-ECV-000002
   - 60601435-ACM-06-PL-DRG-ECV-000003
   - 60601435-ACM-06-PL-DRG-ECV-000005
   - 60601435-ACM-06-PL-DRG-ECV-000006
   - 60601435-ACM-06-PL-DRG-ECV-000100

COLOUR KEY:

- NEW, PROPOSED OR ADDITIONAL
- REDUNDANT OR TO BE REMOVED
- MODIFIED OR TO BE MOVED
- EXISTING OR UNCHANGED
- BY OTHERS
- OS/SURVEY DATA

Revision Details	By	Chkd	Appd	Checked Date	Suffix
Drawing title change	RP	PP	AB	19/02/21	P02
Planning Issue	RP	PP	AB	29/01/21	P01

Purpose of Issue: WIP-S0 SUITABILITY

GRIP Stage: GRIP 4

Client: Northumberland County Council

Project Title: NORTHUMBERLAND LINE

Drawing Title: BEDLINGTON EXISTING & PROPOSED PLATFORM SECTIONS SHEET 1 OF 2

Designed	Drawn	Checked	Approved	Date
D.Foy	R.Price	P.Pacey	A.Bathie	29.01.2021
Signed D.Foy	Signed R.Price	Signed P.Pacey	Signed A.Bathie	

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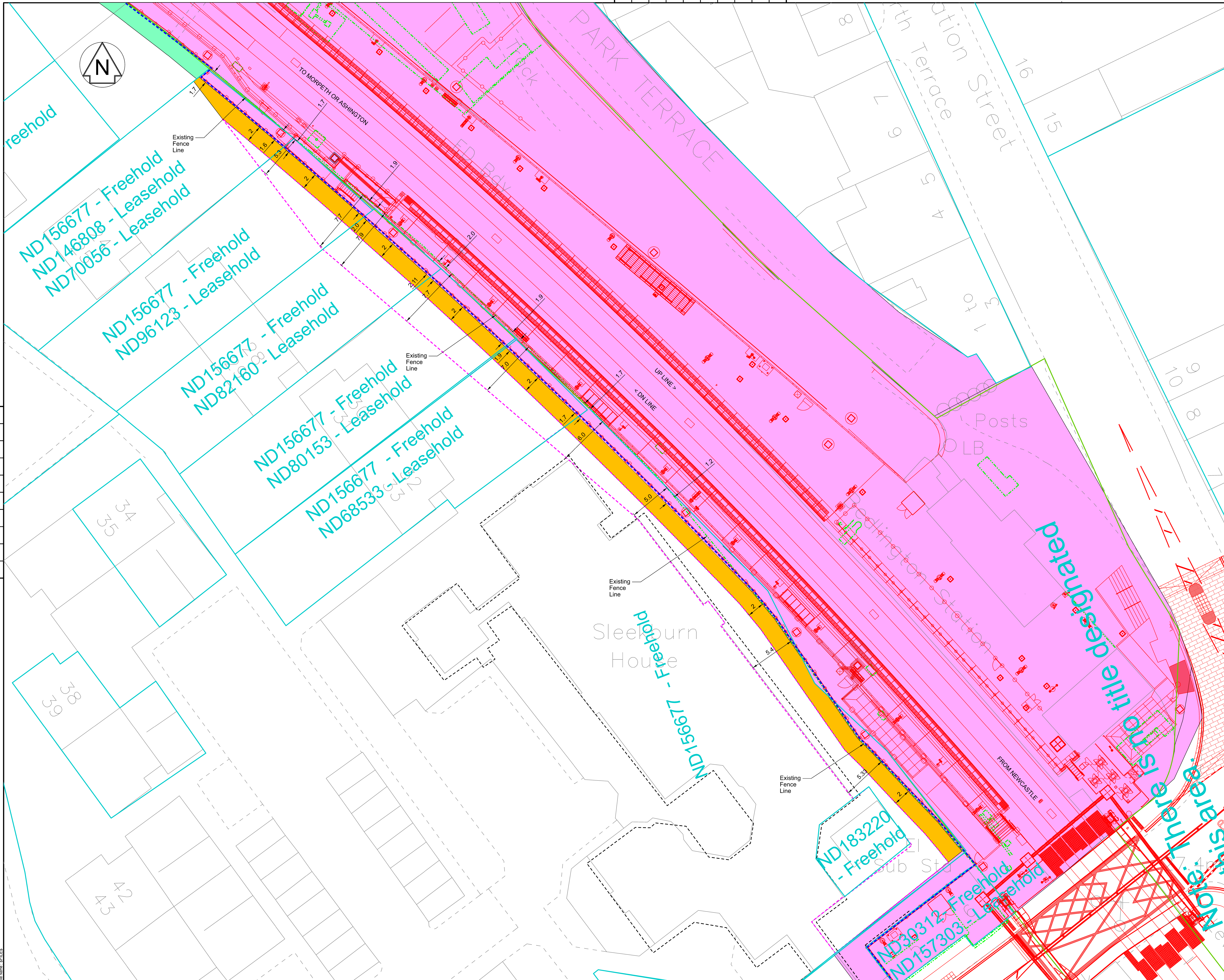
Drawing Number: 60601435-ACM-06-PL-DRG-ECV-000004

Rev: P02

Username: $USER$
File Name: $FILES$
Plot Date: $DATE$ $TIME$
A1: 594 x 841

Appendix O Drawing 60601435-ACM-06-ZZ-SKT-LEP-000001, Rev P01.2,
Sleekburn House Bedlington Revised Land Holding



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION BOX

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Notes

- REVISED LAND TO BE ACQUIRED PERMANENTLY
- REVISED LAND SUBJECT TO POWERS OF TEMPORARY POSSESSION
- REVISED LAND SUBJECT TO POWERS OF TEMPORARY ACCESS
- TWAO LAND NO LONGER REQUIRED
- RAIL OWNERSHIP
- OWNERSHIP BOUNDARIES
- PROPOSED WORKS
- OS MAPPING DATA
- DRONE SURVEY DATA
- EXISTING FENCE OR EQUIPMENT TO BE REMOVED
- PROPOSED STATION BOUNDARY FENCE

Revision Details	By	Chkd	Appd	Checked Date	Suffix
First Issue	WJM	WJM	WJM	07/10/21	P01.2

Purpose of Issue: SUITABLE FOR INFORMATION

GRIP Stage: GRIP 4

Client: Northumberland County Council

Project Title: NORTHUMBERLAND LINE

Drawing Title: SLEEKBURN HOUSE BEDLINGTON REVISED LAND HOLDING

Designed	Drawn	Checked	Approved	Date
---	W.J.Miller	W.J.Miller	W.J.Miller	07/10/21
Signed	Signed	Signed	Signed	

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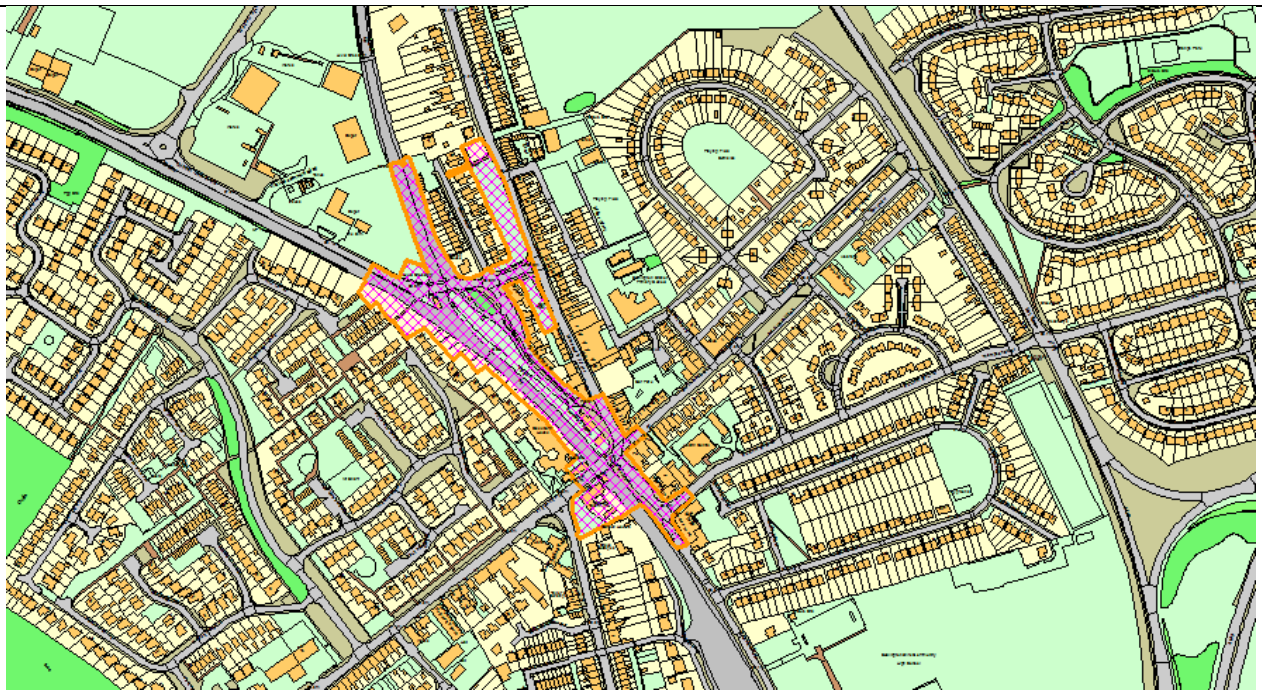
Appendix P Planning Committee Report

Northumberland
County Council

Strategic Planning Committee, 2 November 2021

Application No:	21/01106/CCD		
Proposal:	Construction of a two-platform railway station including: ramped pedestrian access, new highway access; modifications to existing highways including pedestrian footways; provision of parking for cars, electric vehicles, motorcycles, cycles, and taxis and other associated works. Construction of facilities ancillary to the station including, lighting, soft and hard landscaping, surface and subsurface drainage, utilities and other services, boundary treatment and other associated works		
Site Address	Bedlington Railway Station, Station Street, Bedlington, Northumberland NE22 5UZ		
Applicant:	Northumberland County Council County Hall, Morpeth, NE61 2EF,	**Agent:**	Mr Allen Creedy 72 B-Box Studios, Newcastle , NE2 1AN,
Ward	Sleekburn	**Parish**	East Bedlington
Valid Date:	18 March 2021	**Expiry Date:**	9 November 2021
Case Officer Details:	Name: Mr Gordon Halliday Job Title: Consultant Planner Tel No: 07785 727053 Email: gordon.halliday@northumberland.gov.uk		

Recommendation: That this application be GRANTED permission



1. Introduction

1.1 Under the provisions of the Council's current Scheme of Delegation, in cases where the local authority is the applicant in respect of a planning application, it is required to be determined by the Planning Committee.

2. Description of the Proposals

2.1 The Northumberland Line scheme seeks to re-introduce passenger services onto the existing freight line that runs between Newcastle Central Station and Ashington. The scheme includes the construction of six new railway stations and associated infrastructure. It is envisaged that there will be a half hourly service with an anticipated journey time between Newcastle and Ashington of 35 minutes.

2.2 The railway line was formerly known as the Ashington, Blyth and Tyne Line. Passenger services on the line ceased in 1964 since when freight trains have continued to operate.

2.3 This application is for the construction and operation of a new railway station at Bedlington Station. The proposed location for the new station is adjacent to the original railway station in Bedlington Station that closed in 1964. To the north of the proposed station are residential properties on Barrington Road, to the east are residential and business properties on Park Terrace, to the south is Park Road and to the west are residential properties on Blenheim Drive and East Sleekburn House care home.

2.4 The site of the proposed development has an area of 2.75 hectare. It comprises 5 separate areas:

a) The existing railway corridor and disused platforms.

b) The former station buildings and signal boxes owned by Network Rail. The former station buildings would be retained but are not required for the operation of the new station. It is anticipated that the signal box located adjacent to the Bedlington South level crossing will not be required as part of the signalling operation for the line but work on the signalling requirements has not yet been concluded. A Principal Supply Point building to support the proposed new signalling system would be constructed by Network Rail using their statutory powers without requiring planning permission.

c) The Network Rail storage compound which is proposed for car parking.

d) Narrow strips of land currently within gardens of Sleekburn House and gardens of properties on Blenheim Drive. These are required because the width of the land within the existing railway corridor is insufficient to construct the northbound platform.

e) Existing local highways (Clayton Street, Station Road, Park Terrace, Barrington Road and Palace Road). Various works to the adopted highways and footways in the vicinity of the level crossing will be required. Passengers crossing between platforms will use the level crossing. It is proposed that other works to highways and footways will be required to provide access to the car parks and for safety reasons.

2.5 The development proposals include the following main elements:

- Two new platforms, each approximately 100 metres long, with a range of facilities including vending machines, customer information screens, waiting shelters, CCTV, help points and lighting.
- A car park to the north of Ravensworth Road providing 35 spaces including 4 accessible spaces and 4 electric vehicle charging bays,
- Taxi drop off and cycle storage facilities would be provided.
- A new pedestrian crossing at the junction of Barrington Road and Ravensworth Street would be provided to improve access from the proposed car park on Ravensworth Street.
- The two existing level crossings would be upgraded.
- Various highway and footway works to improve access.
- The existing car park to the south of Bedlington South level crossing might be used as a temporary compound during construction.
- The building on Station Road formerly occupied by Boots would be demolished.

