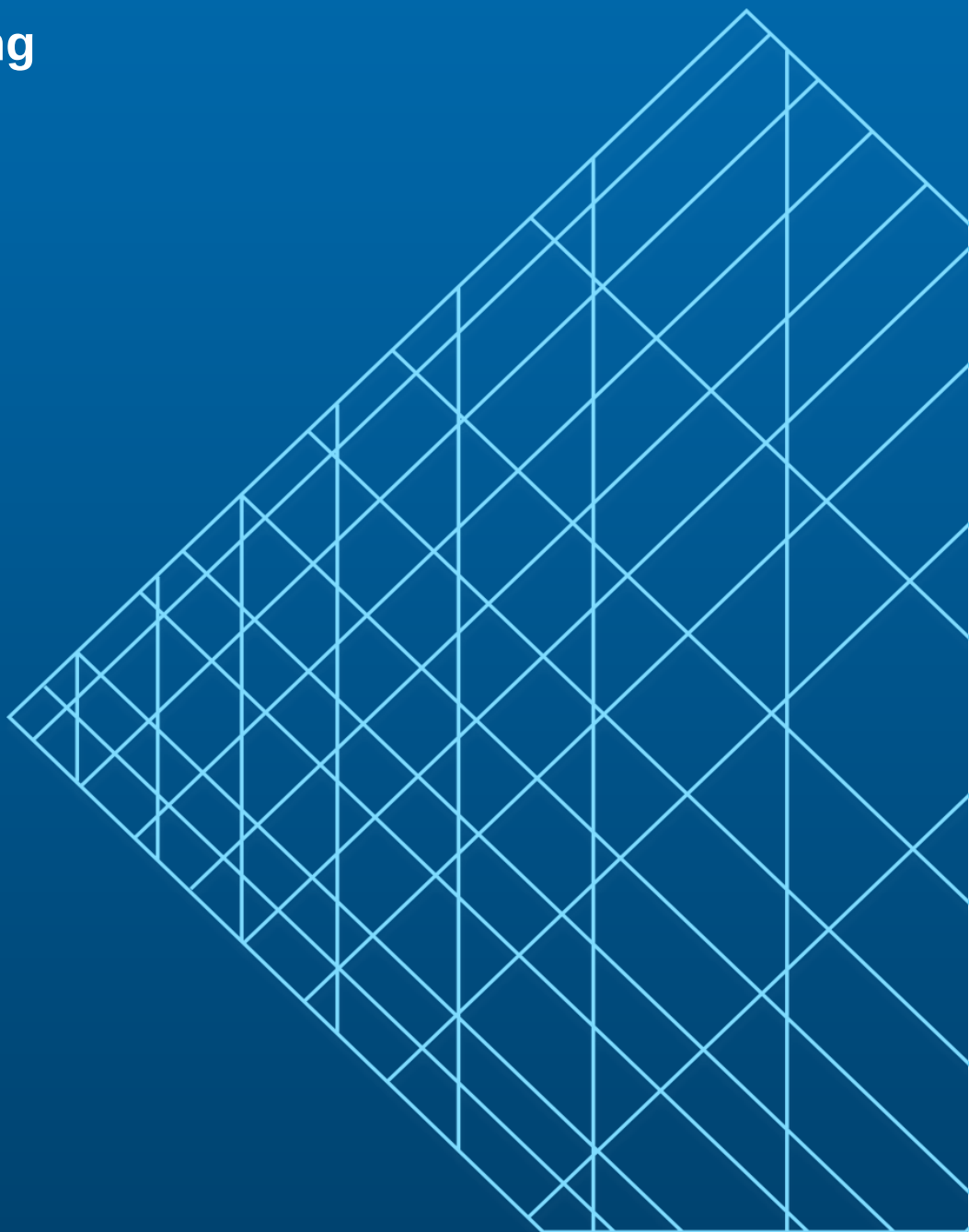
Hunter ACOUSTICS

Independent Acoustic Consultancy Practice

Environmental Noise Survey

CISCM Building
Swansea

5294/ENS1



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Environmental Noise Survey

Project:	**CISCM Building**
Site Address:	Swansea Bay Campus Swansea SA1
HA Reference:	5294/ENS1
Date:	14/08/2019
Client:	AECOM 1 Callaghan Square Cardiff CF10 5BT
Contact:	Wayne.Ganderton@aecom.com

ISSUE / REVISION

Rev	Date			
0	14 August 2019	**Filename**	19.5294_ENS1	
		Description	First issue	
			Prepared by:	**Checked by:**
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		Signature		

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1. INTRODUCTION

Swansea University are proposing to construct a new building at the eastern perimeter of the Swansea Bay Campus, Swansea, SA1 - known as the Centre for Integrative Semi-Conductor Materials (CISCM Building).

The project's ambition is to achieve BREEAM 2018 "Excellent" sustainability rating and therefore all the acoustic credits available within the Hea05 and Pol05 categories are to be targeted.

This report details methodology and results of an environmental noise survey of the site, used for;

a) Setting environmental noise limits for services plant in line with BREEAM Pol 05

b) Assessing sound insulation of the external building fabric to ensure noise intrusion criteria BB93 / BREEAM Hea 05 are met

Appendix A contains graphs, tables and diagrams referenced in this report.

Appendix B describes acoustic terminology used in this report.

1.1 Suitably Qualified Acoustician

The author of this report is considered to be "suitably qualified" for the purposes of a BREEAM assessment.

Meirion Townsend graduated with a BSc(Hons) in Audio Technology from the University of Salford in 2007.

He is a Corporate Member of the Institute of Acoustics (MIOA) and has over 10 years' experience in acoustic consultancy, including BREEAM assessments for schools, healthcare facilities, residential and office developments.

Hunter Acoustics are a member company of the Association of Noise Consultants (ANC) and are on their registration program for pre-completion sound insulation testing.

2. CRITERIA

2.1 BREEAM Hea 05 – Internal Acoustic Criteria

BREEAM New Construction 'Non-domestic Buildings (Wales) 2018 - Hea 05 Acoustic performance has three credits available for Education Buildings as follows;

Figure 2.1 – BREEAM Hea 05 Education Criteria

Table 5.14 BREEAM acoustic criteria for education buildings

Education buildings (three credits)	
First credit - Sound insulation	
Criteria	Achieve the performance standards set out in Section 1 of Building Bulletin 93: Acoustic design of schools: performance standards, February 2015 (BB93)[87] relating to airborne sound insulation between spaces and impact sound insulation of floors.
Testing	A programme of pre-completion acoustic testing is carried out by a compliant test body

