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Twyman House, Camden Road NW1 9LR
Discharge of Planning Conditions (Noise)

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Revision	Date	Notes	Author	Checked	Approved
Ver.3.0	18-03-13	E656A Planning Conditions Discharge - Noise	SP	ND	ND

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1 INTRODUCTION

1.1 Entran Ltd have been commissioned by Taylor Wimpey Limited to undertake a noise survey and assessment for the purposes of discharging a noise related conditions attached to the planning permission to redevelop Twyman House, Camden Road, London NW1 9LR for office/cafe and residential purposes. Principally, the conditions relates to existing transport related sources as well as potential noise from building services. Figure 1 shows the site in relation to the above noise sources.

1.2 The site is 0.86 acres in size and is located within central Camden Town, in the London Borough of Camden. The local area is predominantly residential with mixed-use retail with residential above and commercial buildings along Camden Road. The existing site on Twyman House comprises of a 6 storey office block fronting Camden Road with a lower ground level which is accessible from the rear of the building. The office block resembles typical construction techniques of the 1950's/1960's with a concrete encased steel structure, brick cladding, a flat roof and crittal type steel windows. The site has excellent public transport links and is located only a short distance from Camden Road overground train station.

1.3 The site benefits from an implementable planning permission under reference 2011/2072/P for redevelopment of the site with the erection of a part 4/7/8 storey building, including lower ground level, comprising 54 residential units (Use Class C3) (16 x one bed, 20 x two bed, 15 x three bed and 3 x four bed), 96 sqm of either retail/professional & financial services/cafe (Use Classes A1/A2/A3) at part lower ground floor level fronting canal and 111 sqm of retail/cafe use at part ground floor level fronting Camden Road, with associated hard and soft landscaping, cycle storage and 3 x disabled car parking bays off Bonny Street, following the conversion of Pulse House and demolition of Twyman House.

1.4 Previously (May 2012), Entran reported on the how the conditions attached to the planning permission could be discharged. The May 2012 report (relevant information is reproduced within this report) suggested window specifications to meet with the noise level criteria outlined in one of the noise related planning condition (condition 12, see below). Due to heat gain considerations, an application was made to LB Camden to relax the daytime noise level criteria by 5 dB and the night-time by 3 dB with relation to Condition 12. This application was granted (19 February 2013, 2012/5589/P) after evidence based discussions with the Council's Environmental Health Department (Mr H Bhatti). This report is therefore an update to Entran's pervious noise reports.

1.5 This Report is necessarily technical in nature and contains terminology relating to acoustics and noise. Therefore, a glossary together with a brief introduction to the subject of noise has been provided in Appendix A.

2 NOISE ASSESSMENT CRITERIA

Planning Condition - Noise

2.1 The London Borough of Camden Council have stipulated the following planning conditions (noise):

Condition 11

Noise levels at a point 1 metre external to sensitive facades shall be at least 5dB(A) less than the existing background measurement (LA90), expressed in dB(A) when all plant/equipment (or any part of it) is in operation unless the plant/equipment hereby permitted will have a noise that has a distinguishable, discrete continuous note (whine, hiss, screech, hum) and/or if there are distinct impulses (bangs, clicks, clatters, thumps), then the noise levels from that piece of plant/equipment at any sensitive façade shall be at least 10dB(A) below the LA90, expressed in dB(A).

Condition 12

Prior to commencement on the relevant part of the development hereby approved details of sound insulation and noise control measures shall be submitted to and approved in writing by the Local Planning Authority. The sound insulation and noise control measures shall achieve the following internal noise targets (in line with BS 8233:1999):

Bedrooms (23.00-07.00 hrs) 30 dB LAeq, and 45 dB Lmax (fast)
Living Rooms (07.00-23.00 hrs) 30 dB LAeq,
Kitchens, bathrooms, WC compartments and utility rooms
(07.00 –23.00 hrs) 45 dB LAeq

The sound insulation and noise control measures shall be carried out strictly in accordance with the details so approved and implemented prior to the first occupation of the development and shall be maintained as such thereafter.

Update for Condition 12

LB Camden (letter dated 19 February 2013)has formally granted the application to relax condition 12 and therefore the above noise levels relaxed by 5 dB during the day and 3 dB during the night.