2.6 It is anticipated that the overall construction period, including site clearance, would be approximately 18 months (including Liddle's Street car park which would be the final activity) subject to access, safety and other considerations. Construction would not be continuous with Individual activities such as the construction of car parks and platforms likely to take place within discrete periods of time of much lesser duration. The current programme envisages work on site starting in April 2022 to clear the existing Network Rail compound on Park Terrace which will then be used as the main compound for the construction of the railway station. This would then be followed by the clearance and demolition of the former Boots building and old platforms in June 2022 lasting for 3 months. The works on the construction of the new platforms need to be tied into track and signalling works in the area and they could be constructed concurrently or at different periods. The final works will be to develop the Park Terrace and Liddle's Street car parks.

2.7 As the railway line will continue to operate during the construction period, it is anticipated that the main working period will be between 11pm on Thursdays through to 5am on Mondays, but working would not be every weekend or over the full 79 hours every weekend. The contractor is continuing to work with Network Rail and the project team on a variety of measures that might reduce the period of working and deliver more work during daylight hours in order to reduce the disruption and impacts in the local area, including the impacts to Sleekburn House.

2.8 The application when first submitted included a proposed car park for 31 spaces to be located on the existing amenity green space on Ravensworth Street as the second car park to service the station. There was considerable opposition to this proposal including from the Parish Council and local residents. As a result this car park has been removed from the proposed development. In order to provide the required number of car parking spaces an application has been submitted for a car park providing 31 spaces at Liddle's Street. The Liddle's Street application is the subject of a separate item on the agenda for this Committee meeting.

2.9 It was also previously proposed that the land at Liddle's Street would provide compensation for the loss of the amenity land at Ravensworth Street. This proposal has also been removed as the amenity land at Ravensworth Street is no longer required and the Liddle's Street land is now being proposed for car parking as set out in the previous paragraph.

3. Planning History

Reference Number: 19/02151/SCREEN
Description: Request for a Screening Opinion- Provision of six new train stations, associated upgrading and refurbishment of existing rail infrastructure and engineering works and the reintroduction of passenger train services.
Status: Screening opinion issued

Reference Number: 20/02243/SCREEN
Description: Request for a Screening Opinion- Provision of six new train stations, associated upgrading and refurbishment of existing rail infrastructure and engineering works and the reintroduction of passenger train services.
Status: Screening opinion issued

4. Consultee Responses

East Bedlington Parish Council	Support the return of passenger rail services but object to the proposed car parking at Ravensworth Street on grounds of loss of amenity space and wildlife habitat and concerns regarding increased traffic volumes on a section of road already suffering from vehicles travelling at speed. The preferred option for additional car parking is the commercial land off Barrington Road currently used as a container park that was suggested during consultation. The Council questions the concerns raised regarding this site as crossing the line at the North level crossing and considers that this presents no greater risk than crossing the line at the South level crossing, which is significantly busier, providing access not only to the station but to schools and town centre amenities. The Council does not accept the offer of land at Liddle Terrace to be an adequate or appropriate compensation for loss of amenity land. This land is subject to high levels of anti-social behaviour, in particular drug related crime and motor bike nuisance. Lighting and access is very poor and there is no visual benefit to residents of West View or Ravensworth Street
Environment Agency	No response received.
The Coal Authority	No objection subject to the imposition of conditions requiring investigations to establish the risks posed by past shallow coal mining activity and the carrying out of any remedial works required.
Natural England	No objection.
Lead Local Flood Authority (LLFA)	No objection subject to the imposition of a condition relating to surface water management.
Northumbria Police	Suggestions made for designing out crime in the proposed development.
British Transport Police	Suggestions made for designing out crime in the proposed development.
Fire & Rescue Service	No objection.
Northumbria	No response received.

Ambulance Service	
County Archaeologist	No objections on archaeological grounds subject to the imposition of a planning condition for an appropriate programme of archaeological mitigation.
Strategic Estates	No response received.
County Ecologist	No objection subject to the imposition of appropriate conditions in relation to mitigation measures, lighting and biodiversity net gain.
Public Protection	No objection subject to the imposition of conditions in relation to station tannoy systems, construction noise and vibration, a scheme for the mitigation of rail noise at Sleekburn House, potentially contaminated land and permitted times for construction and collection deliveries.
County Highways	No objection subject to the imposition of conditions and informatives in relation to highway safety and car / cycle parking considerations.
South SE Tree And Woodland Officer	No response received.
Building Conservation	Support the proposed development subject to the imposition of conditions relating to the design and colour palate for station infrastructure to ensure continuity and quality in the appearance and design of the scheme.

5. Public Responses

5.1 Neighbour Notification

Number of Neighbours Notified	435
Number of Objections	41*
Number of Support	0**
Number of General Comments	3

* see paragraph 5.6 below

** see paragraph 5.4 below

5.2 Notices - general site notices were posted on 31 March 2021 and a press notice was placed in the News Post Leader on 1st April 2021.

5.3 Following the submission of revised proposals, including the removal of the Ravensworth Street car parking, full reconsultation and publicity was carried out, including the posting of site notices and a press notice.

Summary of Responses:

5.4 A number of the letters of objection express support generally for the reintroduction of passenger rail services, including the proposed station at Bedlington Station, but raise objections to certain elements of the proposals.

5.5 Most notably the objections related to the loss of the public open space on Ravensworth Street to provide car parking. The reasons stated included:

- this area of green space is highly valued by the local community;
- the requirement for car parking has been overestimated;
- brownfield land should be used for car parking;
- such green spaces are good for people's mental health;

- the provision of parking here will exacerbate existing traffic issues of high speeds and an awkward road layout;
- car parking will impact on pedestrian safety including for children at two local schools;
- increased noise, waste and air pollution will result in a residential area;
- loss of landscape character; and
- more difficult for local people to be able to park their cars.

5.6 As stated in paragraph 2.7 above, the proposal to locate a car park on Ravensworth Street has been deleted from the proposed development.

5.7 Other objections raised are as follows:

- the southbound platform is not needed as the existing northbound platform could serve both directions;
- object to proposed one way traffic system for Park Terrace and Park Terrace being used as an entrance to the car park on grounds of pedestrian safety including school children who also play in the street;
- there is too much focus on catering for customers arriving by car;
- the number of car parking spaces required to service the station has been overestimated.

5.8 Bernicia Homes, who have interests (Sleekburn House and 24 – 33 Blenheim Drive), adjacent to the proposed station development have objected. Whilst expressing general support for the Northumberland Line scheme, they consider that its delivery should not be at the expense of the living standards of their residents. They object on the grounds that their residents will be adversely affected by the proposed station development both during construction and when operational.

5.9 Bernicia Homes have submitted evidence to the Transport and Works Act Order Public Inquiry that is due to commence on 9 November and have asked that this evidence is taken into account in consideration of the planning application. The evidence covers a variety of topics including operational noise, construction noise, mapping inconsistencies, daylighting, timescales for construction works and the Local Planning Authority's duties under the Equality Act.

5.10 The Bernicia objections are dealt with in appropriate sections of this report and include detailed advice received from Public Protection in particular on the noise issues.

5.11 Three general representations raise queries on the submitted documents and issues related to provision for cyclists and active travel.

5.12 The above is a summary of the comments. The full written text is available on our website at: http://publicaccess.northumberland.gov.uk/online-applications//applicationDetails.do?activeTab=summary&keyVal=QQ4FAZQSMS400

6. Planning Policy

Development Plan Policy

6.1 The Development Plan in respect of the application site comprises the saved policies from the Wansbeck District Local Plan (WDLP) (2007). The following saved policies in the WDLP are relevant to the consideration of the application.

GP1 Spatial Strategy
GP4 Accessibility
GP5 Landscape Character
GP6 Trees and Hedgerows
G13 Biodiversity and Wildlife Networks
GP21 Archaeology
GP22 Flood Risk and Erosion
GP23 Pollution and Nuisance
GP25 Noise
GP29 Land Contamination
GP30 Visual Impact
GP31 Urban design
GP32 Landscaping and the Public realm
GP35 Crime Prevention
T1 Ashington, Blyth and Tyne Rail Line
T3 Provision for Cyclists
T4 Provision for Walking
T5 Access for People with Reduced Mobility
T6 Traffic Implications of New Development
T7 Parking Provision in New Development
REC11 Access to the Countryside and Coast

6.2 Paragraph 48 of the NPPF states that weight can be given to policies contained in emerging plans dependent upon three criteria: the stage of preparation of the plan; the extent to which there are unresolved objections to policies within the plan; and the degree of consistency with the NPPF. The Northumberland Local Plan - Publication Draft Plan (Regulation 19) (NLP) was submitted to the Secretary of State for Ministry of Housing, Communities and Local Government on 29 May 2019, and is currently going through the examination process.

6.3 On 9 June 2021, the Council published for consultation, a Schedule of proposed Main Modifications to the draft Local Plan that the independent Inspectors examining the plan consider are necessary to make the plan 'sound'. As such the plan is at an advanced stage of preparation, and the policies in the NLP - Publication Draft Plan (Regulation 19) (Jan 2019) as amended by proposed Main Modifications (June 2021), are considered to be consistent with the NPPF. The NLP is a material consideration in determining this application, with the amount of weight that can be given to specific policies (and parts thereof) being dependent upon whether Main Modifications are proposed, and the extent and significance of unresolved objections.

6.4 The NLP will eventually replace the WDLP plan as the development plan for the application site. The following policies in the emerging NLP are relevant to the consideration of the application.

STP 1: Spatial Strategy
STP2: Presumption in favour of Sustainable Development
STP3: Principles of Sustainable Development
STP4: Climate Change Mitigation and Adaptation
STP5: Health and Wellbeing
QOP1: Design Principles
QOP2: Good Design and Amenity
QOP4: Landscaping and Trees
QOP6: Delivering Well-designed Places
TRA1: Promoting Sustainable Connections
TRA2: The Effects of Development on the Transport Network
TRA4: Parking Provision in New Development
TRA5: Rail Transport and Safeguarding Facilities
ENV1: Approaches to assessing the impact of development on the natural, historic and built environment
ENV2: Biodiversity and Geodiversity
ENV7: Historic Environment and Heritage Assets
WAT3: Flooding
WAT4: Sustainable Drainage Systems
POL1: Unstable and Contaminated Land
POL2: Pollution and Air, Soil and Water Quality

National Planning Policy

6.5 The National Planning Policy Framework (NPPF) (July 2021) and Planning Practice Guidance (PPG) are material considerations in determining this application.

Other Documents

6.6 North East Local Economic Partnership. Strategic Economic Plan (2017)
Northumberland Economic Strategy 2019-2024. (2018)
Northumberland Line Economic Corridor Strategy, (February 2021)

7. Appraisal

7.1 The main issues for consideration in the determination of this application are:

- Principle of the development
- Economic considerations
- Provision for car parking

- Other highway considerations
- Impact on residential amenity
- Impact on the character and appearance of the area
- Impact on biodiversity
- Impact on heritage assets

Principle of the Development

7.2 Saved policy T1 in the WDLP and policy TRA5 in the emerging NLP support the re-introduction of passenger rail services on the Northumberland Line. Saved Policy T1 of Wansbeck Local Plan states as follows. *'The re-introduction of passenger services on the rail line between Newcastle and Ashington will be supported and promoted. Land which may be required for associated facilities such as stations, bus stops and car parks will be safeguarded. Such sites will include Woodhorn Colliery; Ashington Town Centre; North Seaton Road, Ashington; and Bedlington Station'.*

7.3 The choice of site location for the proposed station at Bedlington Station aligns well with saved policy T1, albeit that that Plan's proposals map only depicts the proposed station as an allocation within the track bed and adjacent railway corridor.

7.4 Policy TRA5 in the emerging NLP identifies Bedlington Station as one of the locations for stations on the railway line. The emerging plan does not safeguard a specific site for the station, simply showing the station as a point in approximately the same location as the application site. The proposed location for the station is within walking distance of a very large number of homes and can therefore be regarded as a highly sustainable location for a station halt, meeting several of the criteria in emerging NLP policy STP3.

7.5 An objector considers that only one platform is required. However, the applicant has stated that if only one platform is provided at Bedlington Station this would require additional works to make this stretch of the railway single line which would increase capital costs and significantly constrain operating performance through poorer punctuality and reliability of the service. It would also potentially restrict any future aspirations relating to a future extension of the Northumberland Line to Morpeth. It is therefore considered that the principle of having two platforms has been demonstrated.

7.6 The proposed railway station at Bedlington Station is an integral component of the Northumberland Line scheme. It is concluded therefore the principle of the development of the station is in accordance with saved policy T1 and emerging policies TRA5 and STP3. Other aspects of the proposals, notably the car parking, are dealt with in later sections of this appraisal.

Economic considerations

7.7 The County Council and various regional bodies consider that the re-opening of the Northumberland Line for passenger rail services will be a key to future economic development in South East Northumberland.