Education buildings (three credits)	
requirement	in accordance with the BB93 requirements and the Association of Noise Consultants (ANC) Good Practice Guide, Acoustic testing of Schools[88].
Second credit - Indoor ambient noise levels	
Criteria	Achieve the indoor ambient noise level standards set out within Section 1 of BB93 for all room types.
Testing requirement	A programme of acoustic measurements is carried out by a compliant test body in accordance with the ANC Good Practice Guide, Acoustic testing of schools.
Third credit - Room acoustics	
Criteria	Room acoustics (Control of reverberation, sound absorption and speech transmission index (STI)): **Teaching and study spaces** achieve the requirements relating to reverberation time for teaching and study spaces set out within Section 1 of BB93. **Open plan teaching spaces** achieve the performance requirements relating to reverberation time and STI set out within Section 1 of BB93. **Corridor and stairwells**, for those that give direct access to teaching and study spaces, achieve the performance requirements relating to sound absorption.
Testing requirement	**Teaching and study spaces:** A programme of acoustic measurements is carried out by a compliant test body in accordance with the requirements of BB93 and ANC Good Practice Guide, Acoustic testing of schools. **Open plan teaching spaces:** A programme of acoustic measurements of reverberation time is carried out within open plan teaching spaces. The measurement is carried out by a compliant test body in accordance with the requirements of BB93 and ANC Good Practice Guide, Acoustic testing of schools. STI testing is not required. To demonstrate compliance the SQA shall undertake measurements of reverberation times to compare against the STI model. The SQA should provide a report confirming that the surface finishes and distribution of sound absorption within the completed space is in line with the design intent implemented within the STI model. Where significant changes or differences are observed, the SQA shall re-model the space accordingly to demonstrate that the STI measurement is met by the completed spaces. **Corridors and stairwells:** Installation of a specification compliant with the BB93 criteria demonstrates compliance. A site inspection by the developer or SQA is required to confirm that a compliant specification has been installed.

2.1.1 Building Bulletin 93

Table 1 of BB93 specifies upper limits for indoor ambient noise levels in terms of $L_{Aeq,30min}$ during normal teaching hours

Figure 2.2 – Table 1 of Building Bulletin 93 (BB93)

Table 1: noise activity and sensitivity levels and upper limits for indoor ambient noise level

Type of room	Room classification for the purpose of airborne sound insulation in Tables 3a and 3b		Upper limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB	
	Activity noise (Source room)	Noise tolerance (Receiving room)	New build	Refurbish-ment
Nursery school rooms *Primary school:* classroom, class base, general teaching area, small group room *Secondary school:* classroom, general teaching area, seminar room, tutorial room, language laboratory	Average	Medium	35	40
Open plan: (See also section 1.8) Teaching area Resource/breakout area	Average	Medium	40	45
Primary music room	High	Medium	35	40
Secondary music classroom[1] Small and large practice/group room[1] Performance/recital room[1]	Very high	Low	35	40
Performance/recital room[1] Ensemble room [1] Recording studio[1]	Very high	Low	30	35
Control room - for recording[1] Control room - not for recording	High Average	Low Medium	35	40
Lecture room	Average	Medium	35	40
Teaching space intended specifically for students with special hearing and communication needs[2]	Average	Low	30	35
SEN calming room	High	Low	35	35

Continued…

Type of room	Room classification for the purpose of airborne sound insulation in Tables 3a and 3b		Upper limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB	
	Activity noise (Source room)	Noise tolerance (Receiving room)	New build	Refurbish-ment
Study room (individual study, withdrawal, remedial work, teacher preparation)	Low	Medium	40	45
Libraries:				
Quiet study area	Low	Medium	40	45
Resource area	Average	Medium	40	45
Science laboratory	Average	Medium	40	45
Design and technology:				
Resistant materials, CADCAM area	High	High	40	45
Electronics/control, textiles, food, graphics, design/resource area, ICT room, art	Average	Medium	40	45
Drama studio, assembly hall, multi-purpose hall (drama, PE, audio/visual presentations, assembly, occasional music)	High	Low	35	40
Atrium, circulation space not intended for teaching and learning	Average	Medium	45	50
Sports hall Dance studio Gymnasium/Activity studio	High	Medium	40	45
Swimming pool	High	High	50	55
Meeting room, Interviewing/counselling room, video conference room	Low	Medium	40	45
Dining room	High	High	45	50

Noise from building services under normal conditions should meet the limits for indoor ambient noise levels (IANL) in table 1. Table 2 of BB93 show the tolerances on the IANL limits for different types of ventilation systems under different operating conditions.

Figure 2.3 – Table 2 of Building Bulletin 93 (BB93)

Table 2: summary of ventilation condition, system type and associated IANL tolerance

Condition	Ventilation system	Noise level limit
Normal - ventilation for normal teaching and learning activities	Mechanical[1]	Table 1 value
	Natural[2]	Table 1 value + 5 dB[4]
	Hybrid[2]	Mechanical system noise: Table 1 value
		Total noise level: Table 1 value + 5 dB
Summertime[5] - ventilation under local control of teacher to prevent overheating – allowable during the hottest 200 hrs of the year	Mechanical	Table 1 value + 5 dB[4]
	Natural or Hybrid	≤55 dB
Intermittent boost[6] – ventilation under local control of teacher for dilution of fumes during practical activities as in practical spaces for science, art, food technology and design and technology	Mechanical	Table 1 value + 5 dB[4]
	Natural	≤55 dB
Process - extract[3] can be automatic ventilation for safety and/or under local control of teacher	Mechanical and/or natural	See IoA/ANC guide[Ref1] for operational noise levels

2.1.2 External Ambient Noise Criteria for Natural Ventilation / Opening Windows

The following table calculates the allowable external ambient noise levels in order to meet proposed internal noise criteria in various teaching spaces with windows open.

Table 2.1 – External Ambient Noise Limit Calculation

	Seminar Room	Labs / Offices
IANL New Build $L_{Aeq,30min}$	35dB	40dB
Natural or Hybrid Ventilation Relaxation	+5dB	+5dB
Allowance of Loss Through Partially Open Windows	+13dB	+13dB
External Ambient Noise Criteria $L_{Aeq,30min}$	**53dB**	**58dB**

Therefore, for seminar/teaching spaces opening windows can be used up to an external noise level of 53dB $L_{Aeq,30min}$ and for labs/offices, 58dB $L_{Aeq,30min}$. These external 'criteria are compared with the results of our survey discussed later in this report.

2.2 BREEAM Pol 05 – Atmospheric Plant Noise Criteria

BREEAM New Construction 'Non-domestic Buildings (Wales) 2018 - Pol 05 Acoustic performance has one credit available as follows;

Assessment criteria

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 BS4142:2014(218) is commissioned. Noise levels must be measured or determined for:

2.a Existing background noise levels:

2.a.i at the nearest or most exposed noise-sensitive development to the proposed assessed site

2.a.ii including existing plant on a building, where the assessed development is an extension to the building

2.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.

2.2.1 British Standard 4142:2014

BREEAM Pol 05 refers to British Standard 4142:2014 "Methods for rating and assessing industrial and commercial sound".

This standard describes a rating method comparing L_{Aeq} noise levels from the industrial source with pre-existing background L_{A90} levels at the residential receiver. It advises at a difference (industrial noise - background) of:

- +10dB or higher, likely to be an indication of a significant adverse impact, depending on the context.
- A difference of + 5dB, likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound 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.

A sliding scale of penalties can be applied to industrial/commercial sound levels which have acoustically distinguishing characteristics, including tonality, impulsivity and intermittency.

