TECHNICAL MEMO

Project	Kingston Wharf, Shoreham-by-Sea - Noise Impact Assessment
To	Richard Abraham. HGP Architects
From	Jamie Pearson - 7th Wave Acoustics
Date	28/11/2022
Ref	1176.001M.2.0.JP

1 INTRODUCTION

7th Wave Acoustics (7wa) has been appointed by HGP Architects Ltd, on behalf of PMC Construction Ltd, to undertake a noise assessment of the proposed external fixed plant at the new mixed-use development at Kingston Wharf, Shoreham-by-Sea.

The noise assessment has been prepared to assist with the discharge of the noise related planning condition attached to planning decision notice AWDM/0511/21. This condition and relevant legislation are presented in full in Section 2.

This technical memo has been produced by Jamie Pearson (MIOA) and reviewed by Neil Anderson (MIOA). Jamie has over 10 year's experience in the production of noise impact assessments and has produced a significant number of noise assessments in consultancy roles. Neil is an acoustic expert with 30 year's experience providing noise and vibration advice in the design and construction of major infrastructure projects.

The findings are reported herein.

2 REGULATIONS AND GUIDANCE

As part of the planning permission for the development, a number of noise related conditions were attached to the consent, which includes the following:

Condition 39

"No fixed external air-moving or conditioning plant or equipment shall be installed on the site unless details have first been submitted to and approved in writing by the Local Planning Authority. These details shall include a scheme for attenuating the plant or equipment against noise and vibration, having regard to the principles of BS4142: 2014 and shall achieve a difference between the rating level and background noise level of -10dB. Within 1 month of the installation of the plant or equipment, testing, to demonstrate compliance with the scheme, shall be undertaken and a report of this testing shall be submitted to and approved in writing by the Local Planning Authority.

Reason: To protect residents from noise and vibration in accordance with Policies 34 of the Adur Local Plan and SH7 of the Shoreham Harbour Joint Area Action Plan 2019."

This report has been produced to specifically address the assessment requirements of Condition 39.

BS4142:2014+A1:2019

Guidance on the rating and assessing of sound of an industrial and/or commercial nature is contained in British Standard (BS) 4142: 2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'[1]

The standard states that:

This standard is applicable to the determination of the following levels at outdoor locations

a) rating levels for sources of sound of an industrial and/or commercial nature; and

b) ambient, background and residual sound levels

for the purposes of:

1. *investigating complaints;*
2. *assessing sound from proposed, new, modified or additional source(s) of sound of an industrial nature and/or commercial nature; and*
3. *assessing sound at proposed new dwellings or premises used for residential purposes.*

The determination of noise amounting to a nuisance is beyond the scope of this British Standard. The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs.

Typically, the greater the difference between rating level and background noise level, the greater the magnitude of the impact:

- a difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- a difference of around +5 dB is likely to be an indication of an adverse impact depending on context; and
- the lower the rating level is relative to the measured background sound level, the less likely it is that the specific source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Certain acoustic features can increase the significance of the impact of a specific sound source. These features include tonality and impulsivity, as well as additional characteristics and intermittency of the sound.

[1] British Standard BS4142:2014: Methods for rating and assessing industrial and commercial sound.

Where appropriate, a rating penalty for sound based on a subjective assessment of its characteristics should be established. In other circumstances an objective appraisal of tonal and/or impulsive characteristics may be appropriate.

3 PROPOSED FIXED PLANT

Car Park Ventilation System

A mechanical ventilation system has been designed for the underground car parks of the Kingston Wharf development, to control the build-up of carbon monoxide (CO) and for smoke clearance.

The ventilation system comprises:

- small induction fans, intended to control air movement in the car park, directing polluted air and smoke towards the extraction position; and
- Two axial exhaust fans per car park (4 in total), intended to extract the air out of the car park.

The fans are to be sited within two separate underground plant areas serving the Block A and Blocks B&C car parks. The fans will sit in a horizontal position and extract into a ventilation shaft on the underside of the ground floor RC slab before terminating at ground level. It is understood that a horizontal metal grille is positioned at the ground level termination point.

Both ventilation shafts will also contain splitter silencers for sound attenuation purposes, which will be positioned across the ventilation shaft, just below the metal grille.

Architectural drawings showing the location of the plant areas, ventilation shafts and termination points are presented in Figures A1 to A4 of Appendix A. To date, drawings showing the positioning of the splitter silencer in the ventilation shaft have not be received.

The levels of CO are monitored, and the operation of the fans will be determined by the number of cars using the car park and the measured concentration of CO.

During periods of heavy use and high build-up of CO, the operating capacity may increase to approximately 60% at Block A and to 67% at Blocks B&C. In emergency situations, such as during a fire, the fans will increase to 100% capacity, however, this is not considered to be a ‘typical’ operation.

Substations

It is understood that 3 no. 1000KvA electrical transformers are to be located in 2 no separate substations on site. 2 no. transformers will be located in the substation located to the west of site (Substation 1) and 1 no. 1000KvA transformer is to be located in a substation to the east of the site (Substation 2). The substation locations are shown in Figure A5 of Appendix A.

It is understood that no other external fixed plant will be installed on site.

4 PLANT NOISE LEVELS

Car Park Ventilation System

The sound power data of the fans, as per the supplier's specification (Vent Engineering Ltd) are provided below in **Table 1**. The insertion loss afforded by the proposed splitter silencers are presented below in **Table 2**.

Table 1: Summary of Fan Noise Data

Item	Sound Power Level dB, By Octave Band Frequency (Hz)								
	125	250	500	1k	2k	4k	8k	dB	dB (A)
Block A - 1DENP+LCS080F4-A6/26 @ 60.1%	92	87	87	86	82	79	76	96	90
Block B&C - 1DENP+LCS100F4-A6/24 @67%	99	94	93	92	89	87	84	103	97

Note:

[1] it is assumed that 1 no. fan will operate at any one time (1 operating & 1 duty).

Table 2: Insertion loss of Splitter Silencers

Item	Static Insertion Loss, dB, By Octave Band Frequency (Hz)						
	125	250	500	1k	2k	4k	8k
Block A – R02 4-900	10	16	30	37	37	30	24
Block B&C – R02 5-1200	9	18	32	40	39	28	19

Substation Transformers

Each of the transformers (3 no. in total) will have a 1000kVa power rating. The sound power level of the selected transformers, provided by the suppliers of the transformer, have a sound power level of 59 dB (A).

5 ASSESSMENT OF SOUND LEVELS

British Standard 4142:2014:+A1:2019

The method for predicting the significance of sound of an industrial and/or commercial nature in accordance with the principles of BS 4142:2014+A1:2019 is based on a comparison of the rating level, defined as the specific sound level plus any adjustment for the characteristic features of the sound, with the background sound level, $L_{A90,T}$.

Closest Noise Sensitive Receptors

The closest noise sensitive receptors to the car park extraction fan outlet points are identified in Figures A6 and A7 of Appendix A as R1 and R2.

The closest noise sensitive receptors to the substations are identified in Figures A8 and A9 of Appendix A as R3 and R4.

The R1 receptor is estimated to be c. 3 m from the termination point at ground floor level of Block A.

The R2 receptor is estimated to be c. 10 m from the termination point at floor level of Block C.

The R3 receptor is estimated to be c. 3 m from the substation at ground floor level of Block A.

The R4 receptor is estimated to be c. 9 m from the substation at ground floor level of Block C.

Background Sound Levels

The $L_{A90,T}$ background sound level is the sound level exceeded for 90% of the time in the absence of any sound from the specific source of interest.

'Typical' background sound levels observed over the period of interest, as described in BS4142:2014+A1:2019, are usually established for assessing plant of this kind, with BS4142 stating that a 'representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value'.

Modal statistical analysis of the background $L_{A90,T}$ sound levels, derived using the baseline noise survey data obtained by 7wa in February 2018, during the daytime hours (07:00hrs to 23:00hrs) and night-time hours (23:00hrs to 07:00hrs) are presented in Figures A10 to A13 of Appendix A. Full details of the noise survey are presented in report (ref: 1109.001R.2.0.RF).

Using this statistical analysis, background sound levels of 57 dB $L_{A90,15minT}$ and 41 dB $L_{A90,15min}$ have been adopted for the daytime and night-time periods respectively, at the residential assessment locations R1 and R2.

Background sound levels of 63 dB $L_{A90,15minT}$ and 50 dB $L_{A90,15min}$ have been adopted for the daytime and night-time periods respectively, at the residential assessment locations R3 and R4..

Specific Sound Levels

Due to the separation distance between the individual plant items and receptors, the sparse nature of plant around the development site and the screening provided by the development buildings, a cumulative assessment of the plant is not deemed to be appropriate. As such, the car park extraction system and substations are assessed individually at the closest receptors points.

BS4142:2014 advises that the assessment should be considered over a 1-hour daytime period and 15-minute night-time period. Therefore, the sound specific calculated specific sound level of the plant has been adjusted to take account of the expected use over typical 1-hour daytime and 15-minute night-time periods.

