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Ashington Railway Station

Noise Impact Assessment

Northumberland County Council

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Quality information

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1. Introduction

1.1 Purpose

AECOM has been commissioned by Northumberland County Council (NCC) to complete a noise and vibration impact assessment to accompany the application for planning permission for a new rail station in Ashington. The station will primarily consist of a new platform track and a new platform for railway passengers (the proposed development). The proposed development is a part of the proposed Northumberland railway line upgrades to re-introduce passenger services between Ashington and Northumberland Park (NL Upgrades).

1.2 NL Upgrades

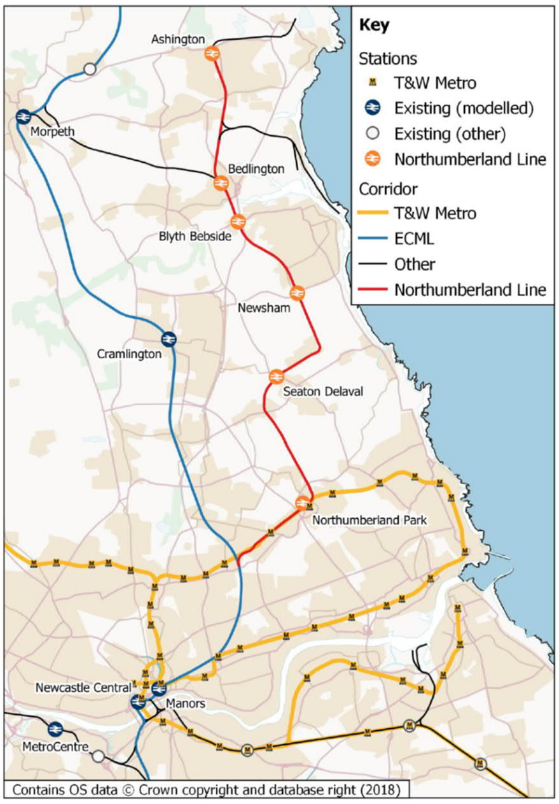
The NL Upgrades will enable the introduction of new passenger services along an existing rail corridor which is presently used only for freight trains. The passenger services will use approximately 6.4 km of the East Coast Main Line and 16 km of existing track, as shown in Figure 1.

At present, alongside the use of existing stations (such as Manors and Newcastle Central) where no works will be required, the construction of six new stations is proposed:

- Ashington;
- Bedlington;
- Blyth Bebside;
- Newsham;
- Seaton Delaval; and
- Northumberland Park (an existing 'Metro' station which will require a new rail platform and pedestrian access etc.)

The proposed NL Upgrades will introduce a total of 32 new train movements in each direction (64 in total) per day, with the line planned to open and start operations in 2024. The timings of the freight trains which currently use the line are not anticipated to significantly change.

Figure 1. The Northumberland Line route and stations



The proposed new passenger trains are assumed to be 3-carriage Class 158 DMUs. Disk-braked DMU passenger trains all emit very similar sound levels; therefore, this will be representative of the eventual train type. These are likely to be upgraded to Vivarail Class 230 D-Train BEMU battery powered trains but the date for the upgrade is yet to be defined. As part of the NL Upgrades, much of the railway track will be renewed, involving replacement of the existing rails and sleepers.

1.3 Proposed Development

The proposed development is anticipated to include a new platform on the western side of the railway line, which will be used for trains travelling to and from Ashington. The proposed development will also introduce a new platform track (approx. 220 m long) to the west of existing railway line to enable access of trains to the platform, new car parks, footways, shelters and signs. The new platform will incorporate a new public address (PA) system, no new building services plant is proposed. The new track to access the platform leaves the existing line close to the east end of Darnley Road, turning west then running alongside the existing tracks to the proposed station. To the south of the point where the new track begins, both existing tracks are proposed to be re-railed. No demolition of existing buildings is proposed. The proposed timings of the passenger train movements at the new station are provided in Table 1 below.

Table 1 Passenger Train Times

Time	Origin	Destination	Comment
05:56	Heaton	Ashington	Empty rolling stock, not on Sundays
06:06 to 19:06	Ashington	Newcastle	Train movements at this time each hour between these times
06:20	Heaton	Ashington	Empty rolling stock, not on Sundays
06:33 to 22:33	Ashington	Newcastle	Train movements at this time each hour between these times
07:00 to 23:00	Newcastle	Ashington	Train movements at this time each hour between these times
07:27 to 20:27	Newcastle	Ashington	Train movements at this time each hour between these times
20:12	Ashington	Heaton	Empty rolling stock, not on Sundays
23:06	Ashington	Heaton	Empty rolling stock, not on Sundays

Time	Origin	Destination	Comment

1.4 Scope of Assessment

The noise and vibration impact assessment scope of works is as follows:

- Review plans and mapping data to identify nearby noise (and vibration) sensitive receptors (NSRs).
- Undertake baseline sound and vibration measurements at locations representative of these NSRs.
- Qualitative assessment of potential construction noise and vibration impacts, in accordance with the guidance in BS 5228:2009+A1 2014 'Code of practice for noise and vibration control from construction and open sites – Part 1: Noise' (BS 5228-1)[1].
- Assessment of the impact of a change in the ambient sound levels at nearby NSRs due to operation of the station generated by the PA system, car parking and trains.
- Assessment of the impact of a change in the vibration levels at nearby NSRs due to the trains in accordance with the guidance in BS 6472-1:2008 'Guide to Evaluation of Human Exposure to Vibration in Buildings Part 1: Vibration Sources other than Blasting'[2]
- Assessment of the impact of Public Address (PA) system sound using British Standard BS 4142:2014 + A1:2019 'Methods for rating and assessing industrial and commercial sound'[3]
- Assess the impact of changes in road traffic noise due to construction and operation of the scheme in accordance with the Highways England document Design Manual for Roads and Bridges LA111[4].

A glossary of acoustic terminology can be found in Appendix A.

1.5 Noise Sensitive Receptors

All nearby NSRs are existing residential properties, they have been identified from ordnance survey mapping data. The identified NSRs are listed in Table 2 and shown in Figure 2 in Appendix B along with the proposed development redline boundary. No nearby non-residential NSRs have been identified.

Table 2 Receptors

Receptor Number	Represented Properties
R1	1 Darnley Road
R2	9 to 16 Oakland Terrace
R3	1 to 8 Oakland Terrace
R4	1 to 3 Ashbourne Crescent
R5	21 and 23 Featherwood Drive
R6	23 Hatchmeadow
R7	10 John Street
R8	6 and 7 John Street
R9	3 to 5 John Street

The above scope, as well as the assessment and baseline survey methodologies (described in Section 3 and Section 5 of this report) were agreed with the Environmental Protection Officer (EPO) at NCC by e-mail.

1 British Standards Institution (2014). BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise'
2 British Standards Institution, (2008). BS 6472-1:2008 'Guide to Evaluation of Human Exposure to Vibration in Buildings Part 1: Vibration sources other than blasting'
3 British Standards Institution (2019). BS 4142: 2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'
4 Highways England (2020). Design Manual for Roads and Bridges LA111 Noise and vibration Version 2

2. Legislative and Planning Policy Context

This section describes the policy and legislation that is relevant to assessment of noise for the NL scheme.

2.1 Legislation

The Environmental Protection Act 1990 and the Control of Pollution Act 1974 provide powers to local authorities for controlling noise and vibration from construction sites and similar works.

2.1.1 Environmental Protection Act 1990

The Environmental Protection Act 1990[5] prescribes 'noise (and vibration) emitted from premises (including land) so as to be prejudicial to health or a nuisance' as a statutory nuisance.

Local Authorities are required to investigate any public complaints of noise and if they are satisfied that a statutory nuisance exists, or is likely to occur or recur, they must serve a noise abatement notice. A notice is served on the person responsible for the nuisance. It requires either the abatement of the nuisance; or works to abate the nuisance to be carried out; or it prohibits or restricts the activity. Contravention of a notice without reasonable excuse is an offence. A right of appeal to the Magistrates Court exists within 21 days of the service of a noise abatement notice.

No statutory noise limits exist for determining a nuisance, therefore the Local Authority can take account of various guidance documents and existing case law when investigating complaints. Lower noise level limits are generally applied when considering the acceptability of a planning permission than those which would be used when considering whether an existing noise source amounts to a statutory nuisance. Demonstrating the use of best practicable means to minimise noise levels is an accepted defence against a noise abatement notice.

Section 122 of the Railways Act 1993[6] provides a defence to actions in nuisance' for licensed railway undertakers and operators in connection with the use of rolling stock on any track, or use any land comprised in a network, station or light maintenance depot for or in connection with the provision of network services, station services or light maintenance services.

When considering a planning application, Local Authority Environmental Health Officers are obliged to consider whether the development under consideration has the potential to cause a statutory nuisance and to use the planning process to avoid this outcome if possible.

2.1.2 Control of Pollution Act 1974

The Control of Pollution Act 1974 (CoPA)[7] requires that Best Practicable Means (BPM) (as defined in Section 72 of CoPA) are adopted to control construction noise on any given site as far as reasonably practicable. Sections 60 and 61 of the CoPA provide the main legislation regarding enabling works and construction site noise and vibration. If noise complaints are received, a Section 60 notice may be issued by NTC with instructions to cease work until specific conditions to reduce noise have been adopted.

Section 61 of the CoPA provides a means to apply for prior consent to carry out noise generating activities during construction. Once prior consent has been agreed under Section 61, a Section 60 notice cannot be served provided the agreed conditions are maintained on-site.

5 Environmental Protection Act 1990, c. 79. Available at https://www.legislation.gov.uk/ukpga/1990/43/contents (accessed 06/11/20)6 Railways Act (1993), ch. 122. Available at https://www.legislation.gov.uk/ukpga/1993/43/contents (accessed 06/11/20)7 Control of Pollution Act 1974, c. 60 and 61. Available at https://www.legislation.gov.uk/ukpga/1974/40/part/III/crossheading/construction-sites (accessed 07/11/20)

6 Railways Act (1993), ch. 122. Available at https://www.legislation.gov.uk/ukpga/1993/43/contents (accessed 06/11/20)7 Control of Pollution Act 1974, c. 60 and 61. Available at https://www.legislation.gov.uk/ukpga/1974/40/part/III/crossheading/construction-sites (accessed 07/11/20)

7 Control of Pollution Act 1974, c. 60 and 61. Available at https://www.legislation.gov.uk/ukpga/1974/40/part/III/crossheading/construction-sites (accessed 07/11/20)

Whilst construction noise and vibration are factors which can be considered during the planning process, Local Authorities have alternative powers under Sections 60 and 6 of CoPA to regulate these issues if complaints arise.

2.1.3 Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996

The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996[8] (NIR) specify that the responsible authority has a duty to carry out, or make a grant to cover the cost of, noise insulation works to residential buildings if specific criteria are met. It applies to new or altered railways but not to intensification (a change in the number or type of trains). There are separate criteria for day (06:00h-00:00h) and night (00:00h-06:00h) periods and meeting either one is sufficient for insulation works to be required.

In the assessment, a 'relevant noise level' is defined in the NIR as the highest total train sound level within 15 years of the new or altered railway becoming operational, with the total sound being the sum of the sound from trains on the existing railway and the sound from trains on the new/altered track.

The following criteria are included in the NIR and all three criteria must be met for an eligible building to qualify for insulation works:

1. The relevant noise level is 68 dB L_{Aeq} or more during the day or 63 dB L_{Aeq} or more during the night.
2. The relevant noise level is higher by at least 1 dB than the sound from the existing tracks).
3. The trains operating on the new/altered infrastructure contribute at least 1 dB to the relevant noise level.

The limit in the NIR is a level at the façade of the property and includes a correction of 2.5 dB for reflection of sound of the façade.

2.2 Planning Policy

2.2.1 National Planning Policy Framework

The revised National Planning Policy Framework (NPPF)[9] was published in February 2019. It sets out the Government's planning policies for England and describes how these are expected to be applied. This NPPF supersedes the previous versions published in March 2012 and July 2018.

The revised NPPF maintains the presumption in favour of sustainable development which should be delivered in accordance with three main objective areas: economic, social and environmental (Paragraph 8). The revised NPPF aims to enable local people and their local authorities to produce their own distinctive local and neighbourhood plans, which should be interpreted and applied in order to meet the needs and priorities of their communities.

Policies and objectives which are of particular relevance to noise and vibration include Paragraph 170:

"planning policies and decisions should contribute to and enhance the natural and local environment by…preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans…"

Paragraph 180 also states:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- *a. mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*

8 The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996, Statutory Instrument No. 428.
9 Department for Communities and Local Government (DCLG), (2019); National Planning Policy Framework.

b. *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason [….]"*

With regards to 'adverse effects' and 'significant adverse effects', the NPPF refers to the Noise Policy Statement for England (NPSE)[10] (see below).

2.2.2 Noise Policy Statement for England (2010)

The NPSE seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. The Statement applies to all forms of noise, including environmental noise, neighbour noise, and neighbourhood noise.

The NPSE sets out the long-term vision of the government's noise policy, which is to *"promote good health and a good quality of life through the effective management of noise within the context of policy on sustainable development".*

This long-term vision is supported by three aims:

- *"Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvements of health and quality of life."*

The 'Explanatory Note' within the NPSE provides further guidance on defining 'significant adverse effects' and 'adverse effects' using the following concepts:

- *No Observed Effect Level (NOEL) - the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established;*
- *Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and*
- *Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.*

The aims can therefore be interpreted as follows (within the context of Government policy on sustainable development):

- The first aim is to avoid noise levels above the SOAEL.
- To consider situations where noise levels are between the LOAEL and SOAEL. In such circumstances, all reasonable steps should be taken to mitigate and minimise the effects. However, this does not mean that such adverse effects cannot occur.

It is recognised that the LOAEL and SOAEL do not have single objective noise-based levels that are applicable to all sources of noise in all situations. The defined levels are likely to be different for different sources, receptors and at different times of the day.

This report assesses the potential noise impacts of the proposed development and mitigation is identified as required to avoid significant adverse effects as per the first aim of the NPSE.

2.2.3 Planning Practice Guidance (2018)

The Planning Practice Guidance (PPG)[11] was published on the 6th March 2014 to provide more in-depth guidance to the NPPF. The PPG aims to make planning guidance more accessible, and to ensure that the guidance is kept up to date.

The PPG states that local planning authorities should take account of the acoustic environment and in doing so consider:

- *"whether or not a significant adverse effect is occurring or likely to occur;*

10 Department for Environment Food and Rural Affairs (Defra), (2010); Noise Policy Statement for England.
11 Department for Communities and Local Government (DCLG), (2017); Planning Practice Guidance.

- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved."*

Further details on the noise exposure hierarchy are provided in Table 3, which has been reproduced from PPG[12].

Factors to be considered in determining whether noise is a concern are identified by PPG. This includes the absolute noise level of the source, the existing ambient noise climate, time of day, frequency of occurrence, duration, character of the noise, and cumulative effects.

Regarding mitigating noise effects on residential development, the PPG highlights that effects may be partially off-set if residents have access to a relatively quiet façade as part of their dwelling or a relatively quiet amenity space (private, shared or public).

Table 3 Planning Practice Guidance Definitions Relating to Noise Effect Levels

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid through use of appropriate mitigation whilst taking into account the social and economic benefit
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent through use of appropriate mitigation

2.2.4 Local Policy

Within the Northumberland Local Plan[13], there is a policy relating specifically to noise, within Policy POL2 "Pollution and air, soil and water quality". This stipulates:

> *"Development proposals in locations where they would cause, or be put at unacceptable risk of harm from, or be adversely affected by pollution by virtue of the emissions of fumes, particles, effluent, radiation, smell, heat, light, noise or noxious substances will not be supported."*

Noise also sits within the following strategies and policies:

- Policy STP 5 "Health and wellbeing (Strategic Policy)", in relation to preventing negative impacts upon noise pollution;
- Policy QOP 2 "Good design and amenity", in relation to minimising adverse impacts on amenity;
- Policy TRA 2 "The effects of development on the transport network", in relation to minimising any adverse impact on communities and the environment; and

12 Paragraph: 005 Reference ID: 30-005-20140306
13 Northumberland County Council (2019) *Northumberland Local Plan*. Available at: https://northumberland-consult.objective.co.uk/portal/planning/localplan/reg19

- Policy ENV 4 “Tranquillity, dark skies and a sense of rurality”, in relation to minimising noise generated during construction and thereafter to conserve tranquillity.