Condition 13

Before any A1/A2/A3 use commences an acoustic report, prepared by a suitably qualified professional, detailing any plant with an external breakout and demonstrating how the Council's noise requirements (as set out in condition 10) will be met, shall be submitted to and approved by the Council in writing. The plant shall be provided with the necessary acoustic isolation and sound attenuation as recommended in the acoustic report and shall be maintained in accordance with the manufacturer's specifications. The acoustic isolation shall thereafter be maintained in effective order to the satisfaction of the Council

National Planning Policy

2.2 The National Planning Policy Framework (NPPF) published on March 27th 2012 sets out the Government's economic, environmental and social planning policies for England. It attempts to summarise in a single document all previous national planning policy advice. Taken together, these policies articulate the Government's vision of sustainable development, which should be interpreted and applied locally to meet local aspirations.

2.3 The NPPF sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

2.4 Under Section 11; Conserving and enhancing the natural environment, the following is stated:

> The planning system should contribute to and enhance the natural and local environment by:
>
> *preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability*

2.5 The document goes on to state:

> *Planning policies and decisions should aim to:*

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

- mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;

- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and

- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason

2.6 As stated above, this document makes reference to avoiding noise generation from new developments that would adversely impact on health and quality of life. It effectively supersedes Planning Policy Guidance (PPG) 24, but does not set absolute criteria. As a result, the guidance and criteria in other relevant documents have been adopted, as a point of specific reference.

2.7 The guidance from the WHO (Vol. 2, Issue 1, 1995 and Guidelines for Community Noise, 1999) is that in order to avoid sleep disturbance the period noise level (L_{Aeq}) should not exceed 30 dB internally and individual noise events should not exceed 45 dB $L_{Amax.}$. Section 3.4 of the WHO Guidelines, states that for good sleeping conditions, indoor noise levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times/night. In order to assess internal noise levels, WHO guidance suggests facade insulation levels of about 15 dB(A) where windows are partially open, and a reduction of 33 dB(A) (PPG24, Annex 6) for closed thermal double-glazing for road traffic.

2.8 The latest WHO guidelines (Night Noise Guidelines for Europe, 2009) are applicable to Member States of the European Region and represent an extension to, as well as an update of, the previous WHO Guidelines for Community Noise. Based on the scientific evidence on thresholds of night noise exposure indicated by $L_{night,outside}$ as defined in the Environmental Noise Directive (2002/49/EC), the latest WHO guidance recommends an $L_{night,outside}$ of 40 dB as a target for the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the

elderly. An $L_{night,outside}$ value of 55 dB is recommended as an interim target for countries where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach.

2.9 The $L_{night,outside}$ is the A-weighted long-term average sound level determined over all nights of the year, where the night is the 8-hour period between 2300-0700 hours. The target noise level excludes sound reflected from a building façade, therefore, a 3 dB façade correction must also be allowed in the case of measurements or predictions at building facades. The receptor height is typically 3.8 to 4.2m above ground level, i.e. as applicable first floor bedrooms, but in the case of areas with single storey dwellings a height of not less than 1 .5m is applicable.

2.10 BS 8233:1999 'Sound insulation and noise reduction for buildings - Code of Practice' similarly recommends a good design standard for bedrooms to be 30 dB L_{Aeq} or a reasonable standard to be 35 dB, and individual noise events should not normally exceed 45 dB L_{Amax} as a reasonable internal standard. The BS design criteria for living rooms are 40 dB L_{Aeq} as a reasonable standard and 30 dB L_{Aeq} as a good standard.

2.11 With respect to external noise levels, reference is made to WHO guidance that states "general daytime outdoor noise levels of less than 55 dB L_{Aeq} are desirable to prevent any significant community annoyance". Application of a similar limit to external garden areas used for amenity purposes would, therefore, prevent significant community annoyance due to rail noise. In this case, the level of 55 dB(A) is a free-field value, i.e. it does not include façade reflection factors.

2.12 However, in considering the application of an outdoor criterion of 55 dB L_{Aeq}, which is derived from the earlier World Health Organisation (WHO) guidance, it is important to take account of the feasibility of achieving such a level. A recent review of 'Health effect-based noise assessment methods: A review and feasibility study' (NPL Report CMAM 16, 1998) reported the following:

"Perhaps the main weaknesses of both WHO-inspired documents is that they fail to consider the practicality of actually being able to achieve any of the stated guideline values. ..... We know from the most recent national survey of noise exposure carried out in England and Wales (Sargent 93) that around 56% of the population are exposed to daytime noise levels exceeding 55 L_{Aeq}

and that around 65% are exposed to night-time noise levels exceeding 45 L_{Aeq} (as measured outside the house in each case). ..... The percentages exposed above the WHO guideline values could not be significantly reduced without drastic action to virtually eliminate road traffic noise and other forms of transportation noise (including public transport) from the vicinity of houses. The social and economic consequences of such action would be likely to be far greater than any environmental advantages of reducing the proportion of the population annoyed by noise. In addition, there is no evidence that anything other than a small minority of the population exposed at such noise levels find them to be particularly onerous in the context of their daily lives."