Specific Sound Levels – Car Park Extraction System

The specific sound pressure level of the fans operating at the Block A Car Park at 60% and in the Blocks B & C Car Parks at 67%, has been calculated and used to estimate specific sound levels at the closest residential receptors.

It is understood that fans will only operate at 100% during an emergency, such as a fire. As this is not a typical operating mode, this scenario has not been considered.

It is assumed the fans will typically operate for 15 minutes in a 1-hour daytime assessment period and typically for 5 minutes during a 15-minute night-time period.

The specific sound levels calculated at R1 and R2 from the Car Park extraction system fans, inclusive of a typical operation on-time correction are 30 dB(A) and 28 dB (A), respectively.

The full calculations are presented in Appendix B.

Specific Sound Levels – Substations

The sound modelling of the sub-stations was undertaken to support the discharge of another noise related planning condition. Full details of the noise modelling undertaken to estimate the sound levels of the substations at the closest receptor points is presented in report ref: 1177.001R.2.0.JP.

The specific sound levels calculated at R3 and R4 from the substations are 19 dB(A) and 39 dB (A), respectively. It is assumed that the transformer plant operates continuously so no on-time correction has been applied to the calculated specific sound levels.

Assessment of Rating Levels

The specific sound levels of the plant were then used to determine the Rating sound level at the closest sensitive receptors.

Where appropriate, a rating penalty for sound based on a subjective assessment of its characteristics should be established and added to the specific sound level.

Analysis of the measured ambient noise data indicates the average daytime (07:00hrs to 23:00hrs) and night-time (23:00hrs to 07:00hrs) $L_{Aeq,15min}$ noise levels at R1 and R2 were 72 dB and 65 dB, respectively.

Average daytime and night-time $L_{Aeq,15min}$ noise levels at R3 and R4 are expected to be 59 dB and 53 dB, respectively.

The highest calculated specific sound levels from the car park extraction plant falls 23 dB and 17 dB below the lowest average daytime and night-time noise levels and the risk of acoustic characteristics being readily distinctive against the residual acoustic environment is considered to be low and no rating penalty has been applied.

The highest calculated specific sound levels from the substation plant falls 20 dB and 14 dB below the lowest average daytime and night-time noise levels. Again, the risk of acoustic characteristics being readily distinctive against the residual acoustic environment is considered to be low and no rating penalty has been applied.

Assessment of Rating Levels - Car Park Extraction System

The daytime and night-time assessments for the car park extraction plant are set out in **Tables 3 and 4** below.

Table 3: BS4142 Assessment of Proposed Plant - Daytime

Item	**Nearest Residential Receptors**	
	(R1)	**(R2)**
Specific Noise Level	36 dB $L_{Aeq,Tr}$	34 dB $L_{Aeq,Tr}$
% On-time correction[1]	-6	-6
Rating Penalty	+ 0 dB	+ 0 dB
Rating Noise Level	**30 dB $L_{Ar,Tr}$**	**28 dB $L_{Ar,Tr}$**
Relevant Background Noise Level	57 dB $L_{A90,T}$	
BS 4142 Assessment Level	**-27**	**-29**
Assessment	Low Noise Impact	Low Noise Impact

Note: [1] It is assumed the fans will typically operate for 15 minutes in a 1-hour period.

Table 4: BS4142 Assessment of Proposed Plant – Night-time

Item	**Nearest Residential Receptors**	
	(R1)	**(R2)**
Specific Noise Level	36 dB $L_{Aeq,Tr}$	34 dB $L_{Aeq,Tr}$
% On-time correction[1]	-5	-5
Rating Penalty	+ 0 dB	+ 0 dB
Rating Noise Level	**31 dB $L_{Ar,Tr}$**	**30 dB $L_{Ar,Tr}$**
Relevant Background Noise Level	41 dB $L_{A90,T}$	
BS 4142 Assessment Level	**-10**	**-11**
Assessment	Low Noise Impact	Low Noise Impact

Note: [1] It is assumed the fans will typically operate for 5minutes in a 15-minute period.

The results indicate that during the daytime period at R1, the calculated rating noise level is 27 dB below the adopted background sound level. During the night-time period at R1, the calculated rating noise level is 10 dB below the adopted background sound level. According to BS4142:2014, this is an indication of low noise impact, depending on context, and the criteria specified in Planning Condition 39 is achieved.

At R2, the calculated daytime and night-time rating levels are 29 dB and 11 dB below the adopted background sound levels, respectively. Again, according to BS4142:2014, this is an indication of low noise impact, depending on context, and the criteria specified in Planning Condition 39 is achieved.

Assessment of Rating Levels – Substations

The daytime and night-time assessments for the transformer substation plant are set out in **Tables 5 and 6** below.

Table 5: BS4142 Assessment of Proposed Plant - Daytime

Item	Nearest Residential Receptors	
	(R3)	**(R4)**
Specific Noise Level	24 dB $L_{Aeq,Tr}$	39 dB $L_{Aeq,Tr}$
% On-time correction[1]	-0	-0
Rating Penalty	+ 0 dB	+ 0 dB
Rating Noise Level	**24 dB $L_{Ar,Tr}$**	**39 dB $L_{Ar,Tr}$**
Relevant Background Noise Level	63 dB $L_{A90,T}$	
BS 4142 Assessment Level	**-39**	**-24**
Assessment	Low Noise Impact	Low Noise Impact

Note: [1] It is assumed the transformers will operate continuously.

Table 6: BS4142 Assessment of Proposed Plant – Night-time

Item	Nearest Residential Receptors	
	(R3)	**(R4)**
Specific Noise Level	24 dB $L_{Aeq,Tr}$	39 dB $L_{Aeq,Tr}$
% On-time correction[1]	-0	-0
Rating Penalty	+ 0 dB	+ 0 dB
Rating Noise Level	**24 dB $L_{Ar,Tr}$**	**39 dB $L_{Ar,Tr}$**
Relevant Background Noise Level	50 dB $L_{A90,T}$	
BS 4142 Assessment Level	**-26**	**-11**
Assessment	Low Noise Impact	Low Noise Impact

Note: [1] It is assumed the transformers will operate continuously.

The results indicate that during the daytime period at R3, the calculated noise level is 39 dB below the adopted background sound level. During the night-time period at R1, the calculated noise level is 26 dB below the adopted background sound level. According to BS4142:2014, this is an indication of low noise impact, depending on context, and the criteria specified in Planning Condition 39 is achieved.

At R2, the calculated daytime and night-time noise levels are 24 dB and 11 dB below the adopted background sound levels, respectively. Again, according to BS4142:2014, this is an indication of low noise impact, depending on context, and the criteria specified in Planning Condition 39 is achieved.

Context

When considering the significance of an impact, BS 4142 advises that the context of the impact should be taken into account. The context of the impact should consider factors such as: the absolute level of sound; the character and level of the residual sound compared to the character and level of the specific sound; the sensitivity of the receptor; and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

It is understood that the proposed development will utilise mechanical ventilation with heat recovery (MVHR). Therefore, the development does not require passive vents, which removes an additional pathway for external to internal noise transfer.

The selected glazing systems for the development provide sound reductions of 35 R_w , 37 R_w and 46 R_w, dependant on the façade of the development. Subtracting the lowest performing glazing system of 35 R_w, from the highest calculated specific noise level of 39 dB, the internal noise level from the specific noise sources is estimated to be up to 4 dB. The specific sound from the plant falls significantly below the guideline internal daytime and night-time noise levels of 35 dB $L_{Aeq,16hr}$ and 30 dB $L_{Aeq,8hr}$ provided in BS 8233:2014 and the plant is likely to be inaudible within the residential flats.

Should the occupants open the windows to the apartments, the sound insulation of the window reduces to approximately 13 dB from a free-field level.

The internal noise level from the specific noise sources with windows open are estimated to be up to 21 dB. The specific sound from the plant again falls below the BS 8233:2014 guideline noise levels.

The risk of adverse noise impact is considered to be low.

Uncertainty

A requirement of BS 4142:2014+A1:2019 is that uncertainty in the measurements and calculations needs to be taken into account when assessing uncertainty in predicted noise impacts.

There are a variety of factors that inevitably limit the accuracy associated with all steps of any sound assessment, including measurement, calculation, or prediction. Factors include, but are not limited to:

- The inherent limitation of calculation/prediction methodology in Standards and guidance; and
- The accuracy of sound source input data of a calculation or sound model and the Operations of plant.

It is imperative to minimise the uncertainty to a level commensurate with the intention of the assessment objective. Measures taken in this assessment to minimise uncertainty are:

- Recognised sound prediction calculations have been used to calculate sound levels at sensitive locations and any assumptions have been stated.

- The equipment assessed is based on information provided by the client and client representatives. The percentage on-time use for plant / activities is not fixed as they can vary. As such, a worst case operation has been assumed; and

- Rounding to integer values has been used in the derivation of the background sound levels and calculations, to avoid an impression of precision to decimal places.