7.8 In the North East Local Economic Partnership's Strategic Economic Plan, the introduction of passenger services to the line is cited as necessary to the achievement of the plan's connectivity goals. The Northumberland Economic

Strategy recognises that increased connectivity will bring huge benefits, especially to the deprived communities of South East Northumberland. The Strategy identifies the reopening of the Northumberland Line to passengers as a key priority.

7.9 The Strategy for the Northumberland Line Economic Corridor seeks to capitalise upon the reintroduction of passenger rail services between Ashington and Newcastle as a catalyst for transformational change. It states: *'The Northumberland Line is expected to have a major impact on the local economy by facilitating economic activity and improving public transport accessibility, providing the foundations for a new and ambitious clean growth economic corridor to be established'.*

7.10 It is concluded that the economic considerations support the principle of the development and should be given substantial weight.

Provision for Car Parking

7.11 Policy T7 in the WDLP states that developers should make appropriate provision in their developments for the parking of motor vehicles and motorcycles. Policy TRA4 in the emerging NLP states that an appropriate amount of off-street vehicle parking sufficient to serve new development should be made available in safe, accessible and convenient locations. However, the emerging NLP does not identify any minimum or maximum parking standards for developments such as the Northumberland Line. The NPPF states that maximum parking standards should only be set where there is clear and compelling justification that they are necessary for managing the local road network or for optimising the density of development in town centres where the aim should be to improve the quality of parking alongside measures to promote accessibility by pedestrians and cyclists (paragraph 108).

7.12 In the planning application that was originally submitted it was proposed to provide two new car parks providing up to 67 spaces. The car park on the Network rail storage compound to the north of Ravensworth Road would provide 36 spaces including 4 accessible spaces and 4 electric vehicle charging bays, A second car park to the south of Ravensworth Street was also proposed and would have provided 31 spaces. The Transport Assessment (TA) submitted with the planning application includes information on forecasting the number of passengers that would use the proposed station and how they would travel to the station. The forecasting identified a demand for between 30 and 70 car parking spaces would be required for Bedlington Station station. It was felt that to provide only for the lower figure would lead to problems of on-street car parking in the residential streets in the vicinity of the proposed station. County Highways has agreed that the proposed number of car parking spaces is appropriate for the proposed development.

7.13 The TA examined the possibility of utilising existing car parking provision in the vicinity of the proposed station. Four car parks were considered at Clayton Street, Ravensworth Street, and Melrose and Jubilee Terrace car parks. The car parks at Clayton Street and Ravensworth Terrace were found to already be operating at over 85% capacity for significant periods. (The Institute of Highways and Transportation consider a car park to be 'full' at an occupancy rate of 85%). The Melrose and Jubilee car parks had lower occupancy rates but not sufficient to provide the required number of spaces to service the proposed new station. The surveys found that there were already instances of informal on-street car parking.

Reconfiguring the layout of the existing car parks was likely to reduce rather than increase the number of spaces due to the need to adhere to parking standards.

7.14 The TA acknowledges that there are few suitable sites for new car parks in the vicinity of the proposed station due to existing built development and other constraints. A site for potentially up to 75 car parking spaces to the north of Barrington Road and west of the railway line currently occupied by containers was considered, but was discounted on grounds of safety and inconvenience to pedestrians, in particular passengers with a disability.

7.15 The proposal to provide car parking on the amenity open space on Ravensworth Street raised policy issues and gave rise to a significant number of objections as set out in paragraph 5.5 above. Following discussions with Council officers a site at Liddle's Street in the Council's ownership was also considered and this is the subject of a separate planning application that is also on the agenda for this meeting. The Liddle's Street site would provide 31 car parking spaces. The officer recommendation for that application is to grant planning permission subject to conditions.

7.16 The replacement of the proposed Ravensworth Street car park by the proposed Liddle's Street car park has resulted in various changes to the original proposals for highway and footway improvements in the area. These include an extension of car parking restrictions to minimise the potential for on-street parking as a result of the development of the railway station. County Highways has agreed the proposals, some of which will require Traffic Regulation Orders under separate legislation at the detailed design stage

7.17 It is proposed that the entrance to the new car park on the storage compound would be from Park Terrace. Three objections have been received pointing out that Park Terrace is currently a no through road that is used by local children to play safely. The residents are concerned that the proposed entrance will make Park Terrace unsafe for pedestrians including school children who also play in the street. They also objected to the original proposal for a one-way system for Park Terrace which would mean that they would need to exit Park Terrace by driving through the new car park. They suggested that the proposed exit from the car park on Barrington Road could be widened to provide both ingress and egress for the car park.

7.18 Amended proposals for the Park Terrace car park have been submitted. The proposal to make Park Terrace on-way has been removed from the proposals and it is only the car park that is one-way. 'No motor vehicles except for access' restrictions are proposed for Park Terrace beyond the car park access junction and also for West View. 'Residents only' parking bays on the section of Park terrace between Barrington Road and the car park access junction are also proposed. An egress on to Barrington Road is not possible due to the risks of vehicles waiting to turn right into the car park blocking the level crossing. County Highways consider that the revised proposals are acceptable in road and pedestrian safety terms.

7.19 County Highways note that car parking requirements and highway impacts have been assessed upon the basis of free car parking being provided. The Cabinet has agreed that there should be no charging at Northumberland Line car parks for one year following which there will be a review. County Highways recommend a planning condition is imposed to ensure that the impacts of any change in car parking charging strategy is addressed through the planning process and any mitigation that might be required is provided as part of any change in strategy.

7.20 Overall therefore it is considered that the car park proposals in the application are in accordance with Policy T7 in the WDLP, Policy TRA4 in the emerging NLP and the NPPF.

Other Highway Considerations

7.21 Policy T6 in the WDLP requires the volume and character of traffic likely to be generated and attracted by the development to be considered in the determination of planning applications and sets out a number of criteria that need to be complied with. A Transport Assessment is required for proposals that have significant transport implications. Policy TRA1 in the emerging NLP requires the transport implications of development to be addressed as part of any planning application and sets out various planning criteria that the development will be required to address. The NPPF requires applications for developments requiring significant amounts of movement to be supported by a transport assessment so that the likely impacts of the proposal can be assessed (paragraph 113).

7.22 A Transport Assessment (TA) and a Transport Assessment Addendum (TAA) have been submitted to support the proposed development. The assessments identify the anticipated transport impacts of the proposed development and outline whether any necessary improvements to accessibility and safety for all modes of travel are required. The TAA was prepared to deal with amendments to the proposed development following the removal of the Ravensworth Street car park and to provide further information on a proposed junction identified by County Highways as requiring additional surveys and modelling to be carried out. The TA and TAA examined the road safety record of the highway network in the locality and no significant road safety problems were identified. The assessments have concluded that the proposed development will not have a significant impact on the surrounding highway network in terms of capacity and safety.

7.23 In commenting on the original TA, County Highways also required amended proposals in relation to access to the railway station by sustainable modes of travel and have endorsed the revised proposals which include the addition of a means of crossing Barrington Road to the west of the level crossing to accommodate the desire line towards the industrial estate and the removal of the former vehicular crossing at the location of the pedestrian level crossing into Blenheim Drive. The maintenance access to the east of the level crossing has also been amended to provide pedestrian priority through the access in the provision of a dropped kerb access rather than a junction. The previously proposed zebra crossing to Barrington Road has been replaced by a series of uncontrolled crossings on all arms of the Ravensworth / Barrington Road junction.

7.24 The proposed three areas for cycle parking at the three entrances to the platforms are considered acceptable by County highways.

7.25 The various off-site highway works required as part of the proposals have been subject to a Stage 1 Road safety audit and this has shown that there are no inherent highway safety issues. Any further amendments and full details of the proposed works are the subject of a recommended planning condition and will be subject to future Road Safety Audits at detailed design stage.

7.26 Previous concerns from County Highways regarding the layout of the proposed Park Terrace car park and its implications for the local network and residents' access and safety have also been addressed and are dealt with in paragraphs 7.17 – 7.18 above.

7.27 County Highways have therefore generally endorsed the findings of the TA (subject to the revisions made in the TAA) and TAA and raised no objection to the proposed development subject to the imposition of planning conditions in the interests of highway and pedestrian safety and the amenity of local residents

7.28 It is concluded therefore that the proposals are in accordance with Policy T6 in the WDLP, the NPPF and policy TRA1 in the emerging NLP.

Impact on residential amenity

7.29 Policy GP23 in the WDLP states that '*planning permission will not be granted for development likely to cause significant harm to either: a) human health and safety; b) the amenity of local residents and other land users; c) the quality and enjoyment of all aspects of the environment'.*

7.30 Policy STP5 in the emerging NLP (as proposed for modification) states that *'Development proposals will be required to demonstrate where relevant and in a proportionate way, that they …(f) prevent negative impacts on amenity; (g) protect, and alleviate risk to people and the environment, and do not have a negative impact on…vibration, air and noise pollution'.*

7.31 The main impacts on residential amenity are noise, vibration, air quality, artificial lighting and daylight. Visual impact is dealt with in a later section of this report.

7.32 A main receptor is Sleekburn House that comprises 29 independent sheltered accommodation flats for the elderly located on two floors. Fifteen of these flats, a communal quiet room and a guest bedroom have an aspect onto the proposed station. The Bernicia Group that owns Sleekburn House has objected to the planning application and also has interests in 10 other nearby properties in Blenheim Terrace. Reference is made to the grounds of objection in the following paragraphs.

Noise

7.33 The main residential receptors for noise from the proposed development are Sleekburn House, Clayton Arms, The Gables and properties on Blenheim Drive, Station Street, Ravensworth Terrace, Park Terrace and West View. These dwellings are already receptors to noise from the current freight rail traffic.

7.34 It is understood that current freight traffic on the line is up to 30 train movements per week with some of these being early morning. Whilst noise from trains is transitory, the proposed half hour frequency for passenger services represents a significant increase on current levels and at stations the impact will be greater as passengers disembark and board. However, the noise from railcars at the station is predicted to be 41 to 63 dBLAaq (without mitigation) which is between12dB below and 10dB above the measured current baseline daytime level. The proposal is to use diesel railcars, therefore most train engines will be located under the chassis of the railcar and a certain amount of noise attenuation will be provided at the station from the platform acting as a barrier. An acoustic barrier is proposed on the west platform to mitigate noise for six of the closest receptors to the station, including Sleekburn House. This would reduce noise from the railcars at these properties to 44 to 57 dBLAeq which is between 9dB below and 4dB over the measured current baseline daytime level.

7.35 The Public Health Protection unit has paid particular attention to the noise impacts on first floor receptors at Sleekburn House. The 'worst case scenario' relates to night-time noise from passing trains. The night period is 23.00 – 07.00 and during these periods it is anticipated that three empty trains (05.51, 06.15 and 23.11) and three stopping trains (06.11, 06.38 and 06.54) will pass Sleekburn House. External façade noise levels at Sleekburn House at night are estimated to be:

LAeq, 8-hour – 41dB (ground floor) and 50dB (first floor)

LAMax – 63dB (ground floor) and 71dB (first floor)

7.36 With windows open (and allowing for 15dB of attenuation through an open window) internals levels would be:

LAeq, 8-hour – 26dB (ground floor) and 35dB (first floor)

LAMax – 48dB (ground floor) and 56dB (first floor)

7.37 The applicant has agreed to install trickle vents in rooms at Sleekburn House which together with closed windows would achieve the following internal noise levels:

LAeq, 8-hour – 11dB (ground floor) and 20dB (first floor)

LAMax – 33dB (ground floor) and 41dB (first floor)

7.38 As Sleekburn House is in a town centre location it will already experience a degree of noise during these time periods. For establishments such as care homes BS 8233 has an internal noise limit of 35dB LAeq. Whilst there is no specific relaxation of the night-time limit for LAMax, Public Protection consider that existing residents at Sleekburn House might be expected to be partially desensitised to rail traffic noise being exposed to it on a regular basis, including much heavier freight trains with a greater number of wagons during the 06.00 – 07.00 night-time period. Public Protection therefore conclude that given the limited number of passenger traffic movements (passing and stopping) in a small proportion of the night period, the predicted night-time noise impacts are expected to be in the Lowest Observed Adverse Effect Level (LOAEL) when taken against the existing rail traffic.

7.39 Planning conditions are recommended relating to noise mitigation at Sleekburn House and details of the proposed acoustic barrier.

7.40 A new source of noise from the proposed development would be the tannoy system. However, noise from the tannoy system at nearby receptors is predicted to be significantly below the existing ambient levels during the day. Even at night the noise impact would meet the internal limit in BS 8223 of 30dB LAeq (accounting for 15dB of attenuation through an open window) and below the existing background level at night of 48dB LAeq. Notwithstanding this, Public Protection have recommended a planning condition requiring details of how noise from the tannoy will operate and be managed and controlled during the night period.

7.41 The noise levels at the car park on Park Terrace are predicted to be below the measured daytime background levels at the nearest noise receptors.

7.42 The predicted cumulative daytime noise impact at receptors close to the station is only between 0.1 and 0.6 dB over existing ambient noise levels of 53dB LAeq and because of this low predicted impact, no noise attenuation is proposed at the station.

