Hunter ACOUSTICS

Independent Acoustic Consultancy Practice

Noise Impact Assessment

South Tyneside and Sunderland NHS Foundation Trust – Integrated Diagnostic Centre

6180/ENS1_REV1



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Noise Impact Assessment

Project:	**South Tyneside and Sunderland NHS Foundation Trust – Integrated Diagnostic Centre**
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1. INTRODUCTION

The new South Tyneside and Sunderland NHS Foundation Trust – Integrated Diagnostic Centre is proposed at South Tyneside and Sunderland NHS Foundation Trust District Hospital, South Shields, NE34 0PL.

The IDC is to comprise MRI and CT Scanning Rooms with ancillary areas.

This report has been commissioned to assess noise emissions limits from the building services.

Specifications for attenuation measures are included where excessive noise levels are indicated, based on information received to date.

Note: Mechanical plant selections are to be finalised at detailed design stage. Reference has been made to the number and type of plant indicated in the Stage 3 MEP design.

2. PLANNING GUIDANCE

2.1 British Standard 4142:2014+A1:2019

British Standard 4142:2014+A1:2019 "Methods for rating and assessing industrial and commercial sound" 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.

As part of a subjective assessment 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.

2.1.1 BS 4142:2014+A1:2019 Section 11

Section 11 of BS 4142:2014+A1:2019 states;

"Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.

1) *The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.*

   Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

   Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse."

When assessing new plant and predicting noise levels to distant residential receivers it is normally not possible to fully assess tonal or impulsive characteristics as manufacturers typically present only octave-band sound data. It is also not possible to predict likely tonal/impulsive content from plant noise breaking out through a main building. Large losses due to screening and distance in the noise prediction model also cannot account for tonal or impulsive content. Subjective opinions on likely tonal content can be suggested based on experience of different types of plant (e.g. tones in fans, or impulses on presses).

It is therefore considered reasonable to apply a 3dB penalty for "other sound characteristic", unless it is can be clearly demonstrated that tonal or impulsive content can be "clearly perceptible" at the receivers.

3. ENVIRONMENTAL NOISE SURVEY

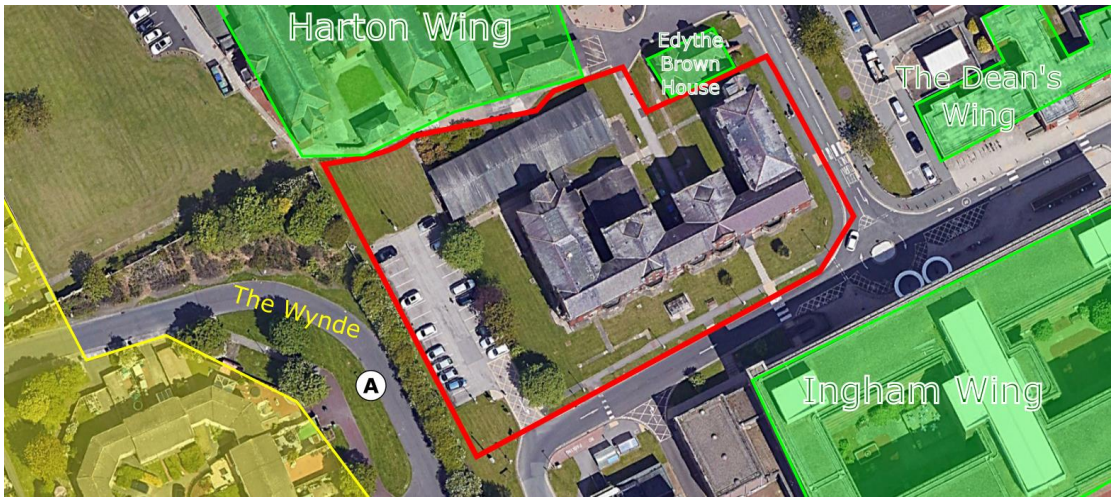
The following environmental noise survey was undertaken by Apex Acoustics, fellow members of the Association of Noise Consultants (ANC), on behalf of Hunter Acoustics Ltd. Data was forwarded to Hunter Acoustics for post-analysis and inclusion in the report.

3.1 Procedures

Continuous noise monitoring was carried out from 1023hrs on Monday, 14 June 2021 to 1033hrs on Tuesday, 15 June 2021 at position A.

Data including L_{Amax}, L_{Aeq} was logged at continuous 1s periods over the monitoring period, to allow for further post-processing analysis of $L_{A90,1hr}$ and $L_{A90,15min}$ values

Figure 3.1 – Site Plan Showing Monitoring Location



Site plan in Figure 3.1 above shows the development site and continuous monitoring positions used, namely:

Table 3.1 – Continuous Monitoring Location Details

Position	Description
A	Fixed to a lamppost on The Wynde, representative of background sound levels at nearest residences

Note: All microphone position approximately 4m above local ground level.