6 CONCLUSION

7th Wave Acoustics has been appointed to undertake a noise assessment of the proposed external fixed plant at the new mixed-use development at Kingston Wharf, Shoreham-by-Sea.

The noise assessment has been prepared to assist with the discharge of the noise related planning condition (Condition 39) attached to planning decision notice AWDM/0511/21.

An assessment of the proposed external plant has been undertaken, to consider the noise impact on residential receptors, in accordance with the principles of BS4142:2014+A1:2019.

During the daytime and night-time periods, the assessment indicates that the plant rating levels fall below the background sound levels by at least 24 dB and 10 dB respectively, indicating the risk of adverse noise impact is low.

The predicted rating levels also comply with the local authority criteria of being 10dB or more below the background sound level specified in Condition 39.

Appendix A: Figures

Figure A1: Location of Block A Ventilation Shaft and Plant

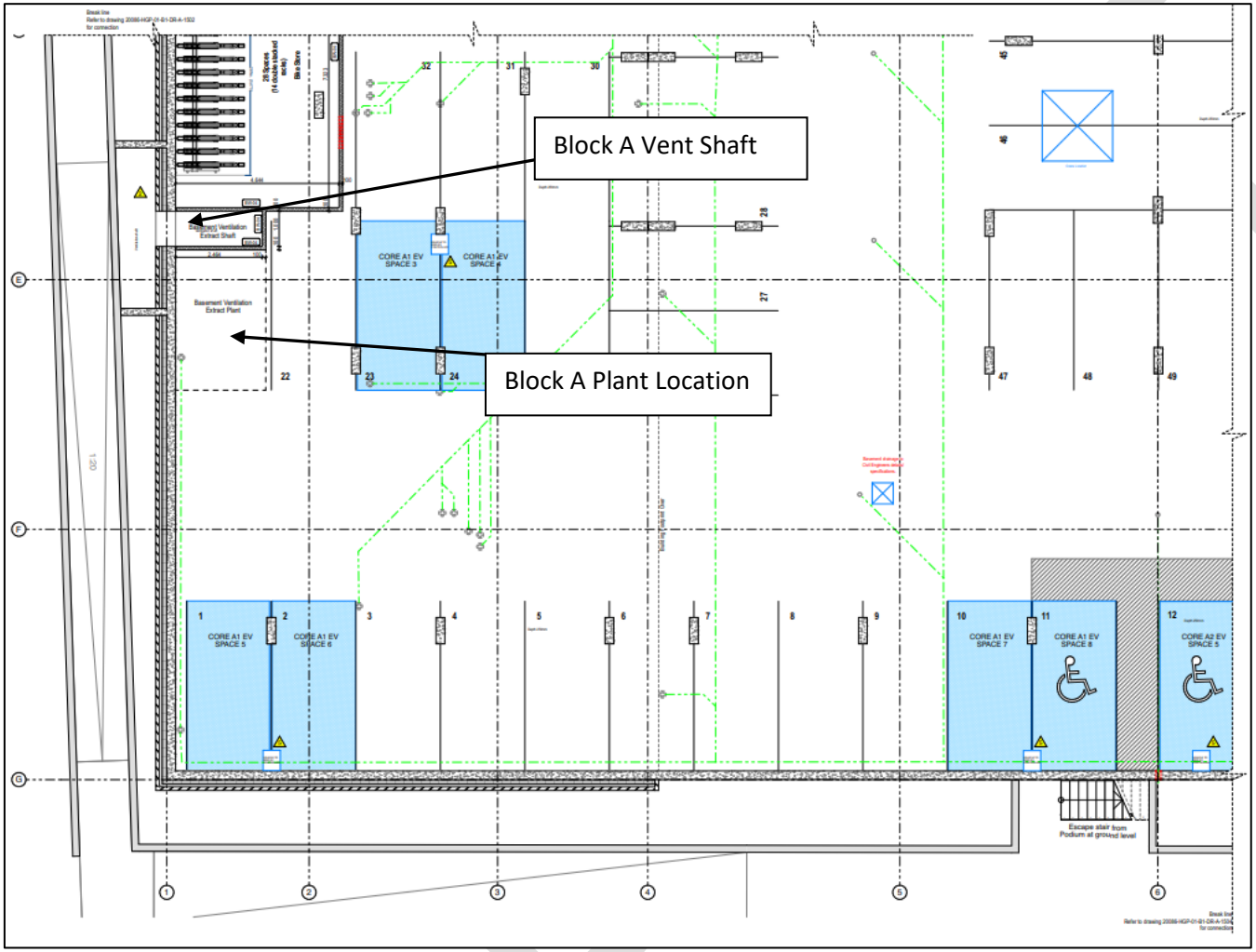


Figure A2: Location of Blocks B&C Ventilation Shaft and Plant

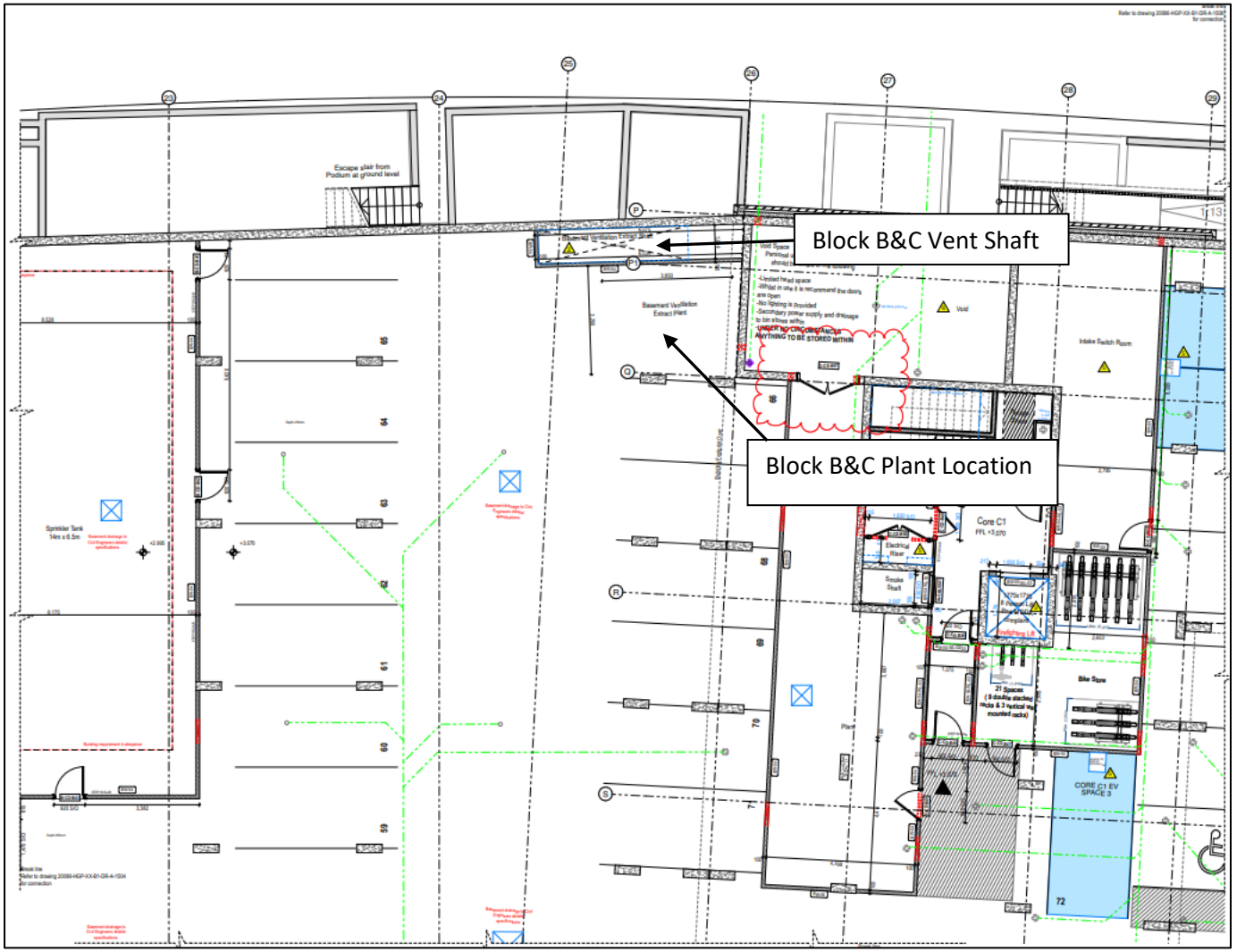


Figure A3: Block A Ventilation Shaft

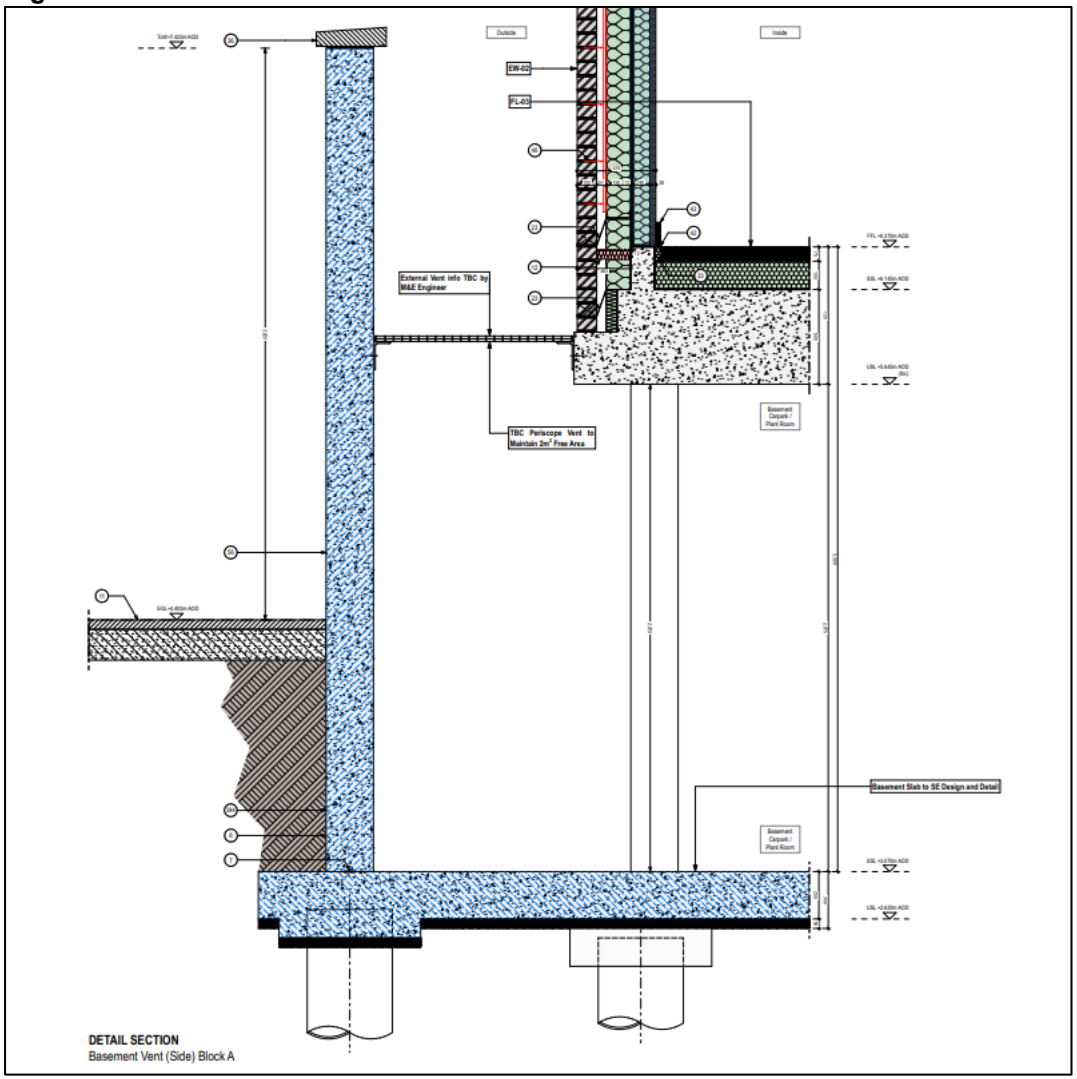