7.43 The recommended conditions require the submission of a construction noise and vibration management plan for the approval of the Local Planning Authority. That plan would be required to provide details of the construction work and methodologies, measures for the control and reduction of noise emissions associated with construction works, liaison with local residents and arrangements for noise monitoring. A main contractor for the Northumberland Line scheme has only recently been appointed and such information is not yet available. However, the applicants have stated that working at night-time and weekends would be necessary, as the line would remain open during construction for the operation of freight services. The expectation would be that the activities that might generate most noise, such as demolition and platform construction, groundworks and tarmacking the car park, would be carried out during normal working hours as far as practicable and this could be controlled through the approval of the planning condition or by a COPA Section 61 ‘prior approval’ or a combination of both. Public Protection also point out that there are noise limits under British Standards 5228 (Code of practice for noise and vibration control on construction and open sites) that they would expect the applicants to adhere to. The applicants estimate that the overall construction period would be up to 18 months (including Liddle’s Street car park), subject to access, safety and other considerations but construction would not be continuous. Individual activities such as the construction of car parks are likely to take place within discrete periods of time of much lesser duration. The construction programme will be refined now that the main contractor for the scheme has been appointed.

7.44 Bernicia Homes have submitted evidence on noise to the forthcoming TWAO public inquiry and have asked that this be taken into account in determining the planning application. This evidence has been examined by Public Protection who consider that their advice to the Local Planning Authority covers the points raised by Bernicia Homes.

7.45 Bernicia Homes consider that the acceptability or otherwise of the construction noise impact should be dealt with at the planning application stage rather than being addressed by way of a condition. However, as pointed out above details of the construction programme are not yet available and Public Protection have recommended that it is appropriate to deal with this matter by imposing a planning condition. They point out that ultimately the applicant will be required to submit adequate and sufficient information to address the impacts of construction noise, including its assessment and proposals for minimisation and mitigation to the satisfaction of the Local Planning Authority. The Local Planning Authority will be advised by Public Protection and has agreed to consult Bernicia Homes on the submitted information.

7.46 Subject to the imposition of appropriate conditions, Public Protection have raised no objections based on noise, either during the operational phase or during construction.

Vibration

7.47 Vibration levels from the proposed railcars are likely to be minimal, especially when compared to the longer and heavier freight trains already using the line and would be significantly below levels that would be noticeable at nearby dwellings. Vibration from plant and machinery during the construction phase will depend on the schedule of works and plant to be used. A contractor has only recently been appointed and as the detailed works and plant are not yet known, this is the subject of a planning condition.

Air Quality

7.48 The railcars will be diesel and there is currently no plan to electrify the line, although the design of the scheme (e.g. the height of bridges) does allow for electrification at some future date. The railcar engines would be similar to those used to drive a large heavy goods vehicle. It is anticipated that the air quality impact from the proposed development would be minimal. Similarly it is considered that the air quality impact from cars travelling to and from the station would be within acceptable levels. A dust management plan for the construction phase has been submitted and Public Protection considers that it is acceptable.

Artificial Lighting

7.49 The external lighting on the platform would be some 5.5 metres from Sleekburn House. The Public Protection team have considered information provided by the applicant on the projected throw from the lighting columns on the platforms and have raised no objection. Similarly it has raised no objection to the lighting proposals for the car park and footways / highways. A condition is recommended requiring the submission and approval of a lighting scheme that shows how and where external lighting will be installed to demonstrate clearly that areas to be lit will not unduly affect residential amenity.

Daylight

7.50 A daylight assessment report for Sleekburn House was submitted with the planning application due to the proximity of the new platform proposed to the south west of the property. The proposals include increasing the height (from 2.5m to 3.4m) of the current privacy fencing / barrier located between Sleekburn House and the proposed platform and moving it closer (in some places by up to 1.3m) to the property. The report reviews the potential change in interior daylight access as a result of the proposed development, based on guidance and methodology set out in the Building Research Establishment (BRE) design guide ‘Site layout planning for daylight and sunlight’.

7.51 The assessment found that ‘good daylight’ as defined by BRE good practice, would be retained for all rooms tested for the proposed fence location and height. Whilst there would be a visible change in views from the rooms, the report concludes that it is unlikely to create a daylight condition which contributes to significant or noticeable daylight losses for these rooms. First floor rooms are largely unaffected by the proposed fence design and height.

7.52 Bernicia Homes have raised concerns regarding the daylight assessment report principally based on their concerns regarding the different mapping techniques

used by the applicants in their submissions. They consider that the position of Sleekburn House has been wrongly mapped with consequential implications for the impacts that will be experienced. The applicants have explained that mapping has been based on a combination of topographical survey, drone survey and Ordnance Survey data. They point out that generally the most accurate of these is topographical data and this is the data that has informed the station designs, including the existing and proposed fence line between Sleekburn House and the railway. They also refer to the roof overhang at Sleekburn House as likely to have affected the position of the building on the plans. The applicants consider that these factors mean that there are no material impacts to the noise and daylight assessment findings in the submissions and none that would lead to an increased impact to Sleekburn House. In respect of noise Public Protection endorse this finding.

7.53 Conditions are recommended relating to ground levels, boundary treatment, landscaping and the acoustic fence and the implications for Sleekburn House will be taken into account in considering applications to discharge these conditions. With the additional safeguards provided by these conditions, it is concluded that the proposals are acceptable in relation to any impacts on daylight at Sleekburn House.

Conclusion on Impact on residential Amenity

7.54 It is concluded that with the proposed mitigation measures and subject to the imposition of appropriate planning conditions, notwithstanding the adverse impacts on Sleekburn House and other nearby receptors particularly during the construction period, the proposed development complies with Policy GP23 in the WDLP and Policy STP5 in the emerging NLP.

Impact on the Character and Appearance of the Area

7.55 When the Ashington Station application was presented to Committee, members raised some issues relating to the design of the proposed development. Design is clearly important and links to other considerations including impact on landscape character, visual amenity, townscape and heritage assets. As members will be aware, the Government has given centre stage in the recent revisions to the NPPF to raise the standards of design and quality of new development.

7.56 Policy GP30 in the WDLP states that developments that in visual terms would cause significant harm to the character or quality of the surrounding environment should be refused. Policy GP32 in the WDLP requires developers to incorporate a high standard of landscape treatment in their developments. Policy QOP2 in the emerging NLP requires development to provide a high standard of amenity for users and not cause unacceptable harm to the amenity of those living in the area. Development proposals should ensure that the physical presence and design of the development preserves the character of the area and does not have a visually intrusive or overbearing impact on neighbouring uses. Policy QOP4 in the NLP (as proposed for modification) states that: *'Where relevant, new development will be expected to incorporate well-designed landscaping and respond appropriately to any existing landscape features'.*

7.57 The application site currently comprises the railway line, Network Rail compound, buildings and platform of the former station, together with various

highways and footways. The boundaries of the site are a mixture of highways, residential properties and their gardens and Sleekburn House.

7.58 A Design and Access Statement (DAS) and a Landscape, Townscape and Visual Overview document were submitted with the application. The DAS points out that the choice of locations for the station was constrained by the track alignment on this stretch of the railway line and the location of existing rail infrastructure. It states that the station size and layout have been designed to meet estimated passenger numbers and to relate to the existing routes, features and buildings around the station, whilst the scale of the proposals is dictated to by Network Rail standards, national legislation and the railway engineering and operating requirements.

7.59 The platforms will be of precast concrete construction with asphalt surfacing. The fencing behind the platforms will be close-boarded timber of a colour to best integrate with the surrounding townscape. Platform furniture and facilities will be designed and coloured to align with the train operating company's branding requirements. The waiting shelters on each platform will provide protection for passengers during inclement weather. The car park and station forecourt area will consist of line marked tarmac with raised kerb pavement and forecourt areas. The DAS concludes that the submitted scheme has sought to balance the competing interests of potential impacts on residential amenity together with the strategic public benefits that will result from the new railway station development.

7.60 The design of the proposed stations on the Northumberland Line, including the station at Bedlington Station, has sought to provide functional and modern railway stations which are compliant with the relevant Network Rail and other industry standards, including those related to accessibility and inclusivity, whilst respecting the local townscape and historic importance of the line's industrial heritage. As referred to in the section below on 'impact on heritage assets' the Building Conservation has raised no objections to the design of the station subject to the imposition of a planning condition requiring details relating to the design and colour palette for station infrastructure to be submitted to ensure continuity and quality in the appearance and design of the scheme as a whole.

7.61 The Landscape, Townscape and Visual Overview document is intended to provide an account of the predicted landscape, townscape and visual effects of the proposed development. It points out that the proposed location for the development is within an urban area with significant rail related infrastructure already present on the site. The layout and views of the landscape around and from the site will not be altered by the development. The overview document concludes that the proposed development will greatly enhance the landscape character of the area due to the improved conditions of the tarmac and paving; the changes to the configuration of the area through expanding footpath widths and altering their alignment to improve safety; increasing green space; and increased quality and maintenance of the proposed planting.

7.62 Bernicia Homes note that the residents of Sleekburn House currently enjoy a largely open green area, with a barrier comprising trees, shrubs and vegetation between the curtilage of the building and the existing platform. They are concerned that the proposals will significantly affect this amenity, and in turn the mental health of elderly residents, the majority of whom spend a large proportion of their time at home, in particular through the erection of a 3.5 metre high acoustic fence but also

through the loss of the current ‘green’ soft landscaping barrier which also provides a habitat for birds and wildlife which is important for residents’ well being.

7.63 The applicants recognise that the proposed increased height and new alignment of the fence will reduce the openness of the existing views and may result in an adverse visual impact for residents of Sleekburn House. However, they consider that the need to mitigate the noise impacts of the proposed development outweighs the change in views from ground floor rooms in Sleekburn House. Landscaping conditions are recommended and the applicants have offered to work with Council officers and Bernicia Homes in formulating the landscaping submissions.

7.64 Some existing trees and green space will be removed to construct the fence, platform and associated infrastructure. At this stage any tree removals are indicative, as the contractor has not been involved in the preparation of the submitted landscape design. Should the Committee decide to grant planning permission, a planning condition is recommended requiring the submission of a final Tree Protection Plan and Arboricultural Method Statement. In approving such a submission the Local Planning Authority will be able to ensure that the trees to be removed are only what is absolutely necessary for the construction and operation of the platform. Where possible compensatory planting would be provided.

7.65 It is concluded that with the proposed mitigation measures and subject to the imposition of appropriate planning conditions, notwithstanding the adverse impacts on Sleekburn House and other nearby receptors particularly during the construction period, the proposed development complies with Policy GP30 and Policy GP32 in the WDLP and Policy QOP2 and Policy QOP4 in the emerging NLP.

Impact on biodiversity

7.66 An Ecological Impact Assessment was submitted with the planning application. It notes that development at the site will lead to a net loss of biodiversity. The provision of net gains for biodiversity in accordance with the NPPF and Policy ENV1 in the emerging NLP is the subject of a recommended planning condition. The County Ecologist has raised no objections to the proposed development subject to the imposition of appropriate planning conditions, including the submission of a scheme of biodiversity net gain. The net gain may be in relation to the application site or the Northumberland Line as a whole. Other recommended conditions relate to mitigation measures and a lighting scheme to maintain the biodiversity value of the site and avoid harm to protected species.

Impact on heritage assets

7.67 A Heritage Statement was submitted with the planning application. It notes that the station at Bedlington dates back to 1850 and whilst some components of the former station complex have been removed since the station closed in 1964, a number of significant structures remain notably, the station building, platform and signal boxes. It notes that the former ‘Boots’ building dating from the 19th century would be demolished to accommodate the new platform and station.

7.68 The Building Conservation team has considered the impact of the proposed development on the setting of these heritage features. It has concluded that while there would be a change to the setting of the surviving railway station and its

buildings and structures, the ability to appreciate their local significance would not be harmed or negatively impacted by the development proposals. Regarding the demolition of the former Boots building, the team considers that the loss of this heritage building needs to be judged in the context of the Northumberland Line scheme's wider public benefits. To ensure continuity and quality in the appearance and design of the proposed development, a condition is recommended requiring details relating to the design and colour palette for station infrastructure to be submitted.

7.69 The Heritage Statement identifies a potential for the Bedlington Station site to be an appropriate focus for a programme of community engagement reflecting the significance of the former Blyth and Tyne Railway in the context of the development of Bedlington and the surrounding area in the industrial period. Discussions on this proposal have taken place following the submission of the planning application and these will continue. Whilst it is not considered that it would be appropriate to impose a condition on this planning application related to this aspect, there are grounds for believing that such a programme will be agreed as part of the development of the overall Northumberland Line scheme.

7.70 The County Archaeologist raises no objections to the proposed development on archaeological grounds. A condition requiring a programme of archaeological work is included in the recommended planning conditions.

7.71 Subject therefore to the imposition of appropriate conditions, the impact of the proposed development on the heritage assets of the area is considered to be acceptable.

Other Matters

Drainage

7.72 A Flood Risk Assessment was submitted with the planning application. This has been reviewed by the Local Lead Flood Authority who have raised no objection to the proposed development subject to the imposition of a planning condition in relation to surface water management.