3 ENVIRONMENTAL NOISE MEASUREMENTS

3.1 Daytime and night-time sample noise levels were monitored on 16/17 April 2012. Statistical noise data was gathered on Camden Road and on Bonny Street as well as short samples on Camden Street. Measurement locations are shown on Figure 1.

3.2 The purpose of the noise monitoring was to provide sufficient acoustic information to undertake an assessment in accordance with WHO/BS8233, to determine the extents of the mitigation measures necessary to satisfy internal noise criteria.

3.3 All noise measurements were undertaken by an experienced consultant competent in environmental noise monitoring, and, in accordance with the principles of BS 7445: 2003: *Description and measurement of environmental noise*.

3.4 All acoustic measurement equipment used during the noise surveys conformed to Type 1 specification of British Standard 61672: 2003: *Electroacoustics. Sound level meters*. Part 1 *Specifications*. A full inventory of this equipment is shown in Table 1 below:

Table 3.1: Inventory of Acoustic Measurement Equipment

Item	Make & Model	Serial Number
Sound Level Meter	Larson Davis 824	1309
Preamplifier	PRM902	1812
Microphone	GRAS 40AE	28488
Calibrator	Larson Davis Cal200	3724
Sound Level Meter	Larson Davis 824	1419
Preamplifier	PRM902	2448
Microphone	GRAS 40AE	31817
Calibrator	Larson Davis Cal200	3723

3.5 The noise measurement equipment used during the surveys were calibrated at the start and end of the measurement period. The calibrator used had itself been calibrated by an accredited calibration laboratory within the twelve months preceding the measurements. No significant drift in calibration was found to have occurred on the sound level meter.

3.6 The microphone was positioned at a height of 1.7 m in a free-field location, i.e. excluding the effect of reflections from buildings or structures and on hard ground. Weather conditions during the survey period were suitable for environmental noise surveys.

3.7 The summary results of the noise survey are presented below (detailed surveys are presented in Appendix B) and the measurement locations are shown in Figure 1. Apart

from transportation related sources, there were no other significant noise sources. It is noted that traffic noise dominates the ambient noise climate.

Table 3.2: Noise Measurement Results

Location	Time Period	L_{Aeq}	L_{Amax}	L_{A10}	L_{A90} dB
Location 1, Camden Road	Day	70.3	82.0	72.1	63.9
	Night	66.5	75.6	68.8	55.0
Location 2, Bonny Street	Day	66.5	78.4	68.8	56.8
	Night	57.7	77.9	58.4	49.8
Location 3, Camden Street	Day	70.3	86.3	73.9	61.5

4 ASSESSMENT & DISCHARGE OF PLANNING CONDITIONS - NOISE

4.1 The noise measurement data gathered on and adjacent to the development site has been utilised to determine potential noise levels at the façade of the proposed development. The measured data was processed using the computer model IMMI2012 and together with other pertinent site data such as the topography, existing or natural acoustical screens such as mounds/buildings etc, noise levels were computed across the development site.

4.2 The daytime and night-time noise levels on a floor by floor basis are presented in Table 4.1. Receptor locations are presented in Figure 2.

Table 4.1 External Façade Noise Levels

Receptor Point	Description	Facade	Floor	Day $L_{Aeq,T}$ dB	Night
R1	Courtyard Block A	NE	Ground	54.8	45.5
		NE	First	54.8	45.6
		NE	Second	54.8	45.7
		NE	Third	54.9	45.8
		NE	Fourth	55.0	46.1
		NE	Fifth/Sixth	55.5	46.9
R2	Block B Facing Bonny St	NW	Ground	62.8	53.4
		NW	First	62.7	53.4
		NW	Second	62.5	53.2
		NW	Third	62.1	52.9
		NW	Fourth	61.7	52.6
		NW	Fifth/Sixth	61.4	52.5
R3	Block B Facing Camden Road	SE	Ground	73.0	69.8
		SE	First	72.9	69.7
		SE	Second	72.6	69.3
		SE	Third	72.1	68.8
		SE	Fourth	71.5	68.2
		SE	Fifth/Sixth	70.9	67.6
R4	Block B Facing Canal 11m from Camden Rd	SW	Ground	69.9	66.3
		SW	First	69.9	66.2
		SW	Second	69.7	66.0
		SW	Third	69.3	65.6
		SW	Fourth	68.9	65.2
		SW	Fifth/Sixth	68.5	64.7
R5	Block B Facing Canal 14m from Camden Rd	SW	Ground	68.6	64.7
		SW	First	68.5	64.6
		SW	Second	68.4	64.5
		SW	Third	68.2	64.2
		SW	Fourth	67.9	63.9
		SW	Fifth/Sixth	67.6	63.5
R6	Block B Facing Canal 20m from Camden Rd	SW	Ground	62.9	58.8
		SW	First	62.9	58.7
		SW	Second	62.8	58.6
		SW	Third	62.6	58.4
		SW	Fourth	62.4	58.2
		SW	Fifth/Sixth	62.2	57.9