Within the Northumberland Local Plan, the Northumberland railway is considered to be a key driver for growth in South East Northumberland and therefore a key aspiration of NCC:

> *“A key priority of the Council is to secure the future reintroduction of passenger rail services on the existing line between Benton Junction and Woodhorn ('The Northumberland Line'), provided that any significant adverse impact on the environment and communities can be mitigated.”*

3. Assessment Methodology

3.1 Construction

As details of the proposed construction schedule and plant to be used are not available at this stage, a quantitative construction noise and vibration assessment has not been carried out. Instead a qualitative assessment focussing on best practicable means has been completed. This considers the potential for significant effects to occur based on distance and timings of the proposed works but does not quantitatively assess the impact of the proposed works.

3.1.1 Construction Noise

The construction noise assessment has been based on British Standard BS 5228-1:2009+A1 2014 ‘Code of practice for noise and vibration control from construction and open sites – Part 1: Noise’ (BS 5228-1)[14].

BS 5228-1 provides practical information on construction noise and vibration reduction measures and promotes a ‘Best Practicable Means’ approach to control noise and vibration. The calculation method provided in BS 5228-1 is based on the number and types of equipment operating, their associated sound power level (L_w), and the distance to receptors, together with the effects of any screening.

BS 5228-1 contains a methodology for the assessment of the significance of effect of construction noise in relation to the ambient noise levels, known as the "ABC method". The criteria for significance provided in BS 5228-1 are reproduced in Table 4.

Table 4 Construction Noise Threshold of Potentially Significant Effect at Dwellings

Assessment Category	Threshold Value (dB) $L_{Aeq,T}$		
	Category A [a)]	Category B [b)]	Category C [c)]
Night-time (23:00 – 07:00)	45	50	55
Evenings and Weekends [d)]	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

NOTE 1: A potentially significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.

NOTE 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values) then a potentially significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.

NOTE 3: Applies to residential receptors only.

Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values.

Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values.

19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays, 07:00 – 23:00 Sundays.

14 British Standards Institution (2014). BS 5228-1:2009+A1:2014 ‘Code of practice for noise and vibration control on construction and open sites – Part 1: Noise’

For the appropriate period (night, evening/weekend, day), the ambient noise level is determined and rounded to the nearest 5 dB. The appropriate Threshold Value is then determined. The construction noise level is then compared with this Threshold Value. If the noise level from the works exceeds the Threshold Value, then there is the potential for a significant effect to occur. However, in line with best practice, this indicator of a potential significant effect is then further considered using professional judgement and accounting for a range of other factors, including:

- the duration of the impact. Based on the guidance in BS 5228-1, construction noise levels above the Threshold Value for less than 10-days (or 10-evenings/weekends or nights) in any 15 consecutive days, or 40-days or less (or 40 evenings/weekends or nights) in any 6-month consecutive period would not normally be considered significant;
- the timing of the impact, night-time impacts being more likely to be considered significant than daytime impacts;
- the location of the impact at the receptor, for example, a receptor may contain areas which are more or less sensitive than others, e.g. in a school, its office spaces or kitchens would be considered less sensitive than the classrooms; and
- the nature, times of use and design of the receptor, e.g. a receptor which is not used at night would not be considered sensitive to night-time construction works.

3.1.2 Construction Vibration

The construction vibration assessment has been based on British Standard BS 5228-2:2009+A1 2014 ‘Code of practice for noise and vibration control from construction and open sites – Part 2: Vibration’ (BS 5228-2)[15].

Vibration due to construction activities has the potential to result in adverse impacts at nearby sensitive receptors. BS 5228-2 indicates that vibration impacts depend on the activity, ground conditions and receptor distance.

Table 5 details Peak Particle Velocity (PPV) vibration levels and provides a semantic scale for the description of construction vibration effects on human receptors based on guidance contained in BS 5228-2.

Table 5 Magnitude of Vibration (PPV) Effects

Peak Particle Velocity Level	Description	Magnitude of Impact
0.14 to < 0.3 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Very Low
0.3 to < 1 mm/s	Vibration might be just perceptible in residential environments.	Low
1.0 to < 10 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.	Medium
>= 10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	High

The vibration criteria presented in Table 5 relates to the sensitivity of building occupants to vibration. Whether an effect is significant requires additional consideration using professional judgement, taking account of the duration and frequency of the effect, as well as the time of day that the effect would be experienced.

In addition to human annoyance, building structures may be damaged by high levels of vibration. The levels of vibration that may cause building damage are far in excess of those that may cause annoyance. Consequently, if vibration levels are controlled to those specified by annoyance then it is highly unlikely that buildings will be damaged by construction vibration.

15 British Standards Institution (2014). BS 5228-2:2009+A1:2014 ‘Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration’

3.2 Operational Sound

3.2.1 Change in ambient sound level

The assessment methodology combines the predicted sound from all sources likely to be emitted during operation of the railway station (i.e. trains, car parking and PA system) for comparison with the current ambient sound levels established from a baseline survey which is described in Section 5.

To predict the sound from the trains and car parking, a model of the railway line and surroundings has been developed in CadnaA version 2020 MR2 sound mapping software. This includes the sound from the moving freight and passenger trains, the passenger trains when stopped at the station and car park. Moving train sound is predicted in accordance with Calculation of Railway Noise[16] (CRN) which includes a minimum train speed of 20 km/h, when the trains are stopped the predictions are in accordance with ISO 9613-2[17]. The proposed freight train compositions are assumed to remain as per the current scenario, passenger trains are taken to be Class 158 DMUs. The proposed battery powered EMU trains are anticipated to emit lower sound levels than the DMUs, therefore the assessment considers the worst-case scenario.

CRN allows prediction of the free-field (i.e. disregarding reflection from the property façade) train sound level in terms of the $L_{Aeq,18h}$. Predictions have been undertaken at ground and first-floor level for each NSR. The limits in the NIR are façade levels, therefore, to allow comparison with the predictions, the limits have been adjusted to a free-field level by subtracting 2.5 dB i.e. 65 dB L_{Aeq} during the day and 60 dB L_{Aeq} at night. As the applicable guidance detailed below is in terms of the $L_{Aeq,16h}$, the $L_{Aeq,18h}$ and $L_{Aeq,16h}$ are assumed to be equivalent. The difference between these parameters is typically no more than 1 dB.

Car parks generate sound by vehicles access the parking area, approaching a parking bay, door slamming and vehicles leaving. The combined car park sound level has been established using the Bavarian State Office for the Environment publication 'Parking lot noise study - Recommendations for the calculation of noise emissions from parking lots, truck stops and bus stations as well as multi-storey car parks and underground garages' (2007)[18]. This describes measured sound levels from a total of 105 car parks and provides a method for calculating the emitted $L_{Aeq,1h}$ based on number of spaces and car park type, which factors in how frequently parking spaces will empty and be taken. Further details on the predictions are provided in Appendix C.

Predictions of PA system sound have been undertaken by Acoustics Plus Ltd on behalf of Kilborn Consulting, as described in the 'System Design and Noise Impact Study' document dated June 2020[19] (PA Noise Report). This report describes the Network Rail performance requirements, which include that "*the system shall provide a minimum SPL of 10dBA above normal ambient noise levels at all times within the range of 65dBA up to the maximum SPL level unless environmental noise pollution issues prevent this figure being achieved.*" Predictions were undertaken of the likely sound levels at four nearby receptors (equating to R7, R8 and R9), whilst achieving a minimum SPL on the platform of 65 dB(A). The predictions were undertaken at ground floor level, the first-floor level has been assumed to be the same as the ground floor level. The modelling was based on the GRIP Stage 3 design of the proposed development and the predicted sound levels at receptors may change as the design progresses. The relevant sections of this report to this assessment have been extracted and are provided in Appendix D.

The IEMA 'Guidelines for Environmental Noise Impact Assessment'[20] have been used to assess the impact of a change in ambient sound level due to the project. These provide guidance on how to undertake a noise impact assessment, with particular focus on the context of an EIA. They aim to apply to all types of new development. On the impact of noise level changes, they state that "*For broad band sounds which are very similar in all but magnitude, a change or difference in noise level of 1 dB is just perceptible under laboratory conditions, 3 dB is perceptible under most normal conditions, and a 10 dB increase generally appears to be twice as loud. These broad principles may not apply where the change in noise level is due to the introduction of a noise with different frequency and/or temporal characteristics compared to sounds making up the existing noise climate. In which case, changes of less than 1 dB may be perceptible under some circumstances.*"

16 Calculation of Railway Noise 1988, Department of Transport, HMSO.
17 International Standards Organisation (1996). ISO 9613-2 1996 'Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation'
18 Bayer. Landesamt für Umwelt (editor): Parkplatzalärmstudie 6. Aufl. Augsburg (2007)
19 Kilborn Consulting (2020). 'System Design and Noise Impact Study' Report ref. 60601435-ACM-01-PL-REP-ETL-000001, Issue: A01. 18th June 2020
20 Institute of Environmental Management & Assessment (2014). Guidelines for Environmental Noise Impact Assessment.

The IEMA Guidelines provide criteria for magnitude of impacts due to noise level changes from a project, as shown in Table 6.

Table 6 Categorising the magnitude of the Basic Noise Change

Noise Change, dB	Impact
0	Very low
0.1 to 2.9	Low
3 to 4.9	Medium
5 to 9.9	High

Also relevant to the impact of the ambient sound is the absolute development sound level. The 1999 World Health Organisations (WHO) guidelines[21] provide external daytime guideline levels *"on balconies, terraces and outdoor living areas"* in terms of a continuous $L_{Aeq,16h}$ noise level of 55 dB to protect the majority of people from being seriously annoyed and 50 dB $L_{Aeq,16h}$ to prevent the majority of people being moderately annoyed.

The WHO guidelines also provide criteria to prevent sleep disturbance due to individual noisy events, stating "*For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10–15 times per night*."

Guidance for the assessment of internal ambient noise levels within residential properties is provided within BS 8233[22], as outlined in Table 7. The BS 8233 guidance is closely aligned to the WHO community noise guidelines detailed above.

Table 7 BS 8233 Indoor ambient noise levels for dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$

Note 7 to the above Table states "*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.*"

3.2.2 PA system noise

As far as AECOM is aware there is no specific relevant legislation or guidance relating to the assessment of noise from Public Address (PA) systems at surface stations. London Underground guidance document G-148 *Manual of Good Practice - Public Address Systems - Noise Management* cites the use of British Standard BS 4142 as a method of assessment.

BS 4142 explicitly states that it is not intended for PA systems and a PA system needs to be heard above background noise to be effective; hence, whether it is suitable for this assessment purpose is arguable. Nevertheless, it continues to be applied to PA systems at London Underground and other stations.

In the absence of any other specific guidance an outline assessment has been undertaken to provide an indication of the level of impact from PA noise on the NSRs which is based on the methodology set out in BS 4142. The basis of BS 4142 is a comparison between the *background sound level* in the vicinity of residential locations and the *rating level* of the sound source under consideration. The relevant parameters in this instance are as follows:

- *Background sound level* – $L_{A90,T}$ – defined in the Standard as the 'A' weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels;

21 World Health Organisation (1999). Guidelines for Community Noise, 1999.
22 British Standards Institute (2014). BS 8233: 2014 'Guidance on sound insulation and noise reduction for buildings'.

- *Specific sound level* – $L_{Aeq,Tr}$ – the equivalent continuous ‘A’ weighted sound pressure level produced by the specific sound source at the assessment location over a given time interval, T;
- *Residual sound level* – $L_{Aeq,T}$ - the equivalent continuous ‘A’ weighted sound pressure level at the assessment location in the absence of the specific sound source under consideration, over a given time interval, T; and
- *Rating level* – $L_{Ar,Tr}$ – the *specific sound level* plus any adjustment made for the characteristic features of the sound such as tonality, impulsivity and intermittency.

When comparing the *background* and the *rating* sound levels, the standard states that:

a. *“Typically, the greater the difference, the greater the magnitude of impact.*

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

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

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

Importantly, as indicated above, BS 4142:2014 requires that the *rating level* of the sound source under assessment be considered in the context of the environment when defining the overall significance of the impact. The standard suggests that in assessing the context, all pertinent factors should be taken into consideration, including the following:

- *“The absolute level of sound;*
- *The character and level of the residual sound compared to the character and level of the specific sound; and*
- *The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.”*

Full details of the specific PA broadcast messages, their duration, number and timings are not currently available. An assessment of likely PA system noise impacts has been undertaken based on the results of the predictions in the PA Noise Report and the measured baseline sound levels described in Section 5.

3.3 Train vibration

Guidance on the assessment of vibration impacts generated by trains on nearby residential properties is available in BS 6472-1 ‘Guide to Evaluation of Human Exposure to Vibration in Buildings Part 1: Vibration Sources other than Blasting’[23]. The Standard assesses human exposure to vibration in terms of the Vibration Dose Value (VDV).

The VDV increases by the same factor if either the acceleration is doubled while the duration of exposure remains constant; or if the acceleration is kept constant and the duration of exposure increases 16-fold.

BS 6472-1 requires that the VDV be determined separately for the 16-hour daytime (07:00-23:00) and 8-hour night-time (23:00-07:00) periods.

To determine the impact of the proposed development, the future vibration levels have been predicted. It was intended to use the results of the baseline survey to determine the current VDV for a freight train passby and the current overall VDV levels during the day and night. However, due to a malfunction with the vibration monitoring equipment during the survey, it was not possible to use measured levels.

The acceleration generated by a train passby typically double for each doubling of speed. However, change in speed will also reduce the duration of the passby, as mentioned above VDV is related to duration (t) by a factor of $t^{0.25}$. Freight train passbys typically generate much higher VDV levels than passenger trains, particularly further from the track. This is partially due to the length of freight trains which increases the duration. Freight trains also have one layer of suspension (as opposed to the two layers in passenger trains), this means they generate much

23 British Standards Institution, (2008). BS 6472 Guide to Evaluation of Human Exposure to Vibration in Buildings.

greater levels of vibration at frequencies below 10 Hz. The rate of vibration decay with distance reduces significantly with increasing frequency, therefore the overall vibration levels from freight trains are greater at properties further from the track.[24] It is not possible to robustly derive the acceleration of a passenger train from a measured freight train passby; therefore, the freight and passenger trains are assumed to generate the same levels of acceleration prior to a correction for speed. This is highly likely to be a significant overestimate.

The guidance on human annoyance from vibration in BS 6472-1 is presented in Table 8.

Table 8 Vibration Dose Value ranges and probabilities of adverse comment within residential buildings

Vibration level (VDV $ms^{-1.75}$)		Probability of adverse comment
Day (07:00 – 23:00)	Night (23:00 – 07:00)	
0.2 - 0.4	0.1 - 0.2	Low
0.4 - 0.8	0.2 - 0.4	Possible
> 0.8	> 0.4	Probable

As the properties are already exposed to vibration from freight trains on the railway line, it is arguably more important to consider the potential impact of the change in the vibration levels than whether the above levels are exceeded. This point is not addressed by BS 6472 but was addressed in the HS2 EIA. Where appreciable levels of vibration were present in the baseline, it applied the criteria set out in Table 9, therefore these are used within this assessment. As vibration levels were not measured during the survey, this prediction exercise has been undertaken to determine the ratio of the likely future to current VDV levels for comparison with the criteria in Table 9. The simplified calculation process discussed above to determine this ratio is dependent on speed and duration and is independent of the actual vibration level.

Table 9 Impact of change in Vibration Dose Value where appreciable vibration is present

Change Classification	Impact criteria (% increase or decrease in VDV)
Negligible	≤ 25
Minor	25 to 40
Moderate	> 40 to 100
Major	> 100

3.4 Road traffic noise

Operational traffic noise impacts due to increases in traffic flows on existing roads have been estimated based on the Calculation of Road Traffic Noise[25] (CRTN) methodology for the calculation of the Basic Noise Level (BNL) at a reference distance of 10m from the nearside carriageway. Predictions have been undertaken for each link included in both the “with” and “without” traffic scenarios for the year 2039. This assessment methodology is adapted from the DMRB requirements for noise assessment of affected routes more than 600 m from a road scheme.