Coal Mining Legacy

7.73 The application site falls within the defined Development High Risk Area, therefore there are coal mining features and hazards that need to be considered in relation to the determination of the application. Coal Authority information indicates the historic unrecorded coal mining activity is likely to have taken place at shallow depth in the vicinity of the application site. A Coal Mining Risk Assessment was submitted with the application. This has been assessed by the Coal Authority who concur with its conclusions and recommendations. The Coal Authority raise no objection to the proposed development subject to the imposition of conditions requiring investigations to establish the risks posed by past shallow coal mining activity and the carrying out of any remedial works required.

Land Contamination

7.74 The application is supported by a Phase 1 desk stop study for potential land contamination that has recommended that various intrusive investigations are carried

out prior to development. Public Protection have endorsed the findings of the study and have recommended conditions requiring site investigations to be carried out to identify any potential contamination from past historical uses of the site.

Equality Duty

7.75 The County Council has a duty to have regard to the impact of any proposal on those people with characteristics protected by the Equality Act. Bernicia Homes consider that an Equalities Impact Assessment should have been submitted with the application and have expressed concern regarding the impact of the proposals on residents of Sleekburn House who as predominantly elderly, including some with disabilities, are a protected group under the terms of the Equality Act 2010.

7.76 In respect of the concerns expressed by Bernicia Homes, there is no requirement to submit an Equalities Impact Assessment with the planning application and it is considered that both the applicants in their submissions and officers in their assessment of the proposals have had due regard to Sec 149(1) (a) and (b) of the Equality Act 2010. The submissions have recognised the potential impacts on residents of Sleekburn House and as set out in this report, officers have considered the information provided by the applicant, together with the responses from consultees and other parties, in assessing the various potential impacts. This assessment has concluded that there would be some adverse effects during both construction and operation but that these impacts would be mitigated to a certain extent by the various measures proposed and also through the imposition of appropriate planning conditions. Officers will continue to apply the equality duty when considering applications to discharge conditions, in particular the conditions relating to noise and landscaping. The adverse impacts need to be weighed in the planning balance against the wider public benefits that would arise through the Northumberland Line scheme, including the proposals for Bedlington Station.

Crime and Disorder Act Implications

7.77 Policy GP35 of the WDLP states that development proposals will be expected to have regard to planning out crime objectives. The Planning Statement submitted with the application states that the design of the proposals has been informed by guidance received from Northumbria Police and British Transport Police. The 'Designing Out Crime' units of both organisations have been consulted on the planning application and have provided recommendations for various measures to assist in reducing the fear of crime and disorder for passengers using the railway and rail staff, including measures related to CCTV, lighting and access. The DAS states that the design of the station platforms and car parks have been developed to include suitable lighting, CCTV, public address system and passenger help points to create an environment which makes vulnerable users feel safe and secure when using the station and its facilities. These matters are the subjects of planning conditions and it is concluded that the policy requirements have been met.

Human Rights Act Implications

7.78 The Human Rights Act requires the County Council to take into account the rights of the public under the European Convention on Human Rights and prevents the Council from acting in a manner which is incompatible with those rights. Article 8 of the Convention provides that there shall be respect for an individual's private life and home save for that interference which is in accordance with the law and

necessary in a democratic society in the interests of (inter alia) public safety and the economic wellbeing of the country. Article 1 of protocol 1 provides that an individual's peaceful enjoyment of their property shall not be interfered with save as is necessary in the public interest.

7.79 For an interference with these rights to be justifiable the interference (and the means employed) needs to be proportionate to the aims sought to be realised. The main body of this report identifies the extent to which there is any identifiable interference with these rights. The Planning Considerations identified are also relevant in deciding whether any interference is proportionate. Case law has been decided which indicates that certain development does interfere with an individual's rights under Human Rights legislation. This application has been considered in the light of statute and case law and the interference is not considered to be disproportionate.

7.80 Officers are also aware of Article 6, the focus of which (for the purpose of this decision) is the determination of an individual's civil rights and obligations. Article 6 provides that in the determination of these rights, an individual is entitled to a fair and public hearing within a reasonable time by an independent and impartial tribunal. Article 6 has been subject to a great deal of case law. It has been decided that for planning matters the decision making process as a whole, which includes the right of review by the High Court, complied with Article 6.

8. Conclusion

8.1 The reintroduction of passenger rail services on the Northumberland Line would bring considerable benefits to communities in south-east Northumberland, including in the Bedlington area. The proposed station at Bedlington Station forms an important part of the overall scheme and is in accordance with Development Plan policy. It is considered these factors in favour of the proposed development should be given substantial weight.

8.2 The proposed new station would be located adjacent to the location of the former station. This is a sustainable location and there are operational and logistical reasons that would mean locating the station elsewhere in the Bedlington area would not be possible. The car parking proposals, as amended, are considered to be appropriate and acceptable.

8.3 The concerns expressed by Bernicia Homes in relation to residents of Sleekburn House who as predominantly elderly, including some with disabilities, are a protected group under the terms of the Equality Act, are recognised. It is considered that there will be some adverse effects on the amenity and living conditions of these residents in particular during the construction of the platforms and also during the operation of the rail services, notwithstanding the fact that the line is currently used by freight trains. However, the proposed mitigation measures and recommended conditions will assist in reducing these impacts and the applicants have made commitments to continue to work with Bernicia Homes in the development of the scheme. The adverse impacts need to be weighed in the planning balance.

8.4 The proposals for the station, car park and associated development are considered to be acceptable subject to the imposition of conditions including mitigation measures to protect the amenity and living conditions of local residents,

including residents of Sleekburn House. Notwithstanding the adverse impacts, in particular for residents of Sleekburn House, It is concluded that the proposal is in accordance with the Development Plan and that the overall planning balance weighs in favour of granting planning permission subject to appropriate planning conditions.

9. Recommendation
That this application be GRANTED permission subject to the following conditions.

General

1. The development hereby permitted shall be begun not later than three years from the date of this permission.

Reason: To comply with Section 91 of the Town and Country Planning Act 1990 (as amended).

2. The development hereby permitted shall not be carried out otherwise than in accordance with the following plans and documents.

60601435-ACM-XX-ZZ-DRG-LEP-000014 (Rev PO1) Site Location Plan
60601435-ACM-01-ZZ-DRG-ECV-000001 Planning Drawing General Arrangement
60601435-ACM-06-PL-DRG-ECV-000001 (Rev PO1) Existing General Arrangement
60601435-ACM-06-PL-DRG-ECV-000002 (Rev PO1.1) Platform General Arrangement
60601435-ACM-06-PL-DRG-ECV-000003 (Rev PO1.1) Up and Down Platforms General Arrangement
60601435-ACM-06-PL-DRG-ECV-000006 (Rev PO1.1) Platform Services General Arrangement
60601435-ACM-06-PL-DRG-ECV-000004 (rev PO3) Platform Sections Sheet 1 of 2
60601435-ACM-06-PL-DRG-ECV-000005 (Rev PO2) Platform Sections General Arrangement
60601435-ACM-06-ZZ-DRG-EHW-060001 (PO3) Bedlington Car Park Highways General Arrangement
60601435-ACM-06-ZZ-DRG-EHW-060005 (Rev PO2) Bedlington Station Highways Drainage Layout
60601435-ACM-06-ZZ-DRG-EHW-060006 (Rev PO2) Traffic Sign and Road Marking Layout
60601435-ACM-06-ZZ-DRG-EHW-060002 (Rev PO2) Bedlington Car Park Highways Typical Cross Sections 1 of 3
60601435-ACM-06-ZZ-DRG-EHW-060003 (Rev PO2) Bedlington Car Park Highways Typical Cross Sections 2 of 3
60601435-ACM-06-ZZ-DRG-EHW-060004 (Rev PO2) Bedlington Car Park Highways Typical Cross Sections 3 of 3
60601435-ACM-06-ZZ-DRG-EHW-060007 (Rev PO2) Vehicle Tracking
60601435-ACM-06-ZZ-DRG-HLG-001301 (Rev PO2) Highways Lighting Proposed Lighting Layout Sheet 1 of 1
60601435-ACM-06-ZZ-DRG-HLG-001302 (Rev PO2) Highways Lighting Contours Layout Sheet 1 of 1
60601435-ACM-06-ZZ-DRG-HLG-001301 (Rev PO2) Highways Lighting Calculation Results Sheet 1 of 1
60601435-ACM-06-ZZ-REP-HLG-001301 (Rev PO2) Lighting Calculation Report
60601435-ACM-06-ZZ-SKT-HLG-001301 (Rev PO2) Proposed Lighting Class Sheet 1 of 1

60601435-ACM-06-ZZ-DRG-EPT-000069 (Rev PO2) Lighting Layout Bedlington Car Park
60601435-ACM-06-ZZ-DRG-EHW-060008 (Rev PO1) Existing Public Utilities Layout
60601435-ACM-06-PL-DRG-ECV-000100 (Rev PO1) Existing Buried Services General Arrangement
60601435-ACM-XX-ZZ-DRG-EEN-000504 (Rev PO1) Bedlington Station Landscape Design
Bedlington Arboricultural Impact Assessment, Aecom for Northumberland County Council. 2020
Northumberland Line: Statement in support of planning application for proposed railway station at Bedlington (Ver. 2.0). SLC Property. 30 July 2021
Northumberland Line Bedlington Transport Assessment Addendum. Aecom for Northumberland County Council. August 2021

Reason: To ensure that the approved development is carried out in accordance with the approved plans and documents.

3. The development hereby permitted shall not be commenced until plans of the site showing the existing and proposed ground levels, including in relation to Sleekburn House to the west of the site, have been submitted to and approved in writing by the Local Planning Authority. Such levels shall be shown in relation to a fixed and known datum point. Thereafter, the development shall be carried out in accordance with the approved details.

Reason: To ensure that the work is carried out at suitable levels in relation to adjoining properties and highways, having regard to amenity, access, highway and drainage requirements in accordance with the NPPF.

Environmental Matters

4. The development hereby permitted shall not be commenced until a Construction Environmental Management Plan has been submitted to and approved in writing by the Local Planning Authority. The approved Management Plan shall be adhered to throughout the demolition and construction period. The Management Plan shall provide for:

a. An assessment of construction noise and vibration including detailing measures for the control and reduction of noise and vibration emissions associated with demolition, earthworks and construction.

b. Details of the disposal of surface water from the development through the construction phase.

c. Equipment cleaning and washing facilities.

d. Excavation plant machinery to be fitted with fuel spill kits.

e. The provision of welfare facilities that shall be maintained by a licenced Waste Carrier.

f. Details of behavioural policies for all site staff to minimise noise, vibration and air quality impacts from vehicles, plant and equipment.

g. The engines / generators of all construction vehicles, plant and equipment shall be turned off when not in use. Hybrid generators shall be used wherever practicable to reduce noise and fuel consumption.

h. Details of the measures to be taken to protect existing trees that will not be removed as part of the development

Reason: To prevent nuisance in the interests of residential amenity in accordance with the NPPF, to ensure that the risk of flooding does not increase during the construction phase, to limit the siltation of any site surface water features, to ensure the welfare of site operatives and to ensure trees are protected from construction works.

5. Details of the proposed boundary treatment to the site shall be submitted to and approved by the Local Planning Authority. The details shall include plans showing the location of existing, retained and proposed new boundary treatments and scaled drawings indicating the positions, height, design, materials, type and colour of the proposed new boundary treatments in relation to existing neighbouring buildings. The approved scheme shall be implemented before the station is brought into operational use.

Reason: In the interests of visual amenity of the area and to ensure that the proposed development does not have an adverse effect upon the appearance of the area in accordance with Policy GP31 of the Wansbeck District Local Plan.

6. Notwithstanding the details submitted, prior to the commencement of development samples of all materials, colours and finishes to be used on all external surfaces shall be submitted to and approved in writing by the Local Planning Authority. Thereafter the development shall be carried out in accordance with the approved details.

Reason: In the interests of visual amenity of the area and to ensure that the proposed development does not have an adverse effect upon the appearance of the area in accordance with Policy GP31 of the Wansbeck District Local Plan.

Land Stability

7. No development shall commence (excluding the demolition of existing structures and any grouting works that are required) until:

a) a scheme of intrusive investigations has been carried out on site to establish the risks posed to the development by past shallow coal mining activity; and

b) any remediation works and / or mitigation measures to address land stability arising from coal mining legacy, as may be necessary, have been implemented on site in full in order to ensure that the site is made safe and stable for the development proposed.

Reason: The site lies in an area where historic unrecorded shallow mine workings are likely to have taken place.

8. Prior to the development being brought into use, a signed statement or declaration prepared by a suitably competent person confirming that the site is, or

has been made, safe and stable for the approved development shall be submitted to and approved in writing by the Local Planning Authority. This document shall confirm the methods and findings of the intrusive site investigations and the completion of any remedial works and / or mitigation necessary to address the risks posed by past coal mining activity.

Reason: In the interests of the users of the proposed development.

Contaminated Land

9. No development shall take place, including any works of demolition, until a full programme of works has been submitted to and approved in writing by the Local Planning Authority. The programme shall allow the identification of 'enabling works', separate from the main demolition and construction works, including major groundworks (i.e. soil stripping).

