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Brondes Age PH, Kilburn High Road.

Noise Assessment

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Appendices

1.0 Introduction

1.1 Sharps Gayler LLP have been commissioned to provide an acoustic assessment relating to a proposed mixed scheme at 328 Kilburn High Road. The proposed development is described as:

"Demolition and redevelopment with a 4 storey building to provide a commercial unit (to be used for A1, A2, A3, or A4 purposes) at ground floor; and 8 self-contained flats (4 x 1 bed, 3 x 2 bed and 1 x 3 bed) at first, second and third floor levels; cycle and refuse storage."

1.2 The site currently comprises a single-storey building, the Brondes Age Public House. The site fronts on to Kilburn High Road, with an elevated railway along the flank (part of the "Overground" network, adjacent to Brondesbury Station).

1.3 This report assesses the sound insulation requirements of the building's external and internal structures necessary to achieve appropriate internal noise level criteria for future residents.

1.4 This report details the environmental noise survey undertaken in January 2017 to assess the current noise climate at the site. This data forms the basis of assessing the acoustic requirements of the building, in order to achieve acceptable internal noise criteria for the proposed uses, and for background noise levels to establish noise emission criteria in future.

2.0 Assessment Criteria

National Policy

2.1 The National Planning Policy Framework (NPPF) sets out the Government's economic, environmental and social planning policies for England and "these policies articulate the Government's vision of sustainable development." In respect of noise, Paragraph 123 of the NPPF states the following:

"Planning policies and decisions should aim to:

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

2.2 The NPPF reinforces the provisions within the March 2010 DEFRA publication, "Noise Policy Statement for England" (NPSE), which states three policy aims, as follows:

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

- *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 improvement of health and quality of life."*

2.3 Together, the first two aims require that significant adverse impacts should be avoided and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

"… all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."

Local Policy

2.4 The London Plan (March 2016) contains policies relating to noise. The policies are general in nature and similar to those above in the NPPF and NPSE regarding avoiding and mitigating noise impacts. The Plan does not give specific criteria but does cross-refer to guidance such as that included in BS 8233: 2014, which is discussed below. The London Plan objectives are met by the application of the criteria and assessment methodologies set out below.

Internal Noise Levels - Residential

2.5 It is possible to apply objective standards to the assessment of noise and the design of new dwellings and how one should seek to achieve these objective standards. The nationally applied standard is BS 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings'. Table 4 of the standard contains the following design targets for residential dwellings, which have been adopted in the consideration of the development design:

BS8233:2014 Table 4 – Indoor ambient noise levels for dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB LAeq, 16 hour	--
Dining	Dining room/area	40 dB LAeq, 16 hour	--
Sleeping (daytime resting)	Bedroom	35 dB LAeq, 16 hour	30 dB LAeq, 8 hour

2.6 NOTE 5 to Table 4 of BS8233:2014 states that *"If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."* Similar advice is given in the Online National Planning Practice Guidance-Noise (PPG-N), which states that "*consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary."*

External Areas (Residential Amenity Space)

2.7 For outdoor areas (i.e. gardens/terraces and balconies), BS 8233:2014 recommends that "*it is desirable that the external noise level does not exceed 50 dB LAeq,T, with an upper guideline value of 55 dB LAeq,T."* However, the document recognises that these guideline values are not achievable in all circumstances and in higher noise areas, a compromise might be warranted. In such circumstances, development should be designed to achieve the lowest practicable levels in these external amenity spaces.

2.8 It should be noted that the guideline values in BS8233, derived originally from the World Health Organisation Guidelines for Community Noise, reflect the Lowest Observable Adverse Effect Level (LOAEL). That is, they are not limits, but levels below which the effects of noise are negligible. Significant effects (i.e. the Significant Adverse Effect Level, SOAEL) would not occur until much higher degrees of exposure. In other words, design for compliance with the LOAEL levels given in the documents would robustly meet the first aim of the NPPF in avoiding significant adverse impacts and the second aim in mitigating and minimising other adverse impact

3.0 Noise Surveys

3.1 An environmental noise survey was carried out from 23rd to 24th January 2017 to determine the existing noise levels in the vicinity of the site. This survey included long-term measurements over a 24-hour period at one location and sample measurements of passing trains at another.

3.2 The measurements are representative of the location of the nearest parts of the site to the relevant noise sources (i.e. Kilburn High Road and the adjacent railway). The measured levels have been analysed to provide "design levels" reported below.

3.3 The measurement locations are shown in Appendix A, and the full survey results and summaries are shown in Appendix B. Measurements were taken at roof level, with a full view of the road and/or railway as appropriate and in free-field conditions.

3.4 The long-term measurements were made in 15 minute periods. Short term measurements of passing trains were made as "Single Event Level" (SEL) measurements, which can then be used, alongside timetable data, to calculate long-term rail noise levels in isolation of other noise sources.

3.5 Measurements were made using calibrated type 1 sound level meters and data logging systems. The meters were field checked for calibration before and after the measurements. No drift was noted. The weather was cold, but dry and calm with no significant wind.

