RED TWIN LIMITED

Consultants in Acoustics

West Cornwall Hospital
Penzance

Noise Impact Assessment

On Behalf of

Kier Construction Limited
No. 1 Victoria Wharf
Malpus Road
TRURO
Cornwall
TR1 1QH

23rd September 2021

R1336.1 V1

Registered in England and Wales No 7046792. Registered Office: 62 Bakers Ground, Stoke Gifford BRISTOL BS34 8GF

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Issue Number	Status	Date	Author	Comment
V1	Initial Issue	23/09/21	Gavyn Bache	Issued for comment

This report has been prepared by Red Twin Limited on behalf of Kier Construction Limited in connection with West Cornwall Hospital and takes into account their particular instructions and requirements.

Red Twin Limited accepts no duty or responsibility (including in negligence) to any party other than Kier Construction Limited and disclaims all liability of any nature whatsoever to any such party in respect of this report.

Report Prepared by:

[redacted]

Gavyn Bache B.Sc.(Hons) PgD MIOA
Senior Consultant

RED TWIN LIMITED
The Red Suite
1st Floor Aztec Centre
Aztec West, Almondsbury
BRISTOL BS32 4TD
T: 01454 203777

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CONTENTS…

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1.0 INTRODUCTION…

This report provides a summary of our assessment of noise impact from the proposed fixed building services plant serving the extension to an existing hospital building.

We have undertaken a noise survey to establish the pre-development external noise levels during day and night time hours.

For assessment of noise impact, we have followed the methodology set out in British Standard 4142:2014 *Method for Rating and Assessing Industrial and Commercial Sound*. This is considered to be the most relevant piece of guidance for the situation and our assessment is described in the following sections.

2.0 BS4142 CRITERIA…

BS4142 presents a method for determining the likelihood of complaints arising from noise levels associated with fixed sources. The procedure set out in the standard involves the comparison of two noise levels at a noise sensitive location, these are,

Rating Noise Level: The level of noise produced by the plant equipment when it has been corrected for tonal and temporal components.

Background Sound Level: The background noise measured as an L_{A90} (the noise exceeded for 90% of the time) when the plant equipment is not operating.

There are other relevant definitions used in the assessment which are as follows,

Specific Sound Level The sound level produced by the source at the assessment location.

Residual Sound Level The sound remaining at the assessment location when the specific sound source is not contributing.

If the plant noise has any distinguishing characteristics such as tonal (e.g. whine, hiss, hum etc) or impulsive components (e.g. bangs, clicks, thumps etc), or if the noise is irregular enough to attract attention, then a penalty is applied depending on the severity of the characteristic.

The penalties can be summarised as set out in Table 1

Acoustically Distinguishing Characteristic	Range of Penalty	Methodology
Tonality	0 dB to +6 dB	Subjective Method, or 1/3 Octave Method, or Reference Method
Impulsivity	Up to +9 dB	Subjective Method, or Reference Method
Other sound characteristics	3 dB	Subjective Method
Intermittency	3 dB	Subjective method

TABLE 1: SUMMARY OF BS4142 ACOUSTIC CHARACTERISTIC PENALTIES

To assess the likelihood of complaints, the difference between the *Rating Level* and the *Background Sound Level* is calculated. A simple comparison of these levels provides the outcome of the assessment as shown in Table 2.

Level Difference (Rating – Background) dB(A)	Assessment Conclusion
Around +10 or more	Likely to be an indication of a significant adverse impact, depending on the context
Around +5	Likely to be an indication of an adverse impact, depending on the context
Zero or less	Indication of the specific sound source having a low impact, depending on the context

TABLE 2: SUMMARY OF BS4142:2014 ASSESSMENT METHOD

The assessment conclusions are all subject to taking into consideration the context of the ambient noise at the site, the character of the specific noise and the sensitivity of the receptors.

Where the assessment takes place prior to the specific source of noise being installed, it is permitted to predict the noise level at the noise sensitive location.

3.0 OTHER DESIGN CRITERIA…

We have considered the Cornwall Council Development Sound Standard: Guidance for Developers on the Assessment of Noise for Planning Applications, February 2017 (June 2017 update), which states the following.

> ***9.0 Sound criterion 2 – BS 4142 Assessment***
>
> *9.1 Sound criterion 2 is applicable to:*
>
> - *The assessment of sound from proposed, new, modified or additional source(s) of an industrial and/or commercial nature, where new noise sources are brought to existing noise-sensitive receptors.*
> - *The assessment of sound at proposed new dwellings or premises used for residential purposes, where the development will be affected by existing noise of an industrial/commercial nature.*
>
> *The rating level $L_{Ar,Tr}$ of sound from the proposed development at the curtilage of amenity areas at Noise Sensitive Receptors should not be greater than the L_{A90} background sound level. The rating level is to be determined in accordance with the methodology prescribed in BS 4142:2014*

The project is understood to be targeting a BREEAM rating. We have therefore considered the single Pol 05 credit – achieved by satisfying the following,

> ***Pol 05 – One Credit***
>
> 1. *There are no noise-sensitive areas within the assessed building or within 800 m radius of the assessed site.*

Or

2. *Where there are noise-sensitive areas within the assessed building or noise-sensitive areas within 800 m radius of the assessed site, a noise impact assessment compliant with BS 4142:2014 is commissioned. Noise levels must be measured or determined for:*

    a) *Existing background noise levels:*

        i) *At the nearest or most exposed noise-sensitive development to the proposed assessed site*

        ii) *Including existing plant on a building, where the assessed development is an extension to the building*

    b) *Noise rating level from the assessed building.*

3. *The noise impact assessment must be carried out by a suitably qualified acoustic consultant.*

4. *The noise level from the assessed building, as measured in the locality of the nearest or most exposed noise-sensitive development, must be at least 5dB lower than the background noise throughout the day and night.*

5. *If the noise sources from the assessed building are greater than the levels described in criterion 4, measures have been installed to attenuate the noise at its source to a level where it will comply with the criterion.*

In addition to the above, we have also considered BS8233:2014 and the World Health Organisation guidance for noise levels which offer good external amenity. A good standard of external amenity is considered to be 55 dB(A) L_{Aeq} and below.

Furthermore, we would expect neighbouring dwellings to maintain reasonable internal noise levels with windows open for ventilation. The BS8233 guidance for reasonable internal noise during the day within a dwelling is 40 dB(A) L_{Aeq}. We would normally expect 10-15 dB(A) reduction through an open window and hence we would not expect the noise level from new plant equipment to exceed 50 dB(A) L_{Aeq} measured 1 m from the external building façade where there is an opening window.

We have based the assessment on the BREEAM target, resulting in a *Rating Level* no greater than 5 dB below the *Background Sound Level*. This would further result in a BS4142 conclusion of low impact.

4.0 EXISTING BACKGROUND SOUND LEVELS…

There are no restrictions on the minimum duration of measurement of the *Background Sound Level* in BS4142, albeit to say they should represent the "*Typical*" background level when the new equipment will be in operation.

We understand the equipment may operate 24 hours a day. We have therefore based our assessment on both the day time and night time periods (07:00-23:00 & 23:00-07:00 respectively).

A survey of the pre-development noise environment has been undertaken in a location which is considered representative of the *Background Sound Level* at the nearest sensitive receiver.

The measurement was taken in a free field therefore we have included a correction of +3 dB to convert the free-field measurement to a façade level in accordance with BS4142 Clause 6.2.

The measurement has been carried out continuously with a logging period of 2 second.

We have assessed the uncertainty associated with the measurement of the background sound level based on the measurement tolerance of a Class 1 sound level meter which conforms with IEC61672-1:2002. The typical uncertainty based on the frequency spectrum of road traffic noise on the measured background level is ±1 dB(A). We have included the uncertainty in our assessment.