Figure A4: Blocks B&C Ventilation Shaft

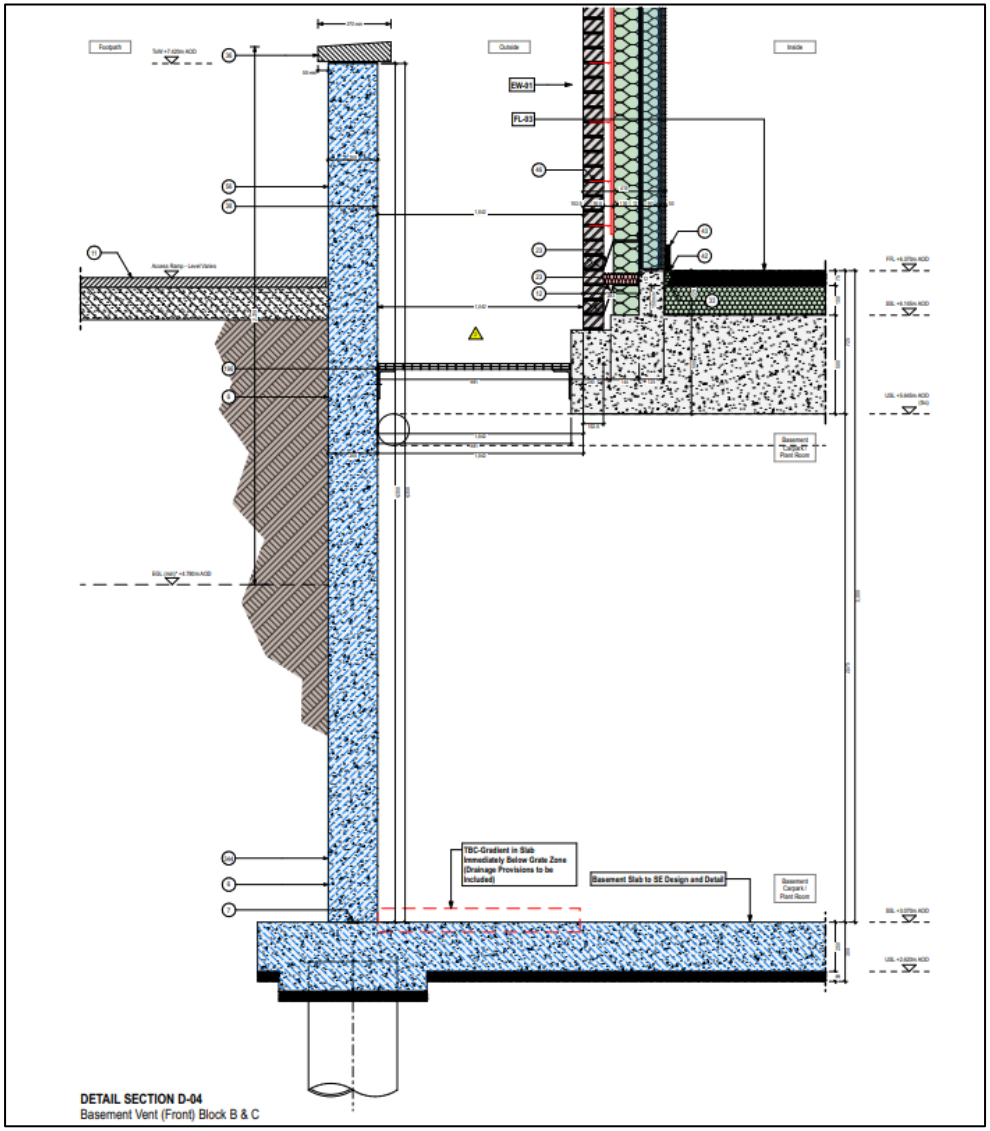


Figure A5: Site Location Plan Highlighting Location of Substations

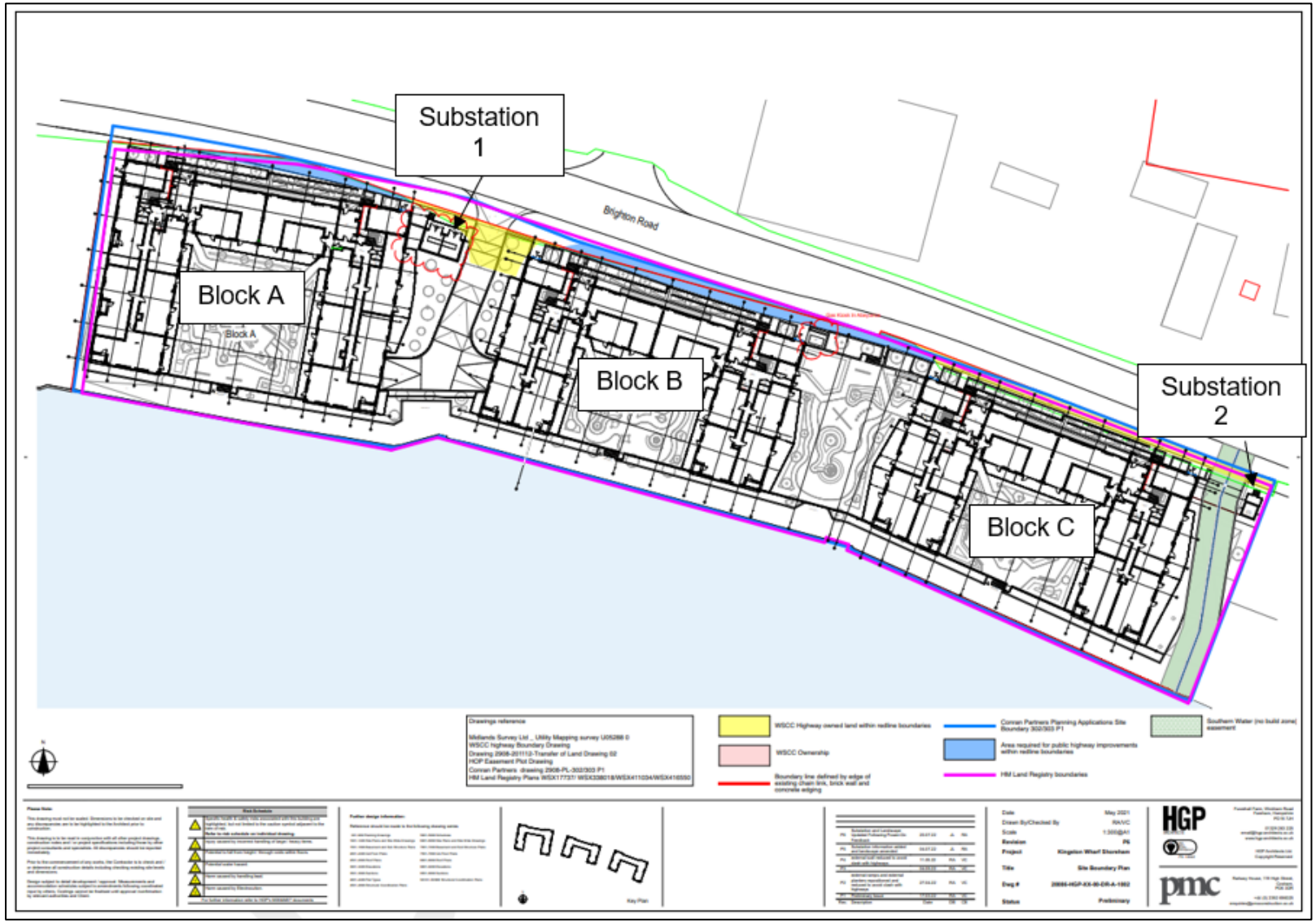


Figure A6: Block A Ground Floor Layout Highlighting Closest Noise Sensitive Receptor to Block A Carpark Extraction System (R1)

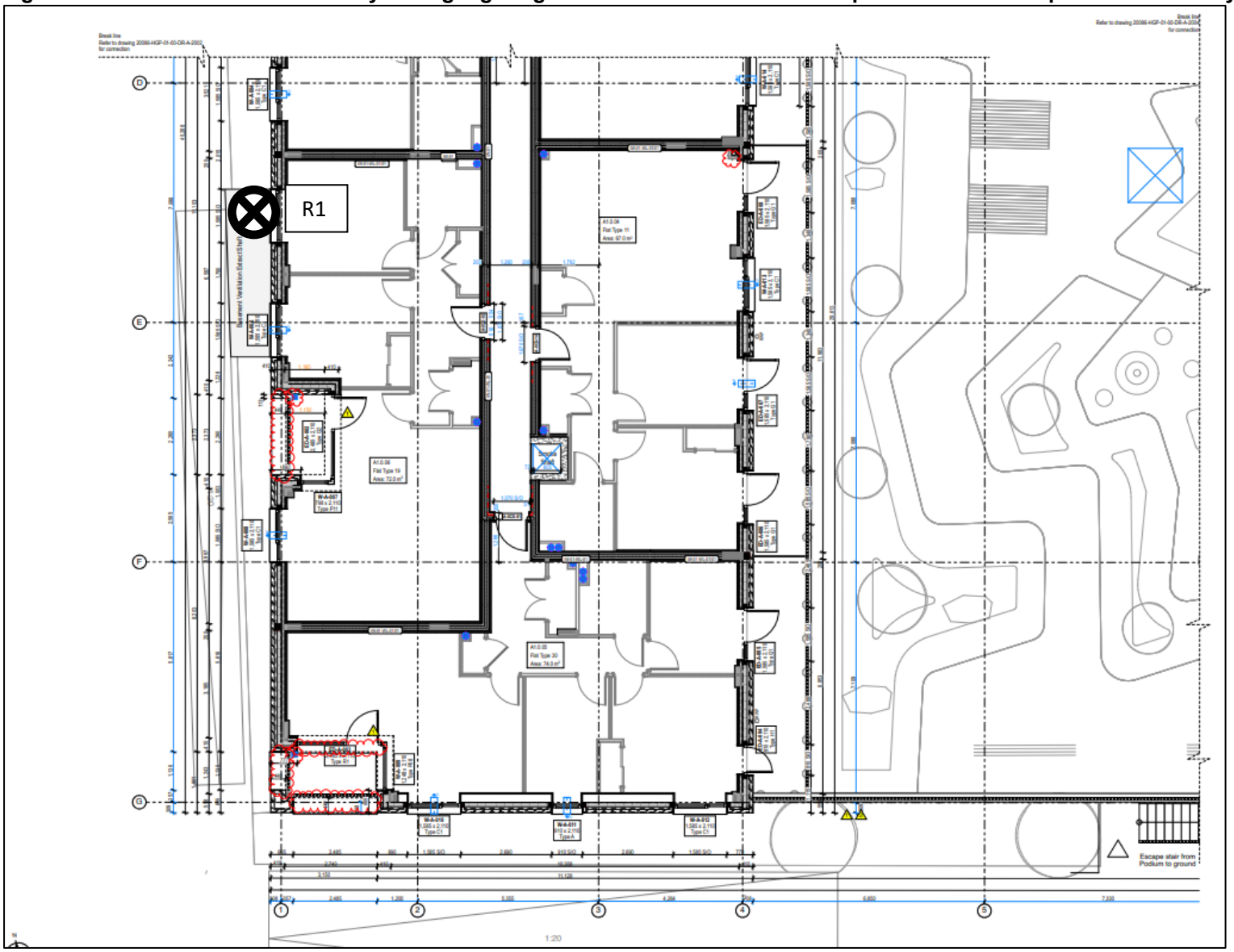


Figure A7: Blocks B&C First Floor Layout Highlighting Closest Noise Sensitive Receptor to Block B&C Car Park Extraction System (R2)

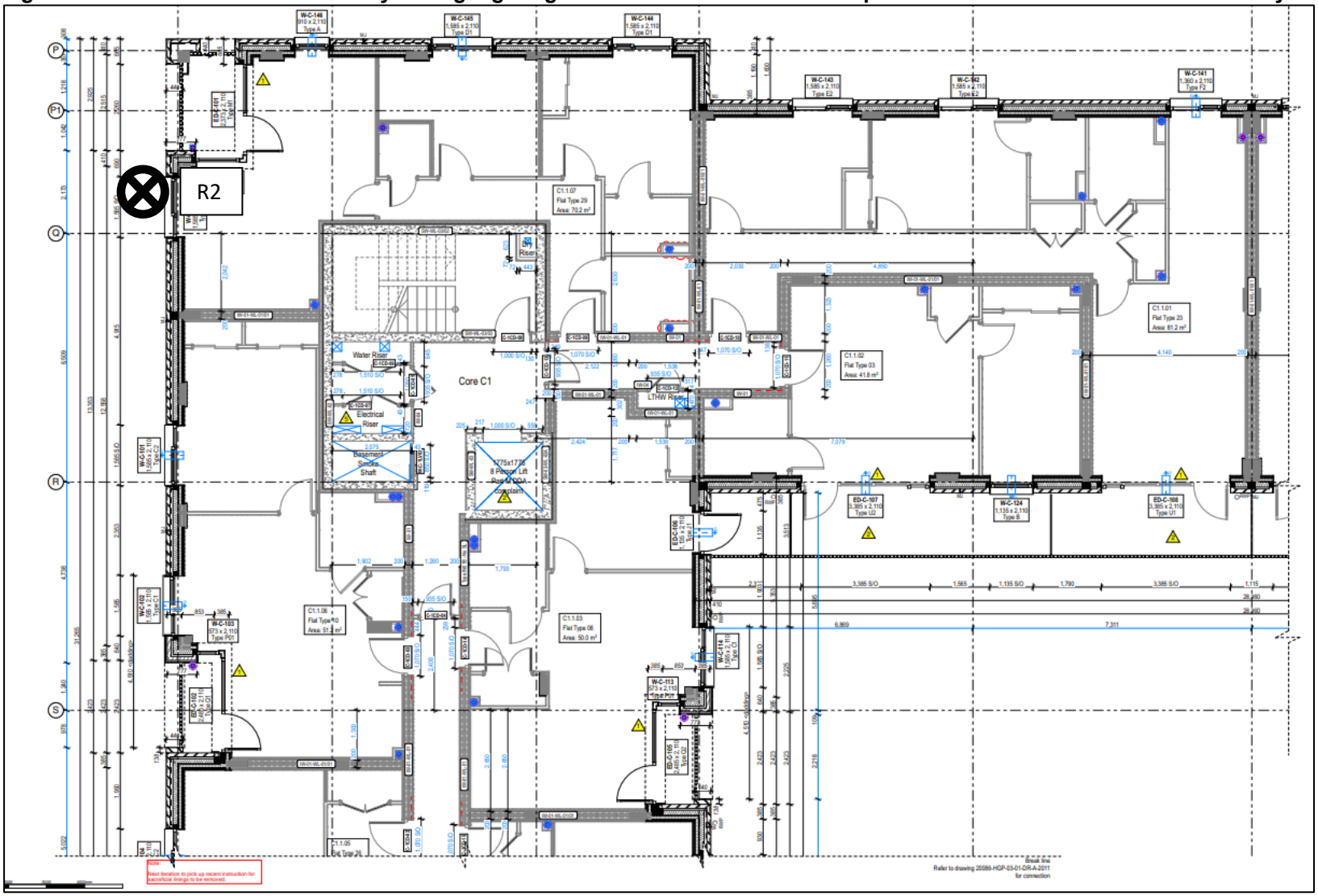


Figure A8: Block A Ground Floor Layout Highlighting Closest Noise Sensitive Receptor to Substation 1 (R3)