Tonality – *A penalty of 2dB for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible.*

Impulsivity – *A penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it clearly perceptible, and 9dB where it is highly perceptible.*

Other sound characteristics – *Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied*

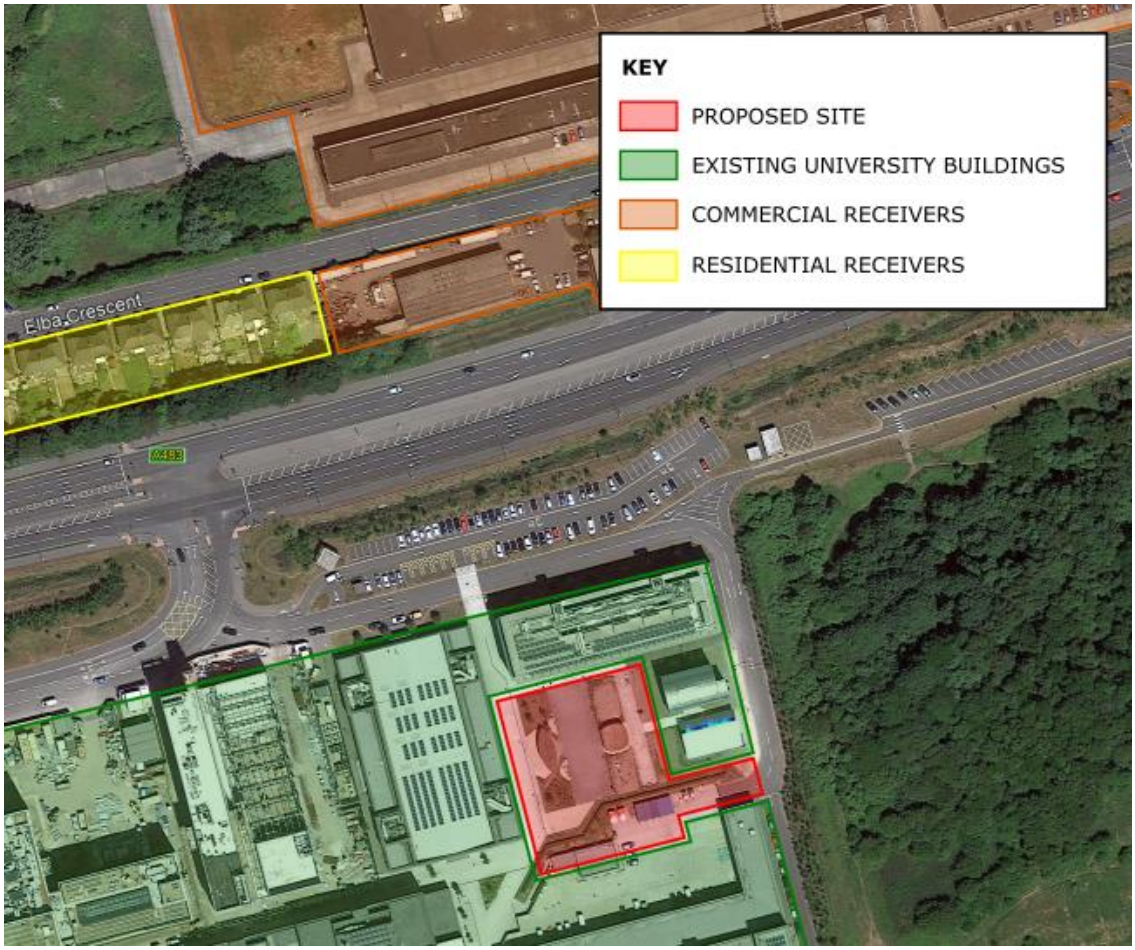
Intermittency – *If intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied.*

In order to carry out a BS 4142 / Pol 05 assessment therefore, it is first necessary to define the pre-existing ambient noise climate at the neighbouring sound sensitive receivers (SSRs).

3. NOISE SENSITIVE PREMISES

Site plan in Figure 3.1 below shows the proposed development site and nearest sound sensitive receivers (SSRs).

Figure 3.1 – Site Plan Showing Nearest Noise Sensitive Premises



Nearest SSRs include;

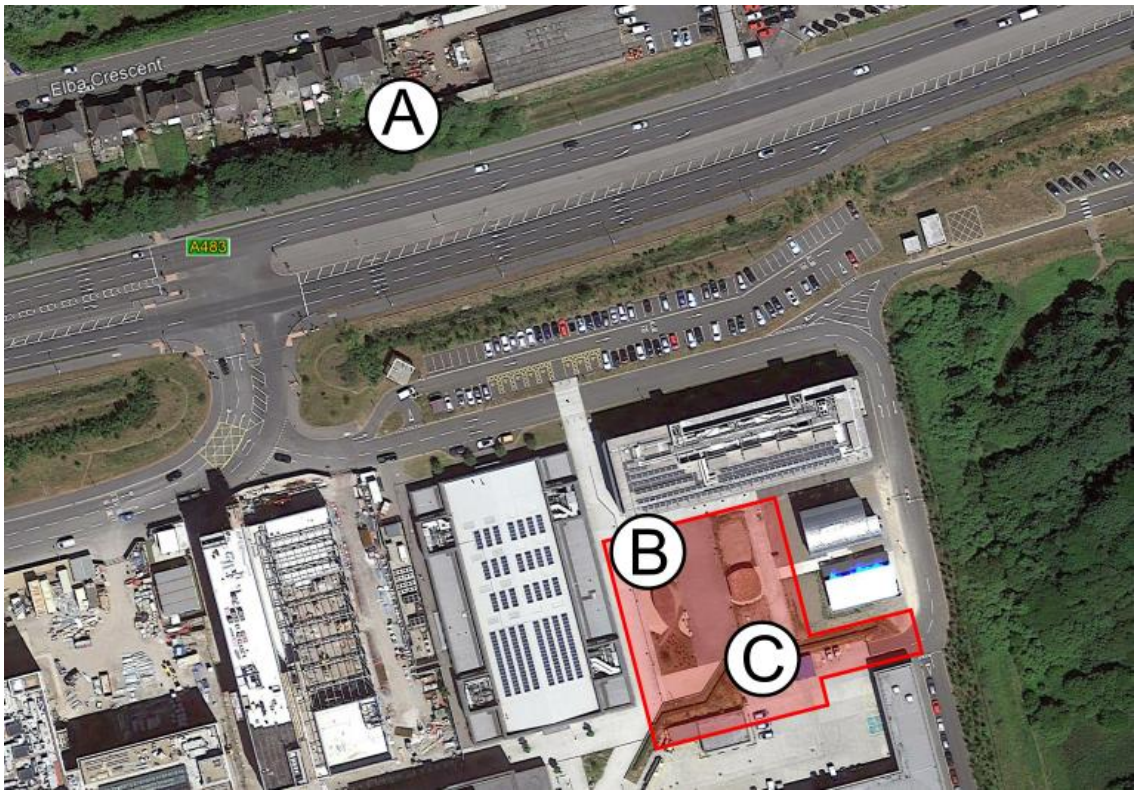
- Residential dwellings on Elba Crescent approximately 130m north-west
- Existing University Buildings immediately surrounding the site, with student residential blocks located approximately 200m to the west
- Commercial units including Celtic Mowers, Corner Park Car Sales and Bay Studios

4. NOISE SURVEYS

4.1 Procedures

Continuous noise monitoring was carried out from 1045hrs on Thursday 01/08/2019 through to 1108hrs on Friday 02/08/2019 to determine ambient sound levels across the proposed development site, along with background sound levels at the nearest SSRs.

