The Downings
Bakers Quay
Gloucester

Noise Impact Assessment Report

29549/NIA1

21 April 2022

For:

Rokeby Living
Provender
Bakers Quay
St Anns Way
Gloucester
GL1 5BQ

Hann Tucker Associates
Consultants in Acoustics Noise & Vibration

[redacted]

Hann Tucker Associates

Noise Impact Assessment Report
29549/NIA1

Document Control

Rev	Date	Comment	Prepared by	Reviewed by	Authorised by
3	21/04/2022	Updated for Final Layouts	[redacted]		
2	08/04/2022	Planning Issue			
1	07/04/2022	Plant Noise Egress Assessment Added			
0	18/03/2022	Draft			

Hann Tucker Associates

Noise Impact Assessment Report
29549/NIA1

Contents

Attachments

1.0 Introduction

Hann Tucker Associates Limited (Hann Tucker) has been commissioned by Rokeby Development Ltd to undertake a noise assessment for a site in Gloucester, Gloucestershire.

The site, which is located on Bakers Quay, is being considered for residential development. The proposals consist of a part new build tower block and part refurbishment of a de-commissioned flour mill.

The site is subject to road noise from St Ann Way, and the surrounding road networks.

Baseline noise conditions have been established by means of a detailed noise survey, presented herein. The findings have subsequently been used to assess the suitability of the site for residential use. Measures required to mitigate noise impacts for the proposed development (when operational) have been discussed in context with relevant national & local planning policies, design standards and good practice guides.

2.0 Objectives

- To review the latest national and local planning policies, industry standards and good practice design guides relating to noise surveys and assessments of proposed residential developments.

- To undertake an environmental noise survey to establish baseline noise levels at selected accessible positions on/around the site.

- To undertake additional manned noise level measurements at the various locations across the site to acquire representative data, specifically characterising the noise emitted by roads around the site.

- Based on the results of the survey, to undertake a noise assessment to assess the suitability of the site for residential use in accordance with the Noise Policy Statement for England (NPSE), National Planning Policy Framework (NPPF), Planning Practice Guidance (ProPG), British Standard (BS) 8233, World Health Organisation (WHO) guidance, Local Authority requirements and other relevant good practice guides.

- To discuss noise mitigation and acoustic design solutions to achieve acceptable noise levels in residential areas.

3.0 Acoustic Terminology

For an explanation of the acoustic terminology used in this report please refer to Appendix A, enclosed.

4.0 Site Description

4.1 Location

The site is located to the south of Bakers Quay, Gloucester and falls within the jurisdiction of Gloucester City Council. See Location Map below.

Location Map (Map Data ©2022 Google)

4.2 Description

The site lies north of St Ann Way and is bound by Baker Street to the south-west, High Orchard Street to the south-east, Merchant's Road to the north-west.

To the south of the site is Bakers Quay Phase 1 which contains apartments, a Premier Inn and a restaurant. An existing apartment building is located directly adjacent to the north of the site, and it is understood that the mill buildings to the west of the site will be residential.

To the north of the site, various commercial and hospitality buildings reside. The dominant noise sources on site were road noise from St Ann Way and the surrounding road networks.

A site plan is provided below:

Site Plan (Map Data ©2022 Google Earth)

5.0 Proposed Development

The proposed development consists of 2no. individual residential blocks. The northern most block (Heritage Block) consists of 49no. residential flats and duplexes across ground plus floors 1 to 4. Furthermore, in the Heritage Block on the ground floor lies a Café, co-working spaces and bin stores.

The southernmost block (Tower Block) consists of 68no. residential flats and duplexes across ground plus floors 1 to 9. On the ground floor lies a resident's lounge, a bin store and 3no. gardens external to the residential plots on the east side of the development.

It is also understood that plant items, namely external condensers are proposed on the roof of both the tower and the heritage blocks.

Drawings of the proposed site plan can be seen attached in Appendix B.

6.0 National Planning Policies

In order to provide a suitable assessment a number of national planning policies have been considered, including:

- The National Planning Policy Framework (NPPF), 2021
- The Noise Policy Statement for England (NPSE), 2010
- Planning Practice Guidance – Noise (PPGN), 2019

The above documents highlight the importance of considering the potential noise effects on any new residential development and provide a qualitative approach to assessment. However, each of the above does not provide any quantitative guidance. As such, all quantitative guidance used to form a noise impact assessment is taken from various other standards and guidance s as detailed in the following sections.

A detailed summary of each of the above National Planning Polices is provided in Appendix C for reference.

6.1 Standards & Guides

6.1.1 ProPG: Planning & Noise

ProPG: Planning & Noise 'Professional Practice Guidance on Planning & Noise' was issued in May 2017 with the primary goal of assisting the delivery of sustainable residential development by promoting good health and well-being through the effective management of noise. It seeks to do that through encouraging a good acoustic design process in and around proposed new residential development having regard to national policy on planning and noise.

It is applicable to noise from existing transport sources (noting that good professional practice should have regard to any reasonably foreseeable changes in existing and/or new sources of noise). The recommended approach is also considered suitable where some industrial or commercial noise contributes to the acoustic environment provided that is "not dominant".b

ProPG advocates a systematic, proportionate, risk based, 2-stage, approach. The approach encourages early consideration of noise issues, facilitates straightforward accelerated decision making for lower risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging.

The two sequential stages of the overall approach are:

- **Stage 1** – an initial noise risk assessment of the proposed development site; and
- **Stage 2** – a systematic consideration of four key elements.
  - Element 1 – demonstrating a "Good Acoustic Design Process";
  - Element 2 – observing internal "Noise Level Guidelines";
  - Element 3 – undertaking an "External Amenity Area Noise Assessment"; and
  - Element 4 – consideration of "Other Relevant Issues".

The ProPG considers suitable guidance on internal noise levels found in BS 8233 (see below) with the addition of an $L_{Amax,f}$ requirement for bedrooms at night, as below.

"Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45 dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events."

6.1.2 BS 8233:2014

British Standard 8233: 2014 "Sound insulation and noise reduction for buildings" recommends design criteria for internal ambient noise levels for dwellings providing a reasonable or good level of protection from external noise. It states that it is desirable that ambient noise levels do not exceed the following guidelines:

Activity	Location	Desirable Internal Ambient Noise Levels	
		07:00 – 23:00	23:00 – 07:00
Resting	Living Rooms	35 dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hour}$	-
Sleeping (Daytime Resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Note 1: the above provides recommended levels for overall noise in the design of a building. However, ground borne noise is assessed separately and is not included as part of these targets, as human response to ground borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity

Note 2: 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.

Note 3: 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.

Note 4: The levels detailed in the table above are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise and are not appropriate in all locations. Where atypical external noise levels are measured (ie high levels of traffic during certain times of the night) an appropriate alternative assessment period (eg 1 hour) and an assessment of individual night time events in terms of SEL or $L_{Amax,F}$ may be more suitable.

For outdoor living spaces, BS 8233 states 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 and 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.

6.1.3 World Health Organisation (WHO)

The current Environmental Noise Guidelines 2018 for the European Region (ENG) supersede the Guidelines for Community Noise from 1999 (CNG). Nevertheless, the ENG recommends that all CNG indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) remain valid. A summary of the guidance from the ENG and CNG is shown in the table below.

Noise Source	CNG guideline indoors all sources	ENG guideline outdoors noise from specific source only
Road traffic	35 dB $L_{Aeq, 16h}$	53 dB L_{den}
	30 dB $L_{Aeq, 8h}$	45 dB L_{night}
Railway	35 dB $L_{Aeq, 16h}$	54 dB L_{den}
	30 dB $L_{Aeq, 8h}$	44 dB L_{night}
Aircraft	35 dB $L_{Aeq, 16h}$	45 dB L_{den}
	30 dB $L_{Aeq, 8h}$	40 dB L_{night}

With regard to single-event noise indicators, Section 2.2.2 of the WHO Environmental Noise Guidelines 2018 state:

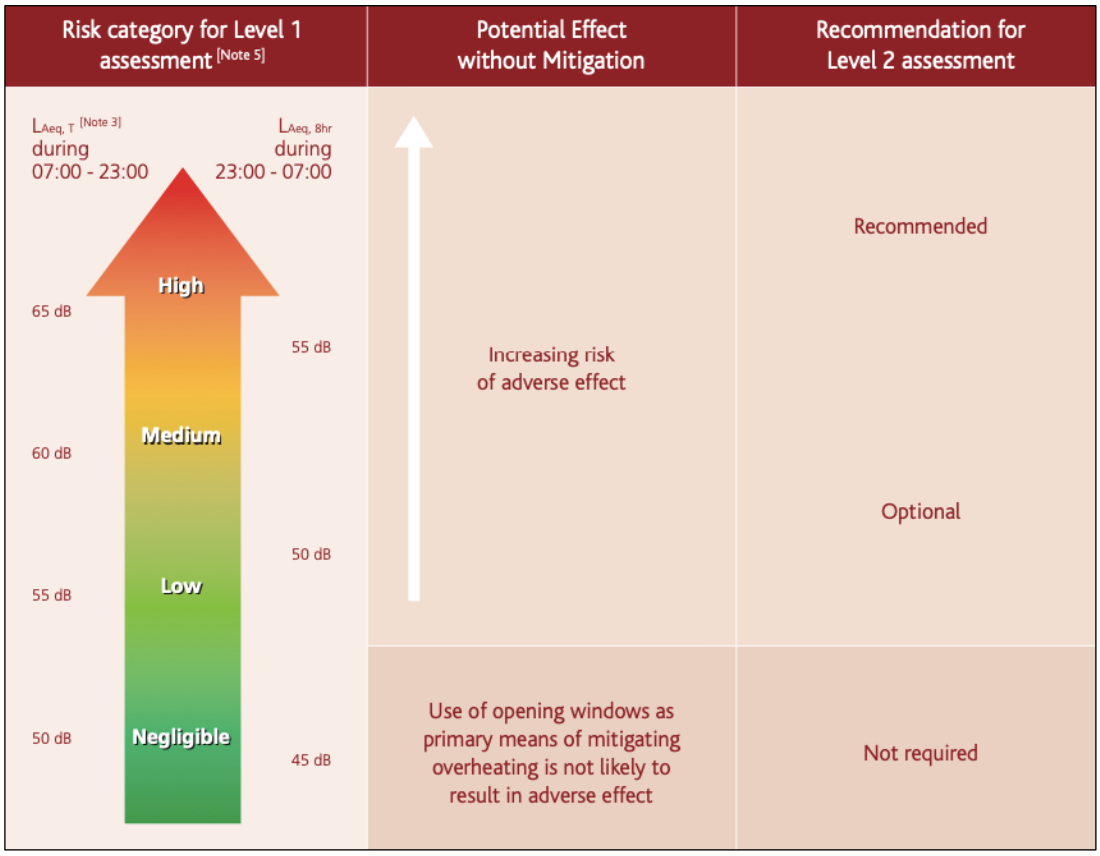
"In many situations, average noise levels like the L_{den} or L_{night} indicators may not be the best to explain a particular noise effect. Single-event noise indicators – such as the maximum sound pressure level (L_{Amax}) and its frequency distribution – are warranted in specific situations, such as in the context of night-time railway or aircraft noise events that can clearly elicit awakenings and other physiological reactions that are mostly determined by $L_{A,max}$.

Nevertheless, the assessment of the relationship between different types of single-event noise indicators and long-term health outcomes at the population level remains tentative. The guidelines therefore make no recommendations for single-event noise indicators."

6.1.4 Acoustics, Ventilation & Overheating Residential Design Guide

The Acoustics, Ventilation and Overheating Residential Design Guide (Version 1.1) was issued in January 2020 by the Association of Noise Consultants (ANC) and the Institute of Acoustics (IOA). This document provides guidance on the interdependence between acoustics, ventilation and overheating.

The AVO guide recommends a two-level approach to assess the potential impact of noise ingress through windows that have been opened to mitigate overheating and also noise from any mechanical services used to provide comfort cooling. The level 1 assessment relates to incident environmental noise levels across a proposed site, it is used to define “risk categories” for each building façade based on these levels. These categories are set out below:



© ANC 2020. AVO Level 1 Assessment

Where a Level 2 assessment is recommended the AVO guide states that the Significant Observed Adverse Effect Level (SOAEL), which is the noise level above which significant adverse effects on health and quality of life occur, is dependent on how frequently and for what duration the overheating condition occurs (i.e. how often the windows need to be open to mitigate overheating). However, the document refers to the overheating condition being “rare” or “most of the time” rather than providing specific durations. Therefore this is open to interpretation.

At planning stage the level of information required to undertake a level 2 assessment in-line with the AVO guide is often not available and a level 1 assessment, which establishes the risk categories of each proposed façade would be most suitable.

6.1.5 BS 4142:2014

BS 4142: 2014 describes methods for rating and assessing the effects of outdoor sound levels, of an industrial and/or a commercial nature, "*on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident*".

The impact of a specific sound is indicated by subtracting the existing background noise level from the rating level (i.e. noise level from the proposed items of plant/machinery/etc plus any acoustic feature corrections). The standard states that:

- "a difference of around +10dB or more is likely to be an indication of a significant adverse impact";
- "a difference of around +5dB is of marginal significance is likely to be an indication of an 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".