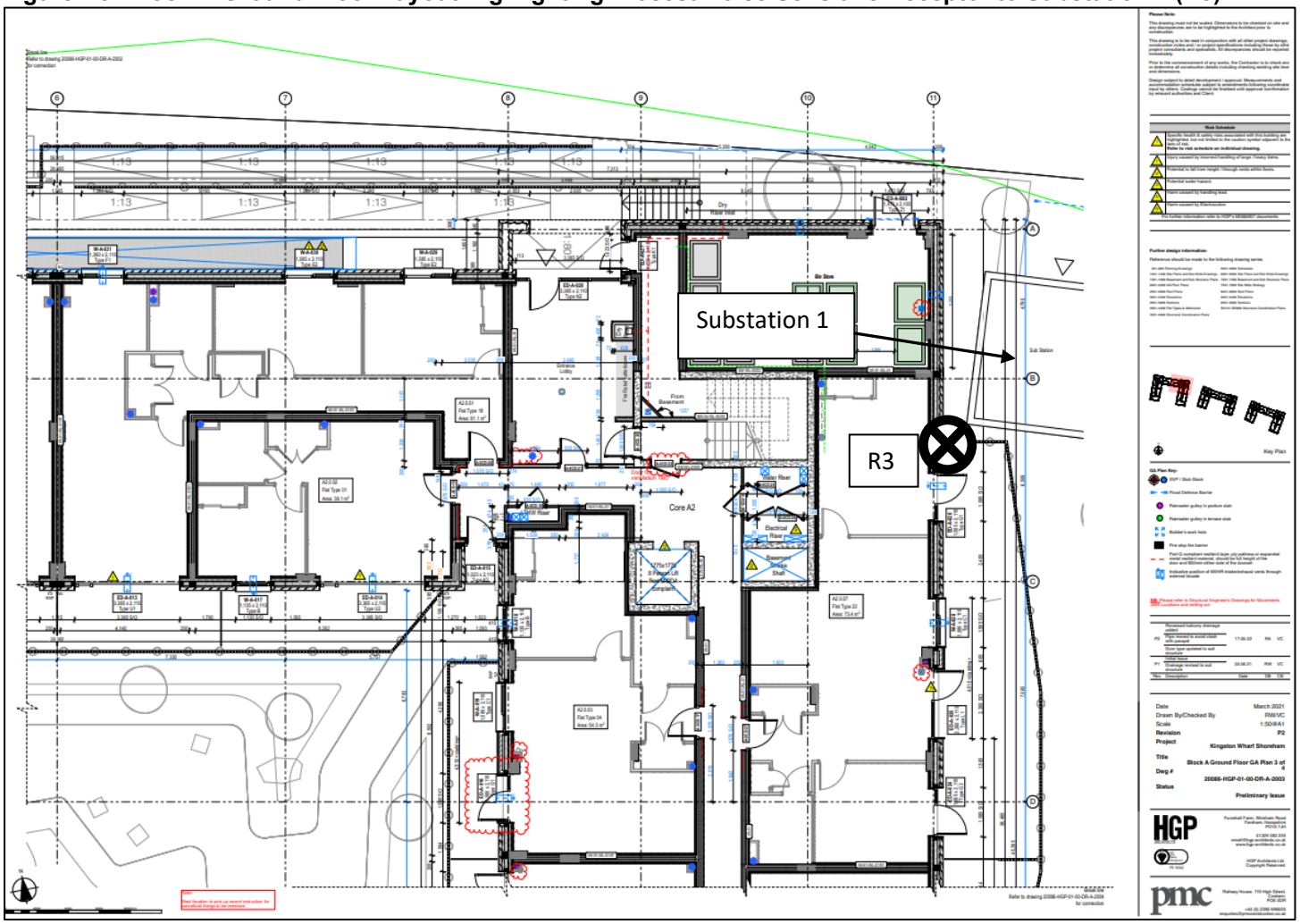


Figure A9: Block C First Floor Layout Highlighting Closest Noise Sensitive Receptor to Substation 2 (R4)

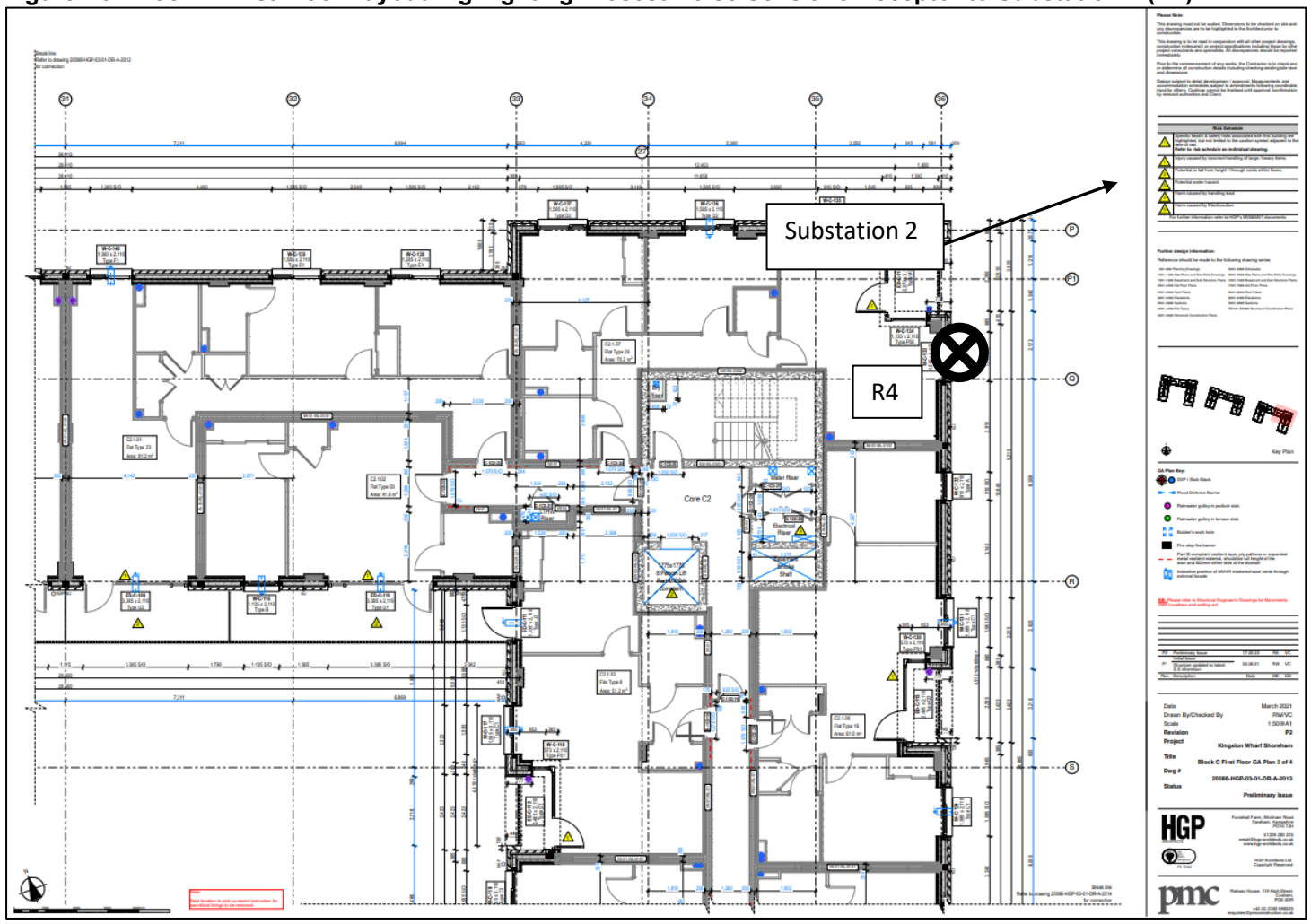


Figure A10: Statistical Analysis of Daytime $L_{A90,15min}$ Sound Levels Measured at LT1 (R3 & R4)