Kilburn High Road

3.6 The results of the survey can be summarised as follows. These are free-field levels and represent the "design levels" used to determine the requirements of the façade sound insulation set out later in the report.

Period	Sound Level (dB)	
	LAeq	LAMAX
Daytime (0700-02300)	69 dB	n/a
Night (2300-0700)	65 dB	81 dB

Adjacent Railway

3.7 Based on the measurements of individual train passbys and timetable data, calculated rail noise levels in isolation (see Appendix C) are as follows. Again, these are free-field levels and represent the "design levels" used to determine the requirements of the façade sound insulation set out later in the report.

Period	Sound Level (dB)	
	LAeq	LAMAX
Daytime (0700-02300)	56 dB	n/a
Night (2300-0700)	48 dB	74 dB

4.0 Sound Insulation Requirements of the Building Envelope

4.1 The acoustic performance of the building elements is expressed below in terms of Sound Reduction Index (R) in octave bands. Example glass configurations are given in the format glass-cavity-glass, in millimetres. It is assumed that the minimum cavity depth would be 20mm, for thermal reasons. The recommendations apply to all floor levels on the facades in question.

Kilburn High Road (Front Elevation)

4.2 Facades on Kilburn High Road will be exposed to relatively high levels of noise, especially at night, dictated principally by road traffic noise and high peak levels from, for example, emergency vehicle sirens etc. This is common for sites such as the proposed development which are in a busy urban location. This will require a high specification for acoustic windows to bedrooms. For typical sized windows the following specifications are recommended:

Window System Performance – R(dB) – Kilburn High Road

	Ref	Octave band centre frequency Hz						
		63	125	250	500	1k	2k	4k
Living Rooms	1	23	26	34	40	42	40	50
Bedrooms	2	25	28	33	43	47	50	56

4.3 The specification above (Reference 1) for living rooms is based on the performance of an example 6-20-10 sealed unit double-glazed system. For information purposes, the overall weighted sound reduction index of the example system is 39 dB R_W+C_{TR}, but it is important that the spectrum performance set out above is achieved, not just the overall sound weighted sound reduction index.

4.4 The specification for bedrooms (Reference 2) is dictated by the high level peak (L_{AMAX}) noise events generated by passing traffic etc. The specification above is based on an example high acoustic performance system, such as a 10-20-8.4(laminated) acoustic glazing system.

4.5 The overall performance of the example system would exceed 45 dB R_W+C_{TR} but it is important that the spectrum performance set out above is achieved, not just the overall sound weighted sound reduction index.

Flank Elevation – Rail and Road Traffic

4.6 Whilst at an angle to the road, the requirements on this façade will still be dictated by road traffic noise, which would dominate over rail noise. It is recommended that the specifications for living rooms (Reference 1) and bedrooms (Reference 2) also be installed on this façade.

4.7 For ease of construction, it may be preferable to install a glazing system meeting the requirements of the specification Reference 1 in the table above to all windows on the front and flank facades. An additional 6mm secondary pane (with a minimum 100mm reveal) can then be installed to bedrooms on these facades to bring the overall specification for those rooms to the requirements of the specification for Reference 2.

Rear Facade

4.8 The rear façade will be very well screened from the road, such that residual rail noise will dictate acoustic requirements. The trains in this location are relatively slow moving into and out of Brondesbury Station. It is understood that very occasional freight traffic uses the line, but this is not considered to dictate acoustic requirements because of the infrequent nature of such events.

4.9 For typical sized windows the following specification is recommended for all rooms:

Window System Performance – R(dB) – Rear façade (all windows)

	Ref	Octave band centre frequency Hz						
		63	125	250	500	1k	2k	4k
All Rooms	3	21	24	22	29	39	33	38

4.10 The specification above (Reference 3) is based on the performance of an example 6-20-6 sealed unit double-glazed system ("standard" thermal double-glazing). For information purposes, the overall weighted sound reduction index of the example system is 33 dB R_w+C_{TR}, but it is important that the spectrum performance set out above is achieved, not just the overall sound weighted sound reduction index.

4.11 Full details of the glazing systems, including window and room sizes would be analysed, on behalf of the developer, prior to installation to ensure the internal standards will be achieved.

4.12 The internal noise environment for future residents would be acceptable, and within BS 8233:2014 standards, by the provision of the glazing systems meeting the above specifications. This can best be ensured by the imposition of a suitably worded planning condition.

Ventilation

4.13 Background ventilation, in accordance with Building Regulations, would need to be provided to residential units. Ventilation can be achieved by way of a number of widely available acoustic vent systems, either in the window frames or through the walls. The acoustic performance of the vents should be so as not to degrade the sound insulation performance of the façade as a whole.

4.14 Alternatively, a whole-building ducted passive or active ventilation system can be installed, with acoustically treated intakes and outlets where necessary. Such a system may be required on the Kilburn High Road and flank façades for bedrooms, as a result of the requirement for a high level of sound insulation to these rooms. Calculations of overall façade performance including cladding, windows and ventilation openings would need to be undertaken to confirm adequate sound insulation on an ongoing basis.

4.15 The final specification and design of any glazing and ventilation systems would be determined at construction stage, and this can be required to be submitted for approval through the imposition of an appropriate planning condition, following the general concepts set out above.