Figure 4.1 – Site Plan Showing Unattended Continuous Monitoring Positions



Site plan in Figure 4.1 above shows the development site and continuous monitoring locations used, namely:

Position A	Located on the western boundary of Celtic Mowers Ltd, 1.8m above local ground height. Location chosen to monitor representative daytime and night-time background sound climate at the nearest residences.
Position B	Located on the north western boundary of the proposed building location, 1.5m above local ground height.
Position C	Located on the southern boundary of the proposed building location, 1.5m above local ground height.

Data including L_{Amax}, L_{Aeq}, and L_{A90} were logged at 15-minute intervals over the monitoring period.

4.2 Equipment

The following equipment was used during our survey;

Table 4.1 - Equipment Used

Make	Description	Model	Serial Number	Last Calibrated	Certificate No.
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-08723-E0	12 December 2018	1612652
	Preamplifier	MA220	1820	12 December 2018	1612650
	Microphone	Capsule	9381	12 December 2018	1612650
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-10021-E0	24 August 2017	UCRT17/1722
	Preamplifier	MA220	5435	24 August 2017	UCRT17/1722
	Microphone	Capsule	8547	24 August 2017	UCRT17/1722
Rion	Type 1 - Sound Level Meter	NL-32	1103396	01 March 2019	UCRT19/1270
	Preamplifier	NH-21	34335	01 March 2019	UCRT19/1270
	Microphone	UC-53A	317921	01 March 2019	UCRT19/1270
Rion	Calibrator (94.04dB @ 984Hz)	NC-73	10355197	01 March 2019	UCRT19/1273

Measurement systems were calibrated before and after the survey, no variation occurred.

4.3 Weather Conditions

Approximate weather data is shown in Figure B.1 & Figure B.2 in Appendix B. To summarise, weather conditions were dry with an occasional breeze throughout both survey periods.

5. RESULTS

5.1 Ambient Noise Levels

Time history graphs in Figure B.3, Figure B.4 & Figure B.5 in Appendix B show L_{Amax}, L_{Aeq} and L_{A90} sound pressure levels measured over consecutive 15-minute periods at positions A, B & C respectively.

Overall, ambient noise levels were controlled by distant road traffic and plant on surrounding buildings.

$L_{Aeq,30min}$ levels at Positions B and C through-out the typical working day (0900-1700hrs) on the proposed development site are summarised below;

Table 5.1 – Summary of $L_{Aeq,30min}$ Results at Positions B and C

	Pos B		Pos C	
	Time (hh:mm)	$L_{Aeq,30mins}$ (dB)	Time (hh:mm)	$L_{Aeq,30mins}$ (dB)
01/08/2019	11:00	52.8	11:00	51.1
	11:30	47.9	11:30	51.3
	12:00	47.5	12:00	50.0
	12:30	47.7	12:30	49.8
	13:00	48.5	13:00	49.8
	13:30	49.8	13:30	52.3
	14:00	52.0	14:00	58.2*
	14:30	47.6	14:30	50.8
	15:00	48.0	15:00	50.1
	15:30	49.4	15:30	51.2
	16:00	47.6	16:00	49.7
	16:30	48.0	16:30	49.8
02/08/2019	09:00	49.7	09:00	53.8*
	09:30	48.0	09:30	50.5
	10:00	52.2	10:00	50.0
	10:30	48.3	10:30	50.3

* Audio recordings indicate these periods were affected by maintenance work (banging/cutting).

Levels are therefore indicated to fall at or below 50dB $L_{Aeq,30mins}$ for the majority of the working day, occasionally rising to 52dB $L_{Aeq,30mins}$ (mainly caused by seagulls/distant maintenance work).

5.2 Background Sound Level Analysis

Background sound levels have been statistically analysed in accordance with BS 4142:2014 as shown in graphs in Figure B.6,

Figure B.7 & Figure B.8 in Appendix B. Representative levels are summarised below;

Table 5.2 – Typical Background L_{A90} Sound Levels

Period	Typical Background L_{A90}		
	Position A	Position B	Position C
Daytime *(0700-2300hrs)*	52dB	45dB	48dB
Night-time *(2300-0700hrs)*	40dB	45dB	48dB

The above background levels at Position A are used to set plant noise limits at the nearest residential receivers in line with the criteria of BREEAM Pol 05 (see section 2.2).

6. DISCUSSION

6.1 Noise Intrusion

Existing ambient noise levels at the proposed development site are not indicated to exceed 53dB $L_{Aeq,30min}$ and therefore a natural ventilation/hybrid strategy utilising openable windows may be feasible as far as controlling traffic noise break-in to the building is concerned. However, controlling noise break-out from the building and associated plant to neighbouring residential and university buildings may require a mechanical ventilation strategy (to avoid relying on opening windows/natural ventilation louvres).

Based on existing ambient noise levels, standard thermal double glazing is indicated to be sufficient to control noise intrusion.

6.2 Atmospheric Plant Noise Limits

Based on results of continuous monitoring, the following plant rating limits are proposed for services plant in line with criteria stated in Pol 05 of BREEAM (see section 2.2 which quotes BREEAM Pol 05 rating level must be at least 5dB lower than the background noise level during the day and night).

Figure 6.1 – Atmospheric Plant Noise Limits

Location	Period		Plant Rating Limits $L_{Ar,Tr}$
Nearest Residential Receivers (Elba Crescent)	Daytime	*(0700-2300hrs)*	47dB
	Night-time	*(2300-0700hrs)*	35dB

Note: Any tonality/impulsivity/intermittency penalties (BS4142) need to be taken off these figures to give the L_{Aeq} plant level limit.

These figures shall be met with all plant operating normally. Stand-by plant may be designed to a higher level (to be confirmed with Local EHO).

These criteria should be confirmed acceptable with the Local Planning Authority.

A suitably qualified acoustician (preferably a member of the Association of Noise Consultants - ANC) should be employed to review proposed plant locations and selections to ensure limits are met with all plant operating at design duties.

We would suggest an initial plant design limit of 50dB L_{Aeq} at 3m is set, the same figure to apply to atmospheric side intake/discharge louvres.

7. CONCLUSION

An environmental noise survey has been carried out for the proposed new CISCM Building at Swansea Bay Campus, Swansea, SA1.

Unattended continuous noise monitoring has been carried out on the proposed development site and at a location adjacent to critical residential receivers.

Ambient noise levels on the site are controlled by road traffic from Fabian Way and fixed services plant on surrounding University buildings.

Based on measured levels at Positions B and C, internal ambient noise criteria within teaching spaces, laboratories and offices are indicated to be achievable via natural/hybrid ventilation with openable windows if desired. However for noisy areas, controlling noise break-out may require a mechanical ventilation strategy, allowing windows to be kept closed.

Atmospheric plant noise limits are included in section 6.2 to meet BREEAM Pol 05 criteria. These figures shall be met with all plant operating normally. Stand-by plant may be designed to a higher level (to be confirmed with Local EHO).