Reason: To provide an identifiable separation of works that will allow the imposition of conditions aimed only at the main demolition and construction works.

10. No development shall take place beyond the 'enabling works' identified under condition 9, until an appropriate scheme of assessments, investigations and remediation has been carried out as detailed below, unless those assessments and investigations demonstrate that remediation is not required, and the Local Planning authority dispenses with any such requirement in writing.

a) Further site investigations are recommended in the Phase 1: Desk Study (The Northumberland Line – Preliminary Sources Study Report – Bedlington Station. AECOM Ltd. dated 26 February 2021 (version 1.0) and shall be carried out to fully and effectively characterise the nature and extent of any land contamination and / or pollution of controlled wastes. These shall specifically include a risk assessment that adopts the Source-Pathway-Receptor principle, in order that any potential risks are adequately assessed, taking into account the site's existing status and proposed new use. The site investigation and findings shall be submitted to the Local Planning Authority without delay upon completion.

b) Thereafter, a written Method Statement (or Remediation Strategy) detailing the remediation requirements for the land contamination and / or pollution of controlled waters affecting the site shall be submitted to and approved by the Local Planning Authority. All requirements shall be implemented and completed to the satisfaction of the Local Planning Authority. No deviation shall be made to the approved scheme without express written agreement of the Local Planning Authority.

Reason: To ensure that risks from land contamination to the future users of the land are minimised and to ensure that the development can be carried out safely without unacceptable risks to future users in accordance with Policy GP29 of the Wansbeck District Local Plan.

11. The development hereby permitted shall not be brought into use or continue in use until a full closure (Verification Report) report has been submitted to and approved in writing by the Local Planning Authority. The report shall provide verification that the required works regarding contamination have been carried out in accordance with the approved Method Statement(s). Post remediation sampling and

monitoring results shall be included in the closure report to demonstrate that the required remediation has been fully met.

Reason: To ensure that risks from land contamination to the future users of the land are minimised and to ensure that the development can be carried out safely without unacceptable risks to future users in accordance with Policy GP29 of the Wansbeck District Local Plan.

12. If during the development, contamination not previously considered is identified, then an additional Method Statement regarding this material shall be submitted to and approved in writing by the Local Planning Authority. The development shall not be brought into use until the measures proposed to deal with the contamination have been carried out. Should no contamination be found during development then the developer shall submit a signed statement indicating this to discharge this condition.

Reason: To ensure that risks from land contamination to the future users of the land are minimised and to ensure that the development can be carried out safely without unacceptable risks to future users in accordance with Policy GP29 of the Wansbeck District Local Plan.

Landscaping

13. All works shall be undertaken in accordance with the submitted Arboricultural Impact Assessment (AECOM 2020) (AIA) and the Tree Protection Plan (Appendix D of the AIA). If there are any changes to the design of the development hereby approved, including any changes to the proposals in the vicinity of Sleekburn House, a final Tree Protection Plan and Arboricultural Method Statement, which shall also be informed by the requirements in BS 5837:2012 Trees in Relation to Design, Demolition and Construction, shall be submitted to and approved by the Local Planning Authority. No development or other operations, including any works within the root protection area (RPA) of the retained trees shall take place except in accordance with the approved AIA or any approved revised AIA.

Reason: In order that retained trees are protected during construction, in the interests of visual amenity of the area and residents of Sleekburn House and to ensure that the proposed development does not have an adverse effect upon the appearance of the area in accordance with Policies GP6 and GP31 of the Wansbeck District Local Plan.

14. Within one month from start on site, a detailed landscaping scheme shall be submitted to and approved in writing by the Local Planning Authority. The landscaping scheme shall be implemented in accordance with the approved details within the first available planting season following the approval of details.

Reason: To ensure that important features are protected and retained in the interests of amenity and to ensure a satisfactory standard of landscaping in accordance with Policies GP6 of the Wansbeck District Local Plan.

15. No trees, shrubs or hedges within the site which are shown as being retained in the approved landscaping scheme required by condition 14, shall be felled, uprooted, wilfully damaged or destroyed, cut back in any way or removed during the development phase other than in accordance with the approved plans or without the

prior written consent of the Local Planning Authority. Any trees, shrubs or hedges removed without such consent, or which die or become severely damaged or seriously diseased within three years from the completion of the development hereby permitted shall be replaced, within the next planting season, with trees, shrubs or hedge plants of similar size and species unless the Local Planning Authority gives written consent to any variation.

Reason: To ensure that important features are protected and retained in the interests of amenity and to ensure a satisfactory standard of landscaping in accordance with Policies GP6 of the Wansbeck District Local Plan.

Biodiversity

16. The development hereby permitted shall not be commenced unless and until a scheme ("the offsetting scheme") for the offsetting of biodiversity impacts at the site has been submitted to and approved in writing by the Local Planning Authority. The offsetting scheme shall include:

a. A methodology for the identification of receptor site(s).

b. The identification of receptor site(s).

c. Details of the offset requirements of the development (in accordance with the recognised offsetting metrics standard outlined in the Defra Metrics Guidance dated March 2012).

d. The provision of arrangements to secure the delivery of the offsetting measures (including a timetable for their delivery).

e. A management and monitoring plan (to include for the provision and maintenance of the offsetting measures in perpetuity).

The written approval of the LPA shall not be issued before the arrangements Necessary to secure the delivery of the offsetting measures have been executed. The offsetting scheme shall be implemented in full accordance with the requirements of the approved scheme.

Reason: To provide net gains for biodiversity in accordance with the NPPF.

17. No development shall take place unless in accordance with the mitigation measures detailed in the report *Ecological Impact Assessment Bedlington Station. SLC Property. January 2021,* including:

- Priority within the planting scheme to be given to native species, ideally of local provenance.
- A checking survey will be undertaken within one month prior to the start of works to determine whether any Schedule 9 invasive plant species are present on site. Stands of any such species will be subject to control / removal by an appropriately licensed contractor as part of the works.
- The former Boots building and station buildings will be subject to a bat activity checking survey within the peak active season (mid-May to end August) prior to the start of any works on these structures, to ensure up-t-date survey data is available in line with current best-practice guidelines.

- No tree felling, trimming or other arboricultural works will be undertaken on any of the mature trees within or adjacent to the site without a suitably qualified ecologist first being consulted in order to address the residual risk of roosting bats being adversely affected.
- Any arboricultural works to follow a method statement produced by a suitably qualified ecologist
- Installation of at least 5 bat boxes and 5 new nest boxes within the retained buildings or trees.
- Vegetation clearance works shall not be undertaken during the nesting period (1 March – 30 September) unless a checking survey by a suitably qualified ecologist has confirmed no active nests have been present within the 5 days before the survey was undertaken.
- Vegetation clearance works will be undertaken using a two-stage cut following fingertip searches for amphibians by a suitably qualified ecologist, the first cut down to a maximum of 10 centimetres, followed by a second search before the vegetation is cut down to ground level. Any amphibians found during the checks will be moved to a suitably vegetated area outside the site which will not be subject to further disturbance.
- Works will not commence until site operatives have received a toolbox talk from a suitably qualified ecologist to ensure that they are aware of the potential presence of protected species, signs to look out for, working methods to be implemented and procedures to be followed in the event any protected species are recorded during the works.
- Works affecting the buildings on the site will proceed on a precautionary method statement and under the supervision of a suitably qualified and licensed ecologist where these structures have the potential to support roosting birds.
- Any trenches opened as part of the works will ideally be closed on the same day. Where this is not possible, either one side of the trench will be cut to an angle of not more than 45 degrees, or a plank large enough for a person to walk on will be installed each night, to provide wildlife an escape route. The trenches will be checked each morning, prior to the recommencement of works, to ensure no protected or notable species have become trapped.
- Any sightings of protected species within the works area will be recorded in the site diary and the project ecologist will be notified immediately. In the unlikely event any great crested newts are identified on site when the project ecologist is not present, all works will cease immediately and a suitably qualified ecologist will be contacted for advice on how to proceed

Reason: To maintain the biodiversity value of the site and avoid harm to protected species that may be present in accordance with Policy GP13 of the Wansbeck District Local Plan.

Highways and Car Parking

18. No passenger rail services shall serve the station until the Liddle's Street Car Park (planning reference 21/03060/CCD) has been implemented in full accordance with its permission and associated conditions.

Reason: In the interests of highway safety, in accordance with the National Planning Policy Framework.

19. Prior to the commencement of passenger rail services at the station the car parking area indicated on the approved plans, including any disabled and EV car parking spaces contained therein, shall be hard surfaced, sealed and marked out in parking bays in accordance with the approved plans. Thereafter, the car parking area shall be retained in accordance with the approved plans and shall not be used for any purpose other than the parking of vehicles associated with the provision of passenger rail services at the station.

Reason**:** In the interests of highway safety, in accordance with Policy T6 of the Wansbeck District Local Plan and the National Planning Policy Framework.

20. Prior to the commencement of passenger rail services at the station, a car parking management strategy detailing the number of car parking spaces, including disabled, EV and other spaces for non-public use, and details as to how these spaces will be made available, shall be submitted to and approved in writing by the Local Planning Authority. The approved strategy shall be implemented in accordance with the approved details before the commencement of passenger rail services at the station.

Reason: In the interests of highway safety and sustainable development, in accordance with Policy T7 of the Wansbeck District Local Plan the National Planning Policy Framework.

21. Prior to the commencement of passenger rail services at the station, details of the proposed highways works shown indicatively on the approved plans shall be submitted to and approved in writing by the Local Planning Authority. The highways works shall include the provision of:

- Access junction to car park from Park Terrace;
- Reconfiguration of Park Terrace;
- Egress junction from car park to Barrington Road;
- Amended access junction to Network Rail Compound from Barrington Road;
- Removal and reinstatement to footway of former access on Barrington Road to west of Level Crossing;
- Pedestrian Crossing Points to Barrington Road and Ravensworth Street;
- Pedestrian Crossing Point and Pedestrian Refuge on Station Road and improvements to footways on Station Road / Clayton Road;
- Traffic Management Measures to Park Terrace, West View and Station Road
- All other associated works.

No passenger rail services at the station shall commence until the highways works have been implemented in accordance with the approved plans.

Reason**:** In the interests of highway safety, in accordance with Policy T6 of the Wansbeck District Local Plan and the National Planning Policy Framework.

22. Prior to the commencement of passenger rail services at the station, details of the proposed advanced directional signage for vehicles, cyclists and pedestrians, shall be submitted to and approved in writing by the Local Planning Authority. No

passenger rail services at the station shall commence until the details have been implemented in accordance with the approved plans.

Reason**:** In the interests of highway safety and sustainable transport, in accordance with Policy T6 of the Wansbeck District Local Plan and the National Planning Policy Framework.

23. Prior to the car parking area being made available for public use, an Operation, Management and Maintenance Strategy for the development shall be submitted to and approved in writing by the Local Planning Authority. The operation, management and maintenance strategy shall detail, how the areas of the development including the car parking area, access roads, drainage, landscaping, CCTV and lighting will be operated, managed and maintained upon completion of the development and the boundaries between any multiple parties in this respect. Following the car parking area being made available for public use, the development shall be managed and maintained in accordance with the approved details.

Reason: In the interests of highway safety and local amenity, in accordance with Policy T7 of the Wansbeck District Local Plan and the National Planning Policy Framework.

24. Prior to any change in charging strategy for the car parking area, details of the amendments and any associated mitigation associated with that change shall be submitted to and approved in writing by the Local Planning Authority. The approved details and associated mitigation shall be implemented prior to the change in charging strategy being implemented.

Reason: In the interests of highway safety, in accordance with the National Planning Policy Framework.

25. Prior to the commencement of passenger rail services at the station, the cycle parking shown on the approved plans shall be implemented in accordance with the approved plans. Thereafter, the cycle parking shall be retained in accordance with the approved details and shall be kept available for the parking of cycles at all times.

Reason: In the interests of highway safety and sustainable development, in accordance with Policy T3 of the Wansbeck District Local Plan and the National Planning Policy Framework.

26. Development shall not commence until a Transport and Construction Method Statement, together with a supporting plan has been submitted to and approved in writing by the Local Planning Authority. The approved Construction Method Statement shall be adhered to throughout the construction period. The Construction Method Statement and plan shall, where applicable, provide for:

1. details of temporary traffic management measures, temporary access, routes and vehicles;
2. vehicle cleaning facilities;
3. the parking of vehicles of site operatives and visitors;
4. the loading and unloading of plant and materials;
5. storage of plant and materials used in constructing the development.

Reason: To prevent nuisance in the interests of residential amenity and highway safety, in accordance with the National Planning Policy Framework.

CCTV

27. A scheme for the provision of a network of closed circuit television cameras (CCTV), including the proposed location cameras, mounting columns, proposals for the use and management of the system and proposals for its installation shall be submitted to and approved in writing by the Local Planning Authority. The CCTV system shall be installed in accordance with the approved details before the station is brought into operational use.

Reason: In the interests of the safety and security of users of the station and car park in accordance with Policy GP35 of the Wansbeck District Local Plan.

Noise and Vibration

28. Prior to any amplified voice or tannoy system becoming operational, full details of the system shall be provided to the Local Planning Authority to show how the system will be operated and managed to minimise noise impacts to local noise sensitive receptors. The proposed system shall be installed, operated and maintained to the satisfaction of the Local Planning Authority in accordance with the details submitted to and approved in writing by the Local Planning Authority.