The noise from the new development is expressed in terms of a rating level and given as a $L_{Aeq, T}$ noise level. The existing background noise level is expressed in terms of a $L_{A90, T}$ noise level. T is the assessment time interval, which is 1-hour for operations during daytime hours (07:00 to 23:00) and 15-minutes for operations during night-time hours (23:00 to 07:00).

BS 4142:2014 states that if a noise source contains an 'acoustic feature', such as tonality, intermittency or impulsiveness, an appropriate penalty should be applied.

6.2 Local Authority Criteria

The site lies within the Jurisdiction of Gloucester City Council. Based on an email received from Alex Mason (Environmental Health Officer at Gloucester City Council) dated 21 December 2015, it is understood that the noise egress requirements for newly installed building services plant is as follows:

"The cumulative noise assessment level (Excess of rating level over background level (LA90)) of sound emitted from any fixed plant or machinery associated with the development hereby permitted shall not exceed 0 dBA at the nearest noise sensitive receptor(s). All measurements shall be made in accordance with the methodology of BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound."

Although not specifically highlighted in our liaison with Gloucester City Council, with reference to the Bakers Quay Phase 1 development, we expect that both internal and external amenity noise levels should be in-line with the requirements of BS8233:2014 and WHO guidelines.

7.0 Baseline Noise Survey

7.1 Procedure

Unattended noise monitoring was undertaken on site over a 4 day period to establish full daytime and night-time noise levels over a typical weekday and weekend period. The monitoring was carried out between 11:30 on Friday 25 February 2022 and 11:30 on Tuesday 1 March 2022 with equipment set up to record broadband and spectral (octave band) sound pressure levels over discrete 5 and 15-minute periods.

An additional manned measurement was performed between 10:45 and 23:00 on Tuesday 1 March 2022 with the purpose of establishing specific noise levels associated with the roads surrounding the site.

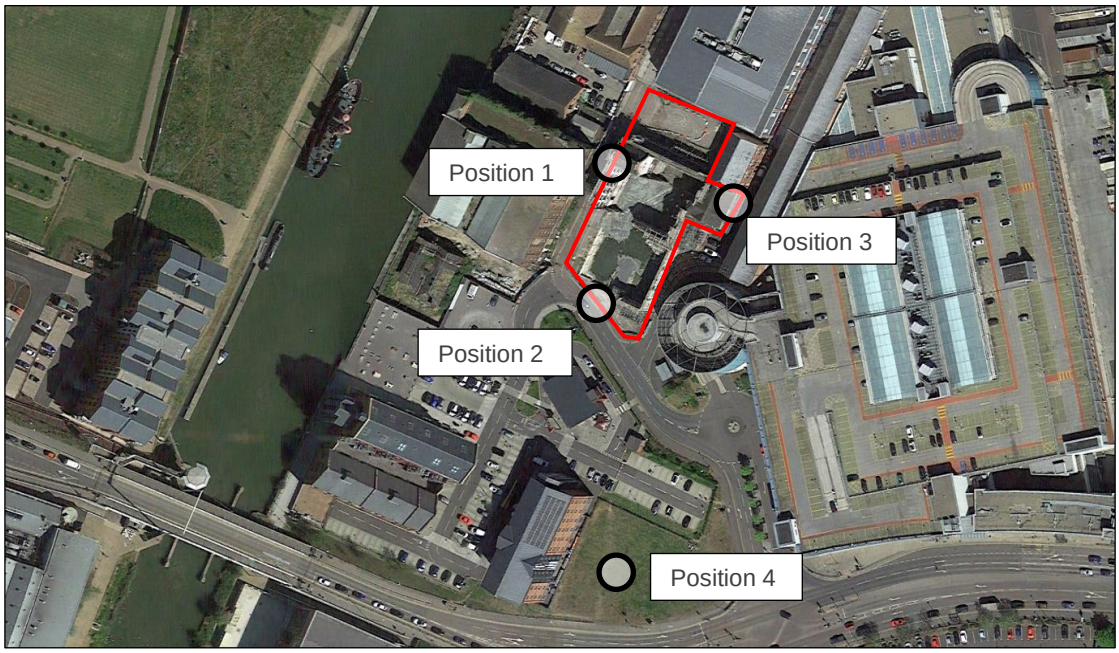
The survey was performed by Rory Nicholls BEng(Hons), AMIOA. All measurements were collated in general accordance with BS 7445-1:2003 *Description and Measurement of Environmental Noise*.

7.2 Measurement Positions

The measurement positions were as described and illustrated below.

Position	Type	Description
1	Unattended	Western façade of site, 3m from façade element, 6m from above ground level
2	Unattended	South-western façade of site, 4m from façade element, 3m above ground level
3	Unattended	Eastern façade of site, 3m from façade element, 4m above ground level
4	Attended	8m away from northern carriageway of St Ann Way, 1.2m above floor level

All measurements were taken under free-field measurement conditions.



Site Plan (Map Data ©2022 Google)

7.3 Weather Conditions

For the unattended survey between Friday 25 February 2022 and Tuesday 1 March 2022, local weather reports indicated no notable periods of prolonged and/or heavy rainfall, with temperatures ranging from 5°C (night) to 12°C (day) and wind speeds were generally considered to be sufficiently low so as to obtain representative noise measurements. During our time on site, skies were clear, wind conditions were calm and road surfaces were dry.

7.4 Instrumentation

The instrumentation used during the survey is presented in the table below.

Position	Description	Manufacturer	Type	Serial Number	Last Calibration
1	Type 1 Data Logging Sound Level Meter	Larson Davis	LXT	5104	15/07/2021
2	Type 1 Data Logging Sound Level Meter	Larson Davis	LXT	4568	15/07/2021
3	Type 1 Data Logging Sound Level Meter	Larson Davis	LXT	5111	15/07/2021
1-3	Calibrator	Larson Davis	CAL200	3083	06/05/2021
4	Type 1 Data Logging Sound Level Meter	Bruel & Kjaer	2250	2600445	15/12/2020
4	Calibrator	Bruel & Kjaer	4231	2115545	13/12/2021

The unattended sound level meter was housed in a weatherproof case with the microphone connected via an extension cable. Manned measurements were taken with a handheld sound level meter mounted onto a tripod. All microphones were fitted with a windshield. Each sound level meter was calibrated prior to and on completion of the survey. No significant deviations occurred (not more than 0.1 dB).

7.5 Results

7.5.1 Unattended Survey

The results of the unattended survey have been plotted on Time History Graph 29549/TH1, 29549/TH2 and 29549/TH3 enclosed in Appendix D. The graph presents the 15-minute A-weighted (dBA) L_{90}, L_{eq} and L_{max} levels at Positions 1, 2 and 3 throughout the duration of the survey.

A summary of the results, as used to inform subsequent assessments against current guidelines, is presented in the table below. The L_{A90} values presented are the 'representative' levels determined through statistical analysis of the 15-minute readings, in line with BS 4142. L_{Afmax} values are the mean '10th highest' 5-minute value. All results are free-field levels.

Position	Daytime (07:00 – 23:00 hrs)		Night-time (23:00 – 07:00 hrs)			
	$L_{Aeq,16hr}$	L_{A90}	$L_{Aeq,8hr}$	L_{A90}	Ventilation L_{Amax}	Overheating L_{Amax}
1	55	49	50	41	72	76
2	58	52	52	41	71	74
3	54	47	46	38	69	75

[1]External L_{AFmax} noise level not normally exceeded more than 10 times a night. This is considered to be the ventilation design case.

[2]Not normally exceeded absolute night-time maximum events should be calculated in-line with the paper *Assessing L_{max} for residential developments: the AVO Guide Approach.* This is considered to be the overheating design case when assessing opening windows as a means of overheating control.

7.5.2 Manned Survey

The following table summarises noise levels recorded for the manned measurement at Position 4.

Position	Date	Period	Sound Pressure Level (dB)		
			$L_{Aeq,15min}$	$L_{A90,15min}$	$L_{Amax,15min}$
4	01/03/2022	10:45 – 11:00	66	58	77

7.6 Discussion of Noise Climate

Due to the nature of the survey, i.e. the majority being unattended, it is not possible to accurately describe the dominant noise sources, or specific noise events throughout the entire survey period. However, at the beginning and end of the survey period the noise climate was noted to be dominated by road traffic noise from St Ann Way, and road traffic noise from other roads located around the city centre.

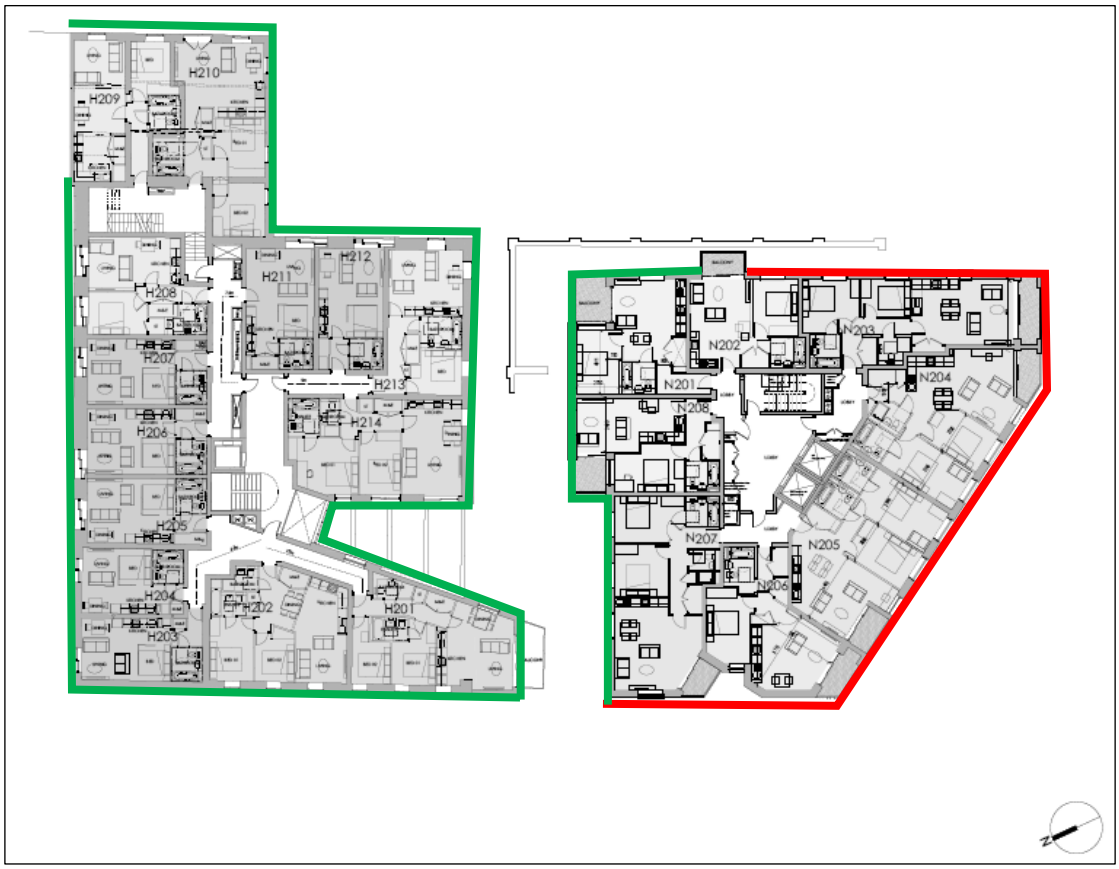
During our time on site, no notable or prolonged periods of noise were observed from the industrial unit to the north of the site, or the cinema and commercial units to the north.

8.0 Incident Noise Levels

The noise levels incident on each building façade have been calculated based on the results of the noise survey. The calculated noise levels have been used in the subsequent assessment of external noise intrusion and are presented in the table below.

Façade Zone	Calculated Incident Noise Levels (dB)	
	Day-time $L_{Aeq,16h}$	Night-time $L_{Aeq,8h}$
Red	58 dB	52 dB
Green	55 dB	50 dB

The location of each façade zone is presented on the plan overleaf.



Mark-up showing Calculated Incident Levels on Façade Zones

9.0 Achieving Internal Noise Levels

9.1 Proposed Criteria

With reference to the acoustic standards and guidelines as reviewed in Section 0, we propose external noise intrusion levels from environmental sources be controlled so as to not exceed the following criteria.

Activity	Location	Desirable Ambient Criteria	
		07:00 – 23:00	23:00 – 07:00
Resting	Living Rooms	$L_{Aeq,16hour}$ 35 dB	-
Dining	Dining Room/Area	$L_{Aeq,16hour}$ 40 dB	-
Sleeping (Daytime Resting)	Bedroom	$L_{Aeq,16hour}$ 35 dB	$L_{Aeq,8hour}$ 30 dB L_{Amax} 45 dB[1]

[1] regular noise events such as trains, aircraft (10-15th highest)

For outdoor living spaces, an upper guideline value of 55dB $L_{Aeq,T}$ is proposed. The above shall be subject to the final approval of Gloucester City Council.

9.2 Assessment of Open Windows

In order to assess the ventilation requirements for the site, we have calculated the internal noise levels with the windows open taking into account the measured incident noise levels set out in Section 7.0 and the typical level of attenuation provided by an open window.

In this regard, BS 8233:2014 states that: “If partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB”. Taking this reduction into account the calculated internal noise levels would be higher than the criteria on all facades of the development.