Taking into consideration the measured levels, tolerances, corrections and the uncertainty, we have used a *Background Sound Level* of 49 dB $L_{A90,1hr}$ during the day and 42 dB $L_{A90,15min}$ during the night for our assessment at the nearest sensitive neighbour.

5.0 PROPOSED PLANT EQUIPMENT…

We understand that the proposed scheme includes 2 No condenser units located externally in a sunken floor zone c. 0.5 m below ground level, 2 No extract fans that discharge at roof level and an air handling unit located internally within a plant room, of which the fresh air intake is located at ground level and the exhaust terminates a roof level.

The proposed location of the new equipment is indicated on a marked-up plan included in the appendix to this letter.

The sound output data, available from the manufacturer for the proposed equipment is summarised in Table 3.

Ref	Make/Model	No Off	Sound Power Level (dB re 1 pW) 1/1 Octave Band Centre Frequencies (Hz)								A
			63	125	250	500	1k	2k	4k	8k	
EF01/1	VES Colourfan CAE0051-1 extract fan	1	66	53	57	48	38	41	54	47	57
EF01/2	VES Colourfan CAE0242-1 extract fan	1	72	60	50	44	38	41	36	41	51
AHUIn	VES MAX17c/FP/S Air Handling Unit Intake	1	68	71	71	68	62	62	58	54	70
AHUEx	VES MAX17c/FP/S Air Handling Unit Exhaust	1	68	72	75	71	72	69	64	59	76
CON1 & CON2	Toshiba RAV-GM561ATP-E {Note 1}	2	69	66	66	62	61	54	50	43	65

TABLE 3: MANUFACTURERS' SOUND POWER OF INSTALLED EQUIPMENT

{Note 1} Spectrum taken from sound pressure data and corrected to achieve A-weighted sound power data.

The intake and exhaust of the air handling unit are understood to be fitted with in-line silencers. The insertion loss performance data of the proposed silencers is summarised in Table 4. We have included the performance of these silencers in our acoustic modelling.

Ref	Attenuator	Insertion Loss Performance (dB) 1/1 Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1000	2000	4000	8000
ATT/B1/1	VES 1000 mm Silencer	-6	-10	-18	-33	-47	-47	-24	-29
ATT/B1/2	VES 1000 mm Silencer	-6	-10	-18	-33	-47	-47	-24	-29

TABLE 4: PROPOSED VES SILENCER INSERTION LOSS PERFORMANCE DATA

6.0 SPECIFIC NOISE LEVEL…

We have modelled the propagation of sound from the plant equipment using the method described in ISO 9613-2.

We have used architectural drawings and on-line mapping tools to estimate the distance between the assessment locations and the closest of the proposed new noise sources.

We have used two assessment locations to represent the closest sensitive location as follows,

> Receiver No 1. Wards within the existing hospital are understood to overlook the plant locations via openable windows at ground, 1st floor and 2nd floor levels. The smallest distance between the new plant and existing buildings is understood to be c. 6 m.
> Receiver No 2. Residential dwelling to the South of the development understood to overlook the plant locations via openable windows at ground and 1st floor levels. The smallest distance between the new plant and residential dwellings is understood to be c. 18 m.

The calculated *Rating Level* of the proposed equipment at the assessment locations, and comparison of these sound levels against the target values, and the resulting conclusions are summarised in Table 5.

Receiver Location	Period	Background Sound Level dB(A) $L_{A90,T}$	Predicted Rating Level dB(A) $L_{Aeq,T}$	Difference Rating - BG dB(A)	BS4142 Conclusion
1	Day 07:00 to 23:00	49 (50±1) (Façade)	28 (Façade)	-21	Indication of a low impact
	Night 07:00 to 23:00	42 (43±1) (Façade)		-14	Indication of a low impact
2	Day 07:00 to 23:00	49 (50±1) (Façade)	31 (Façade)	-18	Indication of a low impact
	Night 07:00 to 23:00	42 (43±1) (Façade)		-11	Indication of a low impact

TABLE 5: SUMMARY OF PREDICTED RATING NOISE LEVELS AT RECEIVERS

When comparing the assessment results against BS4142, the noise level at the receiver from the proposed equipment is expected to be an indication of the specific sound source having a low impact during both the day and night time periods. Both local authority and BREEAM target noise levels are also expected to be achieved.

We have not included a correction for tonal or temporal components. This is considered a reasonable approach on the basis that all the equipment is new and will be installed correctly in accordance with the manufacturer's instructions. Should it transpire that the equipment has more undesirable acoustic characteristics, further penalties to that already included would be applied as described in BS4142 dependent on the prominence of the features.

7.0 CONCLUSIONS IN CONTEXT…

The context of the site is in a location where noise levels are dominated by road traffic. The proposed mechanical plant is thought to be continuous in nature and in keeping with the context of the site during daytime hours.

The receiver location we have used for assessment is connected to the proposed development and therefore very close to the noise sources.. Achieving acceptable noise levels at this location is therefore expected to satisfy acceptable target levels at any residential dwelling outside of this distance by default.

In our opinion, in context, targeting a *Rating Leve*l that is 5 dB below *Background Sound Level* in this environment is considered acceptable and not likely to cause adverse impact to nearby noise sensitive receivers.

8.0 EFFECTS OF UNCERTAINTY…

Where available we have included uncertainty in our calculations.

We have included the uncertainty in the measured values of *Background Sound Level*.

There are other sources of uncertainty in our assessment, such as, tolerances to be applied to manufacturers data, the variation in *Background Sound Level* on a different day, and the calculation tolerances for the propagation model.

The survey of the *Background Sound Level* has been undertaken in full accordance with BS7445 and ANC Green Book Guidance using laboratory calibrated measurement equipment. These precautions will minimise sources of uncertainty in the survey data. The current site conditions exhibit a low variability in the ambient and background sound levels and our data is considered to be a good representation of the site.

We do not expect the effects of uncertainty to have a significant effect on the outcome of our assessment.

9.0 ASSESSMENT CONCLUSION…

We have undertaken an assessment of the proposed new fixed building plant against the methodology set out in BS4142:2014 during day and night time hours.

We have estimated the likely noise levels at the nearest residential buildings based on information provided to us and using standard noise propagation and mapping tools.

Our assessment has concluded that the proposed scheme demonstrates compliance with the derived local authority and BREEAM target noise levels and no further noise mitigation is thought to be required.

If an undesirable tonal or temporal component were evident in the noise output of the equipment, then a further penalty would be applied to the *Specific Noise Level* as described previously. The conclusions reached would be altered and additional noise control measures would be required.

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APPENDIX A – SURVEY DETAILS…

Address: West Cornwall Hospital, St Clare St, Penzance, TR18 2PF

Date: 21st – 22nd April 2021

Measurement Location

Location 1 The monitoring equipment was set up to the South-East of the site at a location considered representative of the proposed extension and noise sensitive receivers. The microphone was pole mounted at c. 3.5 m above ground level and in free-field conditions as indicated in Figure 1.

Equipment (Green)

Brüel & Kjær handheld analyser Type 2250 G4, serial No 2832395 with Type 4189 microphone, serial No 3005055. The microphone was fitted with a Type UA-1404 windshield and the equipment calibration was checked using a Brüel & Kjær Type 4231 acoustic calibrator serial 3012516 before and after the measurements. No significant drift in sensitivity was observed during the survey and no corrections have been made to the measured data. The hand-held analyser and microphone were laboratory calibrated on 1st October 2020 (Certificate No. U35880). Calibration certificates are available on request.

Personnel

The survey was set up and left unattended by Ian Matthews of Red Twin Limited.