R7	Block A facing Canal 30m from Camden Rd	South	Ground	62.9	61.8
		South	First	62.9	61.8
		South	Second	62.9	61.7
		South	Third	62.8	61.6
		South	Fourth	62.4	61.5
		South	Fifth/Sixth	62.3	61.3
R8	Block B Facing Courtyard (adjacent to Block A)	NE	Ground	56.4	47.1
		NE	First	56.4	47.1
		NE	Second	56.4	47.1
		NE	Third	56.3	47.2
		NE	Fourth	56.4	47.4
		NE	Fifth/Sixth	56.5	48.0
R9	Block B Facing Courtyard (adjacent to disabled Car park bays)	NE	Ground	60.7	51.4
		NE	First	60.7	51.3
		NE	Second	60.5	51.2
		NE	Third	60.3	50.9
		NE	Fourth	59.9	50.7
		NE	Fifth/Sixth	59.6	50.7

4.3 In its explanation of the noise limits that define the boundary between NEC B and NEC C, PPG24 states that: *'Because noise should be taken into account when determining planning applications in NEC B, it has been assumed that the minimum amelioration measure available to an occupant at night will be to close bedroom windows'.*

4.4 Therefore, in order to assess the acoustic performance of the proposed dwellings, it is appropriate in the first instance to explore the level of protection that will be afforded by the performance of the glazing elements.

4.5 Table 1 in Annex 6 of Planning Policy Guidance Note (PPG) 24: 1994: Planning and Noise, upon which PPG24 is broadly based, provides examples of typical noise reductions for a dwelling façade with windows. The table shows various levels of noise reduction provided by different glazing configurations and for different noise sources. The values shown are the level difference (in dBA) between the outside and the inside of a typical dwelling and to represent worst case, it is assumed that the outside level is a façade measurement.

4.6 For a road traffic noise spectrum (RTRA), PPG 24 states that standard thermal double glazing (e.g. 4mm glass, 4mm airgap, 4mm glass or similar mass) will provide a façade sound insulation performance of 33 dB(A).

4.7 The daytime and night-time internal noise levels with closed windows on a floor by floor basis are presented in Table 4.2.

Table 4.1 Internal Noise Levels (thermal double glazed windows)

Receptor Point	Description	Facade	Floor	Day $L_{Aeq,T}$ dB	Night
R1	Courtyard Block A	NE	Ground	21.8	12.5
		NE	First	21.8	12.6
		NE	Second	21.8	12.7
		NE	Third	21.9	12.8
		NE	Fourth	22.0	13.1
		NE	Fifth/Sixth	22.5	13.9
R2	Block B Facing Bonny St	NW	Ground	29.8	20.4
		NW	First	29.7	20.4
		NW	Second	29.5	20.2
		NW	Third	29.1	19.9
		NW	Fourth	28.7	19.6
		NW	Fifth/Sixth	28.4	19.5
R3	Block B Facing Camden Road	SE	Ground	40.0	36.8
		SE	First	39.9	36.7
		SE	Second	39.6	36.3
		SE	Third	39.1	35.8
		SE	Fourth	38.5	35.2
		SE	Fifth/Sixth	37.9	34.6
R4	Block B Facing Canal 11m from Camden Rd	SW	Ground	36.9	33.3
		SW	First	36.9	33.2
		SW	Second	36.7	33.0
		SW	Third	36.3	32.6
		SW	Fourth	35.9	32.2
		SW	Fifth/Sixth	35.5	31.7
R5	Block B Facing Canal 14m from Camden Rd	SW	Ground	35.6	31.7
		SW	First	35.5	31.6
		SW	Second	35.4	31.5
		SW	Third	35.2	31.2
		SW	Fourth	34.9	30.9
		SW	Fifth/Sixth	34.6	30.5
R6	Block B Facing Canal 20m from Camden Rd	SW	Ground	29.9	25.8
		SW	First	29.9	25.7
		SW	Second	29.8	25.6
		SW	Third	29.6	25.4