Façade Zone	Calculated Internal Noise Levels (Windows Open) (dB)	
	Day-time $L_{Aeq,16h}$	Night-time $L_{Aeq,8h}$
Red	43 dB	37 dB
Green	40 dB	35 dB

Based on the above, a reliance upon openable windows as a means of background ventilation is unlikely to be suitable across the development as internal noise levels in all facade zones would likely exceed the proposed criteria in Section 9.1.

As such, suitable façade specifications for glazing and ventilators would be required to achieve suitable internal noise levels with windows closed whilst maintaining suitable ventilation rates. These are discussed in Section 9.3.

9.3 Preliminary Guidance for Windows & Ventilators

9.3.1 Overview

The current façade design proposals allow for either cavity masonry external walls or externally clad SFS external walls with punched-in double glazed windows. Background ventilation could be provided to each apartment by means of acoustically rated window ventilators, whole-house MVHR / constant mechanical extract ventilation (MEV), where appropriate. Windows will be openable for purge ventilation.

Our calculations follow BS 8233 procedures and consider the typical apartment room dimensions and window sizes, as per the latest design drawings (at the time of writing).

9.3.2 Preliminary Specifications

Preliminary sound insulation calculations have been carried out in order to specify the minimum sound insulation performance of windows and ventilators. From the results of our assessment, the following minimum preliminary acoustic performance specifications are recommended.

Façade Zone		Façade Element	Preliminary Minimum Sound Reduction Specification
A	Red	Window	30 dB $R_w + C_{tr}$
		Ventilator	35 $D_{new} + C_{tr}$
B	Green	Window	27 dB $R_w + C_{tr}$
		Ventilator	33 $D_{new} + C_{tr}$

Note: At detailed design stage octave band acoustic specifications will need to be developed, and it will be essential that the prospective glazing/cladding system suppliers can demonstrate compliance with these specifications, rather than simply offering generic glazing configurations as described above.

The table above should be read in conjunction with the façade zone mark-up provided in Section 8.0.

9.3.3 Example Glazing Configurations

Example glazing configurations commensurate with achieving the sound insulation performances are given below.

Glazing Specification, $R_w + C_{tr}$ (dB)	Example Configuration
30	Uprated double glazed system e.g. 10/16/4 mm
27	double glazed system e.g. 6/16/6 mm.

9.3.4 Example Ventilation Solutions

Example ventilation solutions commensurate with achieving the sound insulation performances are discussed below.

Ventilator Specification, $D_{new} + C_{tr}$ (dB)	Example Configuration
35	1 x 2,500mm^2 acoustically uprated hit-miss trickle vent per habitable room, or a mechanically assisted supply & extract solution (e.g. local MVHR).
33	1 x 2,500mm^2 standard hit-miss trickle vent per habitable room, or a mechanically assisted supply & extract solution (e.g. local MVHR).

The preliminary performance specifications included above are based on the provision of either full MVHR for rooms, or 1no. ventilator only per habitable room as required. If additional numbers of ventilators are required to achieve the ventilation rates, the performance requirement for the individual ventilators will need to increase.

The table below provides guidance on the increase in performance specification required for additional numbers of ventilators.

Number of Ventilators	Performance Increase on Ventilator Specifications Stated Above
1	+0 dB
2	+3 dB
3	+5 dB
4	+6 dB

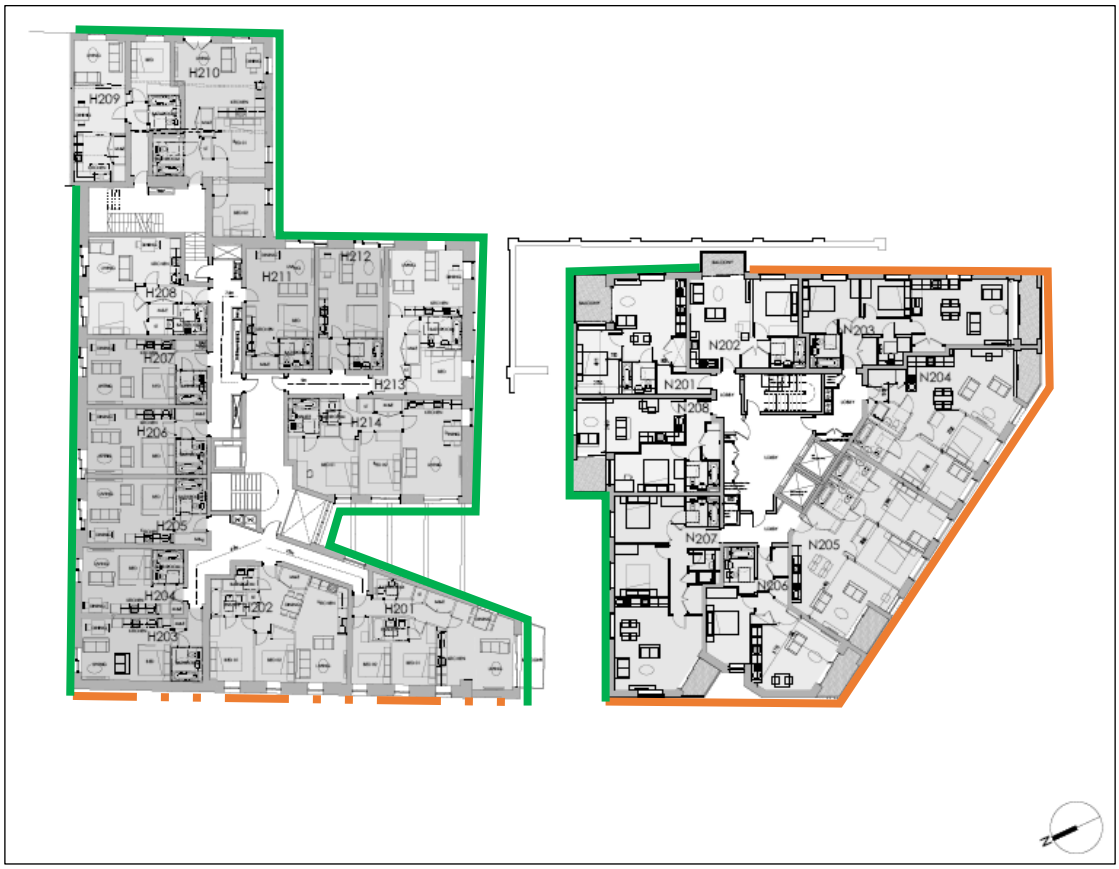
9.4 Ventilation & Overheating

The above presents solutions to satisfy the proposed internal ambient noise limits within dwellings during normal ventilation conditions where windows are closed but ventilators or MVHR systems, to meet Part F minimum ventilation requirements, are operational.

As noted in Section 6.2.4 the Acoustics Ventilation and Overheating – Residential Design Guide (AVO) provides guidance regarding noise and overheating. At this stage a level 1 assessment of the site has been carried out to establish the "risk categories" for each of the proposed building façades. The table below sets out the risk categories and provides guidance as to whether opening windows as a means of overheating control would be suitable.

Incident Day-time Noise Level $L_{Aeq,16h}$	Incident Night-time Noise Level $L_{Aeq,8h}$	Incident Night-time L_{AFMax}	Risk Category	Comments
Below 50 dB	Below 45 dB	Does not normally exceed 58 dB[1]	**Negligible**	Opening windows likely suitable
50 dB to 55 dB	45 to 49 dB	-	**Low**	
55 dB to 65 dB	49 dB to 55 dB	-	**Medium**	Level 2 Assessment Recommended
Above 65 dB	Above 55 dB	Normally Exceeds 78 dB[2]	**High**	Level 2 Assessment Recommended Opening Windows Unlikely Suitable

Based on the above and the calculated noise levels across the site the following mark-up has been produced which show the risk categories across each façade of the proposed development.



Facade Zone Mark-up Showing Overheating Risk Categories Across the Development

Based on the above it would be prudent to ensure habitable rooms in the **Medium** zones are designed so as to remove (or severely restrict) the reliance on openable windows to satisfy overheating targets. This can be achieved by use of solar rated glazing, black out blinds, or through fenestration design. It can be assisted with mechanical ventilation too, such as MVHR with a manual summer boost function. It should also be noted that the façade on the north-west of the site, which is marked as a dashed line in the mark-up above, only exceeds the level which puts it in the **Medium** risk category by 1 dBA.

Air conditioning can also be considered for quality developments. However, the introduction of mechanical solutions should be considered carefully; not only with regard to cost and maintenance, but sustainability and the environment, which are likely to be more prominent drivers for any new development with the LPA's jurisdiction.

10.0 Outdoor Living Spaces

On this scheme, it is understood that there are a number of roof terraces and balconies included in the design. The noise levels within the proposed areas for the roof terraces were calculated using the calculated incident levels. The balconies on the **Green** façade zones (See Section 8.0), as illustrated in Sections 8.0 & 9.0, should achieve external levels below the criteria of 55 dB $L_{Aeq,16hr}$.

With regards to the balconies on the **Red** façade zones (See Section 8.0), we would expect that noise levels on these balconies could be up to 58 dB $L_{Aeq,16hr}$ which is 3 dB above the proposed upper limit of 55 dB $L_{Aeq,16hr}$. It should be noted that ProPG states that these guideline values may not be achievable in all circumstances where the development might be desirable. In such a situation, developments should be designed to achieve the lowest practicable noise levels in these external amenity spaces but should not be prohibited.

Due to the location of the terraces, providing mitigation measures to reduce the noise levels may not be possible. That being said, the noise level could be reduced to circa 55 dB $L_{Aeq,16hr}$ by providing sound absorbent treatment to the external walls and the underside of the terraces themselves.

Notwithstanding the above, significant adverse noise impacts may be partially off-set if the residents have access to a relatively quiet, protected, publicly accessible, external 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). With regards to this, the site is within 500 m of Gloucester Park with is located to the west which should provide the potential occupants of the development with a nearby local green space.

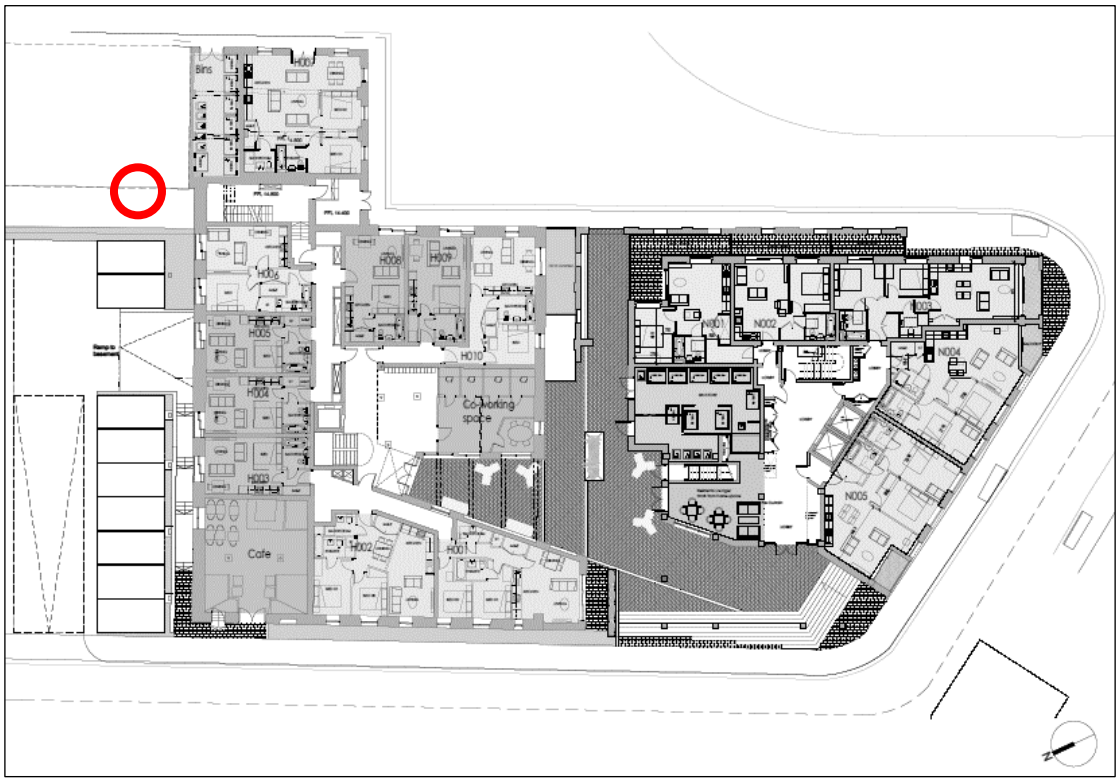
Based on the above given that the terraces on **Red** façade zones may not achieve the recommended criterion of 55 dB $L_{Aeq,16h}$ the exceedance should be considered acceptable given that the exceedance would be 3 dB in the worst case and that the site is located close to a park. The potential benefits of the development should be considered by decision makers when considering site acceptability such as the need for new housing, proximity to major road links, locality of the site to existing relatively quiet external amenity areas, and the fiscal benefits to the local economy.

11.0 Existing Plant Installations Effecting the Site

During our time on site, it was noted that on the western façade of the residential properties to the north-east of site, a total of 2no. small wall mounted condensing unit were situated at approximately 4.5 m and 6.5 m above ground level.