Weather

The weather was suitable for noise measurement with sunny conditions. There was no precipitation at any time during or immediately prior to the survey. Wind speeds were low (<<5 m s^{-1}) and were suitable for noise surveying.

Conditions were acceptable for noise measurement work and in full accordance with BS7445.

Survey Comments

The background and ambient sound at site are considered to be dominated by passing traffic within the hospital carpark in addition to distant traffic on the neighbouring road networks and seagulls.

Location	Start Time	Duration	Parameter dB(A)		
			$L_{Amax,f}$	L_{Aeq}	L_{A90}
1	12:00:00	01:00:00	78	55	45
	13:00:00	01:00:00	85	55	45
	14:00:00	01:00:00	81	54	45
	15:00:00	01:00:00	78	54	46
	16:00:00	01:00:00	88	56	47
	17:00:00	01:00:00	80	53	46
	18:00:00	01:00:00	78	53	45
	19:00:00	01:00:00	76	52	43
	20:00:00	01:00:00	81	52	41
	21:00:00	01:00:00	71	46	39
	22:00:00	01:00:00	68	44	38
	23:00:00	01:00:00	64	44	39
	00:00:00	01:00:00	66	43	39
	01:00:00	01:00:00	62	42	39
	02:00:00	01:00:00	68	43	39
	03:00:00	01:00:00	55	41	39
	04:00:00	01:00:00	58	41	39
	05:00:00	01:00:00	79	50	41
	06:00:00	01:00:00	79	53	43
	07:00:00	01:00:00	77	53	45
	08:00:00	01:00:00	80	56	48
	09:00:00	01:00:00	75	53	47
	10:00:00	01:00:00	82	55	47
	11:00:00	01:00:00	79	54	46

TABLE 6: MEASURED NOISE DATA – LOCATION 1 (FREE-FIELD)

FIGURE 1: PHOTOGRAPH OF SURVEY MEASUREMENT LOCATION NO 1 (LOOKING DUE SOUTH-WEST)

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APPENDIX B – SITE LOCATION PLAN…

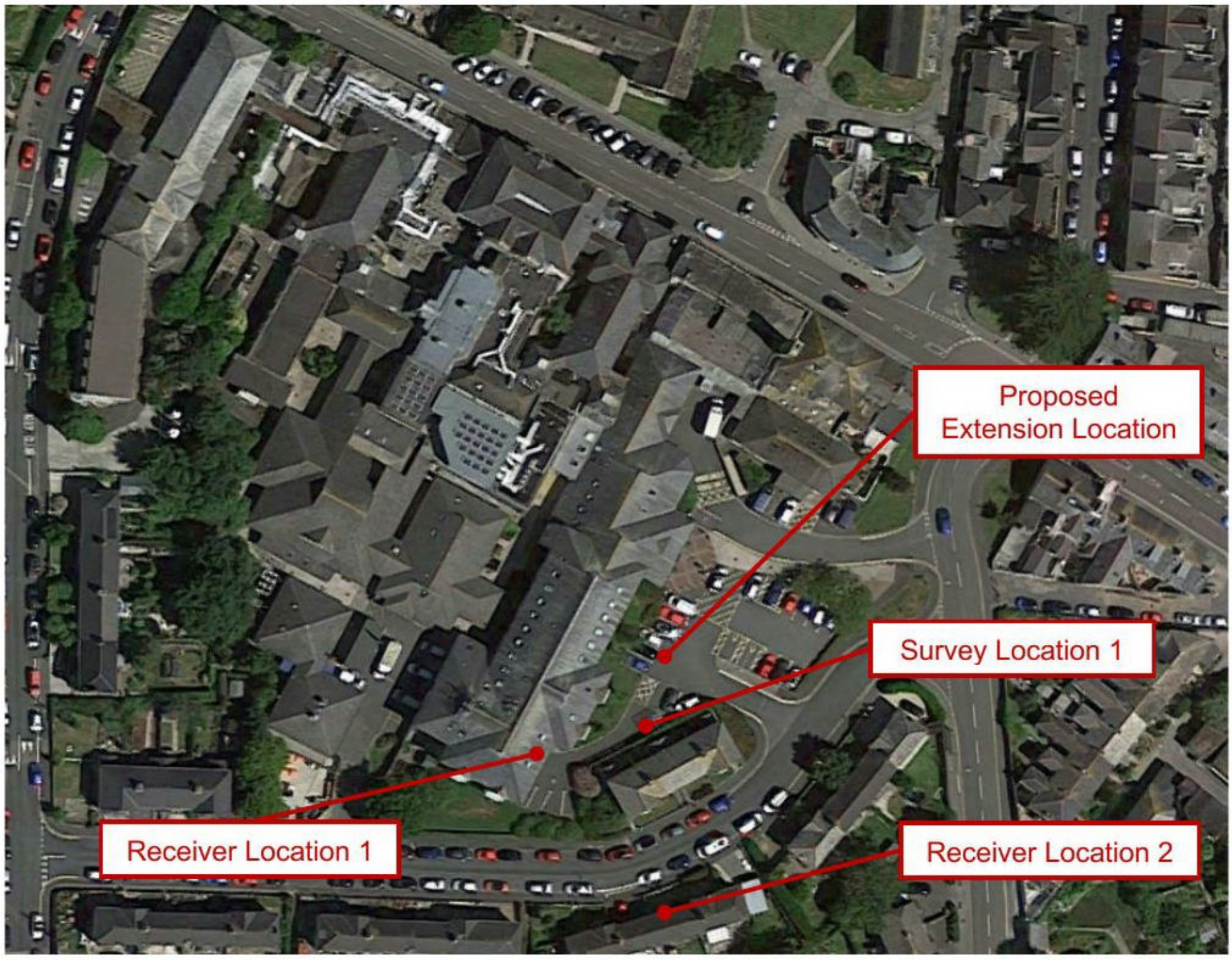

FIGURE 2: AERIAL VIEW OF THE SITE

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APPENDIX C – PLANT LOCATION…