Construction traffic flows have not been provided; therefore, it has not been possible to undertake an assessment of potential noise impacts due to increases in traffic flows during construction. Construction traffic noise impacts will be mitigated via the measures to be outlined in the Construction Traffic Management Plan.

The criteria for the assessment of changes in road traffic noise levels have been taken from Table 3.1 of DMRB and are provided in Table 10.

24 ‘Notes on technical issues for the vibration assessment for the Chiltern Line Upgrade through Wolvercote’. Available at https://mycouncil.oxford.gov.uk/documents/s24011/EWR%20condition%2019%20vibration%20-%20Appendix%2029.pdf. Accessed on 12/11/2020.
25 Department of Transport/Welsh Office, (1998); Calculation of Road Traffic Noise.

Table 10 Classification of Magnitude of Traffic Noise Impacts

Noise Change Band	Magnitude of Impact
0 dB(A)	No change
0.1 – 0.9 dB(A)	Negligible
1 – 2.9 dB(A)	Minor adverse
3 – 4.9 dB(A)	Moderate adverse
5 dB(A) or more	Major adverse

4. Embedded Mitigation

Potential environmental effects have been or will be avoided, prevented, reduced or off-set through the integration of measures into the design and / or management of the proposed development. These are outlined below for the construction and operational phases and will be taken into account as part of the assessment of the likely significant effects.

4.1 Construction

Mitigation measures that are typically applicable to construction sites will be included within the Construction Environmental Management Plan (CEMP) that will be prepared for the proposed development after receipt of planning permission. Preparation and compliance with a final CEMP, which will be based on the outline CEMP submitted with this planning application, is proposed to be secured by planning condition.

The outline CEMP submitted with this planning application requires that the final CEMP will include a detailed construction noise and vibration assessment, including predictions of construction noise and vibration levels at nearby NSRs for comparison with suitable noise level limits. This assessment will be used to identify the mitigation measures which should be incorporated. Predictions will also be undertaken of potential construction traffic noise impacts once sufficiently detailed information is available. The CEMP will also detail the proposed construction noise and vibration surveys and a range of BPM giving regard to the guidance in BS 5228 as described below.

The CEMP will include requirements to set up appropriate mechanisms to communicate with local residents. These will be used to highlight potential periods of disruption during the construction phase, with appropriate complaint procedures put in place.

The construction contractor(s) will undertake and report noise and vibration surveys as is necessary to demonstrate compliance with all noise and vibration commitments and the requirements of the final CEMP.

The application of best practice measures through the implementation of the CEMP will minimise construction noise and vibration impacts. Best practicable means includes the following:

- modern plant should be selected which complies with the latest EC noise emission requirements.
- proper use of plant with respect to minimising noise emissions and regular maintenance. All vehicles and mechanical plant used for the purpose of the works should be fitted with effective exhaust silencers and should be maintained in good efficient working order;
- selection of inherently quiet plant where appropriate. Electrical plant items (as opposed to diesel powered plant items) should be used wherever practicable. All major compressors should be 'sound reduced' models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use. All ancillary pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers;
- machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum;
- the loading and unloading of materials should take place away from residential properties, ideally in locations which are acoustically screened from nearby noise sensitive receptors;
- materials should be handled with care and be placed, not dropped. Materials should be delivered during normal working hours;
- all ancillary plant such as generators, compressors and pumps should be positioned to cause minimum noise disturbance, i.e. furthest from receptors or behind close boarded noise barriers. If necessary, acoustic enclosures should be provided and/or acoustic shielding;
- good community relations should be established and maintained throughout the construction process. This should include informing residents on progress and ensuring measures are put in place to minimise noise and vibration impacts.
- construction contractors should be obliged to adhere to the codes of practice for construction working and piling given in BS 5228 and the guidance given therein minimising noise emissions from the site; and

- site operations and vehicle routes should be organised to minimise the need for reversing movements, and to take advantage of any natural acoustic screening present in the surrounding topography;
- no employees, subcontractors and persons employed on the site should cause unnecessary noise from their activities e.g. excessive 'revving' of vehicle engines, music from radios, shouting and general behaviour etc. All staff inductions at the site should include information on minimising noise and reminding them to be considerate of the nearby residents;
- as far as practicable, noisier activities should be planned to take place during periods of the day which are generally considered to be less noise sensitive i.e. not particularly early or late in the day;
- measures should be put in place to ensure that employees know that minimisation of noise will be important at the site; and
- reference should be made to the Building Research Establishment, BRE 'Pollution Control' guidelines, Parts 1-5 (BRE, 2003).

4.2 PA System Noise

The PA system will be operated in accordance with accepted best practice and this is proposed to be secured by planning condition. Further details on the proposed condition are provided in Section 7.3. Best practice measures have been adapted from the guidance in the London Underground 'Manual of Good Practice, Public Address Systems - Noise Management' Number G-148, dated October 2007[26], as shown below. This site is considered a "noise affected site" in the context of the below guidance.

- General Guidance
  - PA systems should be designed, installed and operated to be compatible with relevant legislation including the Disability Discrimination Act 1995 (DDA) and Environment Protection Act 1990.
  - All PA systems (for trains and other Network Rail premises) in operation adjacent to residential properties should be configured to minimise noise pollution to neighbours whilst taking into account the operator's obligation to provide necessary information to its customers whilst on the network.
  - Any alteration carried out on a PA system to reduce noise pollution:

    a) Should not affect the Sound Pressure Level (SPL) of pre-evacuation or emergency evacuation messages; and

    b) Should be assessed for overall impact on the PA system performance with any consequential risk appropriately mitigated.
  - Noise controls should be integrated to take into account the number of train and station PA announcements, PA operating times and sound pressure levels.
  - Noise controls implemented at a given site should be documented and traceable. Deviations from agreed noise controls should be subject to safety change or similar change reviewing process.
  - A unified process should be used to co-ordinate, record and resolve PA noise complaints from neighbours and customers.
  - Conflicts between environmental noise guidance and Network Rail systems and safety standards should be managed and collectively resolved between Network Rail and other contractors.
- Message Strategy
  - Message sequences and frequencies on trains and stations should comply with the necessary systems and safety standards and guidance.
  - Where compliance with systems and safety requirements could result in complaints or noise abatements the station Group Station Manager (GSM) or Train Operations Manager (TOM) should raise this concern with the relevant systems and safety manager and environment manager for resolution.

26 'Manual of Good Practice, Public Address Systems - Noise Management' Number G-148. London Underground. October 2007.

- At noise affected sites consideration should be given to reducing the total number of PA broadcasts made to adjacent residential properties.
- At noise affected sites where customers can be informed locally regarding service information, consideration should be given to inhibiting the Long Line PA.
- At noise affected sites PA Pre-announcement chimes should be inhibited for non-emergency broadcasts.
- At noise affected sites all non-emergency PA messages should be inhibited as a minimum for weekdays between 2300 and 0700 and where possible reduced between 1900 and 2300 or other times as required by local conditions. Similar restrictions should be considered as required for weekends and public Bank holidays.

- Operational
  - Station staff and train operators where practicable should be encouraged to use the DVA (Digital Voice Announcer) to make routine or repetitive announcements to customers to ensure that broadcasts are made with consistent clarity and loudness to avoid PA amplifiers being overdriven, potentially leading to noise complaints.
  - GSMs and TOMs should consider upgrading Legacy train and station PA systems to include automated DVA's for announcement of routine messages with consistent loudness and clarity.
  - The GSM should ensure station staff required to operate the PA equipment in the course of their duties have been adequately trained and are proficient in the correct operation of their station PA equipment.
  - PA announcements to zones fitted with Ambient Noise Sensors (ANS) should (where possible) be made when the ambient noise level has settled from the peak level i.e. not whilst the train is approaching or leaving the platforms. This is to prevent the ANS lifting the broadcast levels 10dB higher than the sampled background noise.
  - At noise affected sites train PA announcements should be avoided when train doors are open. ANS controlled train PA should be avoided during high ambient noise levels.
  - Where practicable train operators should ensure PA message duplication between train and station broadcasts are avoided. TOMs should ensure that train operators are made aware of PA operational restrictions at specific stations and that these are observed.
  - For noise affected sites except for emergencies, station and line control room staff should ensure all PA announcements (recorded or live) conform to the noise reduction measures documented and agreed between Network Rail and the Local council and or residents.
  - Fire alarm tests should be scheduled during off-peak times on appropriate days to minimise disturbance to adjacent residential properties.

Ambient Noise Sensing (ANS) microphones and controllers will be installed as part of the PA system that will allow the output level to adapt to the ambient sound level.

5. Baseline Monitoring

5.1 Overview

Continuous unmanned sound and vibration measurements were undertaken between 14:04 on Friday 25th and 01:19 on Sunday 27th September, followed by a further period of sound measurements between 14:02 on Thursday 1st and 12:02 on Friday 2nd October 2020. These measurements were at one location in the garden of 1 Ashbourne Crescent (R4). Current freight train sound levels at R1 to R3, R5 and R6 are likely to be higher than measured, as these receptors are closer to the railway tracks. At R1 to R6, the measurement location is considered representative of all other sound sources potentially contributing to the baseline. The remaining receptors (R7 to R9) are closer to Station Road than R4 (and other receptors to the south), therefore baseline sound levels are likely to be higher due to the sound of vehicles on these roads.

Manned sound measurements were undertaken at a location on John Street (near R9 and considered representative of R7 to R9) between 22:51 and 23:21 on 1st October and 06:38 and 07:08 on 2nd October. The timing of the manned measurements was selected to represent the quietest time periods when the trains may operate. Both monitoring locations are illustrated in Figure 3 in Appendix B. The proposed monitoring procedures were agreed by e-mail with the NCC EHO.

Measurements were undertaken during the ongoing coronavirus outbreak, which may have resulted in baseline sound levels being lower than typical because typical road, air and rail transport usage have been reduced by travel restrictions and social distancing measures. Other sound sources may also have been affected – for example, due to changes in operating patterns at industrial and commercial premises. The assessment determines the impact of the proposed development based on the anticipated change in ambient sound level, therefore measuring a low baseline sound level ensures that a worst-case scenario is assessed.

The sound monitoring was undertaken with due regard to the guidance in BS 7445-2: 1991 'Description and Measurement of Environmental Noise'.

5.2 Instrumentation

The instrumentation used to conduct the surveys is detailed in Table 11.

Table 11 Monitoring Equipment Details

Measurement type	Equipment type	Survey Dates (dd/mm/yy)	Model number	Serial number
Unmanned	Sound and Vibration Meter	25/09/20 to 27/09/20	SVAN 958	23421
		01/10/20 to 02/10/20	SVAN 958	14692
Manned	Sound Level Meter	All	Norsonic 140	1403077
Both	Calibrator	All	Brüel & Kjær 4231	2217877

All the above instrumentation has in-date laboratory calibration certificates which can be provided on request. Each sound level meter was calibrated immediately before and after each survey period and no changes greater than +/- 0.2 dB were noted.

Various sound level indicators were logged every 15-minutes, including the equivalent noise level ($L_{Aeq,T}$) and statistical indices such as background sound levels ($L_{A90,T}$) as well as 1/3 octave band data. Sound pressure levels were also logged every second. The sound measurements were taken at a height which was between 1.2 and 1.5 metres above ground level and located at least 3.5 metres from any vertical reflecting surfaces.

The accelerometer was placed directly onto the ground and weighted down with a sandbag, and the ground was judged to be level. It was orientated so that the horizontal axes were parallel (x) and perpendicular (y) to the railway line. The vibration level meter was set to measure VDV levels in one-second time intervals, frequency weighted according to the requirements of BS 6472 (i.e. w_d in x and y axes and w_b in z axis).

5.3 Meteorological Conditions

During the manned measurements, meteorological conditions were monitored and observed to be within the requirements of BS 7445 and BS 4142. For the unmanned measurements, meteorological conditions were obtained from publicly available data (www.skylink.com). The nearest weather station to the proposed development is located at Newcastle International Airport, approximately 18 km to the south-west. Periods when rainfall occurred have been excluded from the sound level measurements, along with periods when the wind speed was in excess of 5 m/s as required by BS 4142.

5.4 Results

5.4.1 Sound

The results of the unattended baseline sound monitoring are summarised below in Table 12. The $L_{Aeq,T}$ values for each of the periods are the logarithmic average of the 15-minute data. The L_{A90} is the lowest 10th-percentile of the 15-minute measured levels over the relevant time period.

Table 12 Unmanned baseline monitoring results

Date	Time Period (hh:mm)	$L_{Aeq,T}$ (dB)	L_{A90} (dB)
Friday 25th September	14:04 to 23:00	51	43
	23:00 to 07:00	45	40
Saturday 26th September	07:00 to 23:00	54	44
	23:00 to 07:00	47	39
Sunday 27th September	07:00 to 23:00 *	N/a	N/a
	23:00 to 07:00	45	39
Thursday 1st October	14:02 to 23:00	48	33
	23:00 to 00:00	35	31
Friday 2nd October	07:00 to 12:02	52	41
	00:00 to 07:00	43	29
Total	07:00 to 23:00	52	40
	23:00 to 07:00	45	36

* No data collected between 01:21hrs on 27th September and 13:47 on 1st October due to monitoring equipment malfunction.

A time history plot of the measured sound levels, showing those time periods excluded due to poor weather conditions, is provided in Figure 5 in Appendix B.

The dominant sound source observed at the beginning of the monitoring period was wind blowing in the trees. Other sounds sources observed were bell chimes, distant traffic and construction work on Oakland Terrace.
The dominant sound source observed at the end of the monitoring period was distant traffic. Other sound sources observed were construction work at the front of the property, a bottle bank, distant sirens and water from a drain on the property.

The results of the manned sound survey are provided in Table 13. Notes were made on sound sources contributing to the measurements during the survey, these are also provided in the Table.

Table 13 Manned baseline sound monitoring results

Date	Start Time (hh:mm)	End Time (hh:mm)	$L_{Aeq,15min}$ (dB)	$L_{A90,15min}$ (dB)	Observed Sound Sources
Thursday 1st October	22:51	23:06	46	35	The dominant sound source observed was mechanical plant noise from a nearby shop. Also noted were distant traffic, bell chimes every 15 minutes, a passing aeroplane and vehicles passing the monitoring location.
	23:06	23:21	45	35	
Friday 2nd October	06:38	06:53	50	43	The dominant sound source observed was birdsong. Also noted were mechanical plant noise from a nearby shop, car passbys, distant traffic, vehicle activity in the car park beyond the railway line.
	06:53	07:08	53	43	

The measured sound levels from the unmanned monitoring, over the time periods when the manned monitoring was undertaken, have been identified. During the evening period, the average sound levels were 38 dB $L_{Aeq,15min}$ (logarithmic) and 32 dB $L_{A90,15min}$ (arithmetic). During the morning period, they were 47 dB $L_{Aeq,15min}$ and 41 dB $L_{A90,15min}$. Comparison of these levels with those in Table 13 indicates that, both in the morning and in the evening, the ambient and background sound levels at the manned monitoring location are higher than at the unmanned one. This is likely to be due to the manned location being closer to Station Road and the contribution of mechanical plant from the nearby shop.

5.4.2 Vibration

The results of the unattended baseline vibration monitoring are summarised below in Table 14.

Table 14 Unmanned baseline monitoring results

Start Date (dd/mm/yy)	Start Time (hh:mm)	End Date	End Time (hh:mm)	VDV ($ms^{-1.75}$)
25/09/20	14:04	25/09/20	23:00	0.027
25/09/20	23:00	26/09/20	07:00	0.005
26/09/20	07:00	26/09/20	23:00	0.012
26/09/20	23:00	27/09/20	01:21	0.001

The average day and night-time measured VDVs (corrected for measurement duration) were 0.024 and 0.005 $ms^{-1.75}$ respectively. The freight train movements on the existing rail line were the only observed as a potential source of vibration in the baseline.