		SW	Fourth	29.4	25.2
		SW	Fifth/Sixth	29.2	24.9
R7	Block A facing Canal 30m from Camden Rd	South	Ground	29.9	28.8
		South	First	29.9	28.8
		South	Second	29.9	28.7
		South	Third	29.8	28.6
		South	Fourth	29.4	28.5
		South	Fifth/Sixth	29.3	28.3
R8	Block B Facing Courtyard (adjacent to Block A)	NE	Ground	23.4	14.1
		NE	First	23.4	14.1
		NE	Second	23.4	14.1
		NE	Third	23.3	14.2
		NE	Fourth	23.4	14.4
		NE	Fifth/Sixth	23.5	15.0
R9	Block B Facing Courtyard (adjacent to disabled Car park bays)	NE	Ground	27.7	18.4
		NE	First	27.7	18.3
		NE	Second	27.5	18.2
		NE	Third	27.3	17.9
		NE	Fourth	26.9	17.7
		NE	Fifth/Sixth	26.6	17.7

4.8 The above assessment indicates that mitigation measures in the form of closed thermal double windows will be sufficient for all façades bar Camden Road/partial SW Canal side facade to reduce internal noise levels to be within BS8233's 'good' criteria as well within Council's planning condition 12 (as amended). For the façade facing Camden Road and 10m of the façade facing the Canal (as measured from the Camden Road), acoustic windows will be necessary. In order to achieve the necessary attenuation for the Camden Road facade (an attenuation of 37 dB Rw), a typical window arrangement of 6/4/4 will be necessary (please note these arrangements are examples only, window suppliers may have their proprietary solutions as long as they meet with the attenuation figure of 37 dB Rw). Twyman House will benefit from 'whole house' ventilation and if necessary, windows can remain closed to keep out noise.

4.9 If the above window arrange also apply for all bedrooms at night, then L_{Amax} levels will also be within the criteria outlined in Condition 12 (as amended, though the L_{Amax} criterion is unchanged from the original permission).

Façade Wall

4.10 The proposed construction of the façades s built up with an external 103mm brickwork, 50mm cavity, 50mm dense mineral fibre, 150mm mineral fibre quilt and 2x15mm layers of 'soundbloc' plasterboards. Using the propriety software 'INSUL', the façade attenuation is estimated at over 50 dB. This level of attenuation is sufficient to allow both double glazed windows and acoustic windows to be set within the façade without comprising the sound insulation.

Building Services Noise

4.11 The proposed development will have items of mechanical services plant at the lower ground level facing Camden Road or the Bonny Street façade. Conditions 11/13 of the planning permission states that noise from mechanical services must be at least 10 dB below the $L_{A90,T}$ if the plant contains either a distinguishable discrete note (whine, hiss, screech, hum) or an intermittent noise signature (bangs, clicks, clatters, thumps).

4.12 On worst-case basis, noise from mechanical plant should be designed to be 10 dB below the $L_{A90,T}$. The measurement survey indicates that the lowest background is 51 dB $L_{A90,T}$ on Camden Road and 49 dB $L_{A90,T}$ on Bonny Street.

4.13 The full inventory of the mechanical services plant will be made available when the details are finalised. However, since noise egress will depend on the insertion loss of the louvers, the maximum allowable noise level within the plant room has been calculated.

4.14 The combined sound reduction index of the façade/louver is calculated to be 42 dB Rw. Therefore, in order to comply with Condition 11/13, the maximum permissible noise level within the plant should not exceed 80 dB.

5 CONCLUSIONS

5.1 Ambient noise levels adjacent to the development site known as the Twyman House, Camden Road NW1 9LR have been measured and assessed in order to discharge planning conditions attached to the planning permission.

5.2 The noise assessment indicates that mitigation measures in the form of closed thermal double windows (**4mm-4mm-4mm**) will be sufficient for all façades bar Camden Road/partial SW Canal side facade to reduce internal noise levels to be within BS8233's 'good' criteria as well within Council's planning **Condition 12 (as amended)**. For the façade facing Camden Road and 10m of the façade facing the Canal (as measured from the Camden Road), acoustic windows will be necessary. In order to achieve the necessary attenuation for the Camden Road facade (an attenuation of 37 dB Rw), a typical window arrangement of **6/4/4 mm** will be necessary to discharge *condition 12 (as amended)*. If the above window arrange also apply for all bedrooms at night, then L_{Amax} levels will also be within the criteria outlined in **Condition 12 (as amended)**. Twyman House will benefit from 'whole house' ventilation and if necessary, windows can remain closed to keep out noise..