APPENDIX A - ACOUSTIC TERMINOLOGY

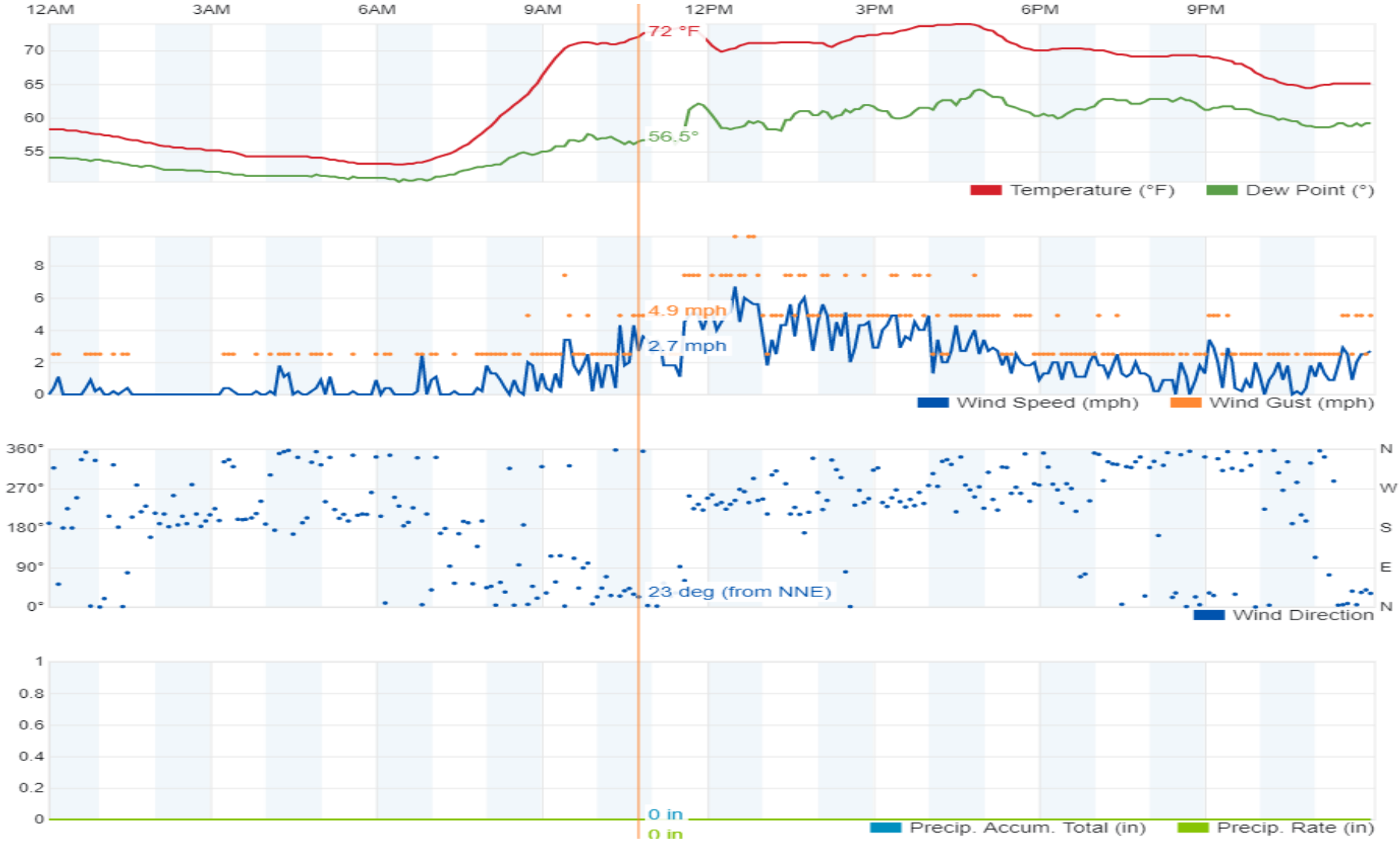
Human response to noise depends on a number of factors including loudness, frequency content and variations in level with time. Various frequency weightings and statistical indices have been developed in order to objectively quantify 'annoyance'.

The following units have been used in this report:

dB(A)	The sound pressure level A-weighted to correspond with the frequency response of the human ear and therefore a persons' subjective response to frequency content.
L_{eq}	The equivalent continuous sound level is a notional steady state level which over a quoted time period would have the same acoustic energy content as the actual fluctuating noise measured over that period.
L_{max}	The highest instantaneous sound level recorded during the measurement period.
L_{10}	The sound level which is exceeded for 10% of the measurement period. i.e. The level exceeded for 6 minutes of a 1 hour measurement - used as a measure of background noise.
L_{90}	The sound level which is exceeded for 90% of the measurement period. i.e. The level exceeded for 54 minutes of a 1 hour measurement - used as a measure of background noise.
SSR	Sound sensitive receiver
$L_{Ar,Tr}$	The 'rating' level, as described in BS4142 – the specific noise plus any adjustment for the characteristic features of the sound