3.2 Meteorological Conditions

Approximate weather conditions are shown in time history graphs in Figure B.1 and Figure B.2 of Appendix B. To summarise, the weather conditions during the monitoring period were dry with an occasional breeze.

3.3 Measurement Equipment

The following measurement equipment was used during the surveys:

Table 3.2 – Noise Monitoring Equipment List

Make	Description	Model	Serial Number	Last Calibrated	Certificate No.
Larson Davis	Calibrator (114.08dB @ 1kHz)	CAL200	9462	21st July 2020	35292
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-05832-E0	1st July 2019	U32196
	Preamplifier	MA220	2241	1st July 2019	U32196
	Microphone	MC230A	A16835	1st July 2019	32195

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

Note: Copies of traceable calibration certificates for all equipment are available upon request.

3.4 Results

Time history graph in Figure B.3 of Appendix B show L_{Amax}, L_{Aeq} sound pressure levels measured at position A. Table B.1 and Table B.2 show calculated daytime $L_{Aeq,1hr}$, $L_{A90,1hr}$ & $L_{Amax,F}$ and night-time $L_{Aeq,15mins}$, $L_{A90,15mins}$ & $L_{Amax,F}$ values.

The following minimum consistent daytime and night-time background L_{A90} sound levels have been determined;

Table 3.3 – Minimum Consistent Daytime and Night-time Background L_{A90} Results

Period	Position A
Daytime (0700-2300hrs) $L_{A90,1hr}$ (dB)	49
Night-time (2300-0700hrs) $L_{A90,15min}$ (dB)	39

A graph in Figure B.4 of Appendix B show statistical analysis of background sound levels measured at position A.

4. CRITERIA

4.1 Sound Sensitive Receivers

Figure 3.1 above shows the development site and the closest residential SSRs highlighted in **YELLOW** on The Wynde, with nearest existing hospital buildings highlighted in **GREEN**:

1) Edythe Brown House: Nutrition & Dietetics; consulting/treatment rooms and offices possibly with partially openable windows.
2) Harton & Parkdale Buildings: consulting/treatment rooms and offices with partially openable windows(?)
3) Ingham Wing: 4-Storey Main Hospital Building is around 20m away. Likely to be main wards (?), with partially openable windows indicated.

4.2 Proposed Noise Criteria

4.2.1 Residential SSRs

At this stage we propose to design to a rating level at least 5dB lower than background noise levels at the nearest residences.

Table 4.1 – Proposed Environmental Night-time Rating Noise Limits

SSR	Proposed Daytime Rating Limit $L_{Ar,1hr}$ (dB)	Proposed Night-time Rating Limit $L_{Ar,15mins}$ (dB)
The Wynde	44	34

These criteria are to apply at the closest noise sensitive receivers with all plant operating normally.

These proposed limits shall be confirmed acceptable with the Local Planning Authority/Environmental Health Officer prior to any orders being placed.

4.2.2 Hospital SSRs

The following guidance is given HTM08-01 relating to plant noise emissions within a hospital site:

• Noise outside the buildings should be controlled to allow the internal noise criteria to be achieved (with windows or trickle vents open for ventilation if the space is naturally ventilated).

• Open external areas should be protected. Noise from services should not exceed the existing daytime background noise level or 50 dB L_{A90}, whichever is the higher. This limit should be achieved in any areas normally occupied by staff (except maintenance staff, notwithstanding the requirements of the Control of Noise at Work Regulations 2005) or the public (for example open courtyards and accessible landscaped areas). This means that noisy plantrooms should not face normally occupied external areas unless adequate acoustic control is provided.

The following internal noise rating criteria are indicated for existing hospital buildings, with an equivalent external noise limit (free-field, at the critical facade) based on a 15dB loss through a partially open window:

Table 4.2 – Room-side Noise Rating Criteria (HTM 08-01)

Area type	Example	Internal Noise rating (NR)	External Noise rating (NR)
Ward, sleeping areas	Single-bed ward, multi-bed ward, on-call rooms, relatives' overnight stay	30	45
	Recovery rooms	35	50
Small office-type spaces	Private offices, treatment rooms, interview rooms, consulting rooms	35	50

- The above are preliminary plant design criteria.

- Alliance should check with the Hospital whether critical rooms / areas nearby are mechanically ventilated, so that windows need not be opened, or if partially open windows are relied upon for natural ventilation.

5. PRELIMINARY PLANT NOISE ASSESSMENT

Reference has been made to the preliminary plant layout drawing. Plant is located in two external plant compounds with full height louvred screens/doors.