External Areas

4.16 The Proposed Development contains balconies. It is unlikely that every balcony on the development would meet the required guideline noise value of 50 – 55 dB due to the external ambient noise levels from road traffic noise. Without enclosing the balcony areas there are no feasible mitigation measures available to reduce the noise level, albeit the recessed balconies proposed will provide the best screening possible. This is not an unusual situation in London, and one where the guidance in BS 8233:2014 Paragraph 7.7.3.2 regarding flexibility applies:

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

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

4.17 The external amenity space proposed is in the form of small balconies where the BS8233:2014 suggests that noise limits should not be necessary.

4.18 The National Planning Practice Guidance contains similar advice (paragraph 009):

"Are there further considerations relating to mitigating the impact of noise on residential developments?

Yes – the noise impact may be partially off-set if the residents of those dwellings have access to:

- *a relatively quiet facade (containing windows to habitable rooms) as part of their dwelling, and/or;*
- *a relatively quiet external amenity space for their sole use, (e.g. a garden or balcony).*

Although the existence of a garden or balcony is generally desirable, the intended benefits will be reduced with increasing noise exposure and could be such that significant adverse effects occur, and/or;

- *a relatively quiet, protected, nearby external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings, and/or;*
- *a relatively quiet, protected, external publically accessible amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance)."*

4.19 There is a park (Kilburn Grange Park) approximately 220 metres from the site.

4.20 On the basis that balconies are small and there is alternative public space nearby, it is not considered that noise levels on balconies should render the development unacceptable in any way given the urban location.

5.0 Noise Generated by the Development

5.1 Noise from the commercial elements will be contained within the buildings by way of normal construction detailing and, possibly, internal noise limits (to control music noise, for example). Such measures are not unusual in urban mixed developments and can either be controlled by planning conditions or lease agreements, or both. Sound transfer from commercial elements to adjacent residential units will be controlled through the design and construction of the development where appropriate. Sound insulation requirements and detailing can be required through the imposition of an appropriate planning condition.

5.2 Plant and machinery noise emissions (for example from lift machinery, water heating systems and mechanical ventilation systems) will need to be controlled, but this is not unusual, and simple measures can be incorporated into the construction design.

5.3 It would be normal to impose a planning condition limiting plant noise emissions to a level relative to the background noise level at the nearest sensitive receptors. It would be common for a Local Authority to have a requirement that plant noise be controlled to 5 dB below the background level at the nearest premises (likely to be other flats on Kilburn High Road). The following condition would be appropriate:

"The level of noise from all fixed plant and machinery installed at the site shall be 5 dB below the pre-existing background noise level at any time when measured or calculated at 1 metre from the facade of the nearest existing noise sensitive properties."

5.4 Background sound levels in the area are relatively high and, from experience, designing plant noise levels to 5 dB below those figures would be practicable with careful selection and location of plant and screening/noise control engineering as appropriate.

6.0 Conclusions

6.1 Noise survey data obtained in January 2017 has been used to assess the noise climate impingent on the proposed future development at the Brondes Age PH site at 328 Kilburn High Road.

6.2 External and internal noise level criteria have been proposed in line with the standards set out in BS 8233:2014, the World Health Organisation guidelines.

6.3 The noise surveys have shown that levels are such that attenuation should be included in the proposed development to control noise. Initial calculations of façade glazing systems required to achieve the internal noise criteria set out have been undertaken. A general specification for acoustic glazing systems is provided.