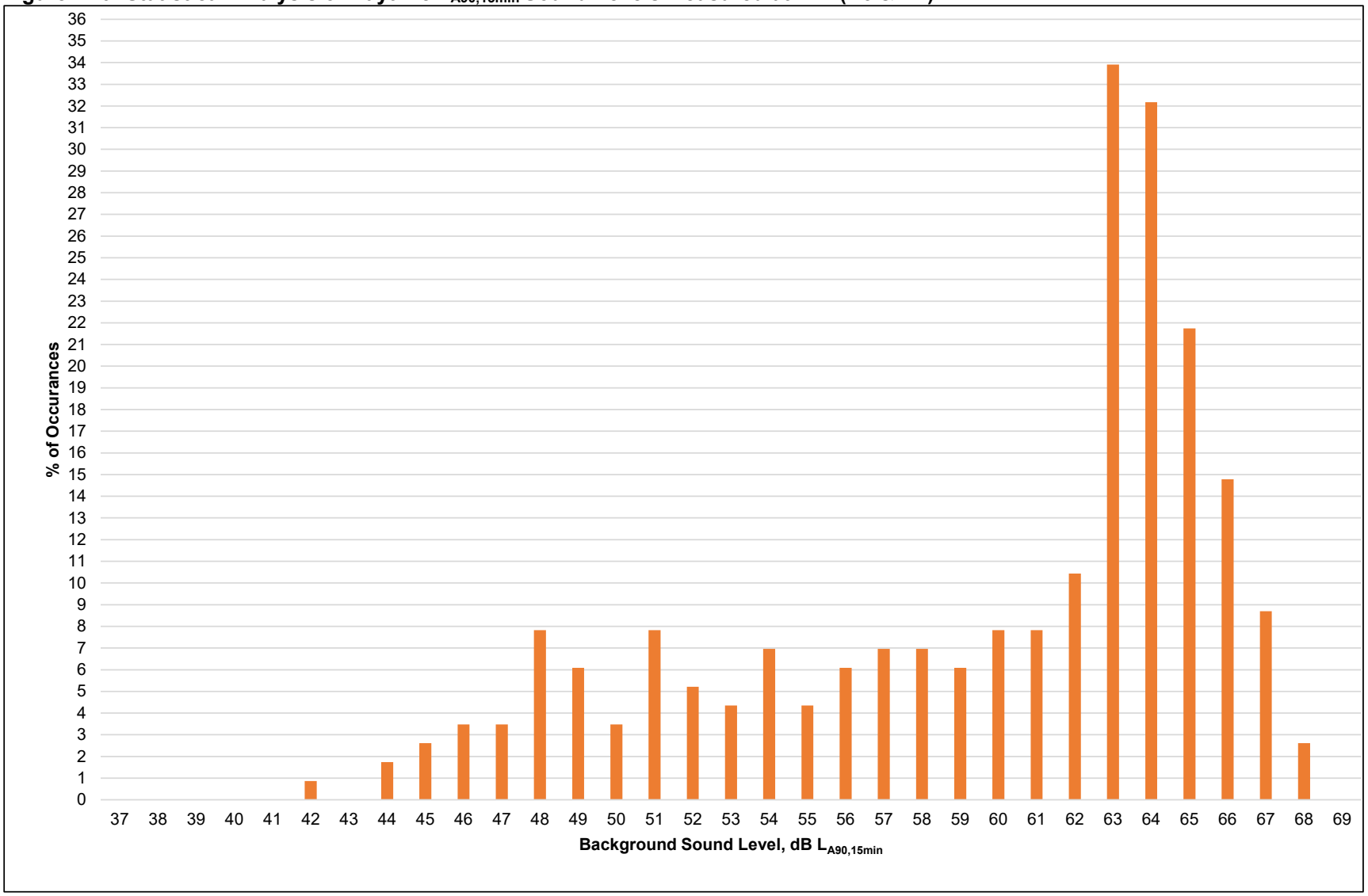


Figure A11: Statistical Analysis of Night-time $L_{A90,15min}$ Sound Levels Measured at LT1 (R3 & R4)

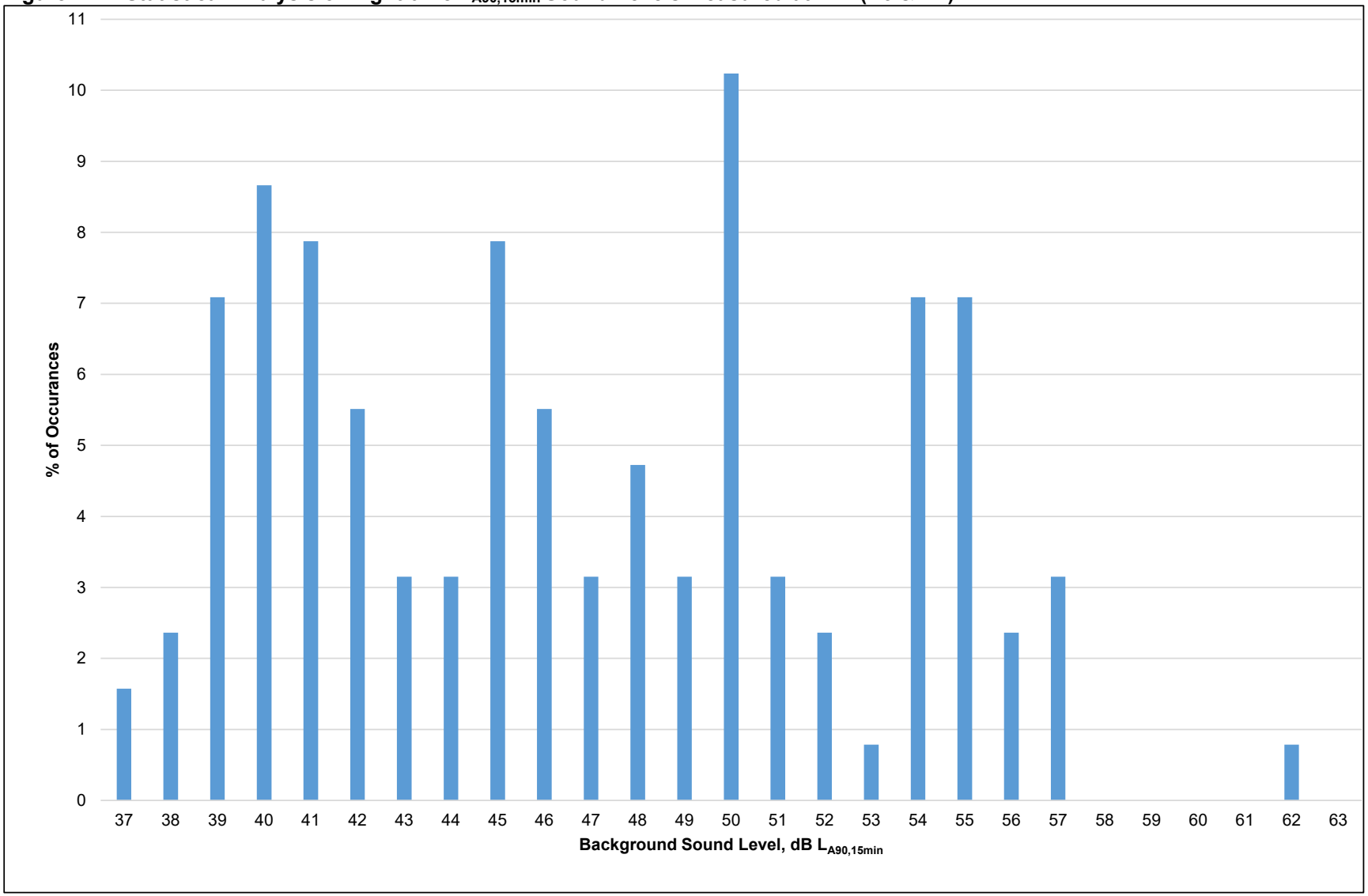


Figure A12: Statistical Analysis of Daytime $L_{A90,15min}$ Sound Levels Measured at LT2 (R1 & R2)