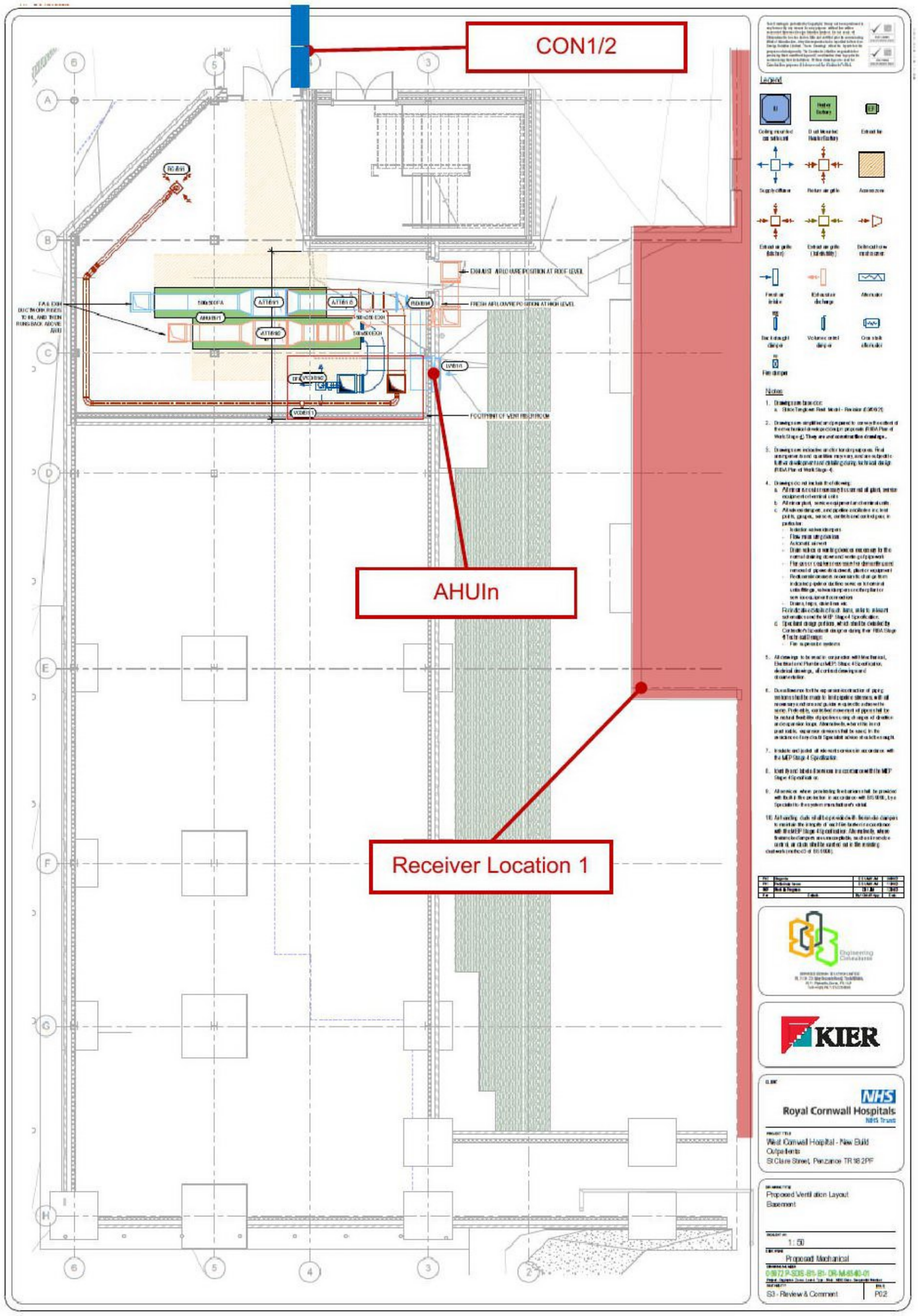

FIGURE 3: SITE PLAN INCLUDING RECEIVER AND GROUND LEVEL PLANT LOCATIONS (NOT TO SCALE)

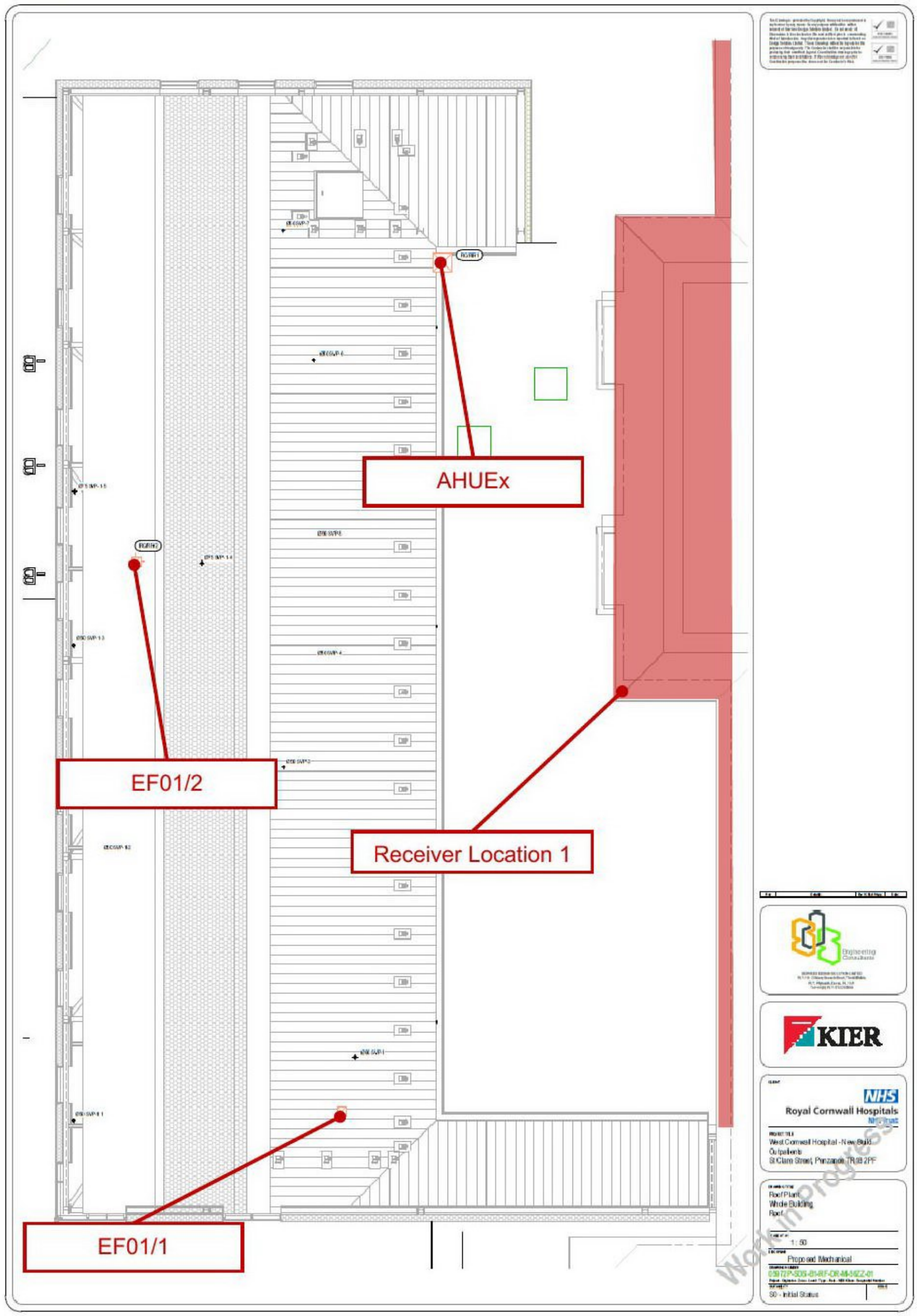

FIGURE 4: SITE PLAN INCLUDING RECEIVER AND ROOF LEVEL PLANT LOCATIONS (NOT TO SCALE)

FIGURE 5: MODEL IMAGE INDICATING CONDENSER LOCATIONS (NOT TO SCALE)

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APPENDIX D – MANUFACTURER'S NOISE DATA…

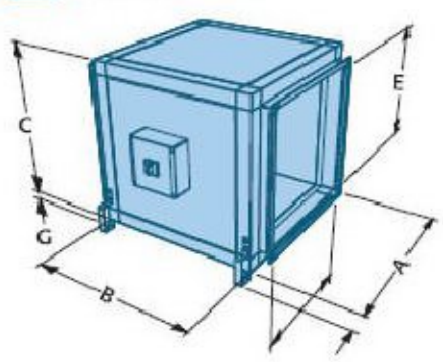
Premium efficiency extract units

Unit configuration

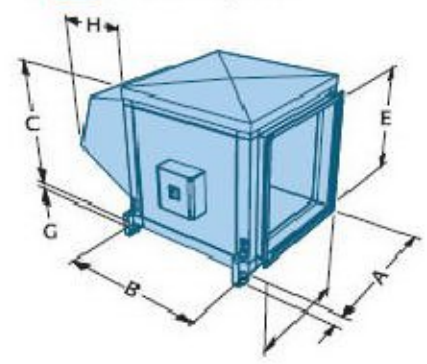
Configuration and handling

CAE0051-1 / P W / EE / LT RB / ISC
RT LB

P Plantroom



W Weatherproof



Unit type	Dimensions (mm)								Weight (kg)	Configuration options					
	A	B	C	D	E	F	G	H		LT	LB	RT	RB	L	R
CAE0 Plantroom extract	340	340	340	240	240	50	25		22	✓	✓	✓	✓		
CAE0 Weatherproof extract	340	340	350	240	240	50	25	200	25					✓	✓