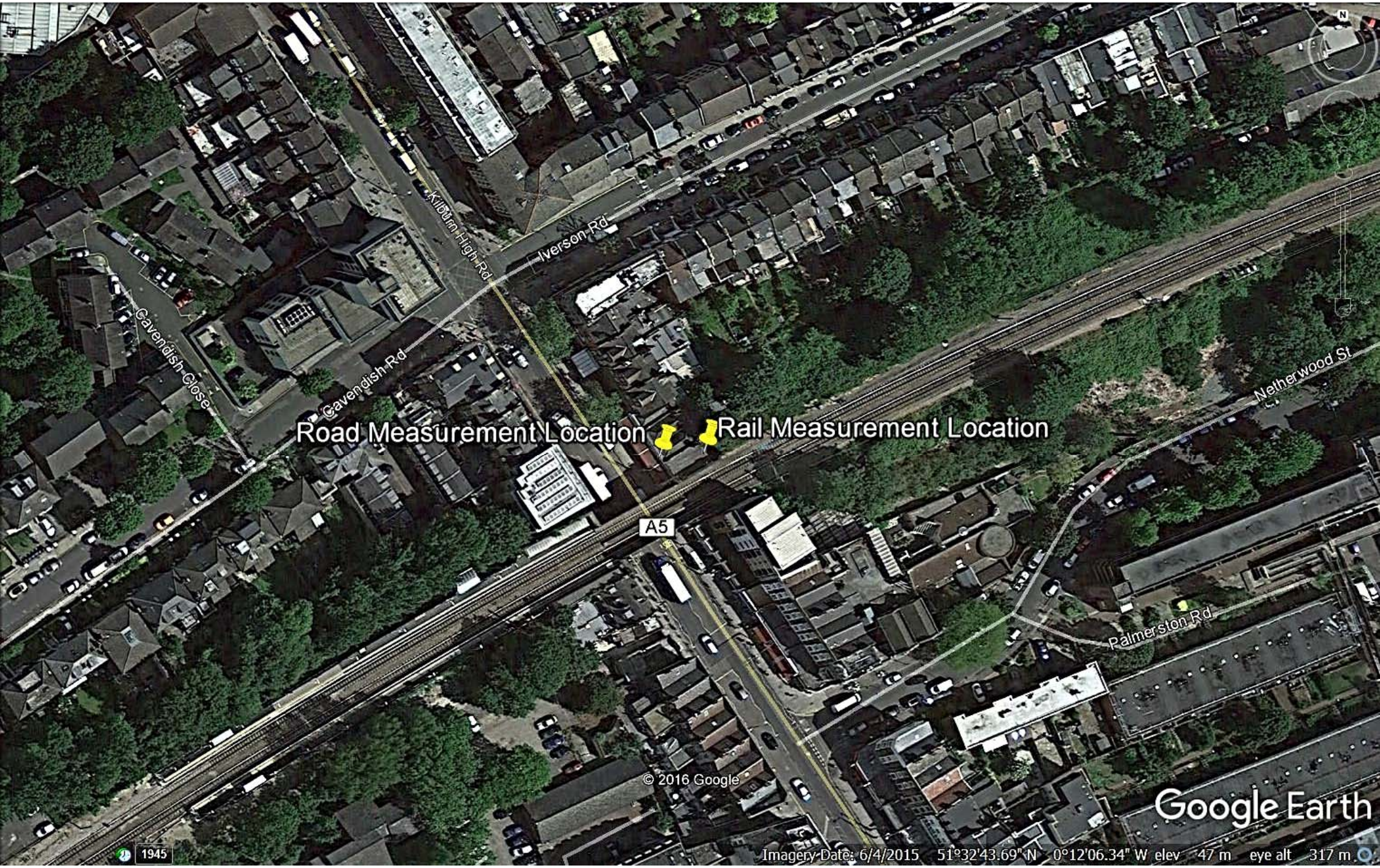
6.4 Ventilation to residential apartments, where it would be expected that windows remain closed to control noise, would be provided via acoustically treated vents in the window frame or walls, or via an alternative whole-building system with carefully located acoustically treated intakes and outlets.

6.5 Whilst balcony spaces on the extremities of the proposed development are expected to exceed guideline values (as is common in urban areas such as this site), the development design would reduce these levels as far as reasonable practicable and a flexible approach in line with the advice in BS 8233:2014 and the online National Planning Practice Guidance is appropriate, including consideration of available public open space nearby.

6.6 Noise from the commercial elements, along with plant and machinery noise emissions, can be controlled by way of planning condition where appropriate/necessary.

6.7 The development can, therefore, be constructed and designed to achieve acceptable standards for future and current residents, in accordance with national standards.

Appendix A: Site Location Plan – Aerial View


Iverson Rd
Kilburn High Rd
Cavendish Close
Cavendish Rd
Road Measurement Location
Rail Measurement Location
Netherwood St
A5
Palmerston Rd
© 2016 Google
Google Earth
1945
Imagery Date: 6/4/2015 51°32'43.69" N 0°12'06.34" W elev 47 m eye alt 317 m