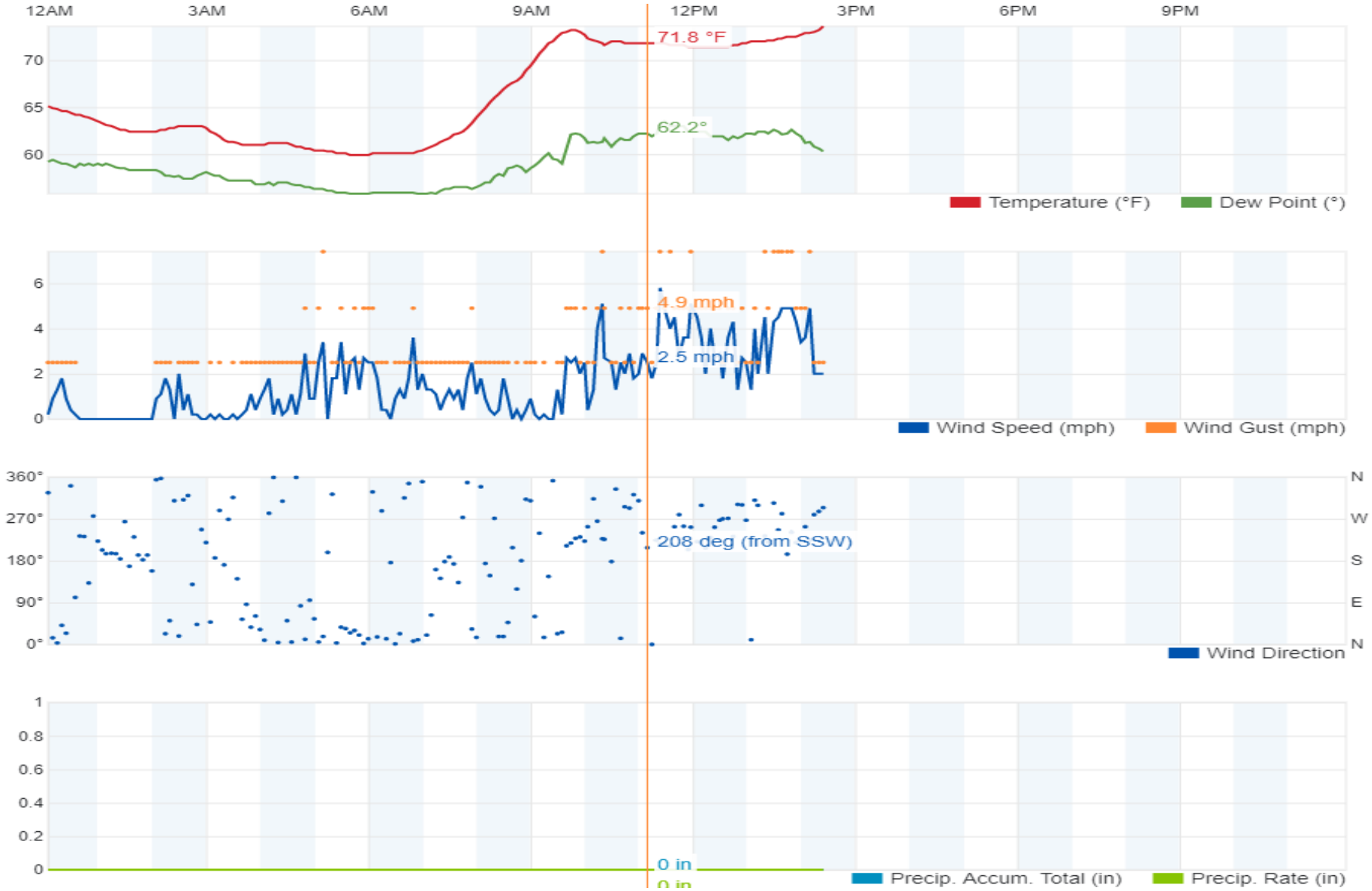
APPENDIX B - DIAGRAMS, GRAPHS AND TABLES

Figure B.1 – Approximate Weather History During Continuous Monitoring Period (Thursday 01st August 2019)



Data taken from www.wunderground.com. Weather Station: ISWANSEA12, located in Swansea [51.62° N, -3.877° W, Elevation 26]

Figure B.2 – Approximate Weather History during Continuous Monitoring Period (Friday 2nd August 2019)



Data taken from www.wunderground.com. Weather Station: ISWANSEA12, located in Swansea [51.62° N, -3.877° W, Elevation 26]

Figure B.3 – Time History at Position A (Thursday 1st August 2019 to Friday 2nd August 2019)

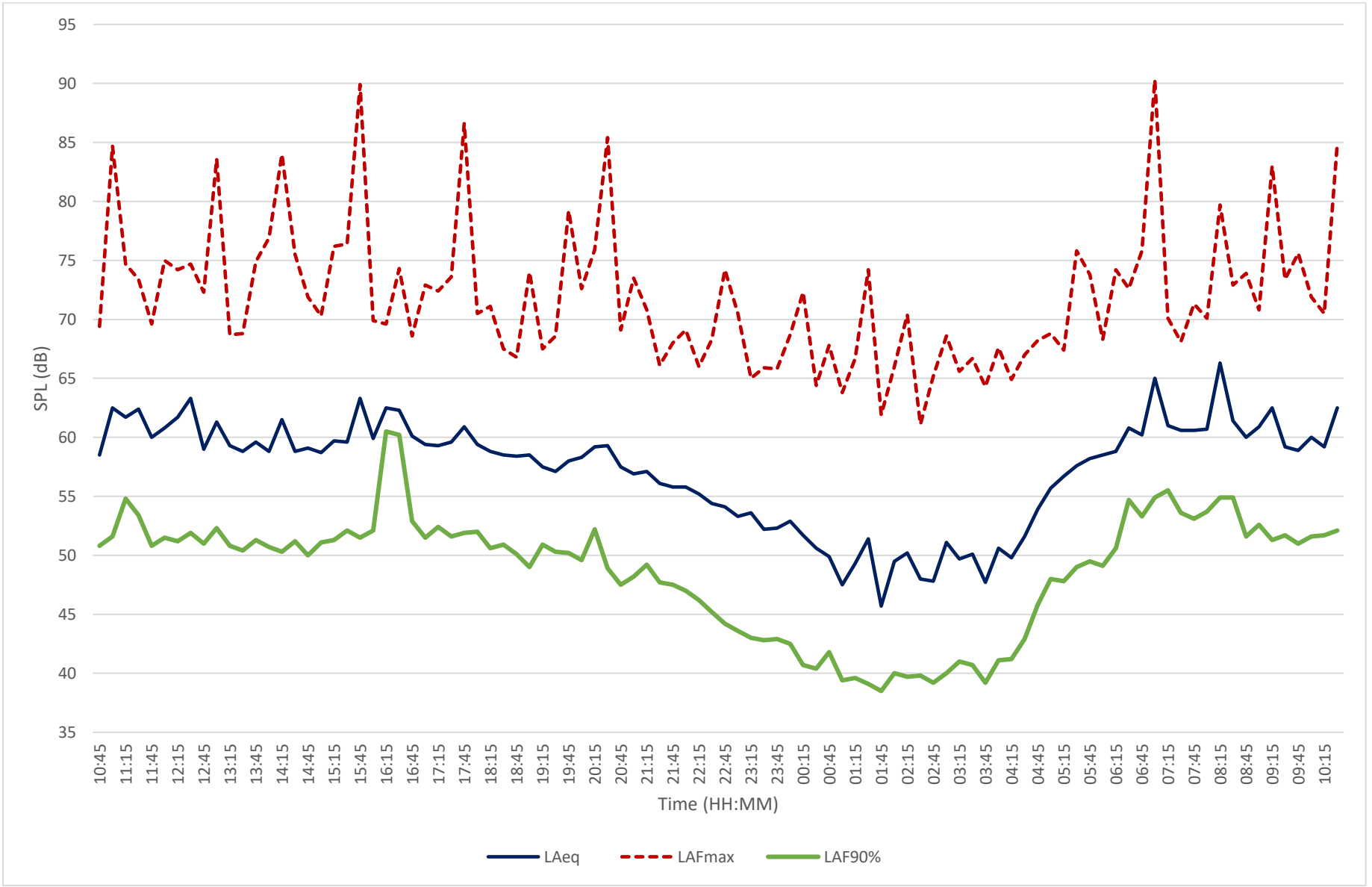


Figure B.4 - Time History at Position B (Thursday 1st August 2019 to Friday 2nd August 2019)