It was not possible to establish the specific unit manufacturer and model. However, representative acoustic data has been used for typical condensing unit to inform a subsequent plant noise assessment.

For clarity the location of these units is shown in the mark-up overleaf.



Mark-Up Showing Location of 2no. Small Air Conditioning Units at 4.5 m & 6.5 m Above Ground Level

11.1.1 Representative Acoustic Data

The below table presents representative acoustic data used in the plant noise assessment for a small condensing unit.

Plant Description	Sound Power Level (dB re 10^{-12} W)
Mitsubishi MXZ-4F83VF (Assumption)	61 dBA

11.1.2 Plant Noise Impact Assessment

This section details our plant noise calculations and assessment to the nearest on-site noise sensitive receiver, being the proposed residential plot approximately 5 m to the south-west of the 2no. units.

	Sound Power Level (dB re 10^{-12} W) dBA	
Mitsubishi MXZ-4F83VF	61	
Correction for 2no. Units	**+3**	
Conformal Area Distance Loss to 5 m	-29	
Calculated Noise Level at Receptor	**35**	
Plant Noise Emission Criteria ($L_{Ar,Tr}$, dB)	**Daytime (07:00 – 23:00 hrs)**	**Night-time (23:00 – 07:00 hrs)**
	49 dBA	**41 dBA**
Cumulative Calculated Specific Sound Pressure Level at Receiver	**35 dBA**	**35 dBA**
Difference (dBA)	**-14**	**-6**

It can be seen from the above that the noise egress from the units could be well below the existing background noise level at the newly proposed window. However, it should be noted that the above assessment is indicative as the exact model of the existing units is not known.

12.0 Development-Generating Noise Impacts

12.1 Newly Installed Building Services Plant

12.1.1 Fixed Plant & Equipment Noise Limits

Based on the results of the noise survey and the requirements of the Local Authority, we propose that the following plant noise emission criteria be achieved incident at the nearest noise off-site sensitive residential windows, in free-field conditions, with all plant operating simultaneously.

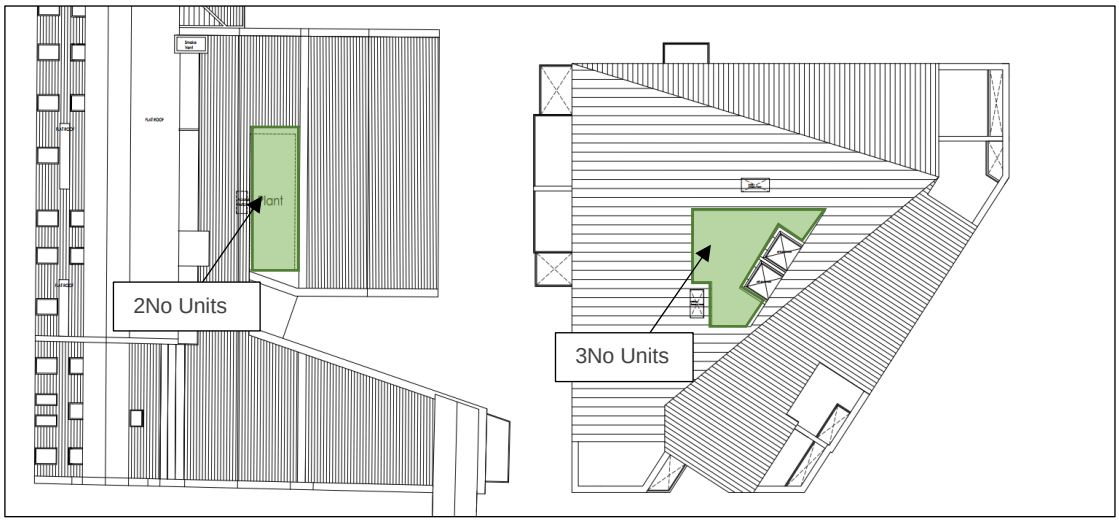
Plant Noise Emission Criteria ($L_{Ar,Tr}$, dB)	
Daytime (07:00 – 23:00 hours)	**Night-time (23:00 – 07:00 hours)**
47	38

Noise shall be assessed in accordance with BS 4142:2014 with corrections applied for any plant emitting noise of a tonal or irregular quality.

The above limits shall be subject to the final approval of Gloucester City Council.

12.1.2 Proposed Fixed Plant & Equipment

We understand that 5No. Daikin EWYT090CZPBA2 air cooled chillers are proposed in total with 3No. units on the roof of the tower and 2No. units on the heritage block roof. The location of the plant items is shown on Thorney & Lumb Drawing C8057-TLP-00-RL-DR-M-701, however, for ease of reference the plant locations are marked-up below:



Location of Proposed External Noise Items

The 2No units on the heritage block will be located within a plant compound that is essentially set into the pitch of the roof. Meaning that the plant may not be screened on one side. However, the 3No units on the tower roof will be located in a plant well and will be screened from all receptors.

The manufactures datasheet indicates the following sound pressure levels for the units when operational:

Unit	Sound Pressure Level at 1m for the unit, dB, at each Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1000	2000	4000	8000	
EWYT090CZPBA2	75	71	66	63	61	61	53	46	67

It is also understood that the units could operate over 24hours particularly in winter with the high heating demand. However, we understand that the following would be the worst-case scenarios:

- Daytime (07:00 to 23:00): All 5No units operating simultaneously.

- Night-time (23:00 to 07:00): 1No units on the tower roof operating and 1No unit on the heritage roof operating.

12.1.3 Plant Noise Impact Assessment

We understand that the proposed units will be operational during daytime (5No total units) and at night-time hours (2No total units).

It should be noted that the proposed plant is not anticipated to exhibit any tonal or impulsive characteristics provided it is well maintained. We understand that the plant could ramp up and down depending on the demands on the various systems. As such, a +3dB feature correction as advised in BS 4142:2014 has been applied for the possible presence of intermittency.

The following tables summarise our predictions of atmospheric noise emissions from the units to the nearest off-site noise sensitive residential windows.

Daytime Assessment

	Sound Pressure Level (dB re $2x10^{-5}$ Pa) at Octave Band Centre Frequency (Hz)								**dBA**
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Sound Pressure Level at 1m	75	71	66	63	61	61	53	46	67
No. Correction 2No Units on Heritage Block	+3	+3	+3	+3	+3	+3	+3	+3	-
Conformal Area Distance Correction	-19	-19	-19	-19	-19	-19	-19	-19	-
Barrier Correction	-14	-17	-20	-24	-25	-25	-25	-25	-
Feature Correction (BS4142)	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Receptor	**48**	**41**	**33**	**26**	**23**	**23**	**15**	**8**	**32**
Sound Pressure Level at 1m	75	71	66	63	61	61	53	46	67
No. Correction 3No Units on Tower Block	+5	+5	+5	+5	+5	+5	+5	+5	-
Conformal Area Distance Correction	-25	-25	-25	-25	-25	-25	-25	-25	-
Barrier Correction	-12	-14	-17	-20	-20	-20	-20	-20	-
Feature Correction (BS4142)	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Receptor	**46**	**40**	**32**	**26**	**24**	**24**	**16**	**9**	**31**
Cumulative Noise Level at Receptor	50	44	36	29	27	27	19	12	**35**
Excess over criteria (47 dB $L_{Ar,Tr}$)	-	-	-	-	-	-	-	-	**-12**

Night-time Assessment

	Sound Pressure Level (dB re 2x10^{-5} Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Sound Pressure Level at 1m	75	71	66	63	61	61	53	46	67
Conformal Area Distance Correction	-19	-19	-19	-19	-19	-19	-19	-19	-
Barrier Correction	-14	-17	-20	-24	-25	-25	-25	-25	-
Feature Correction (BS4142)	+3	+3	+3	+3	+3	+3	+3	+3	-
Calculated Noise Level at Receptor	**45**	**38**	**30**	**23**	**20**	**20**	**12**	**5**	**29**
Sound Pressure Level at 1m	75	71	66	63	61	61	53	46	67
Conformal Area Distance Correction	-25	-25	-25	-25	-25	-25	-25	-25	**-**
Barrier Correction	-12	-14	-17	-20	-20	-20	-20	-20	**-**
Feature Correction (BS4142)	+3	+3	+3	+3	+3	+3	+3	+3	**-**
Calculated Noise Level at Receptor	**41**	**35**	**27**	**21**	**19**	**19**	**11**	**4**	**26**
Cumulative Noise Level at Receptor	46	40	32	25	23	23	15	8	**31**
Excess over criteria (38 dB $L_{Ar,Tr}$)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-7**

Based on the above calculations indicate that the levels of noise egress from the proposed plant units should be in well below the criteria at the most affected off-site receptor.

12.2 Amenity & Commercial Unit Operations

At ground floor level 1no. commercial unit is proposed as part of the development. Considering the prevailing environmental noise climate at the site, we would expect that noise egress via the unit frontage from most general commercial uses (e.g. restaurant, café, shop) should be readily controllable. However, for completeness we advise that operational noise break-out from any proposed use is controlled to no more than 5 dB below the existing background noise level as follows:

Period	Commercial noise break-out Limit, L_{Aeq} (dB)
Daytime (07:00-23:00)	42 dBA
Night-time (23:00-07:00)	33 dBA

Should the operation include music noise, we advise that the above limits are reduced by a further 5 dB

Furthermore, noise transfer through the separating floor structure (and associated flanking paths) from the ground floor commercial units to first floor apartments shall be considered. Once final uses have been confirmed for each unit, an assessment of noise transfer to structurally connected habitable rooms shall be carried out which considers typical noise levels within the commercial unit and the sound insulation performance of the separating construction.

For noise transfer to apartments above, the design intent should be to ensure operational L_{max} noise transfer to apartments does not exceed a level at least 5 dB lower than the anticipated background L_{90} noise level in each octave band.

13.0 Conclusions

A detailed environmental noise survey has been undertaken in order to establish the currently prevailing environmental noise climate around the site.

The environmental noise impact upon the proposed dwellings has been assessed in the context of national and local planning policies.

Appropriate target internal noise levels have been proposed. These are achievable using conventional mitigation measures. Mitigation advice, including the use of suitably specified glazing and acoustically attenuated ventilation, have been recommended to reduce to a minimum the adverse impact on health and quality life arising from environmental noise.

During overheating conditions internal noise levels would likely be compromised within portions of the proposed development (see Section 9.4) if opening windows is relied upon as the sole form of mitigation. Consequently, the following should be considered further:

- Where appropriate the provision of windows with increased G-ratings, and/or permanent blinds/shutters. A summer time boost mode on any provided ventilation systems.

An initial assessment of the outdoor terraces and outdoor amenity areas has been conducted which shows terrace and balcony areas may not reach criteria on the south-western façade, but leniency should be considered due to the close proximity of Gloucester Park.

Based on the results of the survey suitable plant noise egress limits have been set for the development. A review of the proposed plant items has shown that the levels of plant noise egress at the nearest off-site receptor should be well below the proposed plant noise limits.

As commercial spaces are included in the proposed scheme, and external break-out noise level limits from these spaces have been suggested.

The assessment shows the site, subject to appropriate mitigation measures, is suitable for residential development in terms of noise.

Appendix A – Acoustic Terminology

The acoustic terms used in this report are defined as follows:

dB — Decibel - Used as a measurement of sound level. Decibels are not an absolute unit of measurement but an expression of ratio between two quantities expressed in logarithmic form. The relationships between Decibel levels do not work in the same way that non-logarithmic (linear) numbers work (e.g. 30dB + 30dB = 33dB, not 60dB).

dBA — The human ear is more susceptible to mid-frequency noise than the high and low frequencies. The 'A'-weighting scale approximates this response and allows sound levels to be expressed as an overall single figure value in dBA. The $_A$ subscript is applied to an acoustical parameter to indicate the stated noise level is A-weighted

It should be noted that levels in dBA do not have a linear relationship to each other; for similar noises, a change in noise level of 10dBA represents a doubling or halving of subjective loudness. A change of 3dBA is just perceptible.

$L_{90,T}$ — L_{90} is the noise level exceeded for 90% of the period *T* (i.e. the quietest 10% of the measurement) and is often used to describe the background noise level.

$L_{eq,T}$ — $L_{eq,T}$ is the equivalent continuous sound pressure level. It is an average of the total sound energy measured over a specified time period, *T*.