Appendix B: Noise Survey Results

Date	LAeq	LAMAX	LA90	Leq							Lmax						
				63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz
(2017/01/23 13:00:03.00)	71.2	96.2	60.6	72.1	65.4	63.1	61.5	66.8	66.4	60	85.3	79.6	79.5	76.1	94	93.7	84.9
(2017/01/23 13:15:03.00)	66.8	89.9	59.8	71	64	61.8	60.2	62.1	61.2	55.6	84.2	78.3	78.2	74.7	82	86.2	82.1
(2017/01/23 13:30:03.00)	68.1	89.9	59.3	71.7	65.2	62.1	60.9	63.5	62.7	56.7	86.1	80.9	75.9	74.2	86.1	86.6	80
(2017/01/23 13:45:03.00)	68.4	92.8	58.7	70.7	65.4	61.5	60.6	65.4	61.6	55.3	86.1	90.7	76.1	77.9	90.7	88.1	80.6
(2017/01/23 14:00:03.00)	66.7	85	59.2	70.8	64.2	61.5	60.5	62.6	60.5	55.7	85.8	76.9	73.1	74.1	83.1	80.2	79.4
(2017/01/23 14:15:03.00)	67	85.5	60.7	72.3	65.6	64	61.5	62.4	60.6	55.5	86.1	79.6	83.3	81.9	82.9	77.9	74.3
(2017/01/23 14:30:03.00)	65.9	76.8	60.1	72.3	64.6	61.8	60.3	61.7	59.6	53.7	89.7	81.6	74.1	71.6	73.2	71.6	68.7
(2017/01/23 14:45:03.00)	67	79.4	60.3	72.2	64.3	64.2	63.2	62.6	60	53.9	89.3	79.2	78	77.6	74.8	75.3	68.5
(2017/01/23 15:00:03.00)	67.9	87.1	59.3	71.7	65.5	63.6	62.1	62.9	61.4	58.3	85.7	80.3	84.3	81.5	82.4	80.6	82.7
(2017/01/23 15:15:03.00)	66	81.7	60.5	71.4	65.7	62.2	60.6	61.9	59.6	54.1	85	84.4	78.4	76.8	76.7	76	73.4
(2017/01/23 15:30:03.00)	66.5	82.4	59.7	72.3	68	62.8	61.3	62.3	59.8	54.5	89.8	90.1	77.8	72.8	72.6	75.2	78.8
(2017/01/23 15:45:03.00)	65.3	80.4	59.4	70.7	64.3	61.7	60.1	60.9	58.9	53.8	81.5	75.7	74.7	71.4	71	74.4	76.8
(2017/01/23 16:00:03.00)	65.5	77.4	59	71.5	64.3	62.3	60.6	61.4	58.7	53.1	84.5	79.2	76.6	76.2	75.8	71.1	73.1
(2017/01/23 16:15:03.00)	65.7	83.1	60.1	70.9	67.2	63.1	60.5	61.2	59.1	53.4	86.2	87.2	82	73.3	70.9	76.8	76.7
(2017/01/23 16:30:03.00)	66.3	84.6	58.6	71.8	67.7	63.4	61.4	62	59.6	53.8	88.3	89.3	81.4	79.4	81.9	79.2	72.8
(2017/01/23 16:45:03.00)	73.3	100	60.3	71.2	66.6	68	64.1	68.8	68	62.6	86.9	90.2	95.5	90.5	94.2	95.4	91.7
(2017/01/23 17:00:03.00)	66.4	88.1	59.2	72.3	65.7	64.7	62.1	61.1	59.7	55.6	92.2	82.7	84.8	79.5	73	83.4	86.9
(2017/01/23 17:15:03.00)	71.1	97.5	59.6	71.8	65.3	62.1	60.7	66.7	66	61.1	87.6	81.9	75	79.6	93.5	94.4	88.9
(2017/01/23 17:30:03.00)	72.9	100.4	60.3	70.2	65.4	62.8	61.1	65.6	67.8	66.7	83.5	80.1	83.6	77.6	92.2	96.8	96.8
(2017/01/23 17:45:03.00)	74.3	96.9	59.2	70.4	63.9	60.9	61.9	71.6	68.8	55.6	83	76.8	76.9	86.4	95.7	93.6	82.9
(2017/01/23 18:00:03.00)	65.3	84.1	60.3	72.1	66.2	64	60.4	60.4	58.5	53.4	90.2	86.6	88.8	75.6	79.7	79.1	80
(2017/01/23 18:15:03.00)	67.9	91.9	60	71.7	65.5	62	63.3	65	59.1	53.7	89.9	82.3	81.5	91.3	90.9	77.9	73.8
(2017/01/23 18:30:03.00)	65	79.9	59.2	72.3	66.5	62	60.2	60.6	58.5	52.2	88.7	83.2	78	72	70.4	78.1	71.2
(2017/01/23 18:45:03.00)	65.2	81.4	60.8	71.6	67	63.4	60.9	60.4	58	53.4	84	81.6	76.5	74.6	73	72	76.1
(2017/01/23 19:00:03.00)	65.1	83.6	57.9	70	63.1	61.3	60.1	61.2	58.5	51.8	86.4	75.4	76.4	77.7	81.8	76.1	69.6
(2017/01/23 19:15:04.00)	65.9	81.3	59.2	69.9	64.3	61.5	60.6	61.6	59.8	53.5	85.6	80.6	73.6	73.2	75	78.1	73.2