SIZE 0 - CAE0051-1

Noise and silencer data

Fan voltage	Fan speed (RPM)	Sound spectrum dB re 10^{-12} w PWL centre frequency (Hz)								Casting noise breakdown			
		63	125	250	500	1k	2k	4k	8k	NR @ 1m	NR @ 3m	dBA @ 1m	dBA @ 3m
100%	4501	66	53	57	48	38	41	54	47	47	39	43	35
90%	4050	63	58	49	45	36	37	33	34	29	21	35	27
80%	3500	61	56	47	42	33	34	30	30	26	17	33	24
70%	3150	59	54	44	39	30	31	26	27	23	14	30	22
60%	2700	56	51	42	36	27	28	23	24	20	11	27	19
50%	2250	52	47	39	34	23	24	19	20	18	09	24	16

Centre frequency	63	125	250	500	1k	2k	4k	8k
Case insertion loss	-3	-5	-14	-19	-26	-22	-22	-15

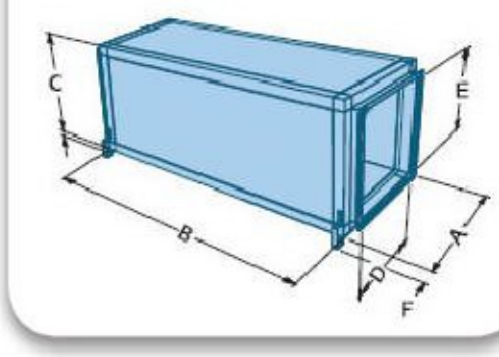
Note: Independently acoustically tested to BS EN ISO 3744:2010.

Silencer option	Sound spectrum dB re 10^{-12} w PWL centre frequency (Hz)							
CAEVA0000/1200	63	125	250	500	1k	2k	4k	8k
Induct loss	-6	-8	-12	-19	-28	-30	-24	-21

Dimensions (mm)	A	B	C	D	E	F	G	Weight (kg)
Plantroom CAEVA0000/1200/STD	340	1300	340	240	240	50	25	46
Weatherproof CAEVA0000/1200/W/STD	340	1300	360	240	240	50	25	55

Note: The silencer will add a maximum of 8 Pa to the external resistance.

Silencer



Note: *Data for design guidance only. Detailed information is available upon request.*

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FIGURE 6: SOUND POWER DATA OF EF01/1

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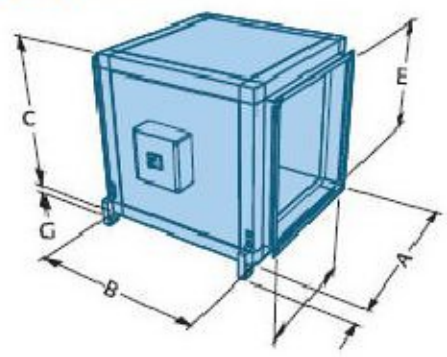
Premium efficiency extract units

Unit configuration

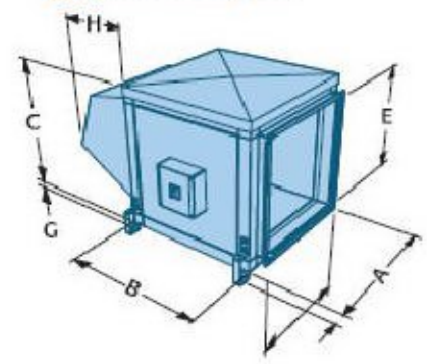
Configuration and handling

CAE0242-1 / P W / EE / LT RB / ISC
RT LB

P Plantroom



W Weatherproof



Unit type	Dimensions (mm)								Weight (kg)	Configuration options					
	A	B	C	D	E	F	G	H		LT	LB	RT	RB	L	R
CAE2 Plantroom extract	500	500	500	400	400	50	25		39	✓	✓	✓	✓		
CAE2 Weatherproof extract	500	500	525	400	400	50	25	250	44					✓	✓

SIZE 2 - CAE0242-1

Noise and silencer data

Fan voltage	Fan speed (RPM)	Sound spectrum dB re 10^{-12} w PWL centre frequency (Hz)								Casting noise breakdown			
		63	125	250	500	1k	2k	4k	8k	NR @ 1m	NR @ 3m	dBA @ 1m	dBA @ 3m
100%	3240	72	60	50	44	38	41	36	41	35	27	38	30
90%	2916	66	58	48	41	33	38	33	36	30	23	34	26
80%	2592	55	50	43	34	27	33	31	31	26	18	28	20
70%	2268	50	52	29	26	16	30	19	32	26	19	25	17

Centre frequency	63	125	250	500	1k	2k	4k	8k
Case insertion loss	-3	-5	-14	-19	-26	-22	-22	-15

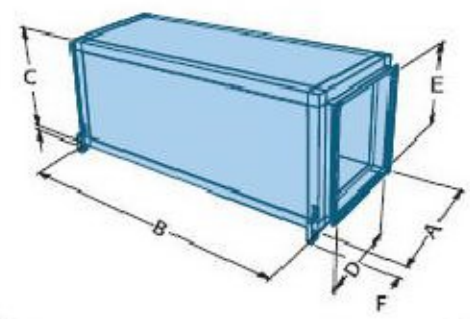
Note: Independently acoustically tested to BS EN ISO 3744:2010.

Silencer option	Sound spectrum dB re 10^{-12} w PWL centre frequency (Hz)							
CAEVA0200/1200	63	125	250	500	1k	2k	4k	8k
Induct loss	-6	-8	-12	-19	-28	-30	-24	-21

Dimensions (mm)	A	B	C	D	E	F	G	Weight (kg)
Plantroom CAEVA0200/1200/STD	500	1300	500	400	400	50	25	70
Weatherproof CAEVA0200/1200/W/STD	500	1300	525	400	400	50	25	80

Note: The silencer will add a maximum of 25 Pa to the external resistance.

Silencer



Note: *Data for design guidance only. Detailed information is available upon request.*

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FIGURE 7: SOUND POWER DATA OF EF01/2

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008 SUPPLY PLENUM FAN - SINGLE FAN

Model	GR35C-ZID.DC.CR-115500/A01	**Working RPM**	1954 RPM
Efficiency	62.8 %	**Working Hz**	31 Hz
Sound Power	78 dbW	**Maximum Hz**	Hz
Fan Blade Type	Backward Curve	**Absorbed Power**	0.71 kW
Fan Finish	Standard	**Motor Type:**	EC (Speed Controller Included)
Motor Power	3.00 kW	**Motor Voltage**	400
FLC	4.80 A		

Frequency	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Inlet-dlb	68	71	71	68	62	62	58	54
Outlet-dlb	70	72	76	72	73	70	65	60

EXTRAS

ACCESSORIES
Access Porthole Fitted
Airflow Pressure Switch - Fitted
Bulkhead Light - Fitted
Lockable Tee Handle To Suit 50mm Panel
ELGN1050 Motor Isolator Supplied Fitted & Pre-Wired

NOTES
The fan and motor sit on a common sub-frame within the casing that is fully vibration isolated.
The fan has a fitted inlet flexible connection.
Where this unit has to pass through restricted access ways, it may be necessary to supply the fan section in more than one piece. This will then require the fan/motor assembly and casing to be bolted together on-site by others.