5.5 Freight Train Sound and Vibration

The Network Rail working timetable has been used, in conjunction with the 1-second time history from the measurement data, to identify the freight train passbys within the measurements. There are between zero (on a Sunday) and 6 passbys per day and 2 per night. The typical sound exposure level (L_{AE}) of a freight train passby is 83 dB and a typical VDV of 0.003 $ms^{-1.75}$. Using the L_{AE} of each train passby and the number of movements, the procedures in CRN have been employed to calculate the contribution of the freight trains to the overall ambient sound levels at the receptors. The typical ambient daytime sound level generated by the freight trains is around 43 dB $L_{Aeq,16h}$. The average daytime ambient sound level was 52 dB $L_{Aeq,16h}$ meaning that the freight trains were not the dominant contributor to this parameter. The contribution from other sound sources appears to have increased the ambient sound level by 9 dB, therefore the ambient sound level from these sources is around 51 dB $L_{Aeq,16h}$.

6. Assessment

The following assessment of impacts includes the embedded mitigation described in Section 4.

6.1 Construction Noise and Vibration

The measured daytime and weekend baseline sound levels, rounded to the nearest 5 dB, are 5 dB or more below the Category A Threshold Values within BS 5228-1. During the night, the baseline sound levels are equal to the Category A Threshold Values. On this basis the applicable Threshold Values for the construction noise assessment at all receptors are:

- 65 dB L_{Aeq} 07:00 and 19:00 Monday to Friday and Saturdays 07:00 – 13:00.
- 55 dB L_{Aeq} 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.
- 50 dB L_{Aeq} at all other times.

The assumed construction schedule is based on a 79-hour programme i.e. constructing between 22:00 hrs Thu to 05:00 hrs Mon. The works at the station are anticipated to last from mid-November 2022 to early March 2023 (i.e. around 4 months). Construction works are anticipated to involve the following activities:

- Site clearance and earthworks, including excavation
- Platform civils works
- Construction of car park
- Landscaping
- Finishing

The earthworks stage, which is expected to involve the use of excavators and dump trucks, is likely to generate the highest noise levels.

The closest properties to the proposed works are around 1 m of the redline boundary. At this distance it is considered likely that, without additional mitigation beyond the BPM outlined in Section 4.1, the above Threshold Values will be exceeded by some of the works. It is also possible that vibration from the works could result in moderate or major impacts based on the criteria in Table 5. The works which are undertaken at night present the greatest risk of resulting in significant noise and vibration effects. Given the duration of the proposed works, significant disturbance of the residents is anticipated unless the recommended mitigation set out in Section 7.1 is carried out.

6.2 Change in Ambient Sound Levels

Table 1 shows that five passenger train movements (2 arrival and 3 departure) are anticipated per night (23:00 to 07:00) If a night-time curfew is not adopted, the PA system night-time operations would only be from around 06:00 to 07:00. The intermittent sound of the PA system over this one hour would not significantly affect the overall night-time (23:00 to 07:00) ambient sound levels. The predicted night-time sound level from the stationary and moving passenger trains at the worst-affected receptor (R9) is 53 dB $L_{Aeq,8h}$. For partially open or closed windows, BS 8233 recommends assuming 15 or 33 dB reductions respectively. This would result in internal levels of 38 (windows partially open) or 20 (windows closed) dB L_{Aeq}. With windows closed, the internal level would be below the 30 dB L_{Aeq} criterion for night-time sound in the standard. It is considered that windows are relatively unlikely to be left open for the entire night-time and the windows closed scenario is much more likely to occur. Five events per night is also below the criterion for sleep disturbance due to individual events (10 to 15 events per night) in the WHO guidelines. On this basis, night-time impacts due to the proposed development ambient sound levels are considered acceptable.

The predicted car parking, PA system, future passenger and freight train railway movements sound levels at ground and first floor level for each receptor is provided in Table 15. The predicted overall development sound levels (passenger trains, car parking and PA system) are then combined with the current ambient sound level (which includes the freight trains) to identify a future ambient sound level. This is compared with the ambient sound level at ground floor level to identify the impact of the change in accordance with the criteria in Table 6. The measured ambient sound level at the manned location (52 dB $L_{Aeq,16h}$) has been assumed to be representative at receptors R1 to R6. The manned measurement location is representative of R7 to R9. The ambient sound level at the manned monitoring location is between 3 and 8 dB higher than at the unmanned monitoring location. For this assessment, the worst-case impact will occur when ambient sound levels are at their lowest; therefore, at R7 to R9, the current ambient sound level is taken to be 3 dB higher than measured at the unmanned location, i.e. a level of 55 dB $L_{Aeq,16h}$.

The sound of freight trains is provided because the NL Upgrades may result in changes to the freight sound levels, particularly where line speeds are anticipated to change. The sound of freight trains is associated with the wider NL Upgrades rather than the proposed development. However, it is considered a potential cumulative impact to those of the proposed development.

The current ambient sound levels at first floor are likely to be higher than measured, due to the reduced screening from nearby sound sources. The current ambient sound levels at first floor are not known; therefore, it is not possible to identify the likely change. A change in external ambient sound levels may not be directly experienced inside a property, where the ambient sound climate is affected by the sound sources inside the building such as conversation and television. At upper floors, there is no external receptor (i.e. amenity area such as a garden) to be affected by the change in external sound levels. Therefore, only the likely internal proposed development sound levels are considered when assessing the potential impact of the development at these locations. The adopted approach is a UK industry standard when undertaking noise impact assessments.

Table 15 Predicted future free-field sound levels

NSR	Floor Level	Freight Train $L_{Aeq,16h}$ (dB)	Proposed Car Park $L_{Aeq,16h}$ (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	50	11	50	N/a	50	54	2.2	Low
	First	53	14	52	N/a	52	55	N/a	N/a
R2	Ground	45	25	47	N/a	47	53	1.3	Low
	First	48	26	51	N/a	51	55	N/a	N/a
R3	Ground	46	30	52	N/a	52	55	3.0	Medium
	First	47	31	53	N/a	53	56	N/a	N/a
R4	Ground	35	39	50	N/a	50	54	2.1	Low
	First	36	41	51	N/a	52	55	N/a	N/a
R5	Ground	50	29	49	N/a	49	54	1.8	Low
	First	50	30	50	N/a	50	54	N/a	N/a
R6	Ground	48	36	54	N/a	54	56	4.4	Medium
	First	49	37	55	N/a	55	57	N/a	N/a
R7	Ground	41	37	60	41	60	61	6.1	High
	First	41	38	60	41	60	61	N/a	N/a
R8	Ground	44	38	64	44	64	64	9.1	High
	First	45	40	64	44	64	65	N/a	N/a
R9	Ground	42	38	63	43	63	64	8.5	High
	First	43	39	64	43	64	65	N/a	N/a

* Future ambient sound level is logarithmic sum of overall development sound level and measured ambient sound level (52 dB $L_{Aeq,16h}$ at R1 to R6 and 55 dB $L_{Aeq,16h}$ at R7 to R9)

Impacts of low magnitude are predicted at four receptors (R1, R2, R4 and R5), medium magnitude at two receptors (R3 and R6) and high at three receptors (R7 to R9). At some NSRs, the predicted future ambient sound levels exceed the WHO guidelines criterion of 55 dB $L_{Aeq,16h}$ as follows:

- R3 – 1 dB at first floor
- R6 – 1 dB and 2 dB at ground and first floor respectively
- R7 – 6 dB at ground and first floor
- R8 and R9 – 9 dB and 10 dB at ground and first floor respectively

Given that medium and high impacts are anticipated, and the WHO guidelines are expected to be exceeded at the above NSRs, mitigation is proposed to reduce impacts at these locations. To determine the focus of mitigation, the dominant sound source in the predictions at these locations has been identified to be the stationary passenger trains at the platforms. This sound source was included in the proposed passenger train sound levels in which also includes the moving passenger trains.

6.3 PA System Noise

The daytime assessment has been undertaken over a 1-hour period between the hours of 07:00 and 23:00. The time between 06:00 and 07:00 is classed as night-time. The PA Noise Report has assumed one announcement of 30 seconds duration will be made in each 5-minute period. Consistent with the principles of BS 4142 as described above, a 15-minute assessment period has been applied to the night-time assessment. The impacts have been assessed at R7, R8 and R9 as these are the NSRs at which the PA system sound levels have been predicted. The manned monitoring location is considered representative of all these NSRs.

A key aspect of the BS 4142 assessment procedure is the comparison between the *rating level* and the *background sound level*. The *rating level* is the L_{Aeq} of the *specific sound source* only but takes account of notable acoustic features such as tonality, percussiveness etc. As stated in Section 3.2.2 a character correction of up to 15 dB could be applied to the specific sound. For this assessment a + 5 dB character correction been applied to the *specific sound level* to obtain the *rating level* based upon +2 dB penalty for a tone and +3 dB for impulsivity, both of which are just perceptible at the NSR.

Based on the manned baseline survey results detailed in Table 13, levels of 43 and 35 dB L_{A90}, during the day and night-time respectively, are representative of a reasonable worst-case.

The results of the BS4142 assessment for both the day and night-time periods are shown in Table 16. For the sake of brevity, the phrase “depending on the context” has been omitted from the conclusions.

Table 16 BS 4142 Assessment

NSR	06:00 to 07:00					07:00 to 23:00				
	L_s (dB)	$L_{Ar,Tr}$ (dB)	L_{A90} (dB)	$L_{Ar,Tr}$ – L_{A90} (dB)	Conclusion	L_s (dB)	$L_{Ar,Tr}$ (dB)	L_{A90} (dB)	$L_{Ar,Tr}$ – L_{A90} (dB)	Conclusion
R7	41	46	35	11	Significant adverse impact	41	46	43	3	Low / Adverse impact
R8	44	49	35	14	Significant adverse impact	44	49	43	6	Adverse impact
R9	43	48	35	13	Significant adverse impact	43	48	43	5	Adverse impact

Table 16 shows that during the night-time period, the BS 4142 assessment indicates a significant adverse impact at all identified NSRs, depending on the context. During the daytime, the BS 4142 assessment indicates an adverse impact at R8 and R9, and low / adverse impact at R7.

Further mitigation options will be explored as part of the detailed design of the PA system. It may be necessary to explore the possibility of flexibility in the Network Rail requirements that minimum PA system sound pressure levels on the platform are 65 dB(A) and 10 dB above the ambient sound level on the platform. This requirement does include the caveat that “unless environmental noise pollution issues prevent this figure being achieved”.

The PA system sound levels reported in Table 16 are required to achieve the Network Rail requirements at the loudest times of the day, when *background sound levels* are likely to be higher than shown in the Table.

Assuming it is possible to deviate from these requirements; the PA system sound level would then be controlled by the ANS microphones and controllers, installation of which is considered best practice, proposed to be required as a condition of consent as discussed in Section 4.2. The PA system sound level would then vary depending on the ambient sound level on the platform, which is also directly related to the *background sound level* at the NSRs i.e. when *background sound levels* are low, PA system sound levels will also be low and vice versa. On that basis, the impacts presented in Table 16 represent a significant worst-case which may not actually occur.

To avoid a significant adverse impact in accordance with the criteria in BS 4142: 2014, it would be necessary for the PA system sound *rating level* not to exceed the *background sound level* by more than 5 dB. Between the hours of 6 and 7, this would require the PA system sound level at the NSR to not exceed 35 dB L_{Aeq} (a reduction in the PA system sound of 9 dB at R8). Between the hours of 06:00 and 07:00 the primary concern would be sleep disturbance therefore it is necessary to consider the PA system sound levels likely to occur inside the nearby properties. Assuming a 15 dB reduction for a partially open window in accordance with BS 8233, the internal level would be 20 dB L_{Aeq}. This is significantly below the 30 dB L_{Aeq} criterion for night-time sound in the standard, however BS 8233 states that the criteria apply to sound “without a specific character”. Sound 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”. The PA system sound is considered to have a specific character and therefore BS 8233 indicates that lower limits may be appropriate. However, AECOM is not aware of alternative guidance which could be applied as a limit to the internal sound level from the PA system; therefore, the assessment in accordance with BS 4142 (i.e. based on external sound levels, rather than the internal criteria in BS 8233) is deemed more appropriate.

Whilst a daytime (07:00 to 23:00) assessment is presented in Table 16, this assumes a constant PA system sound level over this time period and assesses against the typical worst-case *background sound level* over this time. As discussed above, the PA system sound levels will vary over time with the ambient sound level on the platform. As the *background sound levels* at NSRs and ambient sound levels at the platform vary over the course of a day, it is not possible to define an absolute daytime PA system sound level limit at nearby NSRs which would protect residential amenity and achieve appropriate sound levels on the platform. However, section 7.3 sets out the means by which the impact of PA system noise can be controlled to an appropriate level.

6.4 Operational Vibration

It is understood that in the vicinity of the proposed station the speed of the freight trains will remain as current, with a speed of around 24 km/h; therefore, the VDV of a freight train passby is assumed to stay the same as the current situation.

It is also understood that the passenger train speeds as they pass the vibration monitoring location will be around 31 km/h travelling north towards the station and 24 km/h travelling south away from the station. The length of the freight trains is typically around 400 m and the passenger train length will be 69 m. The duration of the passenger train passbys will therefore be shorter than that of the freight trains by a factor of 7.4 (north-bound) and 5.7 (south-bound).

Using the typical freight train passby VDV identified from the measurements (0.003 $ms^{-1.75}$), the current day and night-time VDVs, due to 6 freight train movements per day and 2 per night, have been determined to be 0.0047 $ms^{-1.75}$ (day) and 0.0036 $ms^{-1.75}$ (night). These are significantly below the measured day (0.024 $ms^{-1.75}$) and night-time (0.005 $ms^{-1.75}$) VDVs. The reason for this is that the freight train vibration levels were relatively low, therefore other sources may have contributed to the measured levels.

The proposed development includes new passenger train only tracks to access the station from the main route. These tracks are closer to R2 and R3 than the existing route, therefore, once the development is complete, the passenger trains will be closer to these NSRs than the freight. As discussed in section 3.3, the acceleration due to the passenger train movements has been assumed to be the same as for the freight trains, which is a significant overestimate. As the calculated passenger train VDVs are likely to be much lower than shown, it is not considered necessary to calculate the potential increase in the passenger train VDV to this reduced distance from the tracks. Therefore, impacts at R2 and R3 are not considered.

The unmanned measurement location was 49 m and 53 m from the closest rail of the north-bound and south-bound tracks respectively. At the nearest receptor to the railway (R1), these distances are 14 m and 17 m. The likely VDV of a freight train passby has been calculated at this reduced distance from the tracks, assuming that the acceleration levels reduce due to propagation away from the tracks as per a line source (3 dB reduction per doubling of distance). The predicted future VDVs for each train type, at R4 (represented by the unmanned monitoring location) and at R1, along with the resultant day and night-time VDVs, are provided in Table 17.

Table 17 Future External Free-field VDVs

Train Type	Direction	Number of passbys		R4			R1		
		Day	Night	Passby VDV ($ms^{-1.75}$)	$VDV_{07:00\ to\ 23:00}$ ($ms^{-1.75}$)	$VDV_{23:00\ to\ 23:00}$ ($ms^{-1.75}$)	Passby VDV ($ms^{-1.75}$)	$VDV_{07:00\ to\ 23:00}$ ($ms^{-1.75}$)	$VDV_{23:00\ to\ 23:00}$ ($ms^{-1.75}$)
Passenger	North-bound	32	3	0.0019	0.0044	0.0024	0.0035	0.0095	0.0053
	South-bound	32	3	0.0023	0.0054	0.003	0.004	0.0083	0.0046
	Total	64	6		0.0059	0.0033		0.011	0.0059
Freight	North-bound	3	1	0.003	0.0039	0.003	0.0056	0.0074	0.0056
	South-bound	3	1	0.003	0.0039	0.003	0.0053	0.007	0.0053
	Total	6	2		0.0047	0.0036		0.0086	0.0065
All	Total	70	8		0.0064	0.0041		0.012	0.0074

At R4, the predicted future external vibration levels, for all train types and directions, are lower than those which were measured in the baseline. The predicted daytime level is 27% of that measured, at night-time this value is 82%. This indicates that, once the scheme is complete, the trains are unlikely to be the dominant source in the overall vibration climate at R4. To determine the change in train vibration levels at R4, the predicted future vibration levels have instead been compared with the calculated levels using the freight train passby VDVs. This exercise has also been undertaken at R1.