(2017/01/23 19:30:03.00)	65.8	84.2	59.6	70.7	65	64.5	61.6	60.8	58.9	53.4	82.2	84.2	88.8	82.5	75.1	76.7	73.6
(2017/01/23 19:45:03.00)	73.5	98.4	59.8	72	66.6	62.8	61.4	69.3	68.1	65	88.6	83.6	78.8	83.9	96.5	94.7	90.7
(2017/01/23 20:00:03.00)	65.5	84.7	59.3	69.5	64	63.1	60.1	60.9	58.8	54.9	91.5	77	78.5	74.3	71.3	78.7	79.2
(2017/01/23 20:15:04.00)	69	94.4	58.9	69.3	62.8	60.8	60.3	64.8	63.6	58.7	85	78.3	76.9	81.1	91.1	91.2	84.8
(2017/01/23 20:30:03.00)	65.1	79.4	59.3	70.3	67.7	64.2	60.1	61	58	51.1	89.2	89.2	87.2	75.5	77.5	72.3	66.1
(2017/01/23 20:45:04.00)	65.5	86.5	58.1	69.4	64.1	63	61.6	61.1	58.4	52.2	84.9	81.6	90.2	85.4	78.6	76	77.1
(2017/01/23 21:00:03.00)	65	85.2	55.9	69	61.8	59.1	58.6	61.1	59.1	52.2	87.3	75.6	75.9	69.6	80.7	80.1	78.4
(2017/01/23 21:15:03.00)	68.2	91.9	58.3	71.1	65.6	64.1	61.7	65.5	61.2	52	92.4	86	85.9	83.7	91.2	87.3	77.9
(2017/01/23 21:30:04.00)	65.1	84.7	58.2	68.5	62.2	60.8	60	61	58.3	53	81.8	74.1	72.9	74.9	80.1	79.9	74.7
(2017/01/23 21:45:03.00)	65.1	86.9	57	69	63.5	60.1	60.3	61.3	58.5	52.3	88.3	85.8	78.8	76.6	79.9	82	80.7
(2017/01/23 22:00:04.00)	65.3	77.8	58.1	68.5	61.7	60	60.3	61.7	58.6	51.2	91.3	74.8	74.4	71.7	71.6	74.3	70.6
(2017/01/23 22:15:03.00)	70.9	96.5	57.2	69.5	63.1	60.1	59.4	65.9	65.7	62.7	87.2	87.9	81.2	79	92	92.2	90
(2017/01/23 22:30:03.00)	68.6	94	56	71.7	68.3	65	64.4	64.9	60.9	56	94.8	95	93.1	90.2	91.5	85.1	79.4
(2017/01/23 22:45:03.00)	71.2	97.8	57.1	70.4	65.2	63.3	60.9	66.3	65.7	63.4	92.5	87	80.1	75.8	94.5	91.7	92.4
(2017/01/23 23:00:03.00)	64.5	73.4	55.7	69.6	63.5	60.7	59.8	60.7	57.6	50.5	88	78	74.1	68.5	69.7	70	64.7
(2017/01/23 23:15:03.00)	65.7	82.5	55.9	70.3	62.9	59.7	60.2	61.9	59.5	52.6	90.7	84.9	76.8	83.4	75.9	73.7	76.4
(2017/01/23 23:30:04.00)	64.3	74.5	55.5	67.1	62.2	59.1	58.9	61.1	57.4	48.7	83.5	87.1	77	68.7	72.3	69.6	62.5
(2017/01/23 23:45:03.00)	65.3	80.3	56.7	68.1	62.1	60.6	60.9	61.7	58.6	50.9	85.3	79	76	73.5	75.4	76.2	69.4
(2017/01/24 00:00:04.00)	65.1	80.8	56.6	70.8	64.1	62.8	61.5	60.8	57.7	52.7	88.4	81.7	78.3	77	76.8	73.3	74.2
(2017/01/24 00:15:03.00)	64.5	76.4	55.1	68.1	60.7	58.8	59.1	61.1	57.6	50	89.3	77.1	71.5	70.2	71.2	68.3	71.1
(2017/01/24 00:30:03.00)	64.4	78.4	54.3	67.9	60.6	58.7	59.3	61.2	57.6	49.1	85.4	77.1	73.4	76.6	72	71.1	70.2
(2017/01/24 00:45:03.00)	64.1	79.6	52.4	63.6	60.9	60.9	59.5	60.9	56.9	47.6	80.2	79.5	82.4	78.8	78.1	70.8	63.2
(2017/01/24 01:00:03.00)	63.4	76.4	53.1	67.5	59	57.3	57.5	60.5	56.5	47.2	92.3	77.2	75.8	71	74.3	67.3	64.2
(2017/01/24 01:15:03.00)	63.3	77.7	47.7	66.1	58.4	57.2	57.3	60.2	56.7	48.3	86.5	74.7	74.6	74.5	74.5	70.8	65.2
(2017/01/24 01:30:03.00)	63.8	76.3	46.2	63.9	57.5	57.2	57.9	60.9	57.1	47.9	80.1	75.1	73.8	72.1	72.7	70.7	67.7
(2017/01/24 01:45:03.00)	63.2	79.5	46.3	69.4	63.9	57.7	58.1	60	56.1	47.7	93.3	89.1	74.5	77.2	74.3	69.4	64
(2017/01/24 02:00:04.00)	62.2	76.2	45.2	63	55.1	55	55.6	59.4	55.7	45.5	82	73	71.4	68.4	74.1	69.9	58