5.3 The proposed construction of the façades is built up with an external 103mm brickwork, 50mm cavity, 50mm dense mineral fibre, 150mm mineral fibre quilt and 2x15mm layers of 'soundbloc' plasterboards. The façade attenuation is estimated at over 50 dB. This level of attenuation is sufficient to allow both double glazed windows and acoustic windows to be set within the façade without comprising the sound insulation.

5.4 The proposed development will have items of mechanical services plant at the lower ground level facing Camden Road or the Bonny Street façade. Conditions 11/13 of the planning permission states that noise from mechanical services must be at least 10 dB below the $L_{A90,T}$ if the plant contains either a distinguishable discrete note (whine, hiss, screech, hum) or an intermittent noise signature (bangs, clicks, clatters, thumps). The full inventory of the mechanical services plant will be made available when the details are finalised. However, The combined sound reduction index of the **façade/louver is calculated to be 42 dB Rw**. Therefore, in order to comply with **Condition 11/13**, the maximum permissible noise level within the plant should not exceed 80 dB.

Figure 1 Noise Monitoring Locations

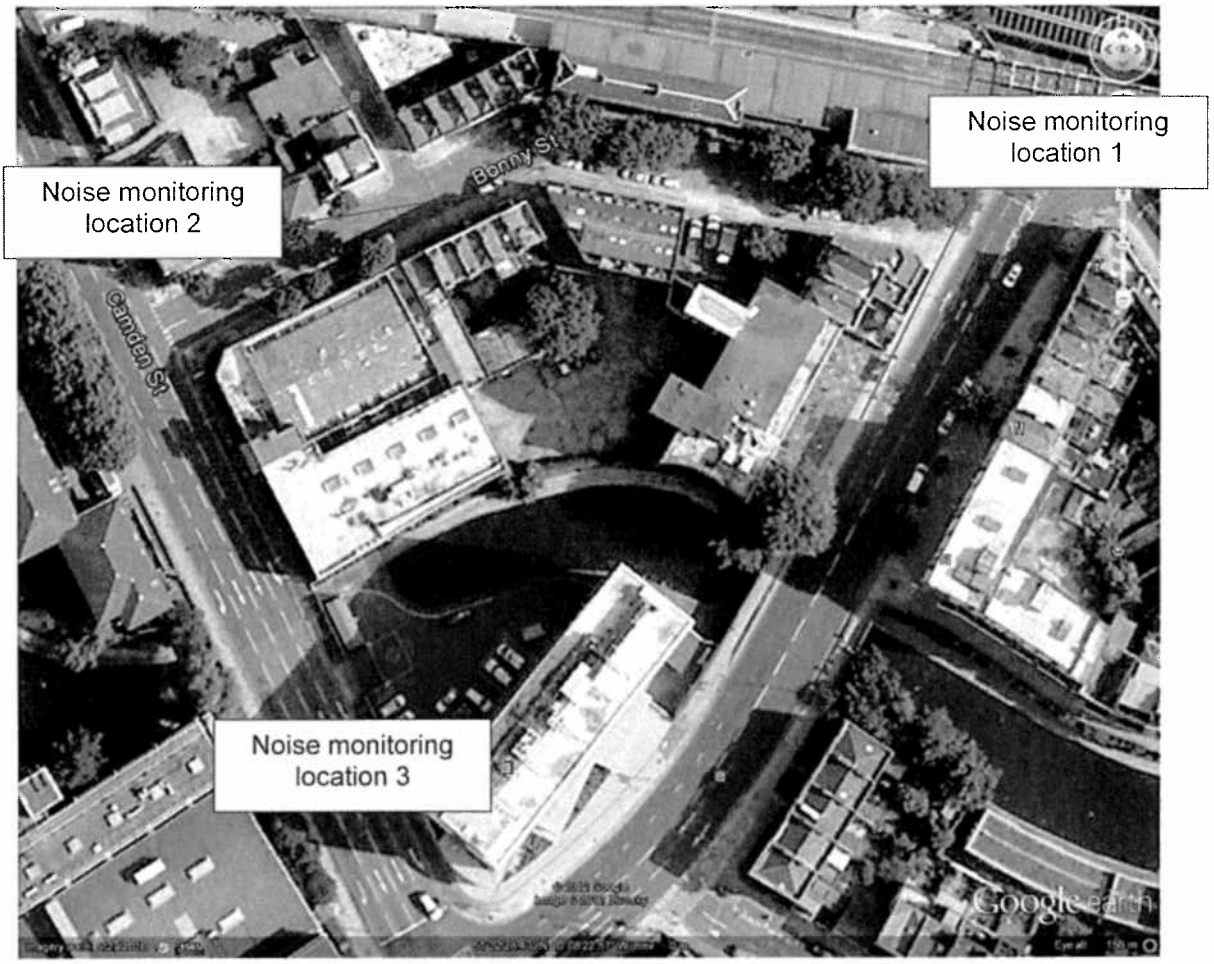
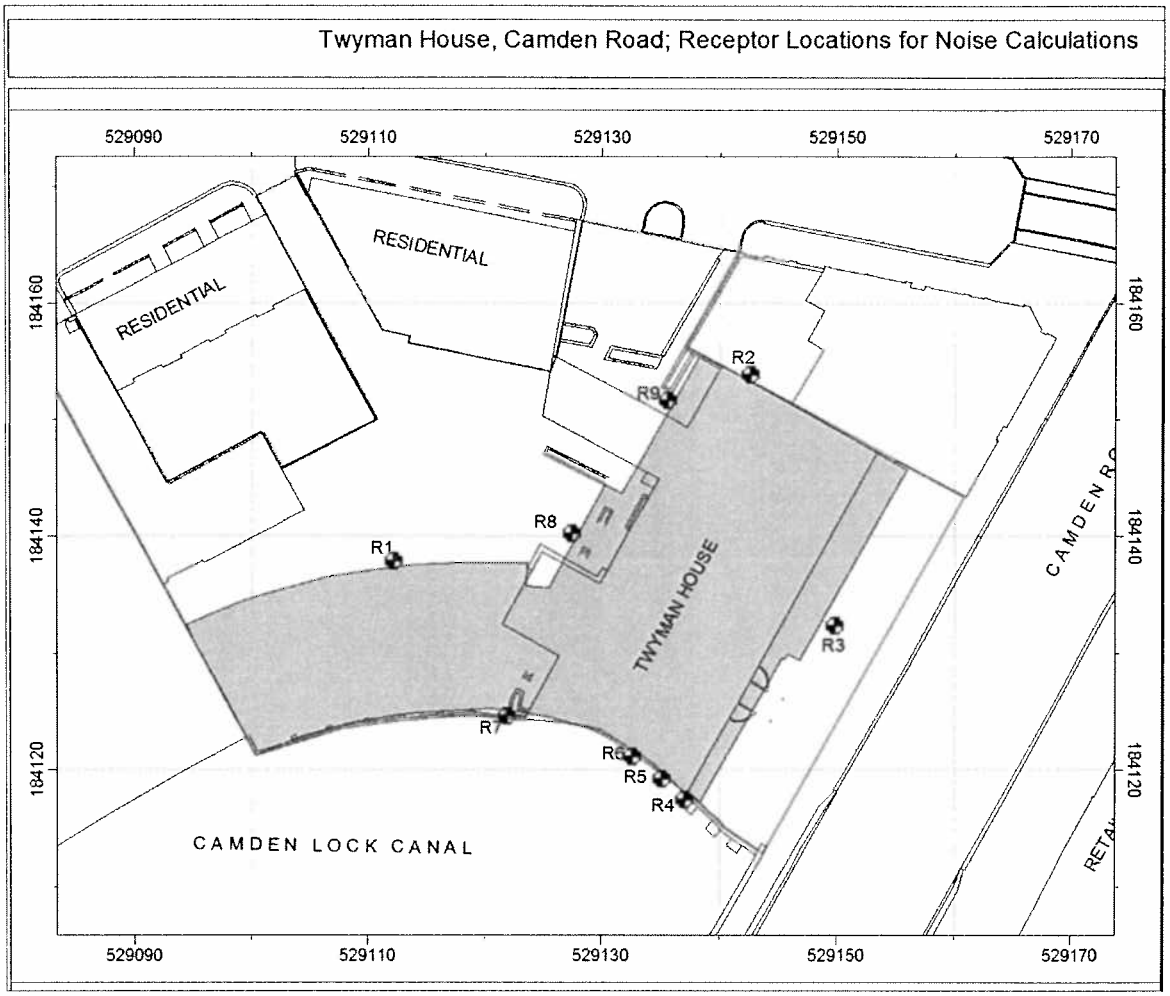


Figure 2 Receptor Locations for Noise Calculations



APPENDIX A – INTRODUCTION TO NOISE

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB.

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs. For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest.

In the UK, traffic noise is measured as the L_{A10}, the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq}. This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the noise measurement should be specified. For example, BS 4142 specifies background noise measurement periods of 1 hour during the day and 5 minutes during the night. The noise levels are commonly symbolised as $_{A90(1hour)}$ and $L_{A90(5mins)}$. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125 ms.