SUPPLY SIDE SECTION E

009 PLENUM

Length	500.0 mm

EXTRAS

ACCESSORIES
Access Porthole Fitted
Bulkhead Light - Fitted
Lockable Tee Handle To Suit 50mm Panel

0010 WATER HEATING COIL

Heater Type	Main	**Medium**	Water
Air On Temp	10.0 °C	**Air Off Temp**	24.0 °C
Water Inlet Temp	75.0 °C	**Water Outlet Temp**	60.0 °C
Fin Material	Copper	**Heating Duty**	12.21 kW
Flow Rate	0.20 L/s	**Face Velocity**	1.72
Fluid PD	15.0 kPa	**Connection Type**	Screwed BSP
Coil Internal Volume	2.1 L	**Connection In/Out**	1 x 1/2" / 1 x 1/2"
Pressure Drop	8.0 Pa		

EXTRAS

NOTES
Water coils are designed suitable for a maximum working pressure of 600kPa(g), a maximum water temperature of 90°C, and are tested to 1700kPa (g) using compressed air, whilst immersed in water. Designs for different temperatures and pressures are available on request.

0011 PLENUM

Length	500.0 mm

EXTRAS

ACCESSORIES
Access Porthole Fitted
Bulkhead Light - Fitted
Lockable Tee Handle To Suit 50mm Panel

FIGURE 8: SOUND POWER DATA OF AHUIN

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EXHAUST SIDE SECTION I

0016 Outlet Section - Low Leakage Damper

Fresh Air Damper

Width	850 mm	**Height**	750 mm
Velocity	1.13 m/s	**Pressure Drop**	0.00 Pa
Material	Aluminium	**Position**	Onair
Finish	None	**Mounting**	External

EXTRAS

NOTES
Low leakage galvanised steel damper
Hand Operated

0017 PANEL FILTERS

Stage #	1	**Face Velocity**	1.48 m/s
Type	Panel	**Pressure Drop**	29 Pa
Media	Cotton / Synthetic Fibre	**Withdrawl**	Side
Filter Grade	M6	**Framework Material/Type**	
Filter Type	AP	**Spare Filters**	1 Set

EXTRAS

ACCESSORIES
Magnehelic Gauge To Suit 0-250 Pa
Filter Pressure Switch - Fitted
Lockable Tee Handle To Suit 50mm Panel

0018 PLENUM

Length	1000.0 mm

0019 EXHAUST PLENUM FAN - SINGLE FAN

Model	GR35C-ZID.DC.CR-115500/A01	**Working RPM**	1887 RPM
Efficiency	63.0 %	**Working Hz**	30 Hz
Sound Power	77 dbW	**Maximum Hz**	Hz
Fan Blade Type	Backward Curve	**Absorbed Power**	0.65 kW
Fan Finish	Standard	**Motor Type:**	EC (Speed Controller Included)
Motor Power	3.00 kW	**Motor Voltage**	400
FLC	4.80 A		

Frequency	**63 Hz**	**125 Hz**	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**	**4 kHz**	**8 kHz**
Inlet-dlb	66	71	70	67	61	61	58	53
Outlet-dlb	68	72	75	71	72	69	64	59

EXTRAS

ACCESSORIES
Access Porthole Fitted
Bulkhead Light - Fitted
Lockable Tee Handle To Suit 50mm Panel
ELGN1050 Motor Isolator Supplied Fitted & Pre-Wired

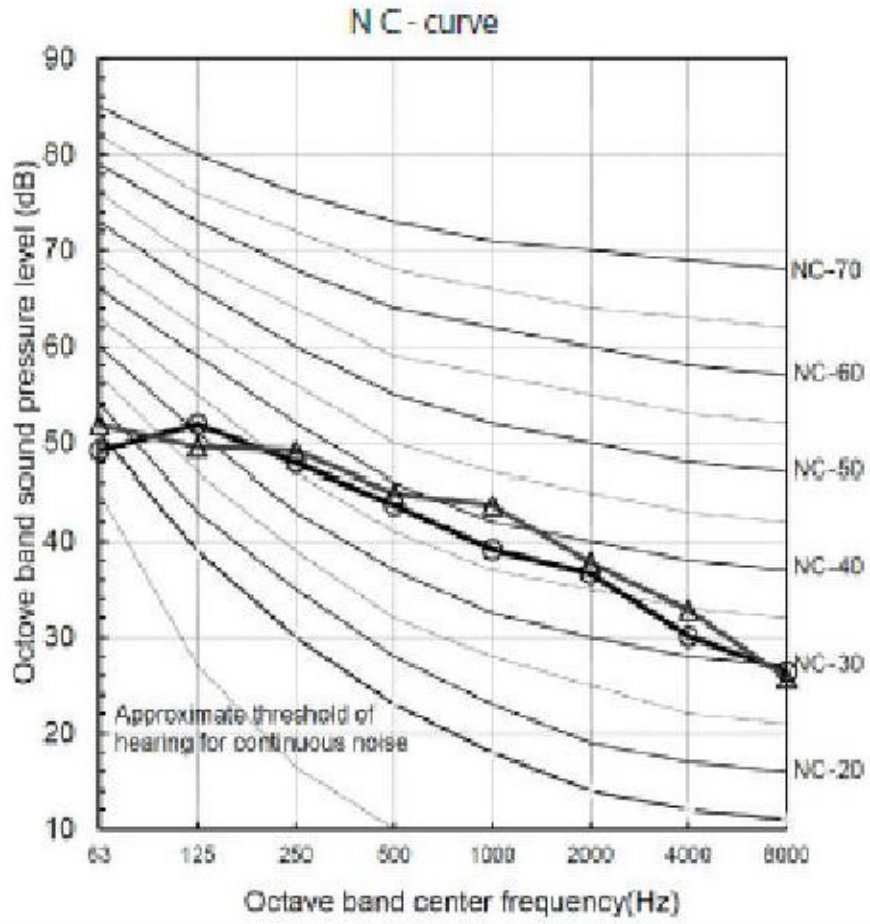
NOTES
The fan and motor sit on a common sub-frame within the casing that is fully vibration isolated.
The fan has a fitted inlet flexible connection.
Where this unit has to pass through restricted access ways, it may be necessary to supply the fan section in more than one piece. This will then require the fan/motor assembly and casing to be bolted together on-site by others.
Information shown is per fan

EXHAUST SIDE SECTION J

FIGURE 9: SOUND POWER DATA OF AHUEX

RAV-GM561ATP-E/TR (*ATJP-E)

Sound pressure level (dB(A))	Cooling	Heating
	46	48



RAV-GM801ATP-E/TR (*ATJP-E)