Date	LAeq	LAMAX	LA90	Leq							Lmax						
				63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz
(2017/01/24 02:15:03.00)	62.9	75.4	46.6	66	58	56.4	56.3	60	56.4	47.1	84.8	75.3	73.7	70.9	72.8	69.6	62.3
(2017/01/24 02:30:04.00)	63.2	78.3	45.8	67.1	59.3	59.1	58.5	59.9	56.2	48	89.1	79.1	78.5	73.9	75.1	71.5	64.8
(2017/01/24 02:45:03.00)	64.1	79.2	48.1	66	59.9	58.9	59.1	61.1	57.2	48.1	89.5	83.8	78.5	75.9	76.4	73.9	65.3
(2017/01/24 03:00:03.00)	63.2	79	43.8	63.8	56.7	55.7	56.4	60.3	56.8	48.4	82.6	79.6	71.1	71.6	75.3	75.3	70.7
(2017/01/24 03:15:03.00)	63.7	76.2	44	65.6	59	59.1	60.2	60	56.7	48.8	84	77.6	74.9	76.1	73.8	70.2	62.9
(2017/01/24 03:30:03.00)	63.8	79.6	48.2	65.8	58.9	58.1	57.5	60.5	57.5	50.8	86.8	79.8	78.1	74.9	76.1	72.6	75.8
(2017/01/24 03:45:04.00)	62.2	75	43.4	64.9	57.6	55.8	56	59.3	55.6	46.7	84.8	77.2	72.7	71.4	71.5	69	61.6
(2017/01/24 04:00:03.00)	64.6	78.3	46.7	66.5	59.3	58.5	59	61.4	58	49.5	87	78.1	73.7	72.5	74.6	73.9	70.3
(2017/01/24 04:15:03.00)	64.1	80.5	44.9	65.7	60.4	59.3	58.6	60.6	57.3	52	87.9	76.9	75.4	74.4	75.7	75.4	76.6
(2017/01/24 04:30:04.00)	66.3	86.9	48.7	68.9	64.8	63.1	62.7	62.7	58.6	51.2	87.1	87.1	85.1	86.2	83.1	76.5	71.8
(2017/01/24 04:45:03.00)	65.1	80.4	49.5	64.1	58.5	59.1	59.4	62	58.6	51	80.9	78.4	78.1	75.3	75.7	75.5	70.8
(2017/01/24 05:00:04.00)	64.5	75.4	46.9	66.2	58.3	57.4	57.9	61.6	58.2	49.7	85.4	74.3	71.8	71.5	72.7	70.6	63.5
(2017/01/24 05:15:04.00)	66.3	78	49.7	67.1	60.5	60.3	60	63.1	60	51.5	83.2	78.6	78.2	74.8	74	73.3	67.1
(2017/01/24 05:30:04.00)	66.2	79.7	50.7	68	61.1	59.6	59.8	63.1	59.9	51.6	84.4	76.5	72.2	73	78.1	71.1	69.2
(2017/01/24 05:45:03.00)	67.3	80.8	53.4	70.3	63.6	61.9	61.2	63.6	61.2	54.7	88.8	78.2	79.5	75.3	76.6	77	71.9
(2017/01/24 06:00:03.00)	67.5	83.9	54.3	71.5	66.1	63.7	62.1	63.9	61.1	53.3	91.8	84.9	82.2	81.2	81.4	78.4	70.4
(2017/01/24 06:15:03.00)	67.9	78.5	55.4	72.2	63.9	63.1	61.6	64.2	61.7	55	91.4	78.6	79.3	78.2	73.4	73.4	73.3
(2017/01/24 06:30:03.00)	66.7	79.3	55.2	71.8	64.9	62.1	61	63.2	60.3	53.1	90	85.8	79.9	75.8	76.2	72.3	69.3
(2017/01/24 06:45:03.00)	67.3	77.9	60.2	72.1	66.1	62.9	61.4	63.2	61.1	55.4	84.6	83	76.7	72.2	74.5	74.6	70.5
(2017/01/24 07:00:03.00)	67.9	83.8	59.1	73.3	66.1	63.8	63.2	63.6	61.4	56.1	90.1	83.7	77	75.6	74.7	77.5	81.5
(2017/01/24 07:15:03.00)	75.6	100.6	59.5	73	64.9	61.6	61.4	71.3	72	57.5	92.8	80.6	72.5	77.4	97.1	98.3	81.7
(2017/01/24 07:30:03.00)	67	81	58.1	72.3	65.9	62.7	61.1	63.1	60.8	54.4	86.3	84.6	79.8	75.1	76.9	76.1	70.8
(2017/01/24 07:45:03.00)	67.1	80.4	59.4	72.2	66.2	64.4	61.5	62.7	60.9	55.2	92.8	84.5	78.6	76.2	78.6	72.2	73.1
(2017/01/24 08:00:03.00)	68	81.4	60.9	72.2	66	66.4	63.7	63.4	61.5	55.9	86.2	82.7	80.7	78.8	79.9	77.3	71.4
(2017/01/24 08:15:03.00)	68.2	85.5	58.5	70.7	66.2	64.8	62.7	64.4	61.6	55	83.8	84.5	89.1	83.3	81	75.2	69.9
(2017/01/24 08:30:03.00)	67.6	84.9	61.7	73.1	67.4	67.4	63.1	63	60.7	54.1	86.3	86.5	90.4	84.9	73.6	71.7	68.2
(2017/01/24 08:45:03.00)	67.7	82.6	59	72.1	66.9	63.9	61.8	63.5	61.5	55.4	85	90.6	82.4	74.7	79.9	78.6	73.3