The scheme is calculated to increase the current daytime train vibration levels by 36% (R1) and 37% (R4), during the night the increase is 14% at both receptors. These are classified as impacts of minor (daytime) and negligible (night-time) magnitude. The future internal vibration levels at R1 are anticipated to be around 0.05 $ms^{-1.75}$ (day) and 0.03 $ms^{-1.75}$ (night) and the internal levels at R4 are even lower than this. These are below the lower end of the VDV ranges within which there is a ‘low probability of adverse comment’ according to BS 6472-1. On this basis, operational vibration impacts are anticipated to be acceptable.

6.5 Road Traffic Noise

Operational road traffic noise has been assessed by considering the change in the forecast road traffic flows in 2039 both with and without the Proposed Development with reference to both the CRTN and DMRB. The predicted changes in noise levels are presented in Table 18.

Table 18 Operational Traffic Noise Effects

Link	2039 Baseline and Committed Development $L_{A10,18h}$ dB	2039 Baseline + Committed + Proposed Development $L_{A10,18h}$ dB	Change in Noise Level dB	Magnitude of Impact
Station Road, West of Kenilworth Road	65.2	65.3	0.1	Negligible
Kenilworth Road	57.6	58.2	0.6	Negligible
Council Road	58.5	58.5	0.0	No change
Station Road	64.0	64.2	0.2	Negligible
John Street	62.8	62.8	0.0	No change
Station Road, East of John Street	59.6	60.0	0.4	Negligible

The calculations show that road traffic noise levels are anticipated to either stay the same or increase by 0.1 dB $L_{A10,18h}$. Therefore, noise impacts due to changes in road traffic flows are not anticipated.

6.6 Assumptions and Limitations

It should be noted than any assessment of sound levels has an associated degree of uncertainty. Although modelling and measurement processes have been carried out in such a way to reduce such uncertainty, it is unavoidable that some remains. The assessment undertaken has made several worst-case assumptions. These assumptions, combined with the known accuracy of the adopted calculation methods, mean that the margin of error incorporated into the assessment is sufficient to avoid the identified sources of uncertainty from worsening the conclusions.

The noted sources of uncertainty in this assessment are discussed in Appendix E.

7. Mitigation

Sections 6.4 and 6.5 show that operational vibration and road traffic noise impacts are considered acceptable without the need for mitigation; therefore, these are omitted from the below discussion. Mitigation options for the remaining impacts are provided below.

7.1 Construction Noise and Vibration

Construction noise and vibration will be generated throughout each proposed 79-hour possession over the construction period. Whilst Best Practical Measures (BPM) are to be implemented in the construction activities (as discussed in Section 4.1), further mitigation beyond BPM is recommended to avoid significant disturbance by the construction activities.

To mitigate the noise emissions from construction works, use of site or activity boundary acoustic barriers to screen neighbouring receptors is likely to be required. The use of site boundary or activity boundary temporary noise barriers can reduce construction noise levels by around 10 dB if line-of-sight from the plant to the receptor is blocked.

When planning the works, it will be necessary to consider the number and type of plant required to complete the work and the timing, duration and phasing of the works. For example:

- where practicable, noisy works should be interspersed between quieter works to provide periods of respite;
- where practicable, the works should be phased to ensure that the noisiest operations are performed during the least sensitive times;
- minimising the duration of the works is generally beneficial, if higher noise levels may result in a significant reduction in the overall duration of the works this should be considered; and
- phasing of works at the closest approach to properties where possible to give periods of respite.

If the implementation of all reasonable mitigation measures and BPM still results in construction noise levels exceeding the Threshold Values, BS 5228-1 does recommend further options such as the provision of noise insulation to affected habitable rooms.

BS 5228-1 also provides example noise limits for determining eligibility for noise insulation and temporary rehousing which are above the Threshold Values. To qualify for insulation or temporary rehousing these noise limits would have to be exceeded *"for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months."* (BS 5228-1 section E.4).

Qualification under this criteria and the adopted mitigation measures which go beyond BPM will be specified in the CEMP described in Section 4.2.

7.2 Ambient Sound

Changes in ambient sound level due to the proposed development are anticipated to result in worst-case impacts of high magnitude at R4, and to R6 to R9. Ambient sound levels are also anticipated to exceed the external daytime sound level criterion in BS 8233 at NSRs R2 to R4, R6 to R9.

As mentioned in Section 6.2, the dominant sound source in the predictions at the worst affected NSRs is the stationary passenger trains at the platform. Therefore, this source should be the primary focus of mitigation. AECOM have been supplied with measurements of the sound of a stationary BEMU train which show that the levels at 7.5 m from the track are no more than 40 dB L_{Aeq} which is likely to be inaudible at the receptor. If the DMU trains are replaced with the BEMUs, this sound source will be removed. The calculations described in Section 6.2 have been updated to identify the overall development sound levels without the contribution of the stationary trains. The highest overall development sound level is 49 dB $L_{Aeq,16h}$ which occurs at the first floor of R1. Assuming a current ambient sound level of 52 dB $L_{Aeq,16h}$ at these locations, the change due to the proposed development is 2 dB, which is a low impact. The limit in the WHO guidelines is also not exceeded, therefore, if the DMU trains are upgraded to BEMUs, further mitigation to reduce ambient sound levels due to the proposed development would not be required.

If the BEMUs are not deployed, to reduce the sound of the trains the only feasible options are: to erect a barrier to block the line of sight to the nearby NSRs; and/or application of acoustically absorbent lining to the vertical trackside surfaces of each platform from ground up to the platform level. A 2.8 m high barrier fence has therefore been included in the station design between the existing up line track and the nearby properties (R7 to R9).The location of the proposed barrier is shown in Figure 4. This figure includes a proposed development design plan which is subject to change and details within this figure other than the barrier design should not be relied upon. The computational model of the railway and surroundings has been updated to include these barriers and the proposed absorption, this has been used to predict the mitigated railway sound levels.

It has not been possible to update the model of the PA system sound to identify the actual effect of the proposed barriers. The barrier has been assumed to achieve a 5 dB reduction in the PA system at receptors R7 to R9 sound which is likely assuming it at least partially blocks line of sight from the NSR to the speakers. If the barrier fully blocks line of sight, the reduction would be expected to be around 10 dB therefore this assumption are considered a reasonable worst-case. The barrier is not likely to block line of sight from the remaining NSRs to the speakers. Table 19 provides an updated version of Table 15 with this mitigation in place.

In order to be effective, the amount of noise transmitted through the barrier must be significantly less than what passes over the top (and round the edges). The effectiveness of a material to prevent the transmission of noise is determined by the thickness and surface density of the material used to construct the barrier. To be effective, the noise level due to noise being transmitted through the barrier must be at least 10 dB below the noise level due to noise passing over the top (and round the edges).

Regarding timber barriers a minimum surface density of 15 kg/m^2 is recommended. Note that timber density is very variable, therefore a surface density of 15 kg/m^2 allows for a degree of variability. Most properly engineered timber barriers use either 30+mm thick timbers or 'double-skinned' timber barriers. Wood must be close boarded with no air gaps between panels or at the bottom.

Sound 'leaks', due to holes, slits, cracks or gaps through or beneath a noise barrier can seriously reduce the barrier performance and must be avoided. The side of the barrier facing the tracks must be absorptive to sound. This will reduce reflections off the barrier which otherwise would reflect off it and be transmitted towards a nearby NSR. Typically, this is achieved by lining the barrier with an absorbent material such as mineral fibre and a protective membrane.

As the platforms are raised above the tracks, the platform between the tracks and NSR can provide some screening to the train sound. However, as with the proposed barrier, the train sound can be reflected off the opposite vertical platform surface and towards a nearby NSR. Lining of the platform surfaces will reduce the level of this reflected sound. An acoustic absorption coefficient of 0.9 has been assumed for the acoustic lining in the modelling which should be achievable.

Table 19 shows that the impact at all NSRs, with the proposed mitigation in place, is no worse than low, which is acceptable. At R7 to R9, the proposed development noise levels do not exceed the limit of 55 dB $L_{\text{Aeq,16h}}$, however the future ambient sound levels combined with other sound sources in the baseline do exceed this limit. These exceedances are not entirely due to the development as the ambient sound levels are already 55 dB $L_{\text{Aeq,16h}}$ at these locations. As the change in ambient sound levels due to the development is a low impact, the noise due to the proposed development is considered compliant with the adopted assessment criteria.

The NIR provide a further mechanism for reducing internal noise levels, however the predicted noise levels in Table 19 indicate that none of the NSRs will experience noise levels in excess of the 65 dB $L_{\text{Aeq,18h}}$ (free-field) criterion for eligibility. In addition, the proposed development does not introduce significant alterations to the track, therefore the NIR do not apply at this location.

It is proposed that impacts are controlled via a condition of consent requiring provision and maintenance of the barriers and acoustic absorption described in this report.

Table 19 Predicted future free-field sound levels with proposed mitigation

NSR	Floor Level	Freight Train $L_{Aeq,16h}$ (dB)	Proposed Car Park $L_{Aeq,16h}$ (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	50	11	50	N/a	50	54	2.2	Low
	First	53	14	52	N/a	52	55	N/a	N/a
R2	Ground	45	25	47	N/a	47	53	1.1	Low
	First	48	26	48	N/a	48	54	N/a	N/a
R3	Ground	46	30	49	N/a	49	54	1.9	Low
	First	47	31	51	N/a	51	55	N/a	N/a
R4	Ground	34	39	45	N/a	46	53	1.0	Low
	First	35	41	47	N/a	48	53	N/a	N/a
R5	Ground	50	29	49	N/a	49	54	1.7	Low
	First	50	30	51	N/a	51	54	N/a	N/a
R6	Ground	48	36	50	N/a	50	54	2.3	Low
	First	49	37	52	N/a	52	55	N/a	N/a
R7	Ground	29	34	51	36	51	57	1.6	Low
	First	31	37	54	36	54	58	N/a	N/a
R8	Ground	33	36	52	39	52	57	1.9	Low
	First	35	39	55	39	55	58	N/a	N/a
R9	Ground	31	35	52	38	52	57	1.8	Low
	First	32	38	55	38	55	58	N/a	N/a

7.3 PA System Noise

For the PA system to be intelligible it needs to be audible (typically a minimum of 6-10 dB above the ambient sound levels on the platform) and this will need to be considered in setting any maximum output level. Assuming the PA system sound reductions discussed in Section 4.2 and further attenuation due to proposed noise barrier, significant adverse impacts are still anticipated at R8 and adverse impacts at R7 and R9 during the night.

If a deviation from the NR requirement of a minimum sound pressure level of 65 dB(A) at all areas of the platform can be agreed, it should be feasible to achieve intelligibility for the PA system whilst avoiding significant adverse effects on nearby NSRs. For example, it may be possible to:

- change the system design such that the minimum sound level criterion is met on only part of the platform at noise-sensitive times; or
- introduce platform zoning i.e. turning off or decreasing the level of certain loudspeaker circuits at noise-sensitive times.

It is proposed that PA system noise impacts are controlled via a condition of planning consent requiring implementation of best practice measures to minimise noise impacts as discussed in Section 4.2 and restriction of PA system operations to 07:00 to 23:00 only. It may also include the following:

- Installation of automated audio control within the PA system which can be set to a maximum allowable sound level over specific operational hours when ambient sound levels are low, to be agreed with the EPO. This control could be set to override the proposed ANS system.
- Agreement between the EPO and station operator on suitable curfew times (if 07:00 to 23:00 is deemed to insufficient) prior to commencement of operations as required.
- Commissioning of the PA system prior to commencement of operations to determine suitable PA system sound levels. The EPO should be invited to attend this exercise.

8. Summary

AECOM has been commissioned by Northumberland County Council (NCC) to complete a noise and vibration impact assessment to accompany the application for planning permission for the proposed new railway station at Ashington.

During the construction of the proposed development, noise and vibration emissions from the works have the potential to disturb the nearby residents. This is primarily because, in order to conduct the works safely, a 79-hour programme of works is proposed i.e. constructing between 22:00hrs Thu to 05:00hrs Mon. The works at the station are anticipated to last from mid-November 2022 to early March 2023 (i.e. around 4 months). BPM will be employed to minimise adverse effects, and these will be defined within the CEMP, which will also include a detailed construction noise and vibration assessment which will define the additional specific mitigation measures required.

The noise impact due to the operation of the development has been assessed by predicting the likely daytime ambient sound levels at nearby sensitive receptors. Without mitigation, worst-case impacts of medium and high magnitude are expected. The predicted external ambient sound levels are also anticipated to exceed the adopted criterion at some receptors, by up to 8 dB at ground floor and up to 9 dB at first floor.

The stationary trains are anticipated to be the dominant sound source in the future ambient sound levels. The proposed development does not result in exceedance of the criteria in the NIR and noise impacts are anticipated to reduce to acceptable levels if the DMU trains are replaced with BEMUs. If the BEMUs are not deployed, a noise barrier is anticipated to be required, along with acoustically absorbent lining to the trackside surface of the proposed platform. The proposed barriers in this report achieve proposed development noise levels which are compliant with the adopted criteria at all nearby properties. Whilst future ambient sound levels with the development may exceed the adopted criteria, this is due to the fact that ambient sound levels at these receptors are already equal to the limit. As the impact due to the change in ambient sound levels is assessed as low, these predicted exceedances are considered acceptable.

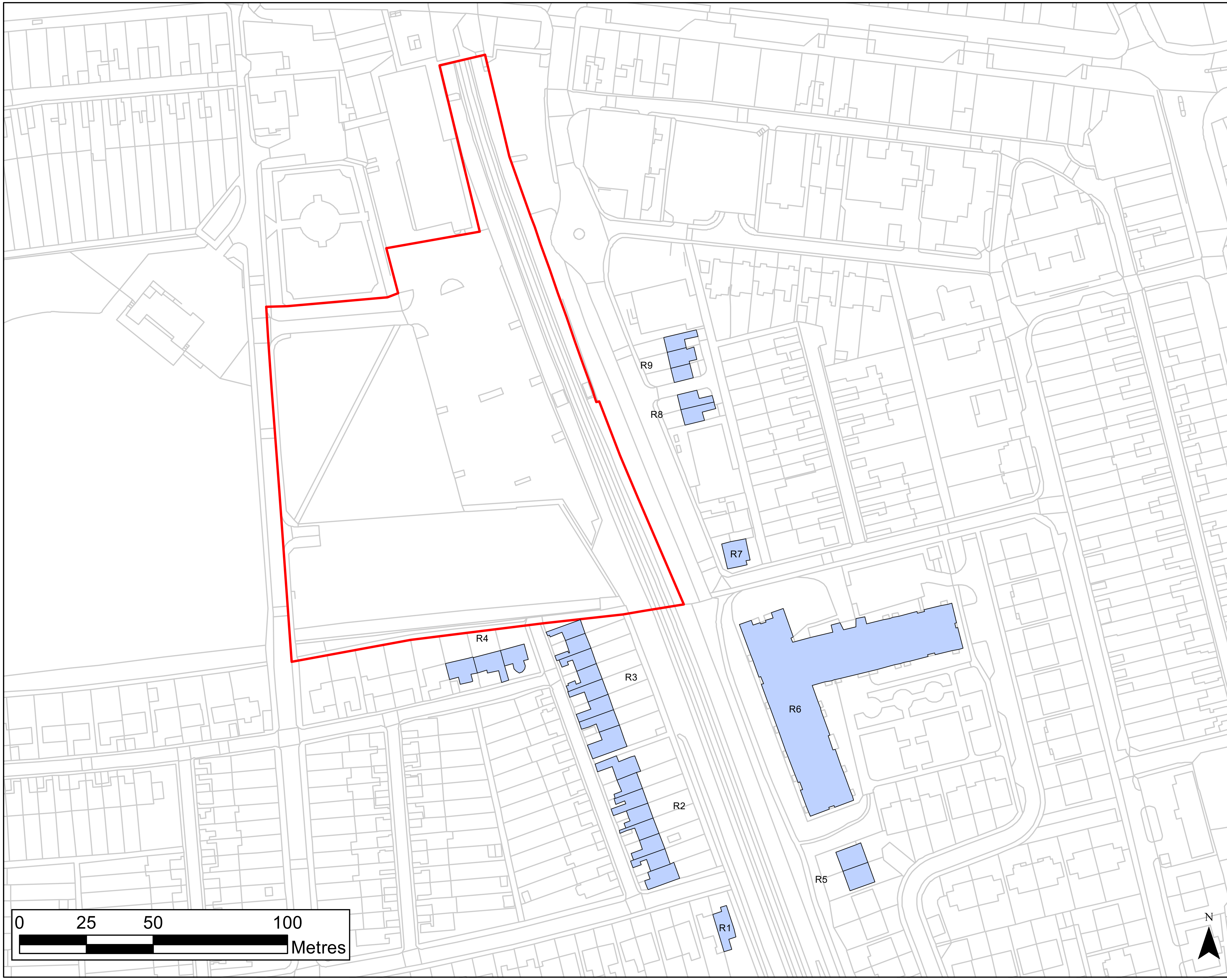
The PA system sound levels have been predicted based on outline design. An assessment of the potential noise impact of the PA has been conducted in accordance with the guidance in BS 4142. The assessment indicates that there is the potential for significant adverse impacts; therefore a curfew is proposed restricting PA system operations to less noise-sensitive times of the day. Further options for mitigation of the PA system sound have been identified and these will be considered throughout the design iteration and system comissioning process to minimise noise impacts on nearby sensitive receptors.