Sound pressure level (dB(A))	Cooling	Heating
	48	52

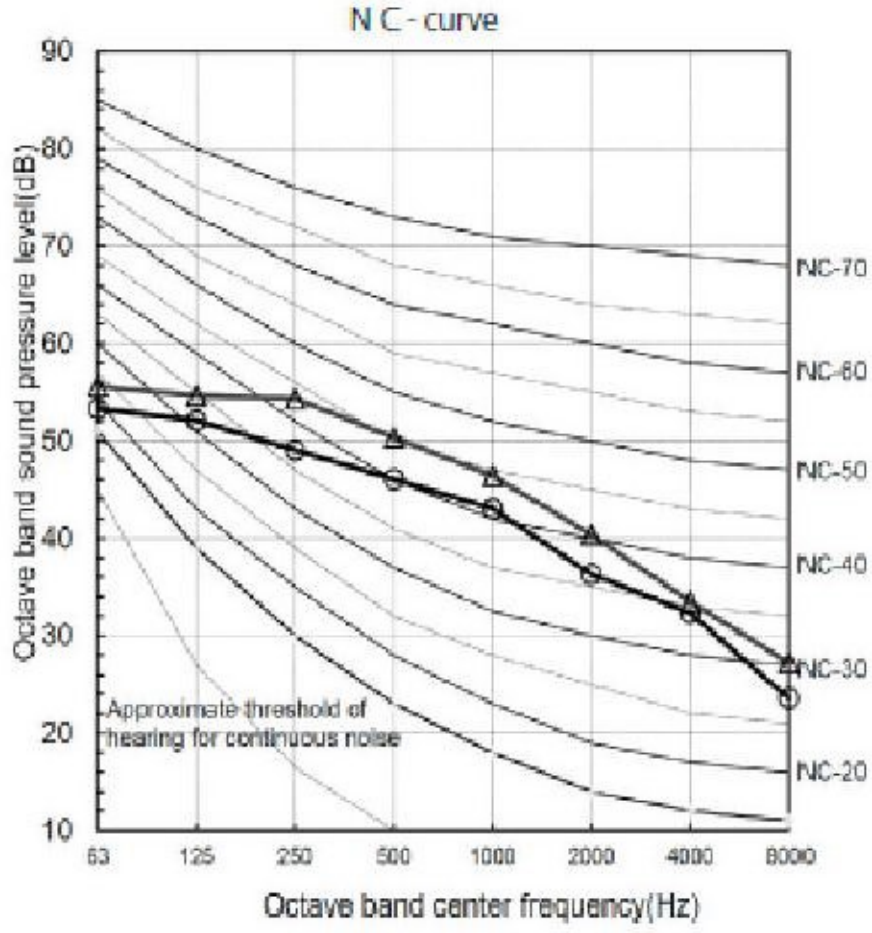


FIGURE 10: SOUND PRESSURE DATA OF CON1 / CON2

APPENDIX E – CALCULATION OF RATING LEVEL…

Noise Modelling Methodology

We have undertaken prediction of the noise exposure of the receiver locations based on the method described in ISO 9613-2 *Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation*.

The ISO propagation model calculates the sound pressure level from a source sound power level in each 1/1 octave band and subtracts various attenuation factors as follows,

$$L_{ft}(DW) = L_w + D_c - \left(A_{div} + A_{atm} + A_{gr} + A_{bar} + A_{misc}\right)$$

Where

$L_{ft}(DW)$	is the equivalent continuous downwind octave-band sound pressure level (dB)
L_w	is the octave band sound power level (dB)
D_c	is a directivity correction that describes the extent by which the $L_{ft}(DW)$ deviates in a specified direction from the level of an omni-directional sound source (dB)
A_{div}	is the attenuation due to geometrical divergence (dB)
A_{atm}	is the attenuation due to atmospheric absorption (dB)
A_{gr}	is the attenuation due to the ground effects (dB)
A_{bar}	is the attenuation due to a barrier (dB)
A_{misc}	is the attenuation due to miscellaneous other effects such as foliage, industrial sites and housing (dB).

The A-weighted total level is obtained by combining the octave band levels with the appropriate weighting and summing the contributions from each source.

Our calculations are performed using a proprietary software package, Predictor V2019.3 available through Brüel & Kjær Ltd in the UK, and it should be noted that the model is an approximation of the real situation. The calculated values are based on geometry information included in the model, some of which is approximate.

The model has assumed a 'hard' ground surface and has included the effects of air absorption at 273 K at 101 kPa and 60% humidity.

Noise Modelling Results

The noise model is indicated graphically in the following images. We have calculated the incident noise level for receiver point in a representative location of the nearest noise sensitive location.