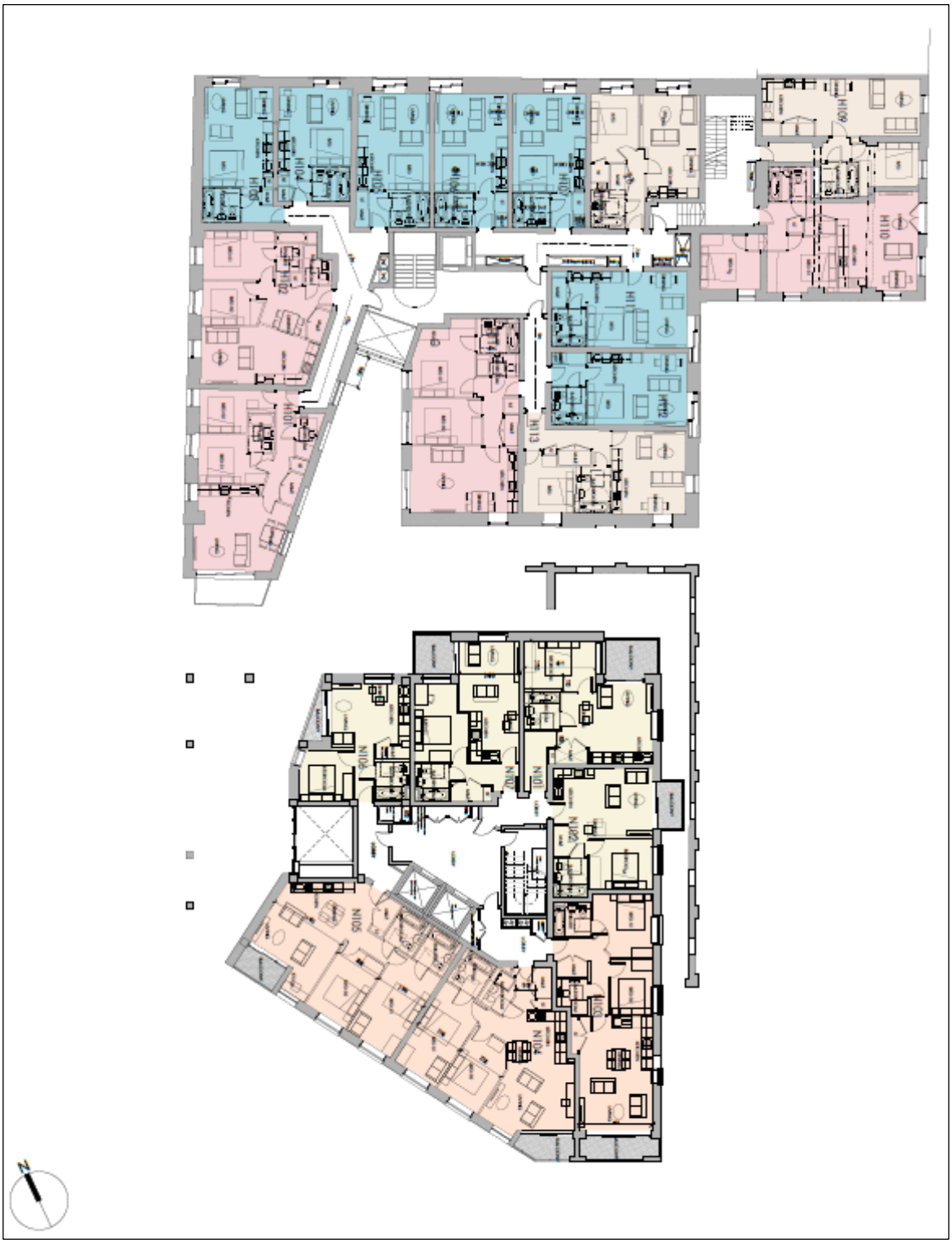
L_{max} — L_{max} is the maximum sound pressure level recorded over the period stated. L_{max} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the L_{eq} noise level.

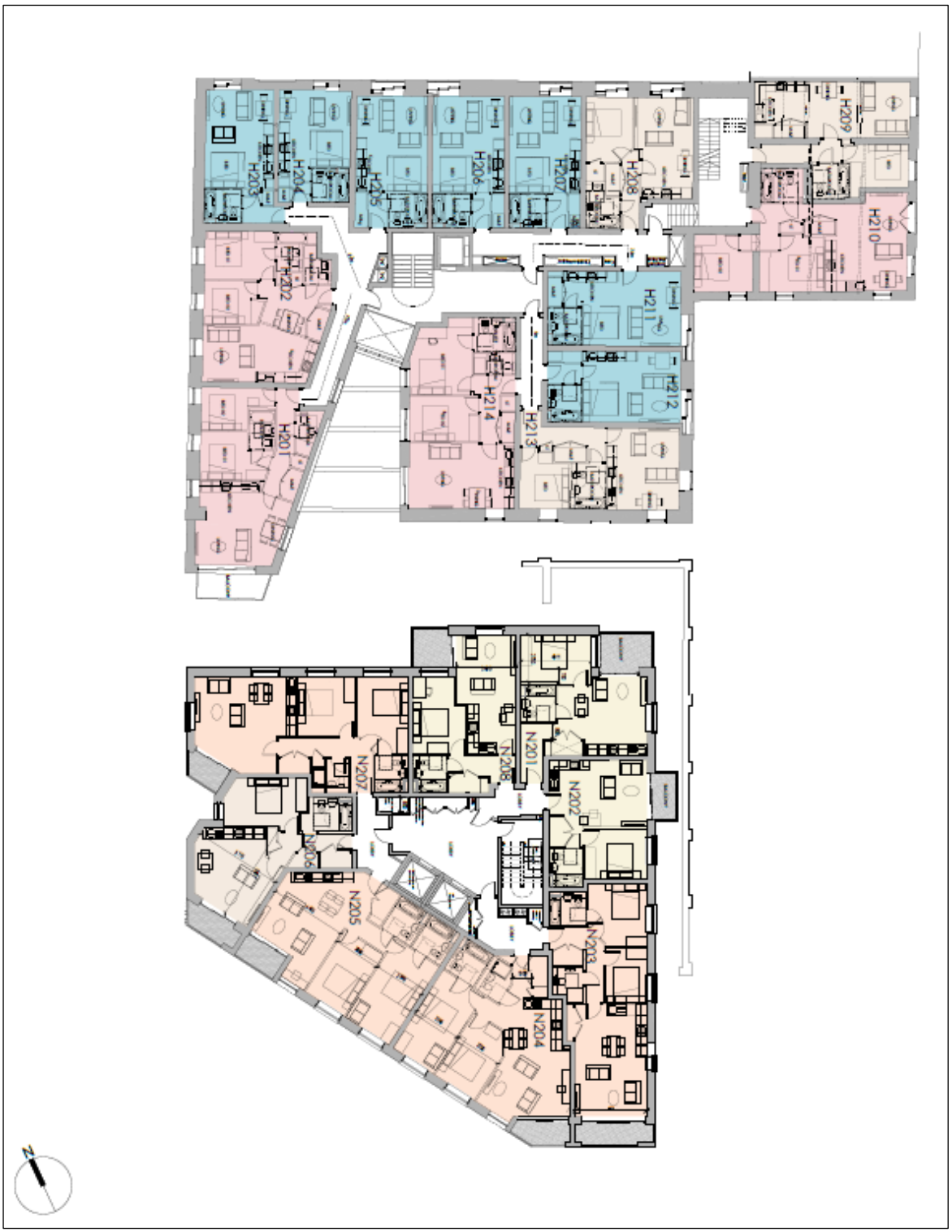
L_p — Sound Pressure Level (SPL) is the sound pressure relative to a standard reference pressure of 2×10^{-5} Pa. This level varies for a given source according to a number of factors (including but not limited to: distance from the source; positioning; screening and meteorological effects).

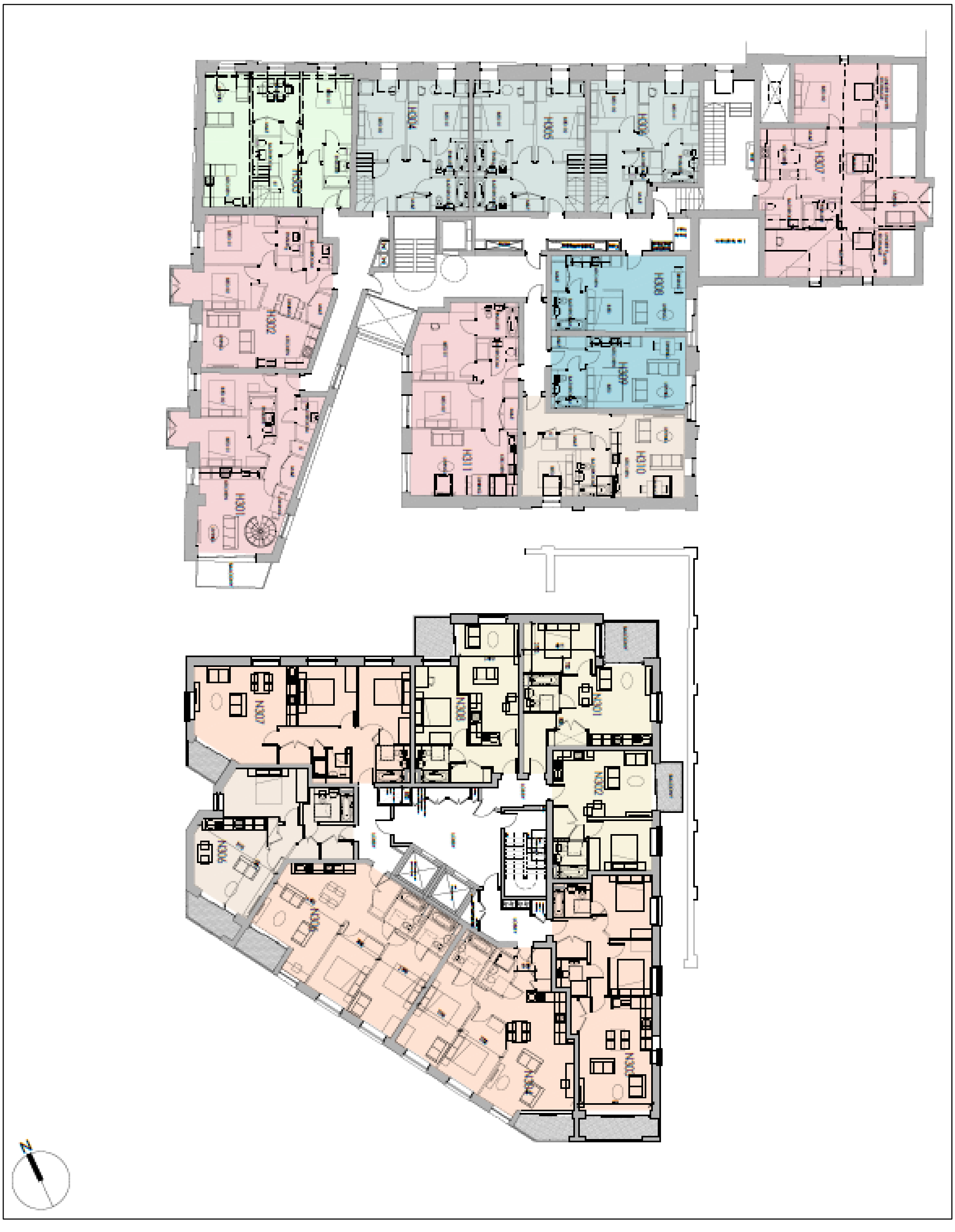
L_w — Sound Power Level (SWL) is the total amount of sound energy inherent in a particular sound source, independent of its environment. It is a logarithmic measure of the sound power in comparison to a specified reference level (usually 10^{-12} W).

Appendix B – Proposed Site Drawings


N
N005
N004
N003
N002
N001
H001
H002
Cafe
H003
Co-working space
H004
H010
H005
H009
H008
H006
H007
Bins