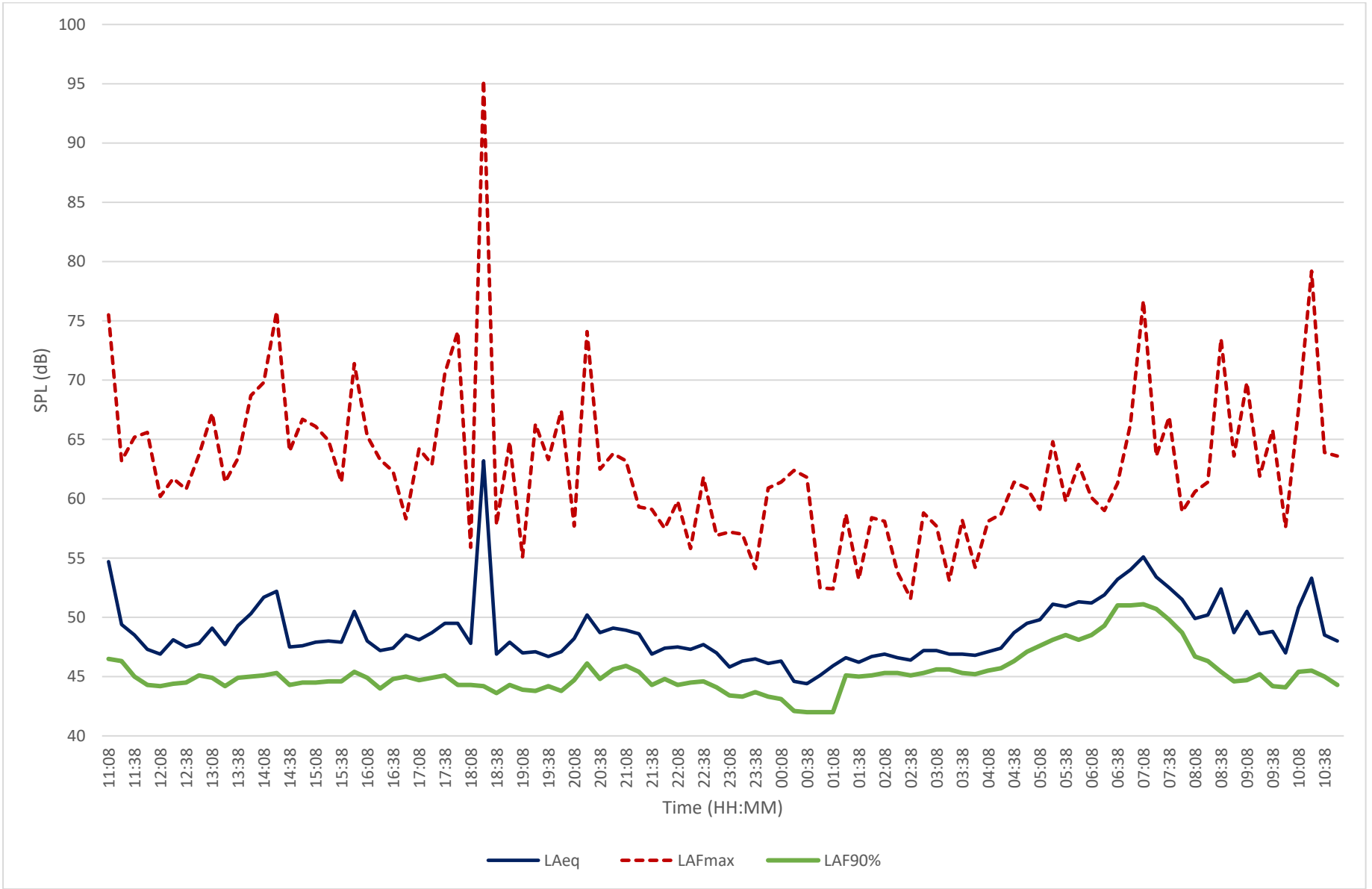


Figure B.5 - Time History at Position C (Thursday 1st August 2019 to Friday 2nd August 2019)