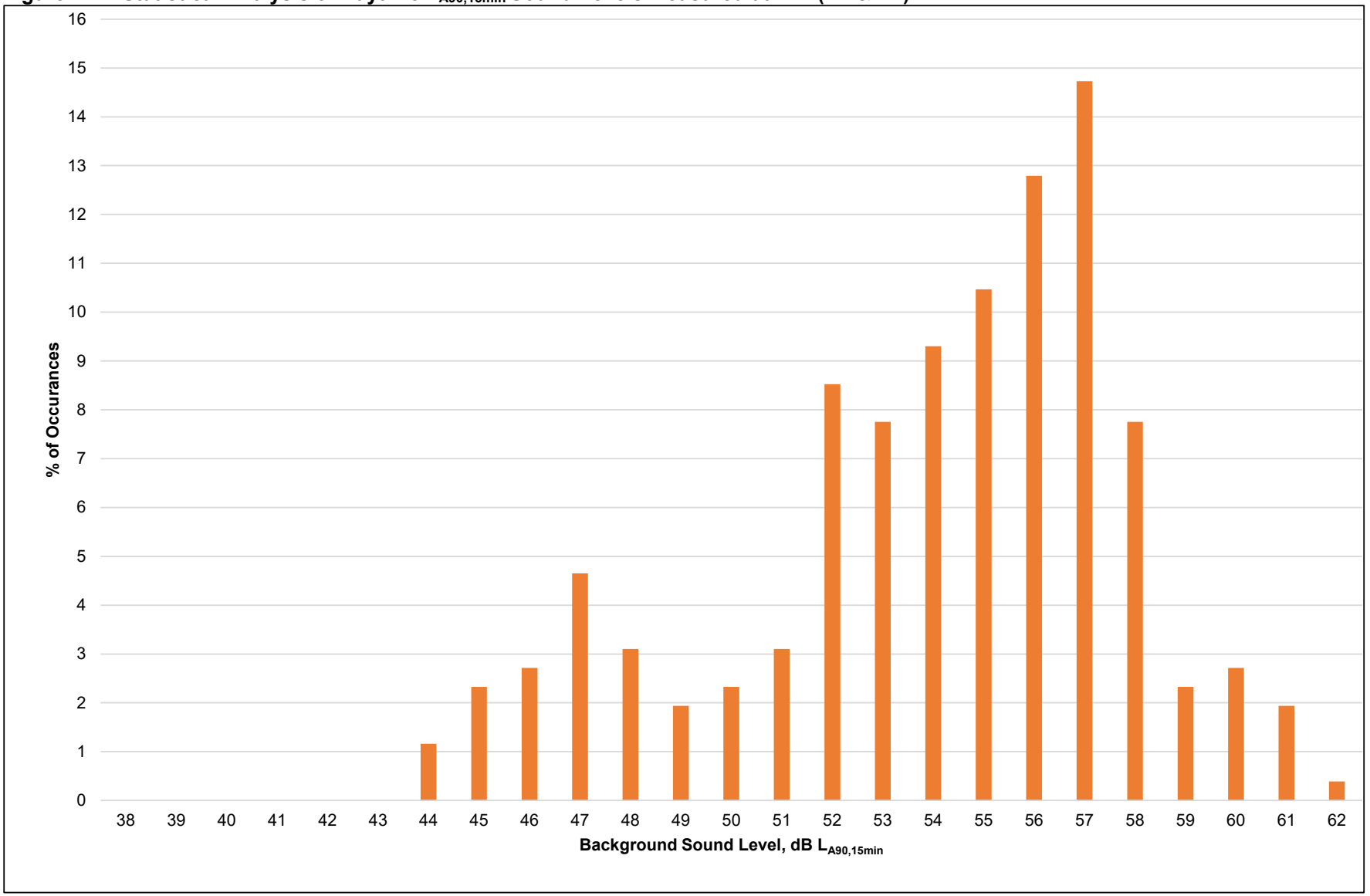
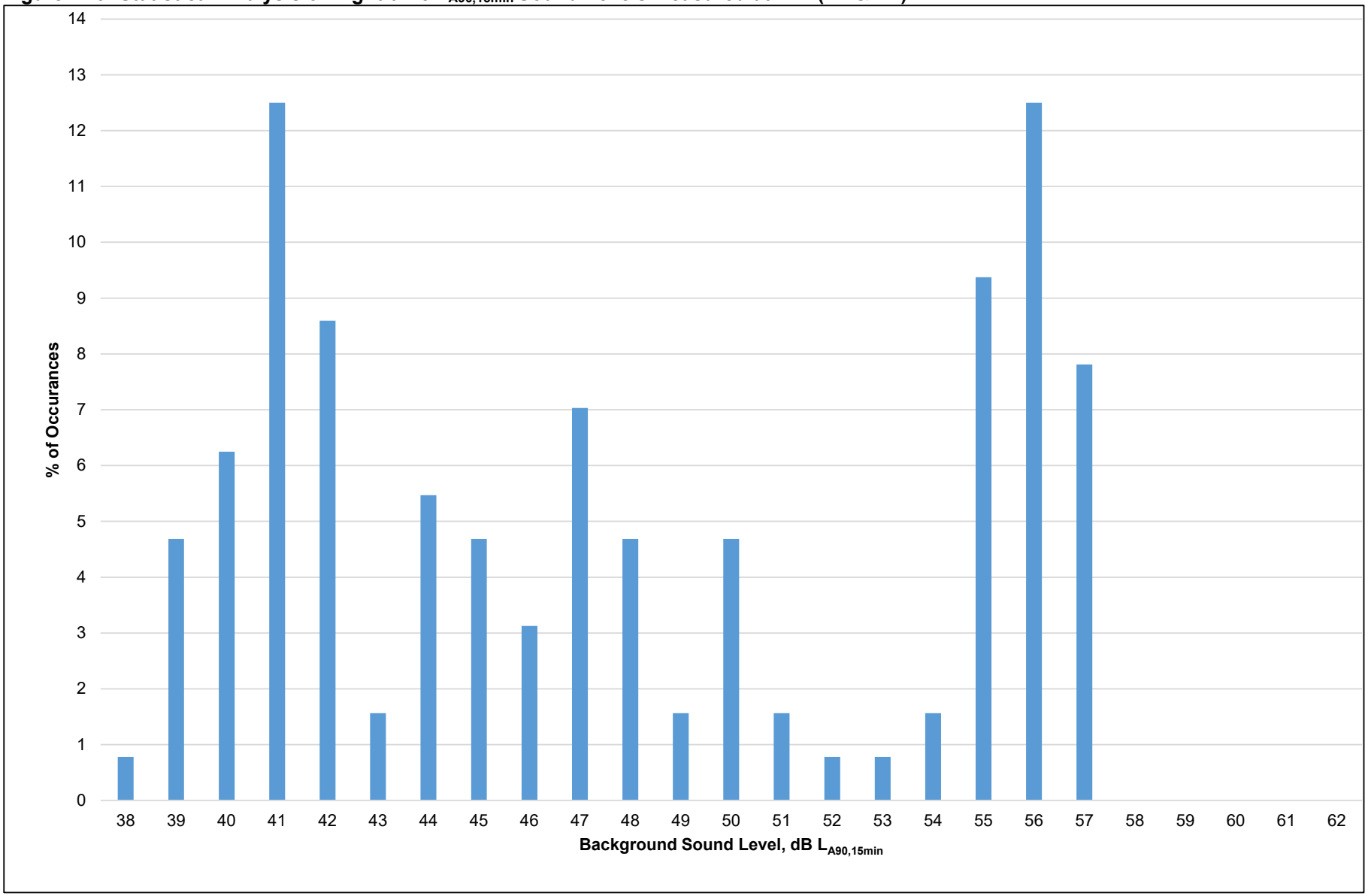


Figure A13: Statistical Analysis of Night-time $L_{A90,15min}$ Sound Levels Measured at LT2 (R1 & R2)



Appendix B: Noise Calculations

DRAFT

Table B1: Exhaust Fan Calculations at R1 – Block A

Stage		Overall	dB, Frequency (Hz)					
		dB(A) L_w	125	250	500	1 k	2 k	4 k
Fan		90	92	87	87	86	82	79
90° Bend		-	-8	-4	-3	-3	-3	-3
Straight Run x c. 0.5m		-	-0	-0	-0	-0	-0	-0
90° Bend		-	-8	-1	-8	-6	-3	-3
Straight Duct x c. 3m			-1	-1	-0	-0	-0	-0
Silencer			-10	-16	-30	-37	-37	-30
End Reflection		-	-1	-0	-0	-0	-0	-0
Output SWL		58	66	62	51	43	39	43
Directivity and Distance	DI(0°)	-	-8	-8	-9	-9	-9	-9
	DI(45°)	-	-3	-3	-3	-3	-3	-3
	20 log r - 8	-	-18	-18	-18	-18	-18	-18
SPL at R1	-	36	46	42	30	22	18	22

Table B1: Exhaust Fan Calculations at R2 – Blocks B&C

Stage		Overall	dB, Frequency (Hz)					
		dB(A) L_w	125	250	500	1 k	2 k	4 k
Fan		97	99	94	93	92	89	87
90° Bend		-	8	4	3	3	3	3
Straight Run x 3m		-	-1	-1	0	0	0	0
90° Bend		-	8	4	3	3	3	3
Straight Duct x 3m			-1	-1	0	0	0	0
Silencer								
End Reflection		-	1	0	0	0	0	0
Output SWL		64	73	67	54	46	44	53
Directivity and Distance	DI(0°)	-	8	8	9	9	9	9
	DI(45°)	-	-3	-3	-3	-3	-3	-3
	20 log r - 8	-	-24	-24	-24	-24	-24	-24
SPL at R2	-	34	38	36	35	33	36	34