H201
H202
H203
H204
H205
H206
H207
H208
H209
H210
H211
H212
H213
H214
N201
N202
N203
N204
N205
N206
N207
N208
N

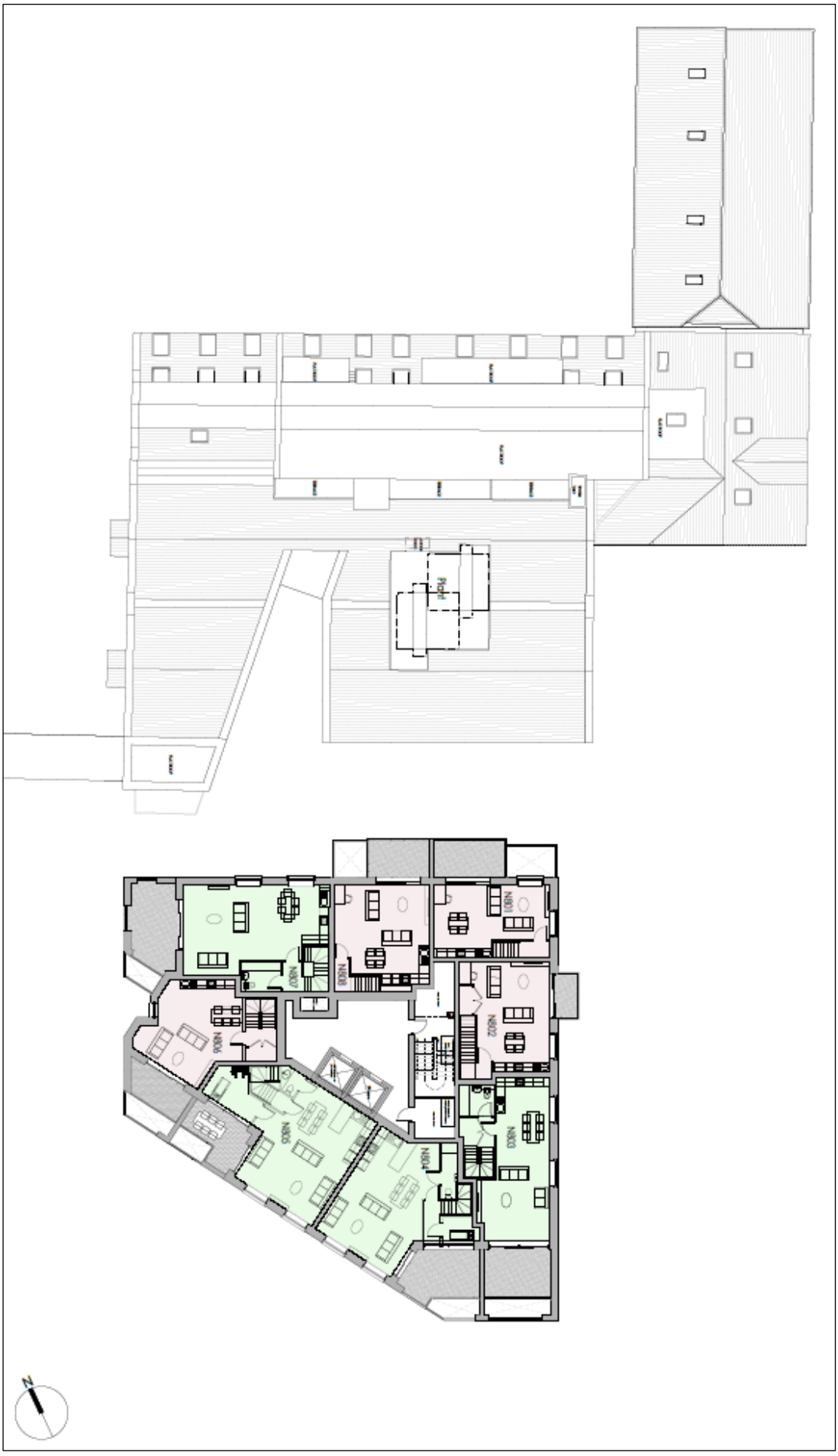


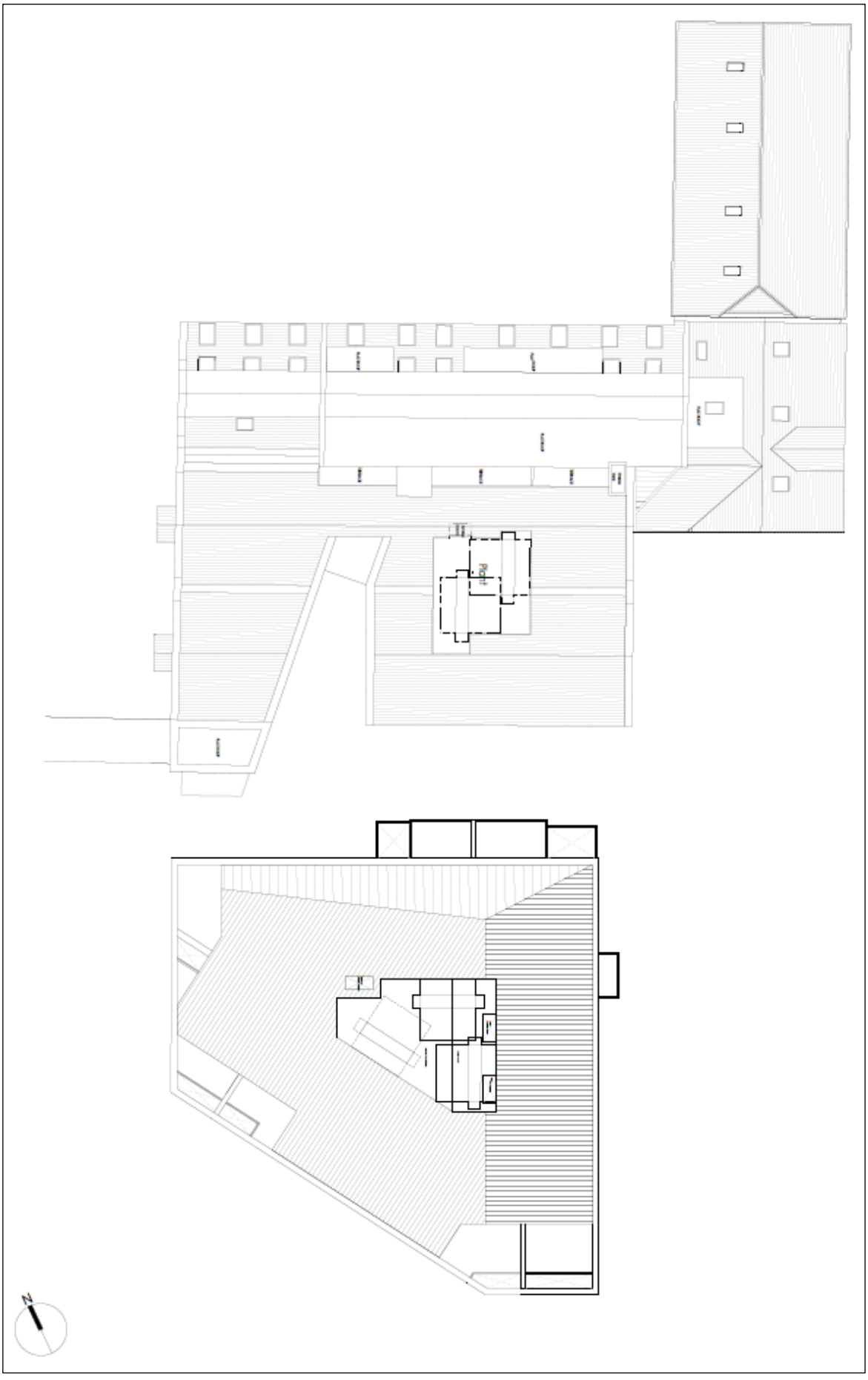

N
N101
N102
N103
N104
N105
N106
N107
N108


N607
N606
N601
N602
N605
N604
N603
N
PH


N
N001
N002
N003
N004
N005
N006
N007
N008
PH1


Roof
N807
N808
N801
N802
N806
N805
N803
N804
N
Roof
N807
N808
N801
N802
N806
N805
N803
N804
N


RDH
N001
N002
N003
N004
N005
N006
N007
N008



Appendix C – National Planning Policies

National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) was first published in 2012, replacing the existing Planning Policy Guidance Note 24 (PPG24) "Planning and Noise", and sets out the government's planning policies for England and how these are expected to be applied.

The latest revision of the NPPF (July 2021) states that planning system should contribute to, and enhance, the natural and local environment by (amongst others) *"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, water or noise pollution or land stability."*

NPPF advises that planning policies and decisions should ensure:

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

"*…new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.*"

The NPPF makes reference to the Noise Policy Statement for England.

Noise Policy Statement for England (NPSE)

The Noise Policy Statement for England (NPSE) was published in March 2010 (i.e. before the NPPF). The NPSE is the overarching statement of noise policy for England and applies to all forms of noise other than occupational noise, setting out the long term vision of Government noise policy which is to "Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."

That vision is supported by the following NPSE noise policy aims which are reflected in three of the four aims of planning policies and decisions in the NPPF as below:

"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."*

The Explanatory Note to the NPSE has three concepts for the assessment of noise in this country:

NOEL – No Observed Effect Level
This is the level below which no effect can be detected and below which there is no detectable effect on health and quality of life due to noise.

LOAEL – Lowest Observable Adverse Effect Level
This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level
This is the level above which significant adverse effects on health and quality of life occur.

None of these three levels are defined numerically and for the SOAEL the NPSE makes it clear that the noise level is likely to vary depending upon the noise source, the receptor and the time of day/day of the week, etc. The need for more research to investigate what may represent an SOAEL for noise is acknowledged in the NPSE and the NPSE asserts that not stating specific SOAEL levels provides policy flexibility in the period until there is further evidence and guidance.

The NPSE concludes by explaining in a little more detail how the LOAEL and SOAEL relate to the three NPSE noise policy aims listed above. It starts with the aim of avoiding significant adverse effects on health and quality of life, then addresses the situation where the noise impact falls between the LOAEL and the SOAEL when *"all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development."* The final aim envisages pro-active management of noise to improve health and quality of life, again taking into account the guiding principles of sustainable development which include the need to minimise travel distance between housing and employment uses in an area.

Planning Practice Guidance on Noise (PPG)

Planning Practice Guidance (PPG) under the NPPF has been published by the Government as a web based resource. This includes specific guidance on Noise although, like the NPPF and NPSE, the PPG does not provide any quantitative advice. It seeks to illustrate a range of effect levels in terms of examples of outcomes as set out in the following table:

Response	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not present	No effect	No Observed Effect	No specific measures required
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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 small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, 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
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

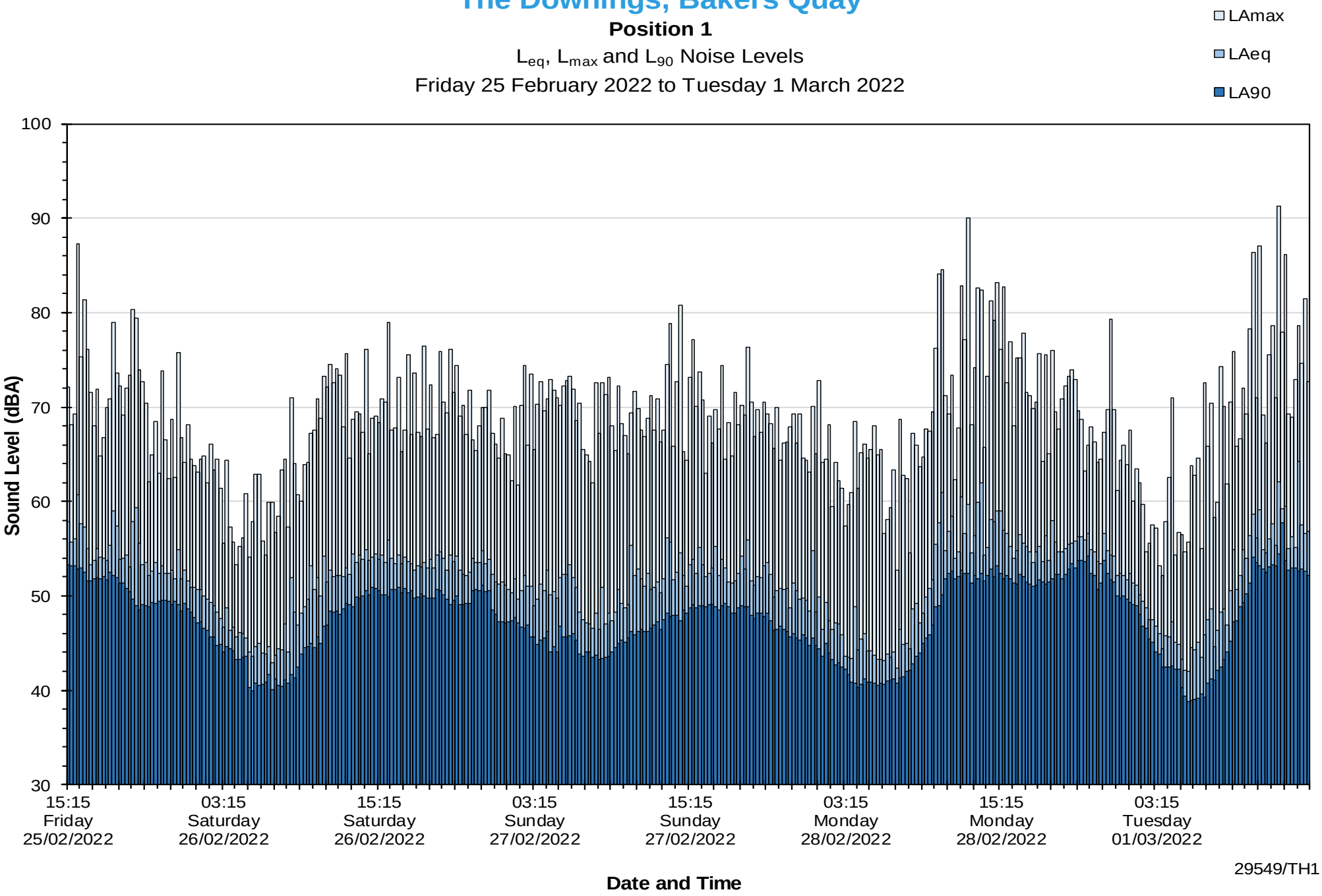
Appendix D – Time History Graphs and Statistical Analysis of Daytime / Night-time Levels