Table A1: Glossary of Terms

Term	Definition
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1/s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
Residual Noise Level	The ambient noise remaining at a given position in a given situation when specified sources are suppressed to a degree such that they do not contribute to the ambient noise level ($L_{Aeq,T}$)
Specific Noise Level	The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source (the noise source under investigation) over a given time interval ($L_{Aeq,T}$)
Rating Noise Level	The specific noise level plus any adjustment for the characteristic features of the noise ($L_{Ar,Tr}$).

APPENDIX B – NOISE SURVEY DETAILS

Location 1 Camden Road

Date	Time	LAeq	LAmax	LA10	LA90
16 April 12	07:00:00	68.1	77.6	70.6	64.2
16 April 12	08:00:00	67.3	74.6	69.6	63.8
16 April 12	09:00:00	70.2	85.3	72.5	65.7
16 April 12	10:00:00	70.7	83.5	72.5	66.2
16 April 12	11:00:00	70.8	81.6	72.7	65.3
16 April 12	12:00:00	71.2	78.3	72.9	64.5
16 April 12	13:00:00	71.5	88.5	73.2	66.5
16 April 12	14:00:00	71.2	78.3	73.0	63.6
16 April 12	15:00:00	71.2	85.4	73.0	63.5
16 April 12	16:00:00	71.2	79.2	72.9	62.5
16 April 12	17:00:00	70.2	82.7	72.3	66.7
16 April 12	18:00:00	71.2	81.5	72.8	63.5
16 April 12	19:00:00	70.6	86.5	72.3	63.5
16 April 12	20:00:00	69.7	87.0	71.7	62.4
16 April 12	21:00:00	68.9	79.6	71.1	60.5
16 April 12	22:00:00	68.0	82.1	70.5	59.5
16 April 12	23:00:00	66.9	75.0	69.5	57.5
17 April 12	00:00:00	65.9	74.3	68.9	54.5
17 April 12	01:00:00	64.5	76.7	67.8	52.2
17 April 12	02:00:00	63.6	74.0	67.2	53.6
17 April 12	03:00:00	64.0	76.7	67.4	50.5
17 April 12	04:00:00	64.7	74.4	67.7	53.2
17 April 12	05:00:00	67.5	75.7	70.1	58.1
17 April 12	06:00:00	70.3	77.7	72.0	60.5

Location 2 Bonny Street

Date	Time	LAeq	LAmax	LA10	LA90
16 April 12	07:00:00	64.7	80.4	67.8	55.6
16 April 12	08:00:00	66.6	81.2	69.7	57.6
16 April 12	09:00:00	67.7	80.8	70.8	59.0
16 April 12	10:00:00	67.6	79.8	71.2	59.7
16 April 12	11:00:00	67.9	76.5	71.4	59.6
16 April 12	12:00:00	67.5	78.5	70.9	59.5
16 April 12	13:00:00	67.8	80.2	71.1	58.6
16 April 12	14:00:00	65.8	80.9	69.1	56.5
16 April 12	15:00:00	65.5	77.7	68.8	56.8
16 April 12	16:00:00	64.9	76.5	68.2	56.6
16 April 12	17:00:00	65.1	80.1	68.4	57.8
16 April 12	18:00:00	71.3	79.8	72.5	58.6
16 April 12	19:00:00	64.5	75.6	67.5	55.8
16 April 12	20:00:00	62.2	74.6	65.4	53.5
16 April 12	21:00:00	60.5	74.6	63.8	52.4
16 April 12	22:00:00	60.3	76.6	64.2	50.9
16 April 12	23:00:00	58.8	78.7	62.3	50.2
17 April 12	00:00:00	57.6	79.4	60.2	49.3
17 April 12	01:00:00	55.7	74.5	56.6	48.9
17 April 12	02:00:00	54.3	77.8	54.9	49.2
17 April 12	03:00:00	54.1	74.6	53.8	49.1
17 April 12	04:00:00	53.5	75.6	53.9	49.3
17 April 12	05:00:00	58.8	80.0	60.8	50.1
17 April 12	06:00:00	61.9	82.3	65.1	51.9

Location 3 Camden Street

Date	Time	LAeq	LAmax	LA10	LA90
16 April 12	1100	70.3	82.5	73.6	60.5
16 April 12	1200	71.3	86.7	73.9	62.6
16 April 12	1300	70.1	89.2	74.2	62.1
16 April 12	1500	69.8	85.4	73.9	60.5
16 April 12	1600	69.6	87.6	74.1	61.7