Reason: To protect residential amenity and provide a commensurate level of protection against noise in accordance with Policy GP25 of the Wansbeck District Local Plan.

29. Prior to the development being brought into use or continuing in use, details of the acoustic barrier(s) as outlined in the document *Bedlington Railway Station Noise Impact Assessment, Aecom. 18 January 2021* shall be submitted to and approved in writing by the Local Planning Authority. The details shall include location, specification, design and performance. The approved scheme shall be implemented in full before the development is brought into use and shall be maintained to ensure it meets the agreed performance for the lifetime of the development.

Reason: To protect residential amenity and provide a commensurate level of protection against noise in accordance with Policy GP25 of the Wansbeck District Local Plan.

30. No development shall take place, including any works of demolition, until a construction noise and vibration management plan has been submitted to and approved in writing by the Local Planning Authority. The plan shall detail the construction work and methodologies, measures for the control and reduction of noise emissions associated with construction works, liaison with local residents and arrangements for noise monitoring.

Reason: To protect residential amenity and provide a commensurate level of protection against noise in accordance with Policy GP25 of the Wansbeck District Local Plan.

31. The development shall not be brought into use until a scheme for the mitigation of rail noise at Sleekburn House has been submitted to and approved in writing by the Local Planning Authority. The approved noise mitigation scheme shall

be implemented in accordance with the approved details before the development is brought into use.

Reason: To protect the amenity of residents of Sleekburn House in accordance with Policy GP25 of the Wansbeck District Local Plan.

32. During the construction period, there shall be no deliveries to or collections from the site, on Sundays or Bank Holidays or outside the hours of 08.00 – 18.00 on Monday to Friday or 08.00 – 13.00 on Saturday.

Reason: To protect residential amenity and provide a commensurate level of protection against noise in accordance with Policy GP25 of the Wansbeck District Local Plan.

Drainage

33. Prior to first use of the car park, details of the adoption and maintenance of all SuDS features shall be submitted to and approved in writing by the Local Planning Authority. The SuDS features shall thereafter be implemented and maintained for the lifetime of the development.

Reason: To ensure that the scheme to dispose of surface water operates at its full potential throughout the lifetime of the development.

Lighting

34. Prior to first use a lighting scheme for all areas of the site including, but not restricted to, the platforms, car park and footpaths, shall be submitted to and approved in writing by the Local Planning Authority. The scheme shall show how and where external lighting shall be installed (through the provision of appropriate lighting contour plans and technical specifications) so that it can be clearly demonstrated that areas to be lit will not unduly affect residential amenity or prevent bats using their territory (e.g. for foraging or commuting) or having access to their breeding sites and resting places. All external lighting shall be installed in accordance with the approved scheme and no external lighting shall otherwise be installed without prior approval in writing from the Local Planning Authority.

Reason: To protect residential amenity in accordance with Policy GD23 of the Wansbeck District Local Plan and maintain connectivity along commuting and feeding corridors for protected animal species in accordance with Policy GP13 of the Wansbeck District Local Plan.

Archaeology

34. A programme of archaeological work is required in accordance with Northumberland County Council Conservation Team (NCCCT) Standards for Archaeological Mitigation and Site-specific Requirements document (17 March 2021) and Level 2 of Historic England’s guidance document ‘Understanding Historic Buildings: A Guide to Good Recording Practice ‘ (2016). The archaeological scheme shall comprise three stages of work as set out below. Each stage shall be submitted to and approved in writing by the Local Planning Authority.

a) No development or archaeological mitigation shall commence on site until a written scheme of investigation based on NCCCT's 'Standards for Archaeological Mitigation and Site-specific Requirements' and Historic England's 'Understanding Historic Buildings' documents has been submitted to and approved in writing by the Local Planning Authority.

b) The archaeological recording scheme required by NCCCT's 'Standards for Archaeological Mitigation and Site-specific Requirements' and Historic England's 'Understanding Historic Buildings' documents must be completed in accordance with the approved written scheme of investigation.

c) The programme of analysis, reporting, publication and archiving if required by NCCCT's 'Standards for Archaeological Mitigation and Site-specific Requirements' and Historic England's 'Understanding Historic Buildings documents must be completed in accordance with the approved written scheme of investigation.

Reason: The site is of archaeological interest and to comply with Policy GP21 of the Wansbeck District Local Plan and the National Planning Policy Framework.

Informatives:

1. Any intrusive activities including initial site investigation boreholes, and / or any subsequent treatment of coal mine workings / coal mine entries for ground stability purposes require the written permission of The Coal Authority, since such activities can have serious public health and safety implications. Failure to obtain permission will result in trespass, with the potential for court action.

2. The prevention of nuisance is the responsibility of the developer and their professional advisors. Developers should, therefore, fully appreciate the importance of professional advice. Failure to address issues of noise, dust and light at the development stage does not preclude action by the Council under Section 79 of the Environment Protection Act 1990 in respect to statutory nuisance.

3. British Standards 5228 (Code of practice for noise and vibration control on construction and open sites) sets out noise limits that the developers will be expected to adhere to, particularly in relation to working outside 'normal working hours'.

4. There shall be no burning of any material associated with the construction phase of the development.

5. It is recommended that the lighting scheme approved under condition 34 is designed in consultation with the project ecologist and follow guidance set out in Institution of Lighting Professionals Advice Note 08/18 (2018).

6. In relation to the works to the highway required to facilitate the development to Barrington Road, Ravensworth Street, Station Road, Palace Road, Park Terrace and West View as well as on the wider highway network to facilitate a highway signage scheme, pedestrian and cyclists' signage, a clear and transparent set of principles should be applied to ensure public benefit.

7. Offsite highway works required in connection with the proposed development are controlled by the Council's Technical services Division. These works should be

carried out before the car parking area is made available for public use. The Council will undertake such works at the applicant's expense. Highways Development Management (higwaysplanning@northumberland.gov.uk) should be contacted to progress this matter.

8. A highway condition survey should be carried out before the commencement of demolition and construction vehicle movements from the site. Highways Development Management (higwaysplanning@northumberland.gov.uk) should be contacted to arrange a survey.

9. The Council's Traffic Management Section at highwaysprogramme@northumberland.gov.uk should be contacted before and during the construction period in respect of any impacts to current and proposed Traffic Regulation Orders.

10. Building material or equipment shall not be stored on the highway unless otherwise agreed. The Streetworks Team on 0345 600 6400 should be contacted for Skips and Containers licences.

11. The Council's Lighting Section at highwaysstreetlighting@northumberland.gov.uk should be contacted before and during the construction period with respect of street lighting to ensure sufficient illumination levels of the public highway.

12. In accordance with the Highways Act 1980, no mud, debris or rubbish shall be deposited on the highway.

13. Road safety audits are required to be undertaken. The Council offers this service and can be contacted at highwaysplanning@northumberland.gov.uk or 01670 622979.

14. The demand for EV car parking spaces is likely to increase in the future to reflect the inevitable increased take up of electric vehicles.

14. Works that do not constitute 'development' or are permitted by virtue of the provisions of the General Permitted Development Order will not require formal discharge to be obtained prior to such works being undertaken.

Date of Report: 21st October 2021

Background Papers: Planning application file(s) 21/01106/CCD

Appendix Q Internal noise level survey

Q.1 Internal noise level measurements were made by my colleague, Elspeth Chatto, from 9:02 am on Thursday the 28th October 2021 to 8:39 am on Friday the 29th October.

Q.2 The noise level measurements were made in the first floor guest room, as indicated in Figure 1 and shown in Figure 2.

Q.3 During the measurement period the window remained closed, with the trickle vent open.

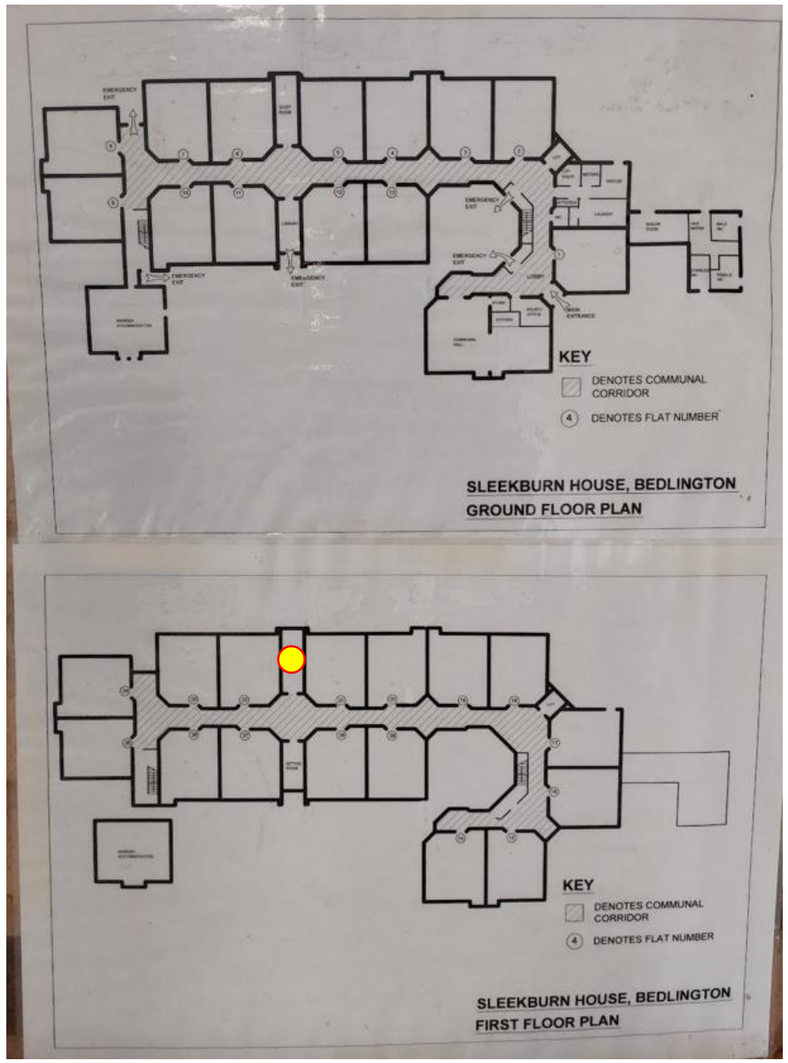


Figure 1: Measurement location indicated by yellow dot

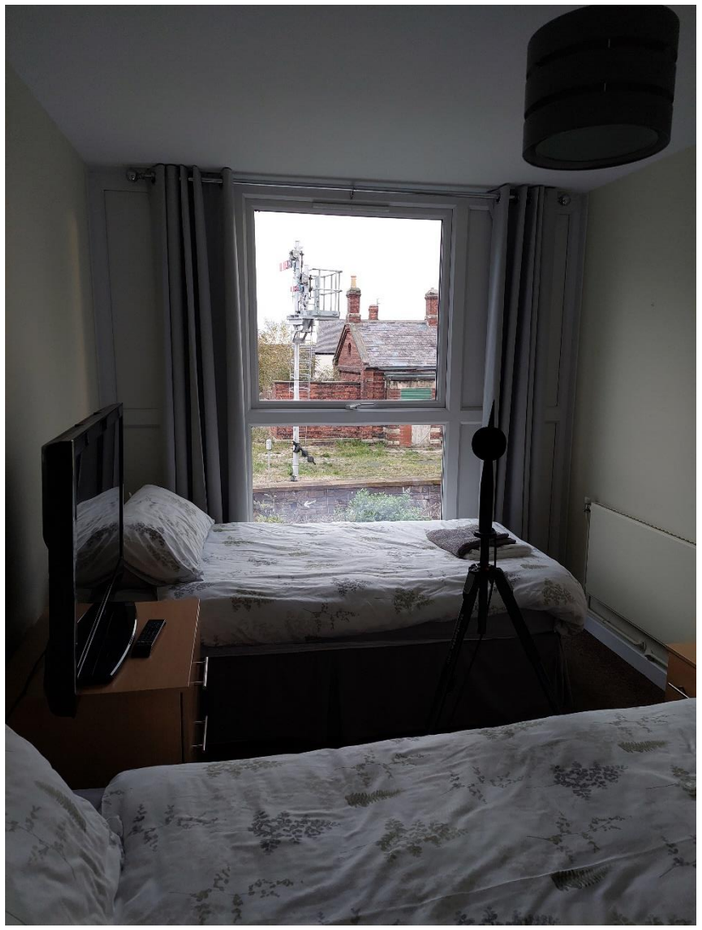


Figure 2: Measurement in progress

Q.4 The equipment used is listed in Table 1.

Equipment	Model	Serial no.
Sound Level Meter	NTi XL2	A2A-14176-E0
Calibrator	Larson Davis CAL 200	15307

Table 1: Equipment used

Q.5 The sound level meter and calibrator used meet the technical specifications of BS 7445 and have current calibration certificates traceable to national standards. The equipment was field-calibrated before and after the measurement with no significant drift in sensitivity noted.