The Downings, Bakers Quay

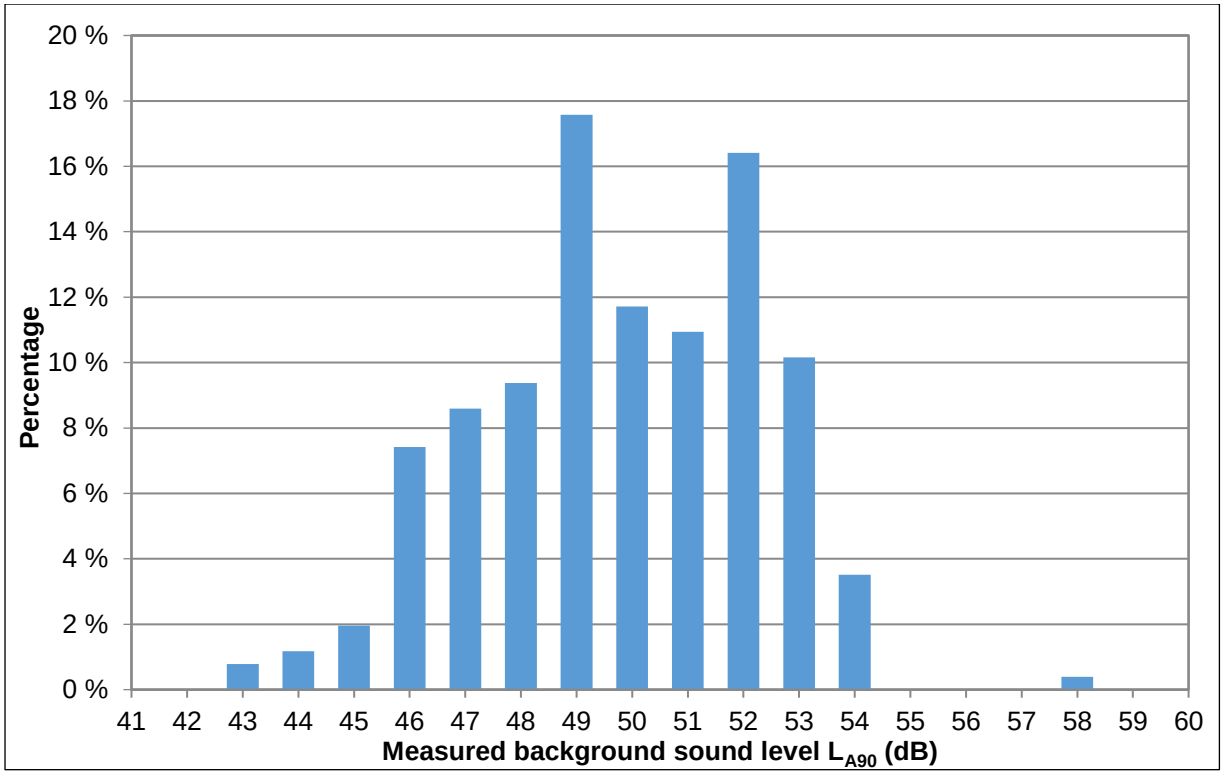
Position 1

L_{eq}, L_{max} and L_{90} Noise Levels

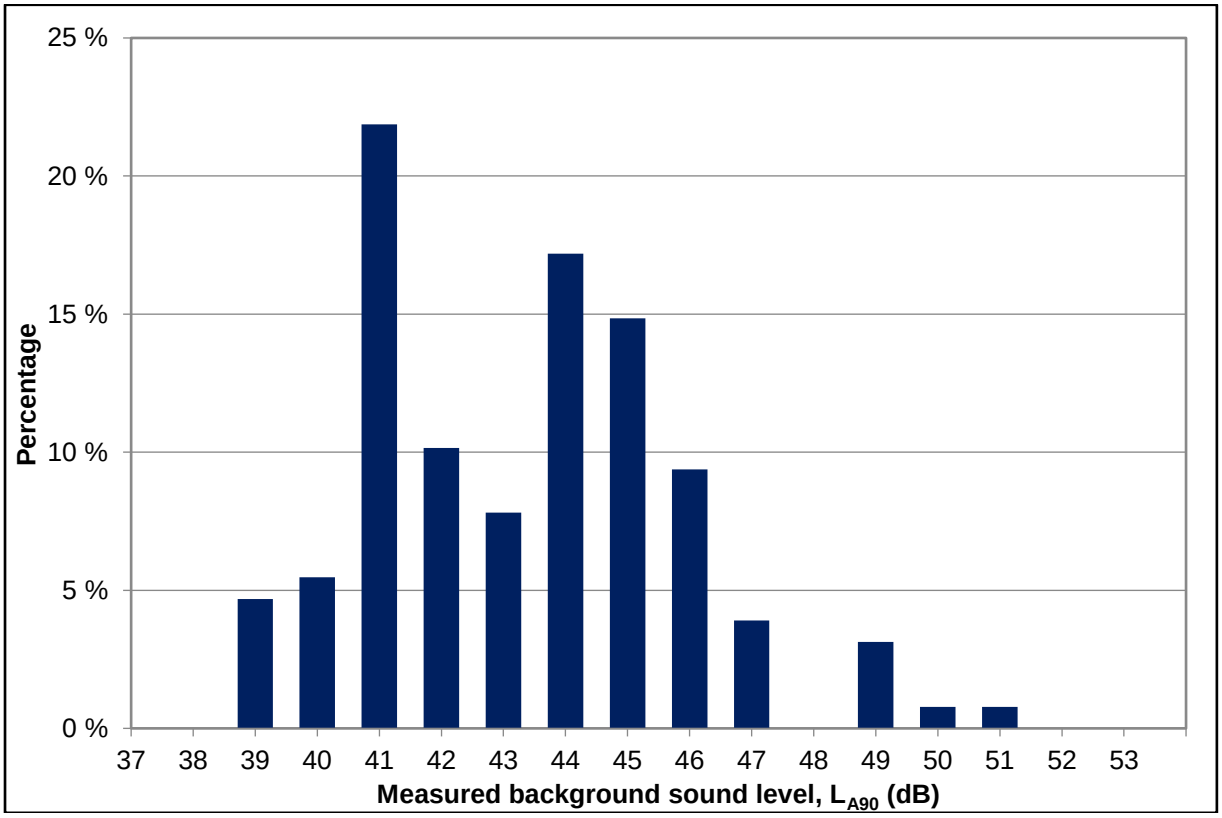
Friday 25 February 2022 to Tuesday 1 March 2022



29549/TH1



Time histogram of measured daytime L_{A90} at position 1



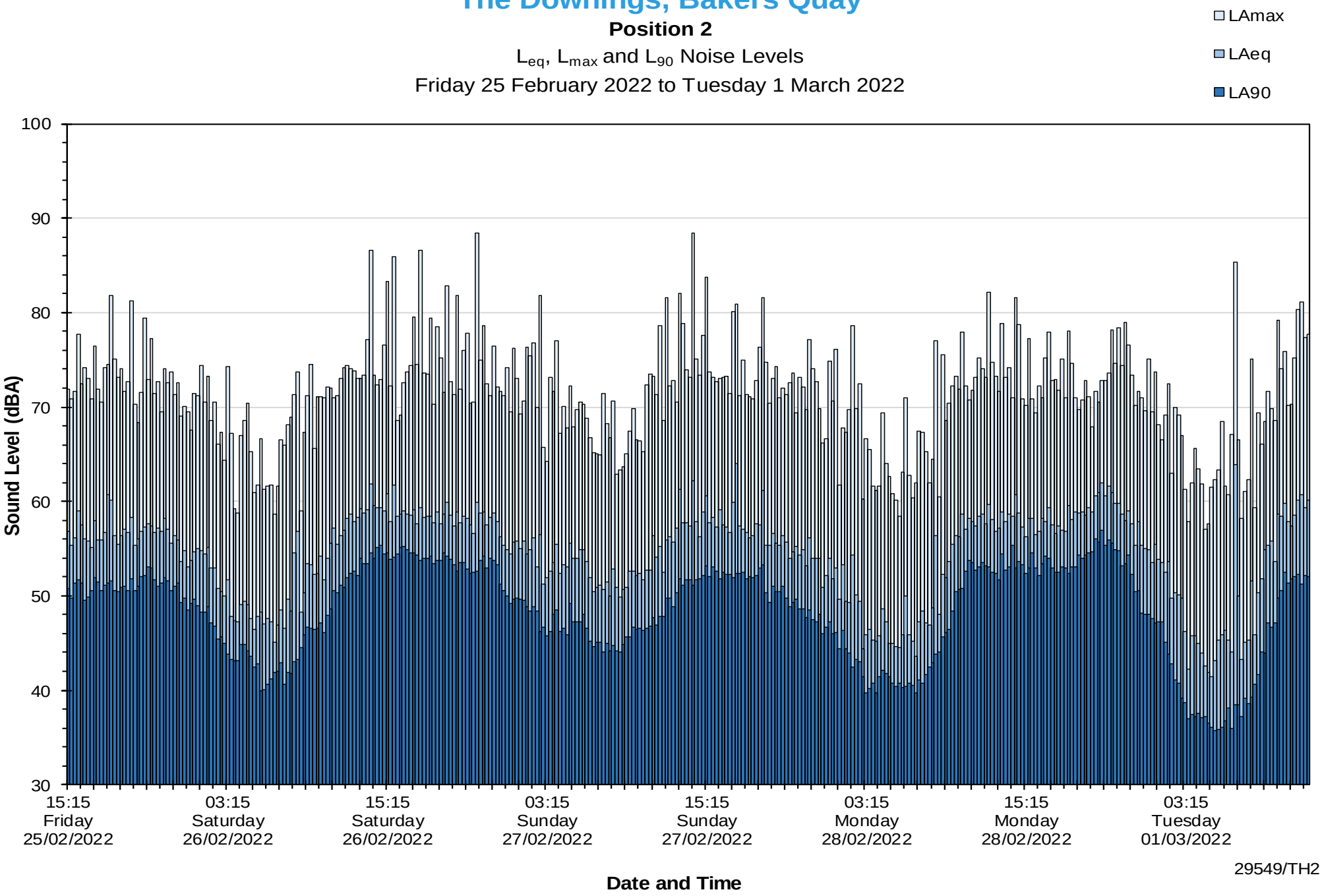
Time histogram of measured night-time L_{A90} at position 1