Appendix A Glossary

Term	Definition
Decibel (dB)	The range of audible sound pressures is approximately 2 x 10^{-5} Pa to 200 Pa. Using decibel notation presents this range in a more manageable form, 0dB to 140dB. Mathematically Sound Pressure level = 20 log {p(t)/p_0} Where P_0 = 2 x 10^{-5} Pa.
A" Weighting (dB(A))	The human ear does not respond uniformly to different frequencies. "A" weighting is commonly used to simulate the frequency response of the ear. It is used in the assessment of risk of damage of hearing due to noise.
Frequency (Hz)	The number of cycles per second, for sound this is subjectively perceived as pitch.
Frequency Spectrum	Analysis of the relative contributions of different frequencies that make up a noise.
Ambient Sound	Totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far (*The ambient sound comprises the residual sound and the specific sound when present)*.
Ambient Sound Level $L_a = L_{Aeq,T}$	Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T.
Background Sound Level $L_{A90,T}$	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.
Equivalent Continuous A-weighted Sound Pressure Level $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, T = $t_2 - t_1$, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation: $$L_{Aeq,T} = 10lg_{10}\left\{\left(\frac{1}{T}\right)\int_{t1}^{t2}\left[p_A\frac{(t)^2}{{p_0}^2}\right]dt\right\}$$ Where p_0 is the reference sound pressure (20µPA); and $P_A(t)$ is the instantaneous A-weighted sound pressure level at time t
Measurement Time Interval T_m	Total time over which measurements are taken (*This may consist of the sum of a number of non-contiguous, short-term measurement time intervals)*
Rating level $L_{Ar,Tr}$	Specific sound level plus any adjustment for the characteristic features of the sound
Reference Time Interval, T_r	Specified interval over which the specific sound level is determined (*This is 1 h during the day from 07:00 h to 23:00 h and a shorter period of 15 min at night from 23:00 h to 07:00 h*)
Residual Sound	Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound
Residual sound level $L_r = L_{Aeq,T}$	Equivalent continuous A-weighted sound pressure level of the residual sound in a given situation at the assessment location over a given time interval, T.
Specific sound level $L_s = L_{Aeq,Tr}$	Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given time interval, T.
Specific Sound Source	Sound source being assessed
$L_{A10,T}$	The A-weighted sound pressure level of the residual noise in decibels exceeded for 10% for a given time interval. This is the parameter defined by the government to describe road traffic noise
L_{AFmax}	The maximum RMS A-weighted sound pressure level occurring within a specified time period. Fast time weighting indicates sound pressure level measurements undertaken using a 125-millisecond moving average time weighting period
VDV	Vibration Dose Value (VDV) is a form of energy averaged vibration level. The vibration dose value has a time-dependency which means that a two-fold decrease in vibration magnitude is equivalent to a 16-fold decrease in the duration of the vibration, i.e. the measured VDV is much more sensitive to changes in vibration level, than changes in vibration duration. For this report the VDV was calculated as defined in BS 6472-1:2008. $$VDV_{day/night} = \left(\int_0^T \alpha^4(t)dt\right)^{0.25}$$ Where: • $VDV_{day/night}$ is the vibration dose value

	• α(t) is the frequency-weighted acceleration using W_b (vertical vibration) or W_d (horizontal vibration) as appropriate. • T is the total period of the day or night during which vibration can occur. For this report VDV is a cumulative measurement of the vibration level received over an 8-hour or 16-hour period

Appendix B Figures



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Project Title:

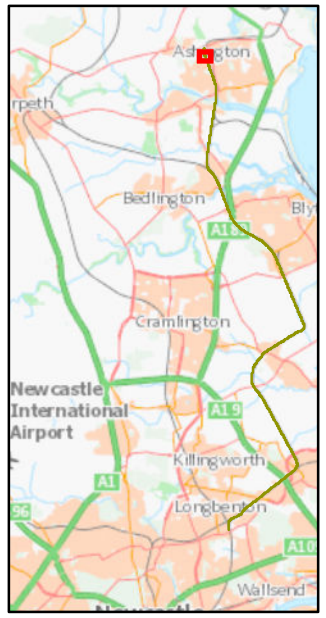
NORTHUMBERLAND LINE UPGRADES

Client:

NORTHUMBERLAND COUNTY COUNCIL

LEGEND

- Receptors
- Redline boundary



AECOM Internal Project No:
60628487

Drawing Title:

Ashington Station
Noise Sensitive Receptors

Scale at A3: 1:1,303.31

Drawing No: 1			Rev:
FIGURE 1			001
Drawn:	Chk'd:	App'd:	Date:
TB	TB	SC	19/11/20

Filename: C:\Users\seckin.basturk\AECOM Directory\Britton, Timothy - Northumberland Line WebTAG\Receptor location drawings\ReceptorLocation_6_Ashington.mxd

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Project Title:

NORTHUMBERLAND LINE UPGRADES

Client:

NORTHUMBERLAND COUNTY COUNCIL

LEGEND

- Short-Term Sound Monitoring Location
- Long-Term Sound and Vibration Monitoring Location

AECOM Internal Project No:
60628487

Drawing Title:

Ashington
Baseline Monitoring Locations

Scale at A3: 1:1,250

Drawing No: 1			Rev:
FIGURE 2			001
Drawn:	Chk'd:	App'd:	Date:
CJ	TB	SC	06/11/20

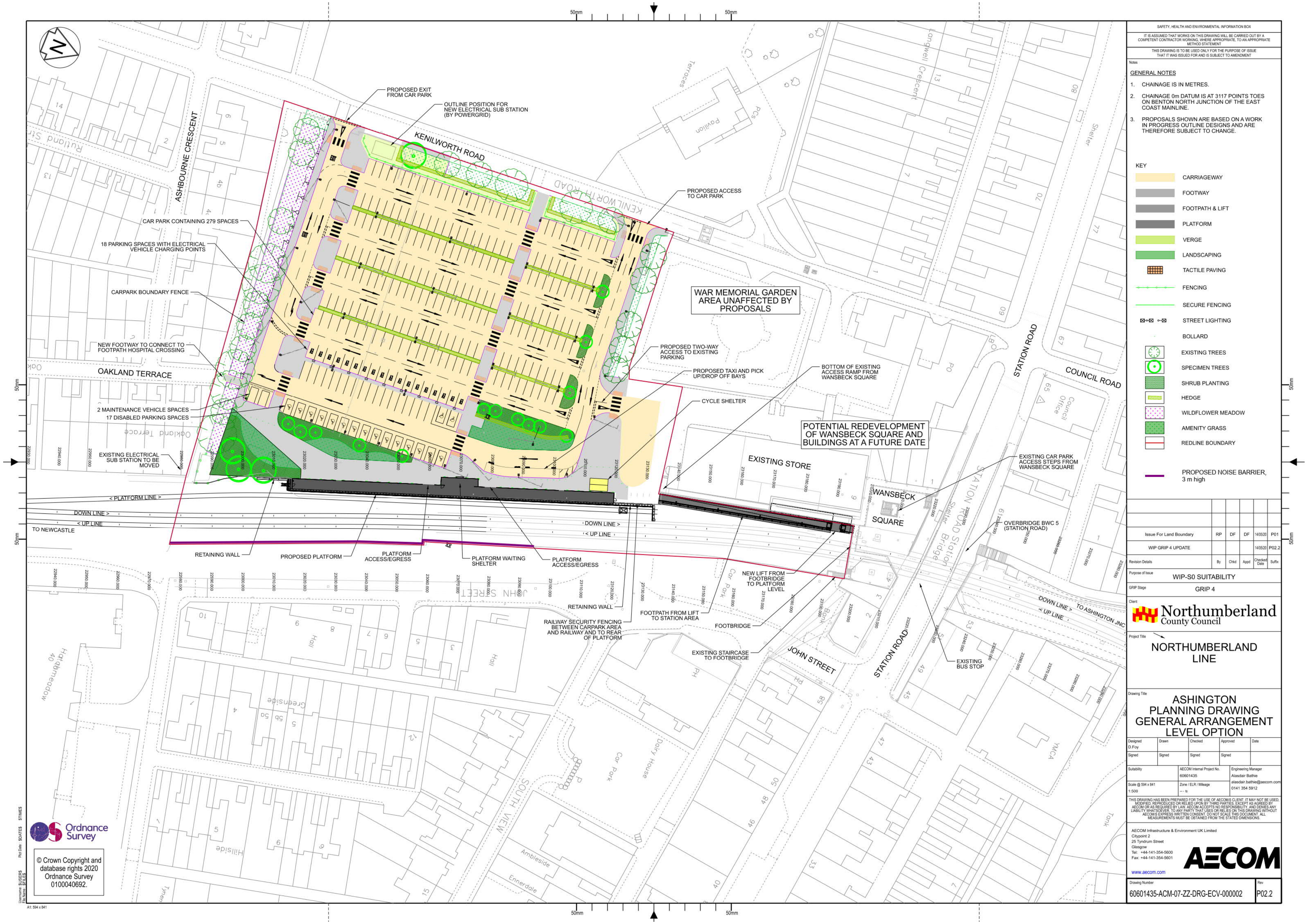

Figure 4 Noise Barrier Location

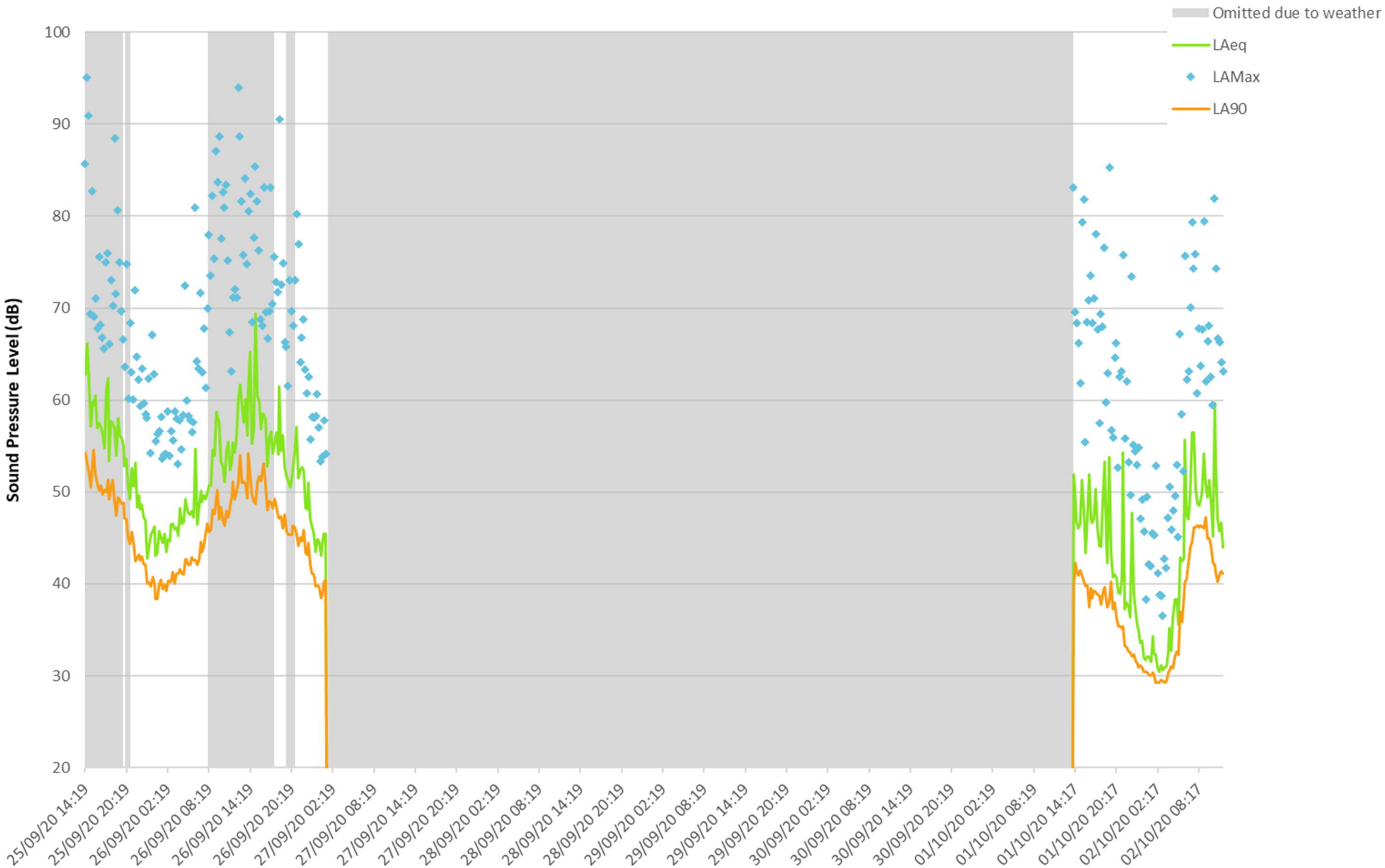

Figure 5 Unmanned Sound Monitoring Results

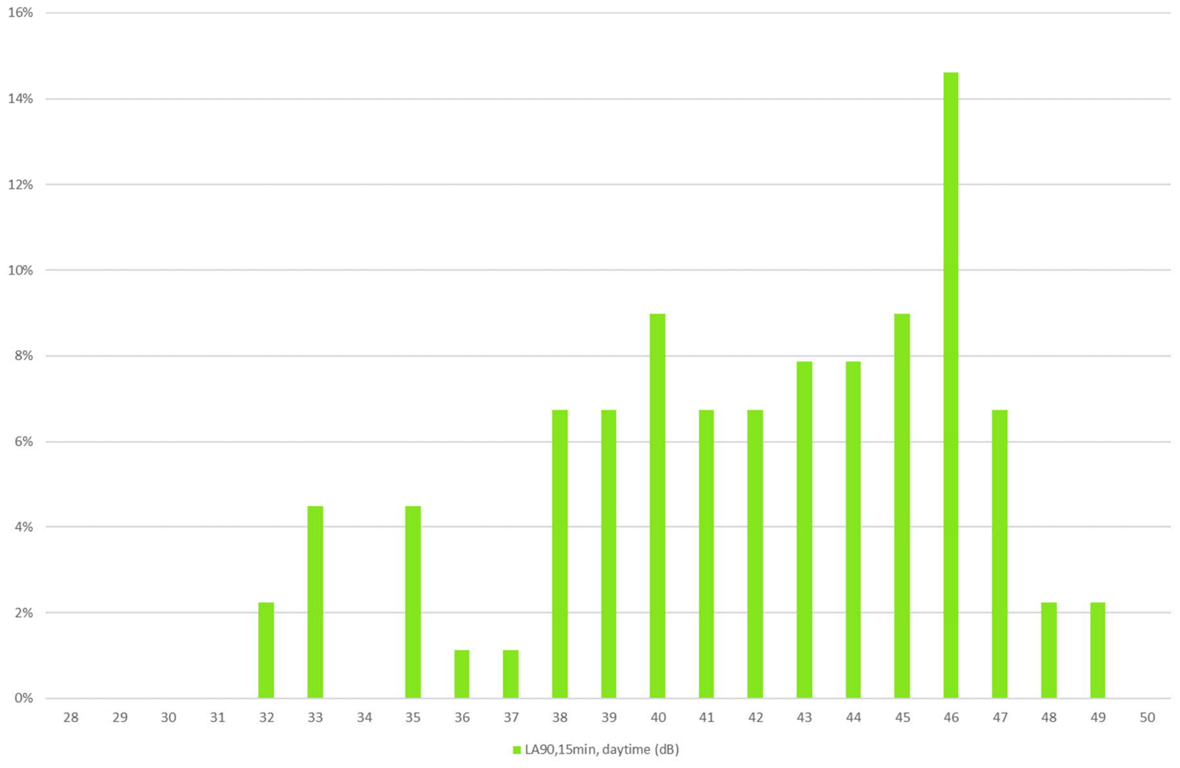

Figure 6 Daytime background sound levels

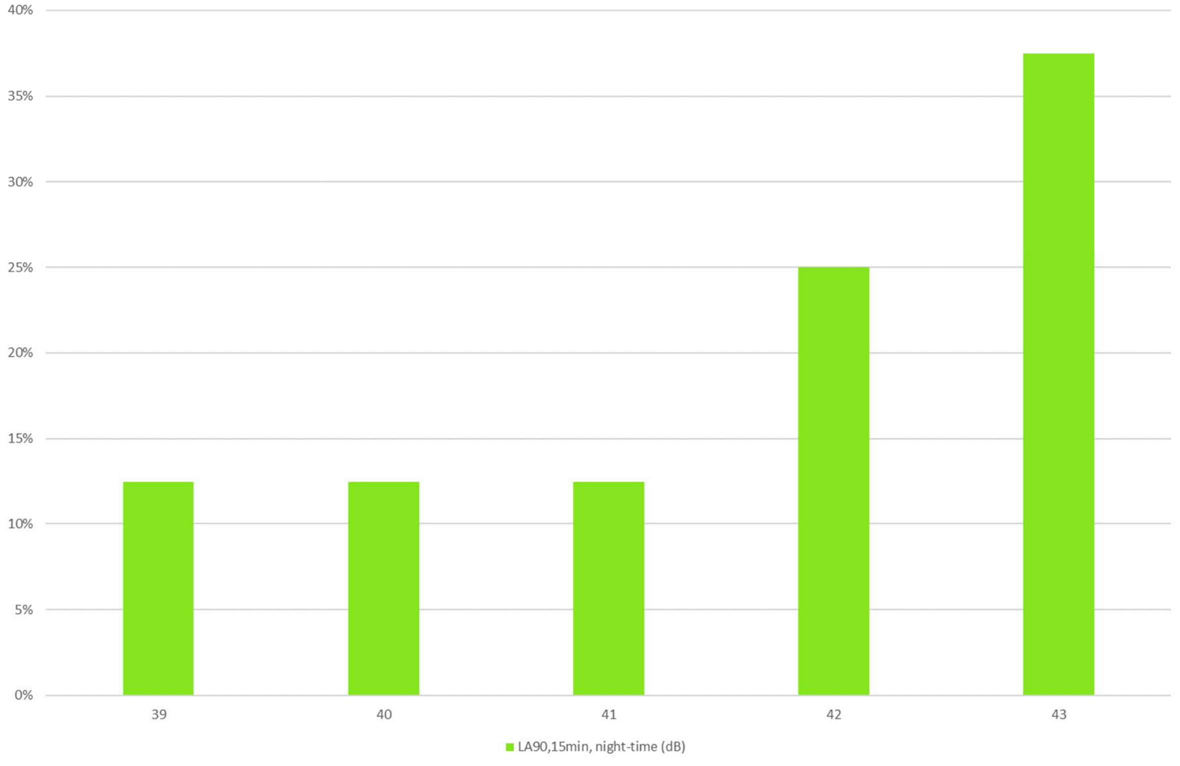

Figure 7 Night-time (06:00 to 07:00) background sound levels

Appendix C Acoustic Modelling of Railway Sound

8.1 Prediction Methodology

Modelling of sound levels from the proposed scheme have been undertaken using CadnaA (version 2020 MR1) acoustic modelling software. This software implements various sound propagation calculation methodology for different sound source types included in the model. The sound from railway sources has been calculated in accordance with the method set out in the Calculation of Railway Noise (CRN) (Department of Transport, HMSO 1995) and sound from idling trains were calculated following the method set out in the ISO 9613-2:1996 Attenuation of sound during propagation outdoors.

8.2 Acoustic Modelling Input Data

Data sources used for this modelling are shown in Table C.1.

Table C.1 Data sources

Data	Source file	Received From
OS mapping	TopographicArea.shp AddressBasePlus_FULL_2020-09-16_001	NCC
Existing topography	Northumberland Lines Complete_260620_OS.dwg DRONE-SURVEY - OS.dwg	AECOM
	LIDAR-DTM-2m-2019-NZ26ne LIDAR-DTM-2m-2019-NZ27ne LIDAR-DTM-2m-2019-NZ27se LIDAR-DTM-2m-2019-NZ28ne LIDAR-DTM-2m-2019-NZ28se LIDAR-DTM-2m-2019-NZ36nw LIDAR-DTM-2m-2019-NZ37nw LIDAR-DTM-2m-2019-NZ37sw LIDAR-DTM-2m-2019-NZ38sw	Publicly available LIDAR data downloaded from environment.data.gov.uk
Proposed topography, station layouts and tracks	60601435-ACM-01-ZZ-DRG-ECV-000001.dgn 60601435-ACM-03-ZZ-DRG-ECV-000001.dgn 60601435-ACM-04-ZZ-DRG-ECV-000001.dgn 60601435-ACM-05-ZZ-DRG-ECV-000001.dgn 60601435-ACM-06-ZZ-DRG-ECV-000001.dgn 60601435-ACM-07-ZZ-DRG-ECV-000002.dgn Proposed track layout on local grid.dwg	AECOM
Proposed railway movements, train speed profiles and railway gradient	RailSys fahrdynamik & plots - C66+665.88t IIA-C 75mph_UP.xlsx RailSys fahrdynamik & plots - C66+2438.40t IIA-C 60mph_DN.xlsx RailSys fahrdynamik & plots - 3car C158_DN_20200728.xlsx RailSys fahrdynamik & plots - 3car C158_UP_20200728.xlsx	SLC Rail, 27/10 – 03/11/2020
Road traffic movements on proposed station access roads	Ashington DS AADT Sensitivity Test.pdf Bebside DS AADT Sensitivity Test.pdf Bedlington DS AADT Sensitivity Test.pdf Newsham DS AADT Sensitivity Test.pdf NPark DS AADT.pdf SD DS AADT Sensitivity Test.pdf	AECOM

8.3 Acoustic Model Settings

Acoustic modelling has been undertaken using the following model settings:

- Maximum search radius of 2000 m.
- Maximum number of reflections: 1
- Noise predictions carried out at height of:
  - 1.5 m above ground to represent sound monitoring locations.
- As building height data were not included in the provided datasets, a default building height of 6.5 m has been assigned to all buildings with the exception of those with a footprint smaller than 10 m^2, which has been assigned a default height of 2.0 m.
- Ground absorption has been set as below:
  - A ground absorption value of G=1.0 (representing soft grounds) has been assigned to areas classified as natural land within OS mapping.
  - Remaining areas set to G=0.0 (representing hard grounds).
- Rail track assumed to be continuous welded rail on concrete or timber sleepers and ballast (CRN track correction factor of 0 dB).

Train details and used for railway noise modelling are shown in Table C.2.

Table C.2 Train Details

Train Movements	Train Type / Number of Vehicles	Vehicle CRN Noise Correction (dB)	
		Rolling	Full Power
Passenger trains operating between Ashington and Newcastle: - 32 daytime movements for each direction (northbound and southbound); and - 1 night-time northbound movement (empty train, before the start of the service in the morning).	Class 158 / 3	7.6	N/A
Freight train 1: 4 daytime movements for each direction (loaded northbound and empty southbound), operating along the entire scheme	Class 66 / 1	13.0	-13.4
	4 axle IIA type C wagons / 24	7.1 (loaded) 10.4 (empty)	N/A
Freight train 2: 4 daytime movements for each direction (empty northbound and loaded southbound), operating along the entire scheme	Class 66 / 1	13.0	-13.4
	HTA 4 axle / 24	7.1 (loaded) 10.4 (empty)	N/A
Freight train 3: 1 daytime movement for each direction, operating between West Sleekburn junction and Bedlington only	Class 66 / 1	13.0	-13.4
	2 axle PCA hopper wagons / 23	12.0	N/A

The provided train speed profile and railway gradient information were processed to identify those railway segments where locomotives will be on full-power as per the guidance in CRN. To do this, the following rules were adopted:

- Where railway gradient is lower than 10%, trains with increasing speed are assumed to be on full-power.
- Where railway gradient is equal or higher than 10%, trains with increasing or constant speed are assumed to be on full-power.

It is understood that each passenger train will be idling at stations, for a maximum period of 1 minute between arrival and departure. The only exception to this is the Ashington station where the idling period is 7.5 minutes (on average, likely to vary from 6 to 9 minutes) for each train. The sound emissions from idling trains was modelled with the following assumptions:

- Sound power level of the idling passenger train (Class 158) = 107.4 dB

- Idling train was modelled as a line source (~61 m long) located on the relevant railway centre line along the relevant station, at 0.4 m above the ground.

Appendix D PA Sound Design Report

1. Introduction

1.1. Acoustics Plus Ltd (APL) is an independent firm of multi-disciplinary acoustic engineers. APL is engaged by both private and public sector clients. APL is a registered member of The Association of Noise Consultants (ANC) and the author is a corporate member of The Institute of Acoustics (IOA).

1.2. APL has been instructed by Kilborn Consulting to model the proposed public address system (PA) which will provide audio coverage to the public areas of Ashington station. APL shall also outline the potential noise impact of the use of the proposed PA system upon adjacent residential occupiers following the station development.

1.3. The purpose of the PA is to provide audible and intelligible customer information. The performance of the PA system is determined objectively using the following parameters:

(a) Sound pressure level (SPL);

(b) Speech Transmission Index for Public Address (STIPA)

1.4. STI requirements should be attained for a SPL level that is adequate to maintain a reasonable signal-noise ratio over and above existing ambient noise levels.

1.5. With regard to system performance, APL has been advised that the following performance requirements are applicable (extracted from Network Rail Standard NR/L2/TEL/30134 Issue2).

8.1.1 Loudspeaker Coverage

Loudspeakers shall be positioned so that the minimum required sound pressure levels (SPL) can be achieved in areas specified by the Sponsor. Areas that need to be considered include:

a) Passenger Waiting Room

b) Ticket/Booking Hall

c) At platform waiting areas (defined as the first passenger-used door at front of train to the last passenger-used door at rear of train of the longest train stock used at the station)

d) Concourse area

8.1.3 Minimum Levels

The system shall provide a minimum SPL of 10dBA above normal ambient noise levels at all times within the range of 65dBA up to the maximum SPL level unless environmental noise pollution issues prevent this figure being achieved.

8.1.5 Maximum Levels

The system shall not exceed an average SPL over 8 hours of 85dBA and a maximum SPL of 90dBA.

8.4 Speech Intelligibility

The PA system shall have a minimum STI target of 0.5 in the areas specified in section 8.1.1 and 0.45 in acoustically difficult areas with due consideration given during the design to the reverberation time in all enclosed areas.

1.6. There are no specific standards or performance specifications in relation to noise overspill from PA systems. Network Rail Standard NR_L2_TEL_30134 Iss 2 acknowledges the issue in para 8.13 by stating *"The system shall provide a minimum SPL of 10dBA above normal ambient noise levels at all times within the range of*

65dBA up to the maximum SPL level unless environmental noise pollution issues prevent this figure being achieved."

1.7. BS4142:2014 Methods for rating and assessing industrial and commercial sound is often quoted when assessing the likelihood of complaint from a variety of sound sources. However, the revision to the standard in 2014 states (note item g):

"The standard is not intended to be applied to the rating and assessment of sound from:

a) recreational activities, including all forms of motorsport;

b) music and other entertainment;

c) shooting grounds;

d) construction and demolition;

e) domestic animals;

f) people;

g) public address systems for speech"

1.8. Notwithstanding the above and in the absence of any other specific guidance, the noise limits for the new PA system shall therefore be defined as follows:

- *For new PA systems the noise emissions should not exceed the 'marginal significance' rating level of +5dB above background noise levels as defined in BS 4142:1997 during defined operational periods. This was determined to be 07:00-22:00hrs. The PA system would not be available for use outside of these hours, with the exception of safety critical announcements;*
- *Non-residential receptors are out of the scope of this methodology and will be looked at on a case-by-case if deemed necessary.*
- *In the event that the new system is used for emergency evacuation purposes (voice alarm, VA), the VA mode is considered to be exempt from the noise limits and is not included in the assessment*

1.9. In order to determine the allowable specific noise level in accordance with the procedure described above, an evaluation of the following was undertaken:

(a) Background noise measurements obtained by Acoustics Plus;

(b) Predictions of noise from the proposed PA system at the nearest noise sensitive properties (using acoustic modelling);

2. Background Information

2.1. In the case of Ashington Station, a new PA system is proposed to provide audible and intelligible customer information announcements. It is the intention to provide the ability to broadcast audio along the full length of the platform.

2.2. Given the location of the station and its proximity to residential properties, it is likely that the normal operation of the PA system will be audible at adjacent noise sensitive properties around the station. A site location plan showing the stations proximity to residential properties is shown in Figure 1 below. For clarity, the nearest noise sensitive properties (along with the proposed platform) have been outlined.

Figure 1 – Site Location Plan

2.3. The new PA system will be designed based on best practice noise mitigation measures as a standard part of the system design process. This will include the adoption of the latest available technology and the selection/positioning of loudspeakers to minimise noise nuisance to nearby residents.

2.4. The standard mitigation design measures shall include:

(a) The use of ambient noise sensing microphones to limit the volume of PA broadcast levels. ANS microphones will be installed on the platform. This will allow the PA system to automatically detect the local ambient noise conditions for each zone and to adjust PA announcement levels to an appropriate level. In this way broadcast levels can be reduced to the minimum required during quieter periods at the station, hence minimising the noise impact at nearby properties;

(b) *Level reduction during unsociable hours. The new systems' configuration software will allow the automatic reduction of PA system output levels during early morning and/or late evening hours;*

(c) *Optimisation of loudspeaker layout designs. The noise impact of a distributed PA system can be minimised by:*

- *keeping loudspeaker positions as low as practically possible;*
- *using a larger number of evenly distributed loudspeakers set at lower power;*
- *aiming loudspeakers appropriately towards the platform area and in the opposite direction to neighbouring properties, where possible.*

2.5. Measurements of ambient noise at the proposed location of the station were obtained during typical traffic hours on 16th June 2020.

2.6. The following average ambient noise level was measured and is considered as representative of existing noise levels experienced at the nearest noise sensitive properties. A level vs time history plot is shown in Figure 2. The highlighted events were excluded from the overall ambient noise survey project results.