Compliant with BREEAM and Local Authority target levels

Compliant with Local Authority target levels, but not BREEAM

Not compliant with either BREEAM or Local Authority target levels

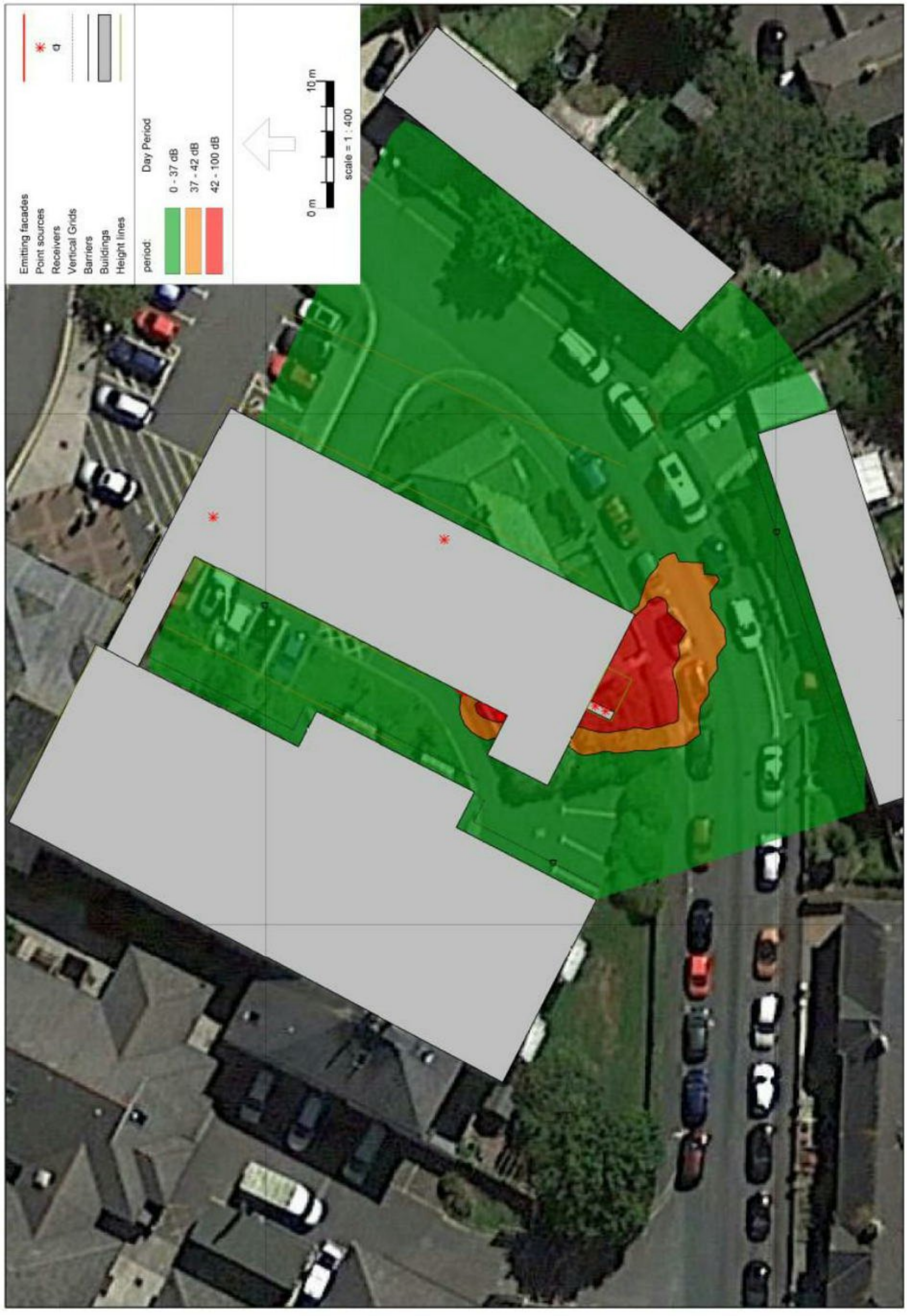


FIGURE 11: SITE-WIDE NOISE LEVEL CONTOURS AT H. OF 1 M

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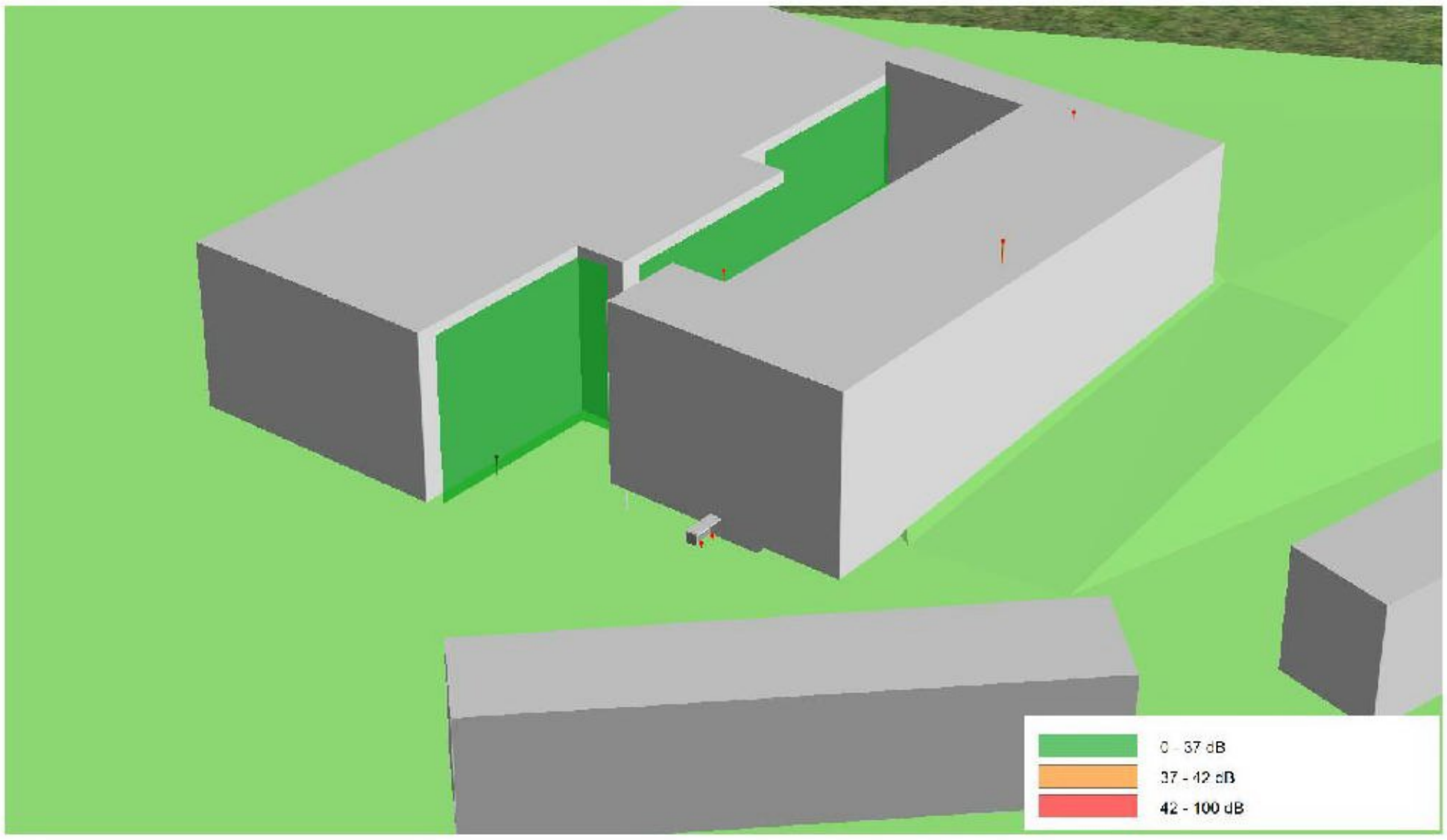

FIGURE 12: CONTOURS AT 1 M FROM FAÇADE OF RECEIVER 1

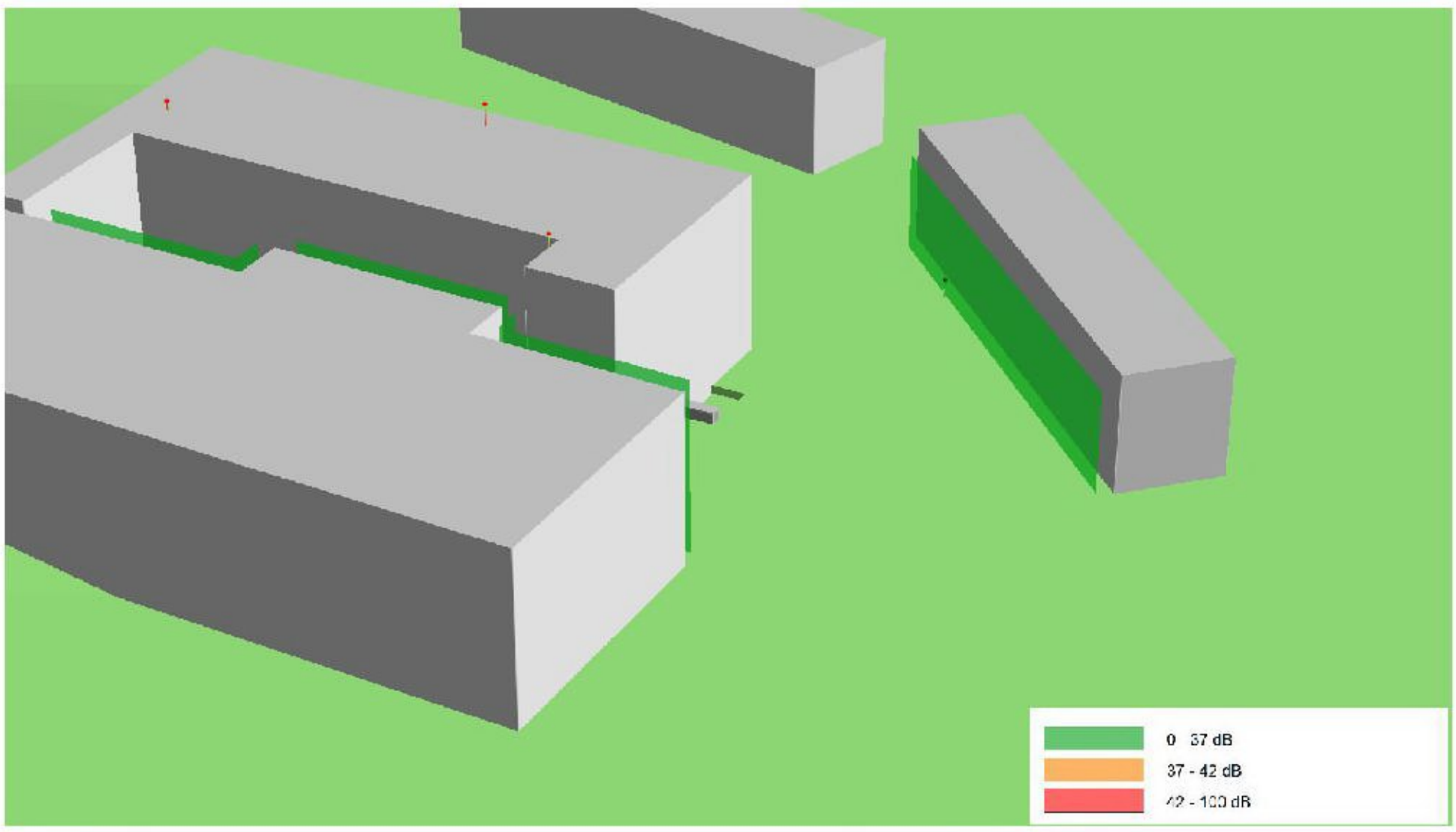

FIGURE 13: CONTOURS AT 1 M FROM FAÇADE OF RECEIVER 2