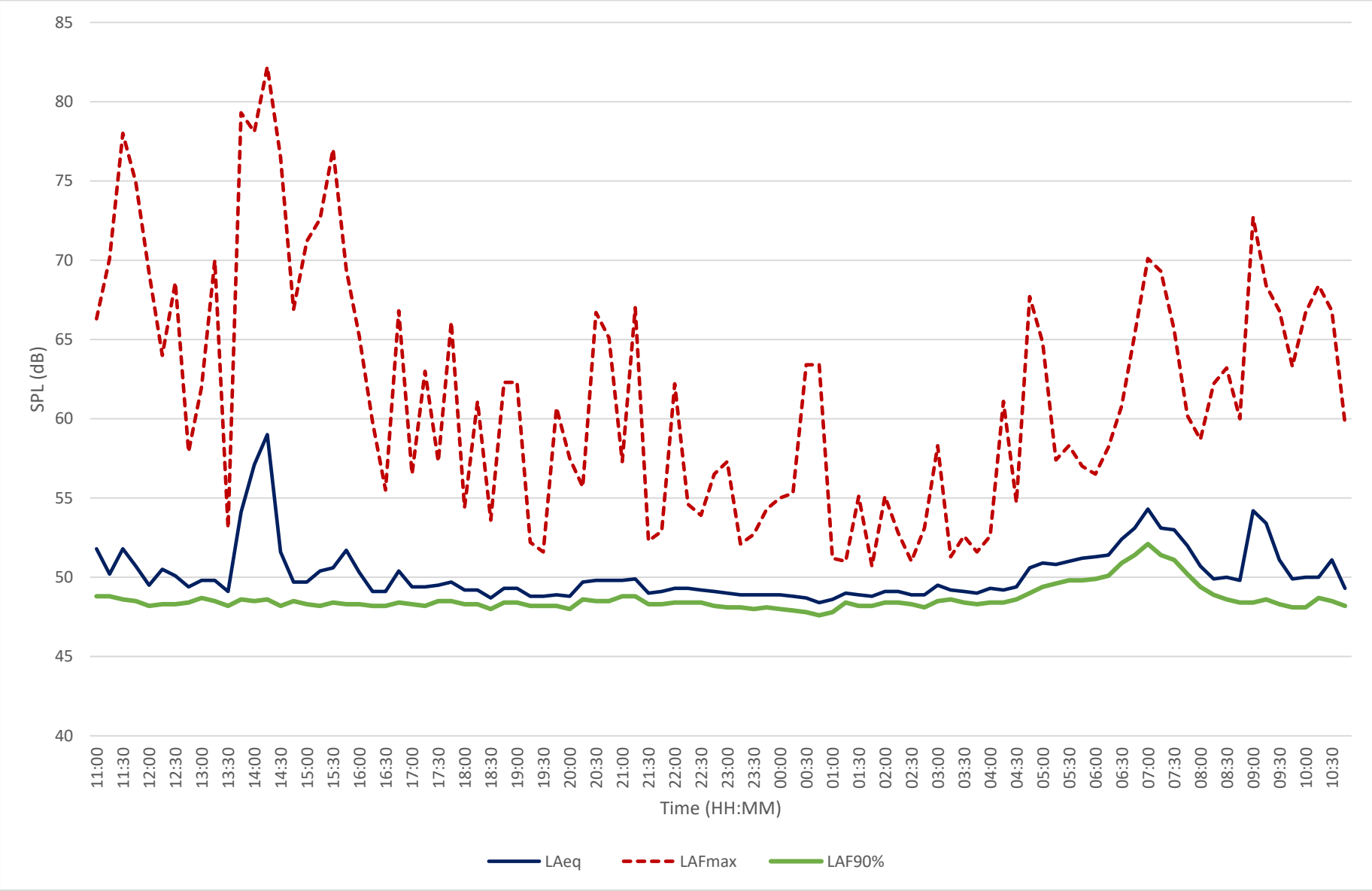


Figure B.6 – Most Commonly Occuring Background Noise Level at Position A

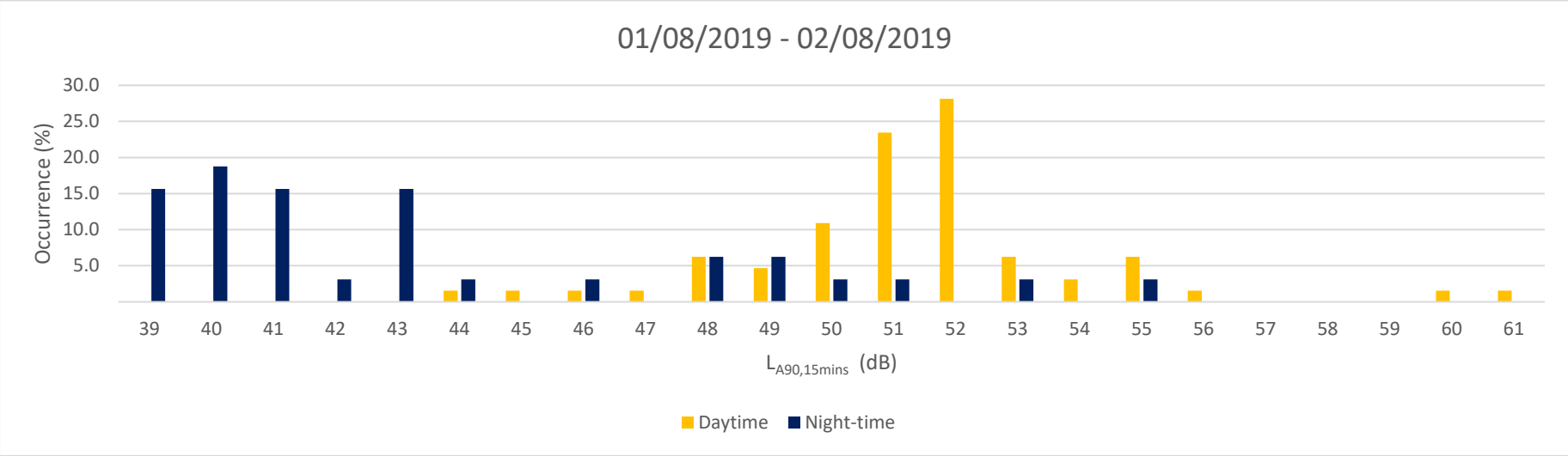


Figure B.7 – Most Commonly Occuring Background Noise Level At Position B

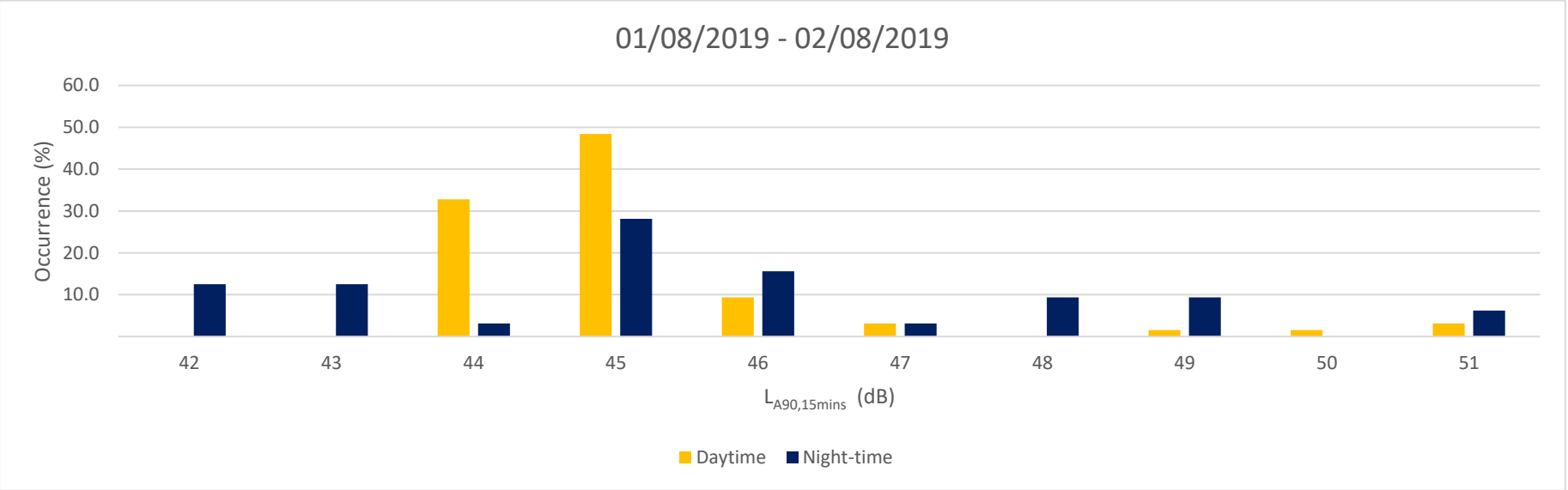
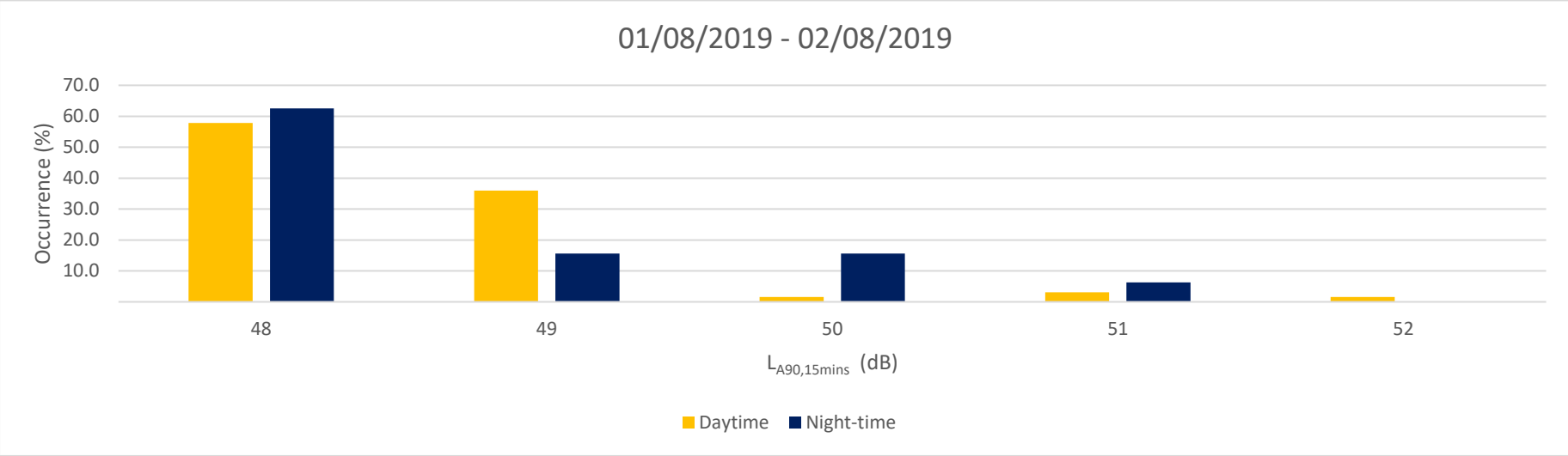


Figure B.8 – Most Commonly Ocuuring Background Noise Level At Position C



APPENDIX C - DRAWING LISTS

The following Stride Treglown drawings have been used in our assessment;

Table C.1 – Drawing List

Drawing Title	Drawing Number	Rev	Date
Proposed Site Plan	152296-STL-XX-ZZ-DR-A-ZZZZ-19001	06	05/07/2019
00_Ground Floor Plan	152296-STL-XX-00-DR-A-ZZZZ-10001	09	24/07/2019
01R_First Floor Lab Floor	152296-XX-01R-DR-A-ZZZZ-10003	09	24/07/2019
02R_Second Floor Office Level	152296-STL-XX-02R-DR-A-ZZZZ-10006	09	24/07/2019
Proposed Gas Store	152296-STL-XX-XX-DR-A-ZZZZ-SK-301	09	24/07/2019