Q.6 The measured noise level are shown in Table 2. During the daytime period the minimum measured $L_{Aeq,1hr}$ was 23 dB; during the night-time the minimum $L_{Aeq,1hr}$ was 19 dB.

Start date and time	Duration (T) / h:mm:ss	Free-field $L_{Aeq,T}$ dB
28/10/2021 09:00	0:52:35	25
28/10/2021 10:00	0:59:31	25
28/10/2021 11:00	1:00:00	25
28/10/2021 12:00	1:00:00	25
28/10/2021 13:00	1:00:00	25
28/10/2021 14:00	1:00:00	26
28/10/2021 15:00	1:00:00	26
28/10/2021 16:00	1:00:00	28
28/10/2021 17:00	1:00:00	27
28/10/2021 18:00	1:00:00	24
28/10/2021 19:00	1:00:00	31
28/10/2021 20:00	1:00:00	25
28/10/2021 21:00	1:00:00	23
28/10/2021 22:00	1:00:00	24
28/10/2021 23:00	1:00:00	21
29/10/2021 00:00	1:00:00	22
29/10/2021 01:00	1:00:00	22
29/10/2021 02:00	1:00:00	21
29/10/2021 03:00	1:00:00	22
29/10/2021 04:00	1:00:00	20
29/10/2021 05:00	1:00:00	22
29/10/2021 06:00	1:00:00	33
29/10/2021 07:00	1:00:00	25
29/10/2021 08:00	0:37:55	27

Table 2: Measured noise levels

Appendix R NCC Draft Letter of Assurances

That the land to be acquired or used over plot 269 at Bedlington near **Sleekburn House** in exercise of the powers in the Order will be limited to the extent shown on the attached plan numbered 60601435-ACM-06-ZZ-SKT-LEP-000001-P01.1 ("**Plan 2**").	
That, subject to any amendments or further revisions approved by the local planning authority, NCC will comply with the following conditions when implementing the planning permission for Bedlington station: ***Condition 4**: The development hereby permitted shall not be commenced until a Construction Environmental Management Plan has been submitted to and approved in writing by the Local Planning Authority. The approved Management Plan shall be adhered to throughout the demolition and construction period. The Management Plan shall provide for:* *a. An assessment of construction noise and vibration including detailing measures for the control and reduction of noise and vibration emissions associated with demolition, earthworks and construction.* *b. Details of the disposal of surface water from the development through the construction phase.* *c. Equipment cleaning and washing facilities.* *d. Excavation plant machinery to be fitted with fuel spill kits.* *e. The provision of welfare facilities that shall be maintained by a licenced Waste Carrier.* *f. Details of behavioural policies for all site staff to minimise noise, vibration and air quality impacts from vehicles, plant and equipment.* *g. The engines / generators of all construction vehicles, plant and equipment shall be turned off when not in use. Hybrid generators shall be used wherever practicable to reduce noise and fuel consumption.* *h. Details of the measures to be taken to protect existing trees that will not be removed as part of the development* ***Reason**: To prevent nuisance in the interests of residential amenity in accordance with the NPPF, to ensure that the risk of flooding does not increase during the construction phase, to limit the siltation of any site surface water features, to ensure the welfare of site operatives and to ensure trees are protected from construction works.*	

***Condition 13**: All works shall be undertaken in accordance with the submitted Arboricultural Impact Assessment (AECOM 2020) (AIA) and the Tree Protection Plan (Appendix D of the AIA). If there are any changes to the design of the development hereby approved, including any changes to the proposals in the vicinity of Sleekburn House, a final Tree Protection Plan and Arboricultural Method Statement, which shall also be informed by the requirements in BS 5837:2012 Trees in Relation to Design, Demolition and Construction, shall be submitted to and approved by the Local Planning Authority. No development or other operations, including any works within the root protection area (RPA) of the retained trees shall take place except in accordance with the approved AIA or any approved revised AIA.* ***Reason**: In order that retained trees are protected during construction, in the interests of visual amenity of the area and residents of Sleekburn House and to ensure that the proposed development does not have an adverse effect upon the appearance of the area in accordance with Policies GP6 and GP31 of the Wansbeck District Local Plan.*	
***Condition 14**: Prior to the commencement of development, a detailed landscaping scheme shall be submitted to and approved in writing by the Local Planning Authority. The landscaping scheme shall be implemented in accordance with the approved details within the first available planting season following the approval of details.* ***Reason**: To ensure that important features are protected and retained in the interests of amenity and to ensure a satisfactory standard of landscaping in accordance with Policies GP6 of the Wansbeck District Local Plan.*	
***Condition 15**: No trees, shrubs or hedges within the site which are shown as being retained in the approved landscaping scheme required by condition 14, shall be felled, uprooted, wilfully damaged or destroyed, cut back in any way or removed during the development phase other than in accordance with the approved plans or without the prior written consent of the Local Planning Authority. Any trees, shrubs or hedges removed without such consent, or which die or become severely damaged or seriously diseased within three years from the completion of the development hereby permitted shall be replaced, within the next planting season, with trees, shrubs or hedge plants of similar size and species unless the Local Planning Authority gives written consent to any variation.* ***Reason**: To ensure that important features are protected and retained in the interests of amenity and to ensure a satisfactory standard of landscaping in accordance with Policies GP6 of the Wansbeck District Local Plan.*	
***Condition 20**: No development shall take place, including any works of demolition, until a construction noise and vibration management plan has been submitted to and approved in writing by the Local Planning Authority. The plan shall detail the construction work and methodologies, measures for the control and reduction of noise emissions associated with construction works, liaison with local residents and arrangements for noise monitoring.* ***Reason**: To protect residential amenity and provide a commensurate level of protection against noise in accordance with Policy GP25 of the Wansbeck District Local Plan.*	

Condition 21*: The development shall not be brought into use until a scheme for the mitigation of rail noise at Sleekburn House has been submitted to and approved in writing by the Local Planning Authority. The approved noise mitigation scheme shall be implemented in accordance with the approved details before the development is brought into use.* ***Reason****: To protect the amenity of residents of Sleekburn House in accordance with Policy GP25 of the Wansbeck District Local Plan. We note that trickle vent surveys are being undertaken to confirm whether any additional noise mitigation is required]*	
The contractor appointed to construct Bedlington station will apply to the local authority for prior consent to undertake the works under section 61 of the Control of Pollution Act 1974 ("**CoPA**"). Under section 60 of CoPA the local authority can serve a notice specifying how construction works should be carried out, including working hours and noise/vibration limits. Breaching the terms of the notice is an offence.	
The design of Bedlington station will include the construction of acoustic fencing 3.5m (c.11 ft 5in) between Sleekburn House and the adjacent railway line, designed to mitigate the impacts of railway noise and to ensure that the privacy of residents is maintained. The proposed details of this fencing are included in the Noise Impact Assessment which is available on the NCC planning portal for the Bedlington station planning application (ref: 21/01106/CCD, see p.34 of the Assessment). This fencing will be installed as part of the scheme of mitigation required to discharge condition 16 referred to above. The current drawings for the platform and fencing for the station are shown on the attached plan numbered 60601435-ACM-06-PL-DRG-ECV-000004_P02 ("**Plan 3**").	
The following additional measures will be implemented by the contractor appointed to construct Bedlington station, the full details of which will be confirmed closer to the commencement of construction: a. A communications plan will be developed in consultation with Bernicia that provides Bernicia with details of the works including: i. A named person from the contractor's construction team and contact details; ii. A timetable for the full period of construction works; and iii. Information about the timings and anticipated duration of any particularly loud construction works.	
NCC will provide not less than 4 weeks' notice of the commencement of the construction works in the vicinity of Sleekburn House.	

Appendix S Ward Hadaway letter 2 November 2021

Leeds
Manchester
Newcastle

ward hadaway

Gordon Halliday MRTPI
Development Management
Planning Services
Northumberland County Council

Your Ref:
Our Ref: FMO.BER090.109
Doc No: 33354046v1
Date: 02 November 2021

By email: Gordon.Halliday@northumberland.gov.uk

Dear Gordon

Bedlington Station

As you are aware we act for the Bernicia Group.

We have had sight of the Officers' report to the Strategic Planning Committee this afternoon at 3pm.

The report singularly fails to grapple with construction noise, rail noise and PA noise among other impacts. Instead it in effect seeks to defer consideration of those impacts to a subsequent condition stage.

We note that section 7 of the report as regards noise impacts has been taken more or less verbatim from the Public Health Protection Unit (PHPU) memorandum of 27 September 2021 as updated on 18 October 2021. The Committee report states at paragraph 7.35 that the PHPU has "paid particular attention to the noise impacts on the first floor receptors at Sleekburn House" and thereafter assesses a "worst case scenario" for trains. What is missing from the Committee report however is the caveat in the memo that "the acoustician has used library data for similar rail traffic in similar situations to inform the prediction of noise levels at the first floor of Sleekburn House". We should be obliged if you could clarify what "library data" has been used. In any event further assessment is deferred by application of condition.

In addition we note that there is simply an "expectation" at this time as to what the PA tannoy impacts will be. No adequate detailed assessment has been put forward by the applicant or Council to inform the decision of Committee.

In turn impacts arising from construction are not detailed in the report and are also suggested to be put off to another day by application of condition.

The potential severity of each of these impacts and their cumulative impact warrant deferring any decision in respect of planning permission to a later date when those impacts have been assessed in detail and all appropriate information is put before members.

Following sight of the Committee report further noise measurements have been undertaken by Apex Acoustics on behalf of Bernicia. In the event therefore that Committee were minded to approve the application we would propose on a without prejudice basis that the below conditions A-C, informed by further measurements and assessment, be imposed on any planning permission to be granted.

Sandgate House, 102 Quayside
Newcastle Upon Tyne
NE1 3DX
UK
730360 Newcastle Upon Tyne 30

Condition A

No development shall take place, including any works of demolition, until a Noise Attenuation Management Plan, including a post-implementation monitoring plan, has been submitted to, and approved in writing by the local planning authority.

The Noise Attenuation Management Plan shall meet the following criteria:

(a) The level of noise emitted from announcements or alerts via a Public Address system (or other) on the site shall not (except in the case of emergency) exceed a level of 47 dB $L_{Aeq,10sec}$ between 0700 and 2300 all days, i.e. Monday to Sunday, and a level of 35 dB $L_{Aeq,10sec}$, at any other time, as measured at a distance of 1 m from any first floor window of Sleekburn House ("Open Window Scenario"); or, if it has been demonstrated to the satisfaction of the local planning authority that the Open Window Scenario cannot be achieved;

(b) The level of noise emitted from announcements or alerts via a Public Address system (or other) on the site shall not (except in the case of emergency) exceed a level of 23 dB $L_{Aeq,10sec}$ between 0700 and 2300 all days, i.e. Monday to Sunday, and a level of 16 dB $L_{Aeq,10sec}$, at any other time, as measured within any first floor room of Sleekburn House with windows closed and an alternative attenuated means of ventilation provided. The alternative ventilation must be capable of achieving a ventilation rate of not less than 4 air changes per hour whilst not exceeding a noise level of 30 dB $L_{Aeq,1hr}$, and not exceeding a noise level of 25 dB $L_{Aeq,1hr}$ when providing ventilation at the minimum whole dwelling rates as defined in AD-F. Ventilation and announcement noise levels should be measured in accordance with the most recent revision of the Association of Noise Consultants Measurement of Sound Levels in Buildings, or its successor ("the Closed Window Scenario").

Noise levels from passenger trains should not exceed a level of 45 dB L_{AFmax} at any time within any first floor room of Sleekburn House. Where this requires windows to be closed, an alternative means of ventilation must be provided which meets the specifications outlined in the Closed Window Scenario above.

The development shall not be brought into use until all measures required by the Noise Attenuation Management Plan have been installed and become fully operational.

The measures required by the approved Noise Attenuation Management Plan shall thereafter be maintained and monitored.

Condition B

Construction work, including demolition, shall not take place until a scheme for protecting Sleekburn House from noise from the construction work shall have been submitted to and approved in writing by the local planning authority.

The level of construction noise emitted from the site shall not exceed:

- 65 dB L_{Aeq} 07:00 hrs to 19:00 hrs Monday to Friday
- 65 dB L_{Aeq} 07:00 hrs to 13:00 hrs Saturdays
- 55 dB L_{Aeq} 19:00 hrs to 23:00 hrs Monday to Friday
- 55 dB L_{Aeq} 13:00 hrs to 23:00 hrs Saturdays
- 55 dB L_{Aeq} 07:00 hrs to 23:00 hrs Sundays

- 50 dB L_{Aeq} at all other times, i.e. including the night-time

as measured at a distance of 1 m from any window of Sleekburn House.

Where the predicted noise levels exceed the criteria stipulated in section E.4 of BS 5228, then noise insulation measures and temporary re-housing of the residents of Sleekburn House (or the reasonable costs thereof) shall be provided.

Noise monitoring must be undertaken during the construction period to show compliance with the criteria above.

Condition C

Notwithstanding the provisions of Article 3 of the Town and Country Planning (General Permitted Development) (England) Order 2015 (or any order revoking and re-enacting that Order with or without modification), no noise-generating development shall take place on the site under or in accordance with Part 8 of Schedule 2 to that Order.

Yours sincerely

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