Location	L_{eq} Octave band ambient noise level (dB)							dBA
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
John Street	45	40	39	38	36	43	40	47

Table 1 – Station background noise measurements

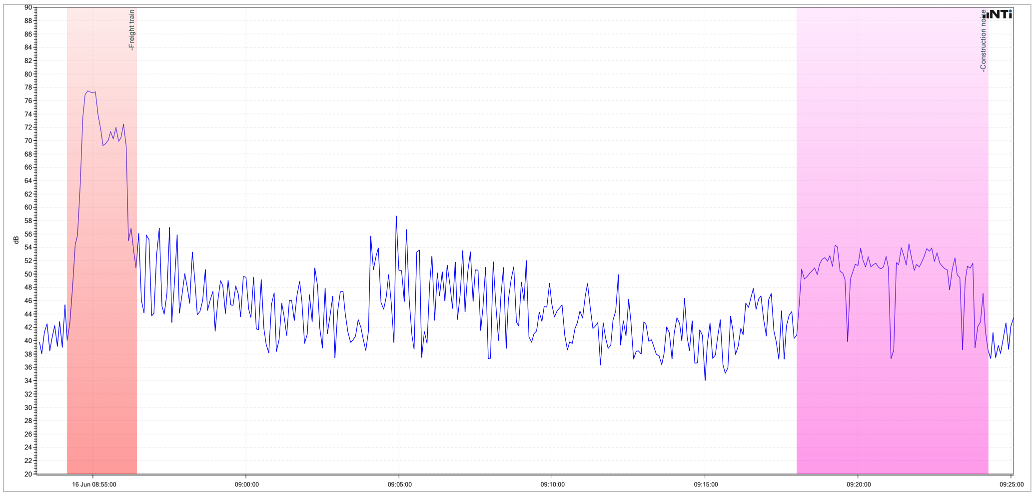

Figure 2 – Ambient noise level v time plot

3. Loudspeaker Design

3.1. The acoustic models were created using Enhanced Acoustic Simulator for Engineers (EASE 4.4.61.16 AURA Module 4.0).

3.2. Acoustic modelling using EASE consists of the following steps:

(a) *The import of geometry data from a CAD based program such as AutoCAD or SketchUp.*

(b) *The assigning of acoustic properties of each surface within the model (to include absorption coefficients and scatter).*

(c) *The placement and definition of proprietary loudspeakers (to include sensitivity and directivity).*

(d) *The calculation of relevant acoustic parameters, such as SPL and STIPa.*

3.3. The geometry data was extracted from scaled drawings provided by Kilborn Consulting. Minimal station detail was available, other than the likely lighting post spacing which was advised to be 12m.

3.4. The 3D geometry utilised for the purposes of acoustic modelling is shown in Figure 3 below. The lighting posts have been employed for loudspeaker placement.

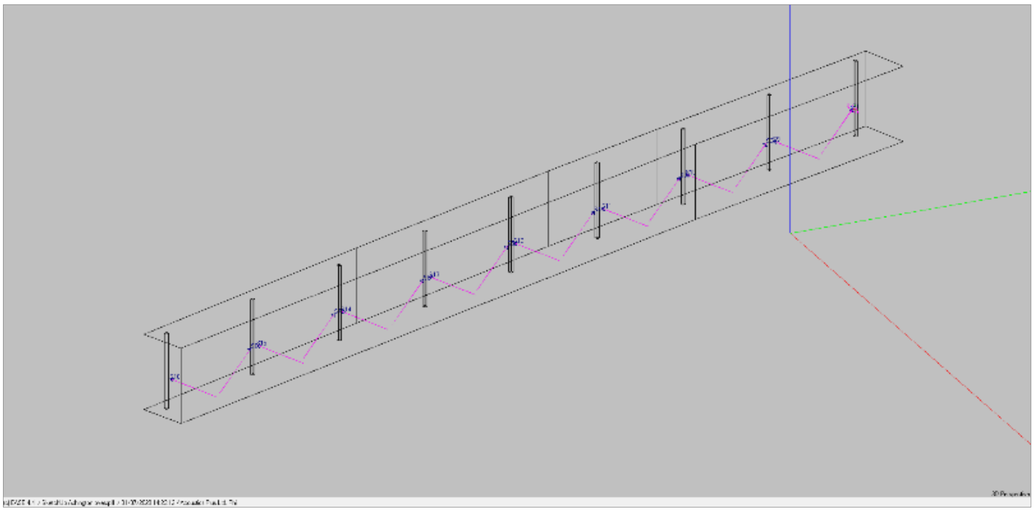

Figure 3 – Platform acoustic model

3.5. The design of the proposed public address system consists of projector loudspeakers mounted on the lighting posts at a height of 2.8m. The overall gain of the public address system has been adjusted to achieve a minimum SPL on the platform of 65dBA, which is more than 10dB above ambient noise levels.

3.6. The design has utilised an increased number of loudspeakers to ensure individual loudspeakers can be powered as low as possible to minimise noise overspill to nearby noise sensitive properties.

3.7. The acoustic modelling exercise produced the following predictions of audibility and intelligibility (see Figures 4 and 5). The predictions are based on a 1m grid of receiver positions at a height of 1.6m above finished floor level, in accordance with the requirements of para 8.1.2 of NR/L2/TEL/30134 Issue2.

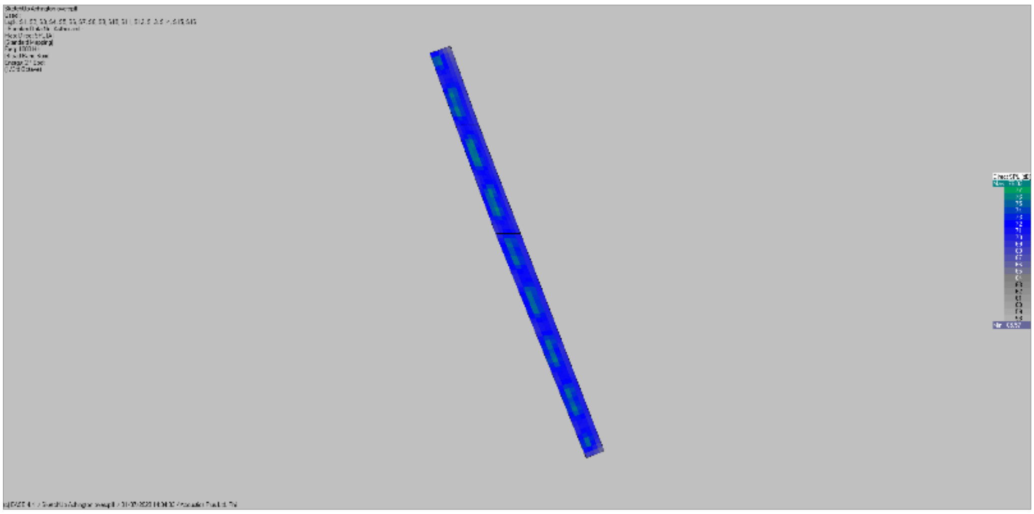

Figure 4 – Platform SPL predictions

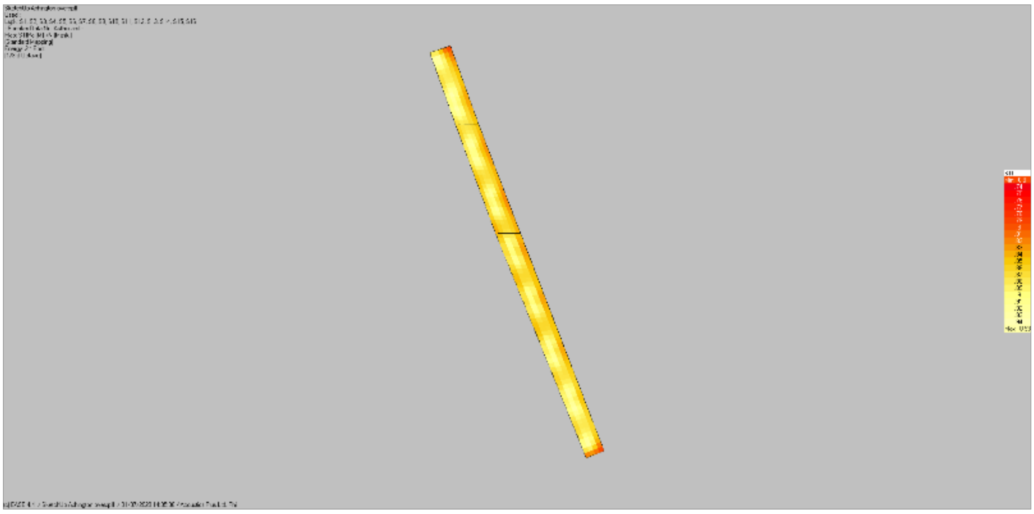

Figure 5 – Platform STIPA predictions

3.8. The average sound pressure level on the platform is 71dBA. The average speech intelligibility rating (x̄ - σ) is 0.836 STIPA. The predictions of STIPA account for signal masking and prevailing ambient noise levels.

4. Noise Assessment

4.1. A noise assessment was undertaken to predict the noise overspill from the station. An acoustic model was used to predict how the noise from the PA system will propagate away from the station premises, factoring in loudspeaker placement and directivity, announcement frequency and proximity of noise sensitive properties. The model was used to predict the specific noise level at a number of the worst affected receptor locations for the station.

4.2. Since the PA systems will not be in constant use, a correction was applied to account for the typical duration and frequency of PA broadcasts at the station. Whilst the exact number or duration of future announcements cannot be determined exactly, it is considered that allowing for an announcement of duration 30 seconds every 5 minutes would seem reasonable.

4.3. The following formula was used to adjust the sound pressure level, L_p, for on-time correction over a 1 hour reference period:

ΔL_p, dB = 10log (T_o / T_r)

Where:

T_o = On-time interval and,

T_r = reference time interval (1 hour

4.4. From the foregoing example of announcement duration and frequency, the calculation would be as follows:

Revised on-time correction = 10log (360/3600) = -10dB

4.5. Given that the acoustic characteristics of the announcements can be considered to be significantly different to the existing ambient noise, a +5 dB distinct character correction was assumed as part of the assessment in determining rating noise levels.

4.6. From the foregoing, the noise impact assessment was based on a minimum platform announcement level of 65dBA (extracted from NR_L2_TEL_30134 Iss 2) and corrected as follows:

On time correction = -10dB

Acoustic character correction = +5dB

4.7. The background noise measurements used in the assessment were obtained by APL and are reported in Table 2 below.

4.8. The target noise levels based on the preceding assumptions are therefore as follows:

BS4142 calculation	Daytime
Measured background noise level, dB $L_{A90,T}$ in area	*37dBA*
Target excess of rating level over background noise level, dB(A)	*5dB*
Target rating level, dB at the nearest residential property	*42dBA*

TABLE 2 – BS4142 TARGET NOISE LEVELS

4.9. In order to calculate the noise impact of the proposed PA system, an acoustic model of the station was used. This acoustic model correctly accounted for the placement and directivity of the speakers together with the distance from the platform speakers to the adjacent noise sensitive properties. The acoustic model utilised a GRIP 3 OS plan.

Figure 6 – Noise sensitive properties

4.10. This model was imported into acoustic modelling software in order to calculate the noise impact. Listener 'seats' were placed at 4No. noise sensitive façades.

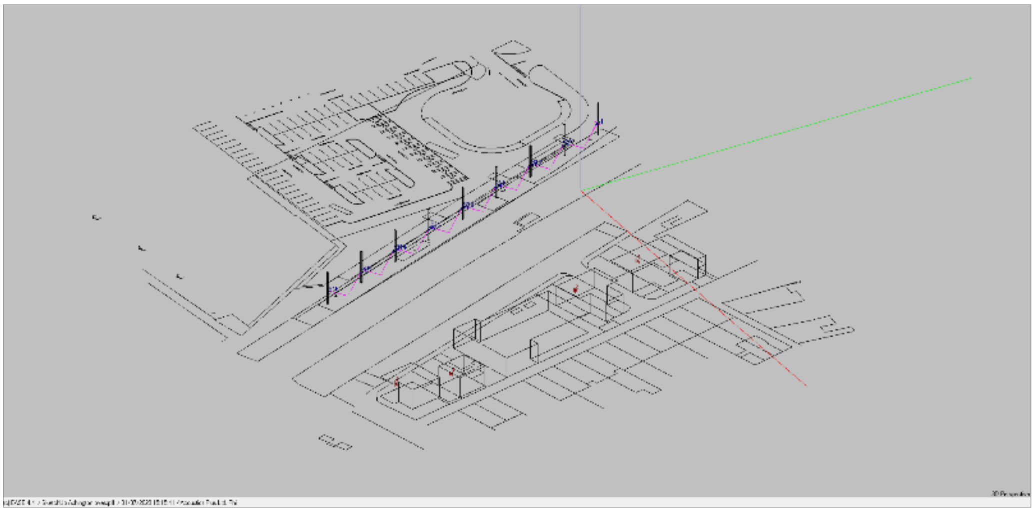

Figure 7 – Station acoustic model showing listener positions

4.11. The noise impact was calculated at 4No. listener seats as indicated in Figure 7. The following results were obtained at each listener position, based on an average platform announcement level of 71dBA and a minimum SPL of 65dBA.

Noise impact assessment	Predicted noise level	Excess over target rating level
Listener seat 1	48dBA	*+6dB*
Listener seat 2	49dBA	*+7dB*
Listener seat 3	46dBA	*+4dB*
Listener seat 4	46dBA	*+4dB*

Table 3 – BS4142 rating level

5. Comments

5.1. In order to meet the minimum SPL requirements outlined in para 8.1.3 of Network Rail Standard NR/L2/TEL/30134 Issue2, the noise impact assessment demonstrates that there is a likelihood of adverse impact, particularly during the evening period when the background noise around the station is likely to be lower.

5.2. Given the proximity of noise sensitive properties adjacent to the proposed station, it is considered impossible to meet the minimum Network Rail SPL requirements whilst meeting the proposed target rating levels.

5.3. Notwithstanding the above and given the very low ambient noise levels, it would be possible to operate the PA system at a lower level to minimise the loss of amenity risk whilst still maintaining a minimum SPL of 10dBA above normal ambient noise levels at all times.

Appendix E Sources of Uncertainty

The following sources of uncertainty have been noted:

- Future railway sound predictions have utilised the calculation method in CRN. The CRN calculation method assumes a smooth track and does not account for rail or wheel roughness. The report produced by AEAT on behalf of Defra “Rail and wheel roughness – implications for noise mapping based on the Calculation of Railway Noise procedure”[27] recommends a correction to the predicted level using CRN to account for the rail roughness. The correction varies from 0 dB (at speeds of less than 42 km/h) to a maximum of around 5 dB at speeds of 200 km/h. At the train speeds anticipated in the vicinity of the proposed development (between 0 and around 60 km/h), this correction is around 1 dB or less. A 1 dB change would not significantly alter the conclusions of this assessment. The current condition of the railway track is not known therefore the calculations undertaken to inform this assessment have not accounted for any present roughness or potential reduction in roughness due to the proposed NL Upgrades. It is also a requirement of the NIR that the calculation method in CRN is used when determining property eligibility.
- Road traffic sound emissions have been based on provided traffic flow data for the year 2039. The uncertainty in these data (discussed in the Transport Assessment) is therefore also present in this assessment.
- Building heights have been estimated as described in section 8.3. Where screening due to existing buildings exists, a degree of uncertainty in predicted sound pressure levels at the receptors will result from the use of these estimates. The main source of sound in the predictions is the trains passing by the properties, at which point there will be direct line of sight between the property and the track. Therefore this uncertainty is expected to be minimal.
- Predictions of future train vibration are based on standard assumptions which will have a wide degree of accuracy. In particular, the assumption that the acceleration generated by freight and passenger train passbys is unlikely to be accurate, in reality passenger trains are likely to generate much lower levels of acceleration. Therefore the assessment considers a worse impact than is likely to occur.
- The modelling of PA system sound has been undertaken by a third party. AECOM Acoustics has relied upon the results but have not validated the model. Therefore, the uncertainty in these predictions is unknown. The modelling will be refined during the detailed design stage and this will decrease the associated uncertainty. The predictions of the sound level at R9 are based on an indicative masterplan layout submitted as part of the outline planning application. Before the properties can be constructed or occupied, a detailed planning application has to be submitted which may change the locations of the closest properties to the railway, which would change the railway noise levels.

In addition, any measurement of existing ambient or background sound levels will be subject to a degree of uncertainty. Environmental sound levels vary between days, weeks, and throughout the year due to variations in source levels and conditions, meteorological effects on sound propagation and other factors. Hence, any measurement survey can only provide a sample of the ambient levels. Every effort is made to ensure that measurements are undertaken in such a way to provide a representative sample of conditions, such as avoiding periods of adverse weather conditions, and school holiday periods (which are often considered to result in atypical sound levels). However, a small degree of uncertainty will always remain in the values taken from such a measurement survey.

27 Defra Research Report, AEAT (2004). Rail and wheel roughness – implications for noise mapping based on the calculation of railway noise procedure.