The Downings, Bakers Quay

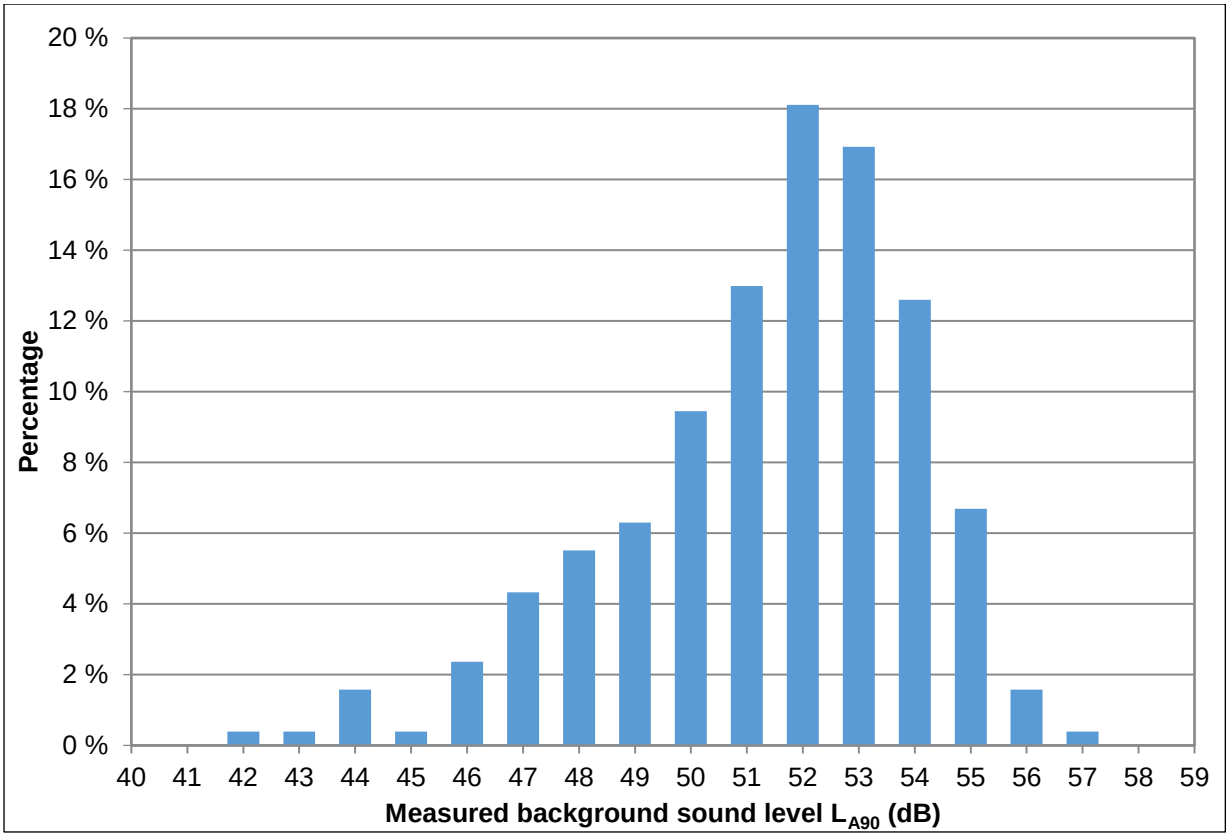
Position 2

L_{eq}, L_{max} and L_{90} Noise Levels

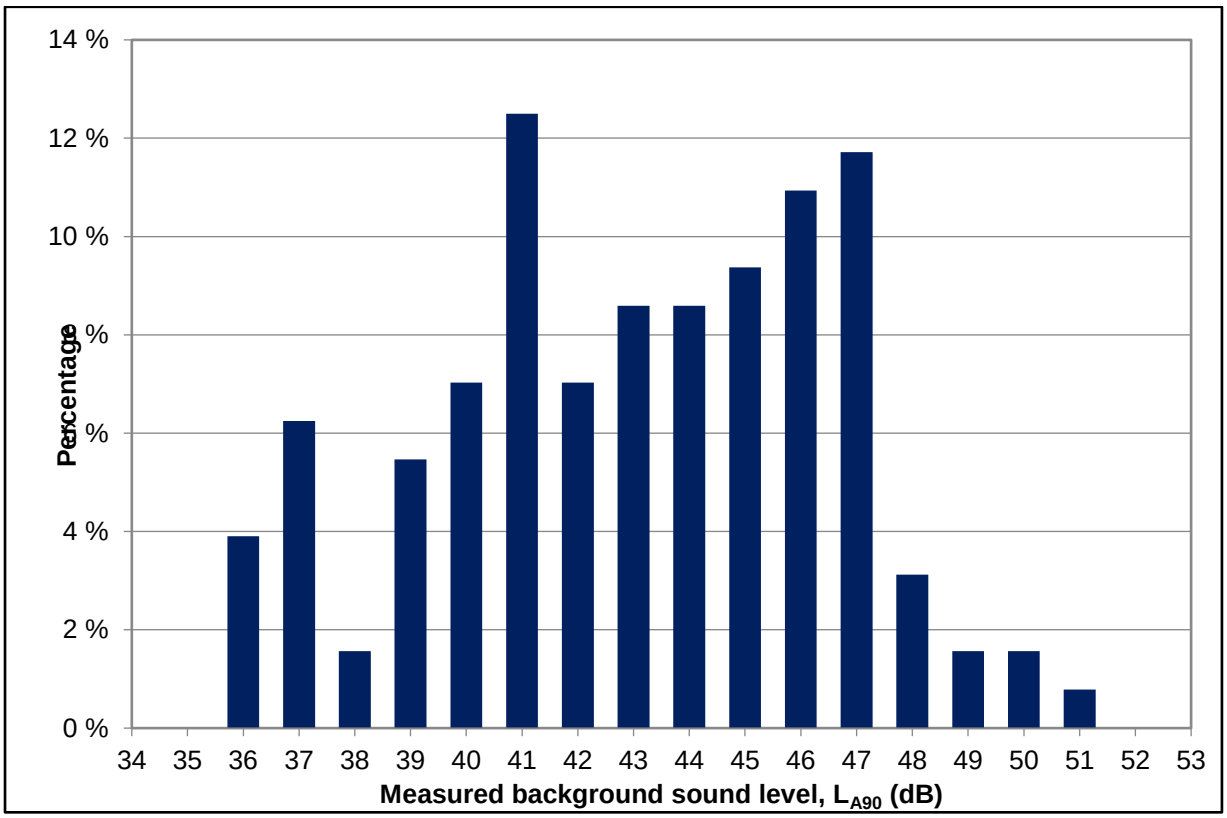
Friday 25 February 2022 to Tuesday 1 March 2022



29549/TH2



Time histogram of measured daytime L_{A90} at position 2



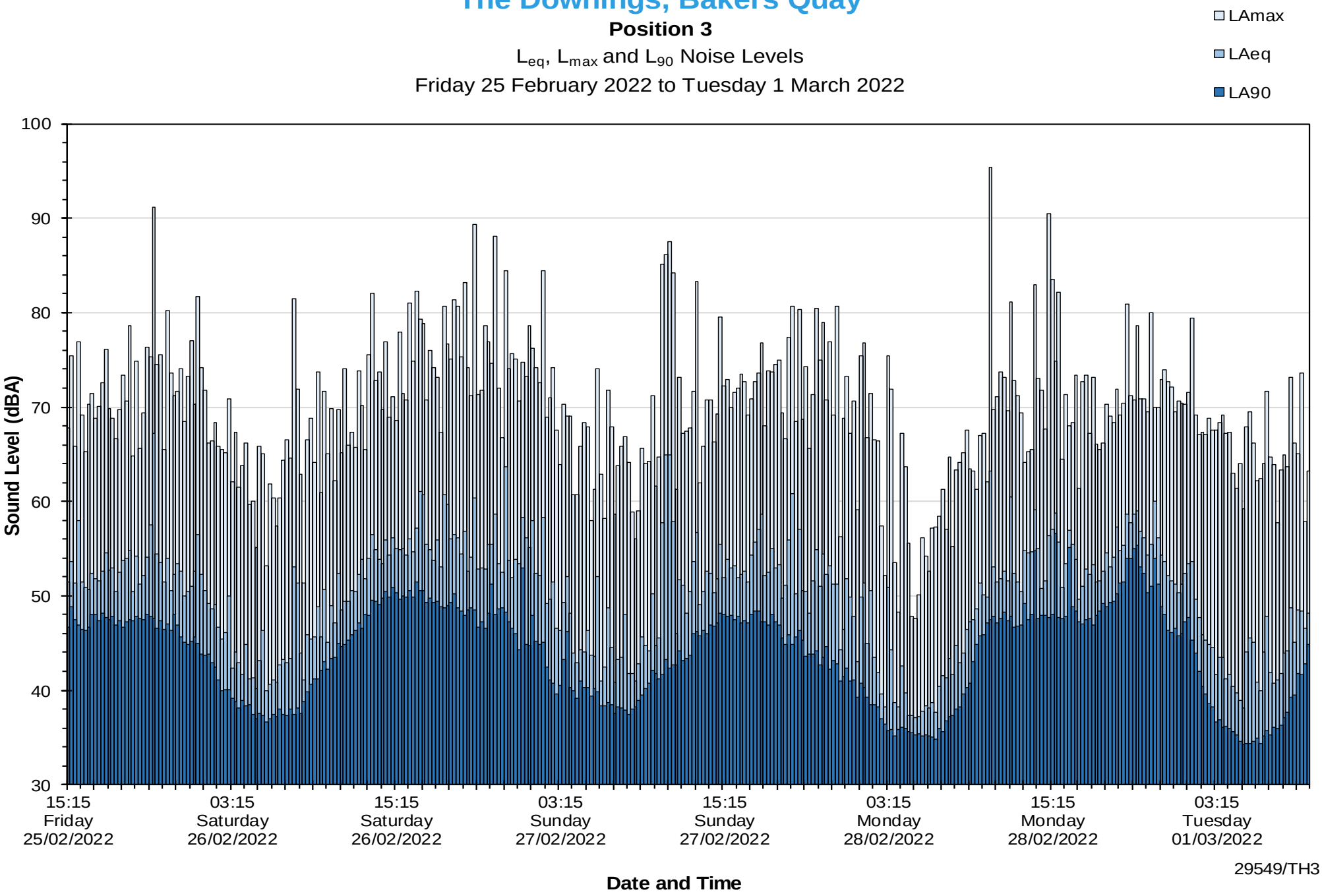
Time histogram of measured night-time L_{A90} at position 2

The Downings, Bakers Quay

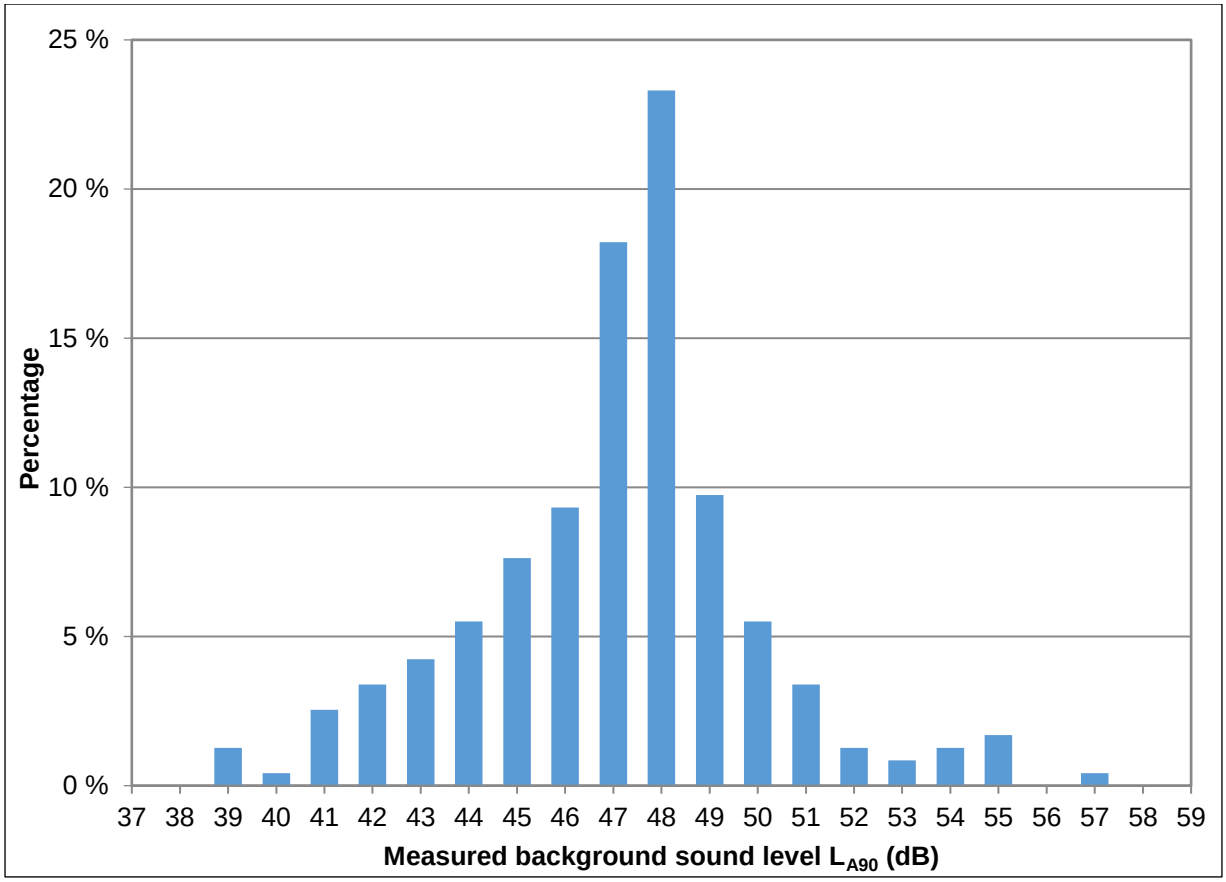
Position 3

L_{eq}, L_{max} and L_{90} Noise Levels

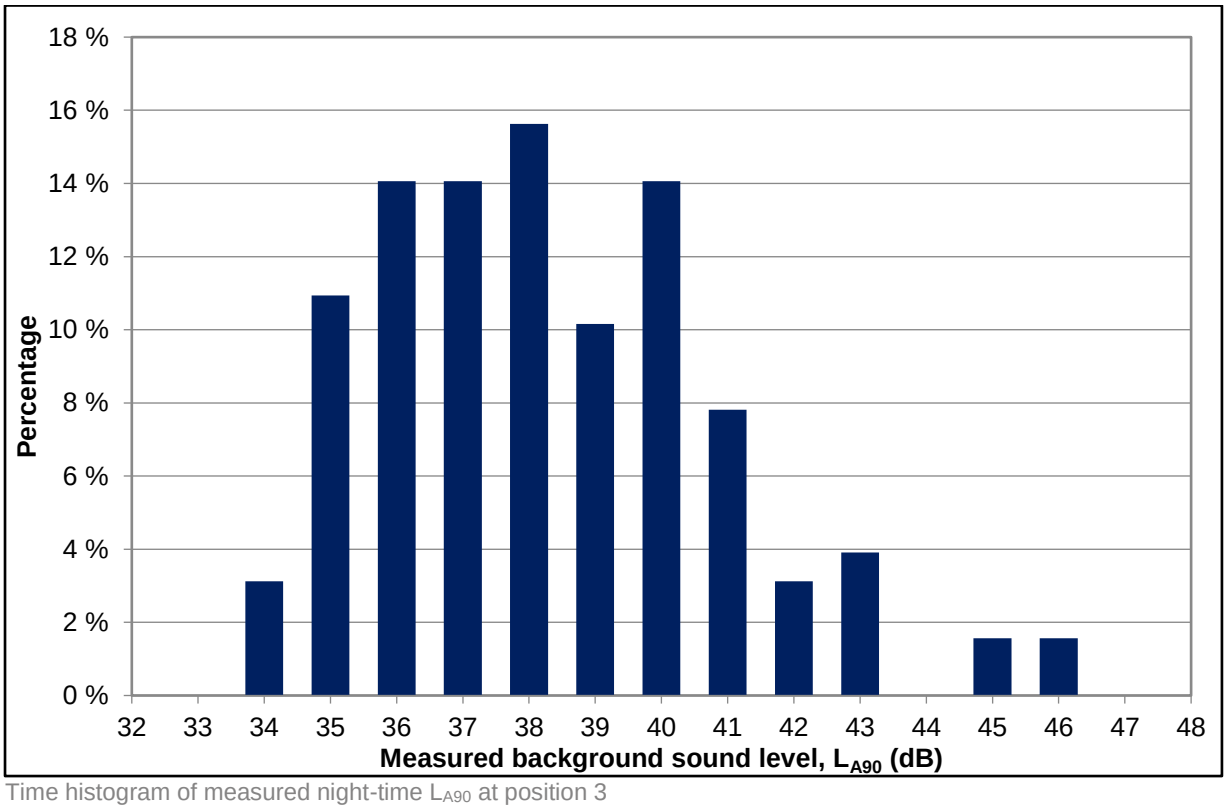
Friday 25 February 2022 to Tuesday 1 March 2022



29549/TH3



Time histogram of measured daytime L_{A90} at position 3



Time histogram of measured night-time L_{A90} at position 3