(2017/01/24 09:00:03.00)	67.5	87.8	61.3	72.1	66.6	65.8	64.9	62.7	60.2	53.9	86.9	84.7	89.2	90.5	76.4	70.2	71.1
(2017/01/24 09:15:03.00)	67.1	79.5	59.8	73.9	67.2	63.9	62	62.8	60.7	54.4	91.5	85.4	78	78.3	73	75.4	68.9
(2017/01/24 09:30:03.00)	67.3	84	59.1	72.2	65.8	64	62.4	63	60.7	55.1	87.4	79.1	82.6	82.6	79.6	76.5	74.7
(2017/01/24 09:45:03.00)	69.9	94	59.9	72	66	62.7	67.4	65.1	61.8	56.3	88.5	83.3	77.1	92.9	89.6	80.5	81.5
(2017/01/24 10:00:03.00)	67.5	82.2	59.7	72.7	66.3	64.6	62	63.4	61.1	55	88.7	83.9	85.6	79.6	76.3	74.2	73.7
(2017/01/24 10:15:03.00)	67.6	84.4	61.4	72	66.6	64.2	62.1	63.3	61.1	56.3	88.9	90.5	86.7	83.9	77.2	74.8	79
(2017/01/24 10:30:03.00)	68.8	96.7	60.3	73.3	66.8	63.8	66.3	64.2	60.8	55.3	93.6	87.3	81.8	97.7	89.3	82.3	78.7
(2017/01/24 10:45:03.00)	66.3	80.3	59.4	71.5	64.7	62.4	61.2	62	60	54	85.4	79.1	80.4	80.9	74.7	73.4	72.2
(2017/01/24 11:00:03.00)	71.4	96.8	58.3	71.8	64	62.4	61.2	66.5	65.7	63.6	90.6	79.2	79.6	81.7	90.8	92.1	89.9
(2017/01/24 11:15:04.00)	66	82.9	60.4	73.4	67.4	63.1	60.9	61.5	59.5	54	87	82.5	78.9	77.2	75.9	79.5	73.9
(2017/01/24 11:30:03.00)	66.7	94.1	60	72	65.1	62.7	61.4	62.7	60	54.6	84.3	79	80.2	85.7	92.8	84.3	77.6
(2017/01/24 11:45:04.00)	65.3	74.6	59.4	71.9	64.4	61.6	60.1	61.1	58.9	52.6	86.4	79.3	74.8	71.4	71.5	71	69.5
(2017/01/24 12:00:03.00)	65.8	76.2	58.6	71.6	63.8	61.6	60.6	61.7	59.6	53.1	89.8	80.3	76.7	71.7	70.7	73.7	68.3
(2017/01/24 12:15:03.00)	67.4	88.1	59.4	71.6	65.8	66.1	63.7	63.3	59.6	53.8	84.4	86.2	89.2	85.7	85	77.5	73.4
(2017/01/24 12:30:04.00)	66.2	81.3	59.2	71.9	65.6	62.7	61.2	61.9	59.8	54.1	85.4	81.4	80	74.4	75.6	75.4	74.6
(2017/01/24 12:45:03.00)	70.8	97.8	58.3	70.9	66.1	63.6	61.2	65.1	66	62.2	85.2	86.7	83.7	76.6	90	95.4	90.5
(2017/01/24 13:00:03.00)	64.8	76.1	59.1	70.4	63.2	60.6	59.7	60.9	58	52.1	90.4	77	71.6	72	70.8	70.2	69.9
(2017/01/24 13:15:03.00)	65.9	84.2	59.3	70.6	64.7	62.5	60.3	61.9	59.1	53.8	84.6	79.3	78.3	78.6	83.9	72.9	76.5
(2017/01/24 13:30:03.00)	70.6	98	59	71.9	64.8	61.8	59.9	64.8	66.4	61.4	88.3	78.7	74	75.2	88.6	95.9	90
(2017/01/24 13:45:04.00)	76	99.8	60.6	72.8	67.9	66.5	63.6	71.7	72.2	57.2	92.5	88.9	90.8	86.9	96.7	97.6	78.1
(2017/01/24 14:00:04.00)	65.5	78.1	59.4	71.2	64.7	62.4	60.4	61.1	59	53.6	88.6	81.1	78.3	71.5	73.7	73.1	72.2
(2017/01/24 14:15:03.00)	65.8	87.6	59.3	71.7	65.2	61.3	60.2	61.7	59.4	53.5	85.2	83.4	73.6	84.6	85.9	78.2	78.1
(2017/01/24 14:30:04.00)	65.7	78.6	59.6	71.6	65.1	62.5	60.8	61.4	59.1	53.2	86.9	83	78.8	75.3	72.9	74.2	70.9
(2017/01/24 14:45:03.00)	64.9	66.2	64.2	70.9	64.1	61.1	59.8	61.2	58.3	50	77.1	69	63.9	63.3	62.2	59.6	51.5

Appendix C: Rail Noise Calculation

Project: **Brondes Age, Kilburn**

$L_{Aeq16hr} = 10 \text{ Log}\left(\frac{10^{SEL} \times No.}{57600 \text{ s}}\right)$

$L_{Aeq8hr} = 10 \text{ Log}\left(\frac{10^{SEL} \times No.}{28800 \text{ s}}\right)$

Fill in: Average Measured SEL
No of Events (16 hour day or 8 hour night)

Day

SEL	No.
80.0	215

$L_{Aeq16hr}$ = **55.7** **dBA**

Night

SEL	No.
80.0	20

L_{Aeq8hr} = **48.4** **dBA**