It is understood that plant would operate 24-hours a day, but at a reduced duty during the night.

The following reviews plant compound noise limits required to meet criteria. Initial plant selections are reviewed against these. A detailed review would be undertaken at Stage 4 once final plant selections have been confirmed.

5.1 AHU Plant Room 6.01

The following plant is indicated

- CT AHU2
- 10no VRF/DX condensers mounted to the inside of the compound screen

The plant enclosure is located 20m from Edythe Brown House, and is not facing residential receivers.

5.1.1 AHU Plant

Suitable attenuation shall be included to AHU inlet and discharge, selected to meet NR45 / 50dB(A) @20m.

In order to meet NR50 at 20m overall AHU casing noise levels should be selected to meet a maximum 75dB(A) @1m. This is not indicated to be significant and should be easily met based on the initial Barkell selection. Barkell should confirm casing radiated noise levels.

5.1.2 Condensers

An initial noise limit of 68dB(A) @1m per condenser is indicated. Based on initial plant selections condenser noise levels of 47-51dB(A) @ 1m are indicated well below this.

5.1.3 Louvred Screens

Based on the above acoustically treated louvres are not likely to be required. However, final louvre performance requirements would be confirmed based on final plant selections and AHU casing radiated noise levels.

5.2 AHU Plantroom & MRI Chillers 6.05 & 6.06

The following plant is indicated

- MRI AHU1
- 2no MRI Chillers
- 8no VRF/DX condensers mounted to the inside of the compound screen

The plant enclosure located 25m from Harton Wings and 55m from residential SSRs on The Wynde.

5.2.1 AHU Plant

Suitable attenuation shall be included to AHU inlet and discharge, selected to meet NR45 / 50dB(A) @20m.

In order to meet NR50 at 25m overall AHU casing noise levels should be selected to meet a maximum 60dB(A) @1m. This is not indicated to be significant and should be easily met based on the initial Barkell selection. Barkell should confirm casing radiated noise levels.

5.2.2 Chiller Plant

At this stage in order to meet the night-time residential limit chillers should be selected to meet a maximum 60dB(A) @1m / 40dB(A) @10m.

Initial plant selection rated at 55dB(A) @10m is indicated excessive. Chiller manufacturer should confirm noise level at low noise / night mode. However, additional mitigation measures may be required, to be confirmed at the detailed design stage.

5.2.3 Condensers

An initial noise limit of 56dB(A) @1m per condenser is indicated. Based on initial plant selections condenser noise levels of 44-56dB(A) @ 1m are indicated to meet this, with the majority of VRF condensers well below this.

5.2.4 Louvred Screens

Based on the above acoustically treated louvres may be required. However, final louvre performance requirements would be confirmed based on final chiller plant selections, along with confirmation of noise levels for low noise / night mode operation.

5.3 Detailed Design

A full review of atmospheric plant noise emissions including specifications for inlet & discharge silencers, attenuated louvres (where indicated), as well as room-side noise levels is to be undertaken at the detailed design stage once plant selections have been finalised.

6. CONCLUSION

The new South Tyneside and Sunderland NHS Foundation Trust – Integrated Diagnostic Centre is proposed at South Tyneside and Sunderland NHS Foundation Trust District Hospital, South Shields, NE34 0PL.

This report has been commissioned to assess noise emissions from building services plant for atmospheric side at nearby sound sensitive receivers (SSRs) at nearby residences, as well as existing hospital buildings.

Atmospheric side noise criteria are set out in section 4 of this report.

Reference has been made to the number and type of plant indicated in the Stage 3 MEP design.

Preliminary specifications for proposed external plant including air handling units, chillers and condensers have been given. Initial plant selections have been compared against these.

Note: Mechanical plant selections are to be finalised at detailed design stage. A full review of atmospheric plant noise emissions including specifications for inlet & discharge silencers, attenuated louvres (where indicated), as well as room-side noise levels is to undertaken at the detailed design stage once plant selections have been finalised.

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_{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.
$L_{Ar,Tr}$	The 'rating' level, as described in BS 4142:2014 – the specific noise plus any adjustment for the characteristic features of the noise.
SSR	Sound sensitive receiver
R_w	Weighted Sound Reduction Index. R_w is a single number (dB) referring to the ability of a wall or other building structure to provide sound insulation. The higher the number, the better the sound insulation. R_w refers to sound insulation achieved in an acoustic testing laboratory.
NR	Noise Rating' is a graphical method for assigning a single number rating to a noise spectrum. It can be used to specify the maximum acceptable level in each octave band of a frequency spectrum for a particular application.

APPENDIX B - DIAGRAMS, GRAPHS AND TABLES

Figure B.1 – Approximate Weather History for Monday, 14 June 2021

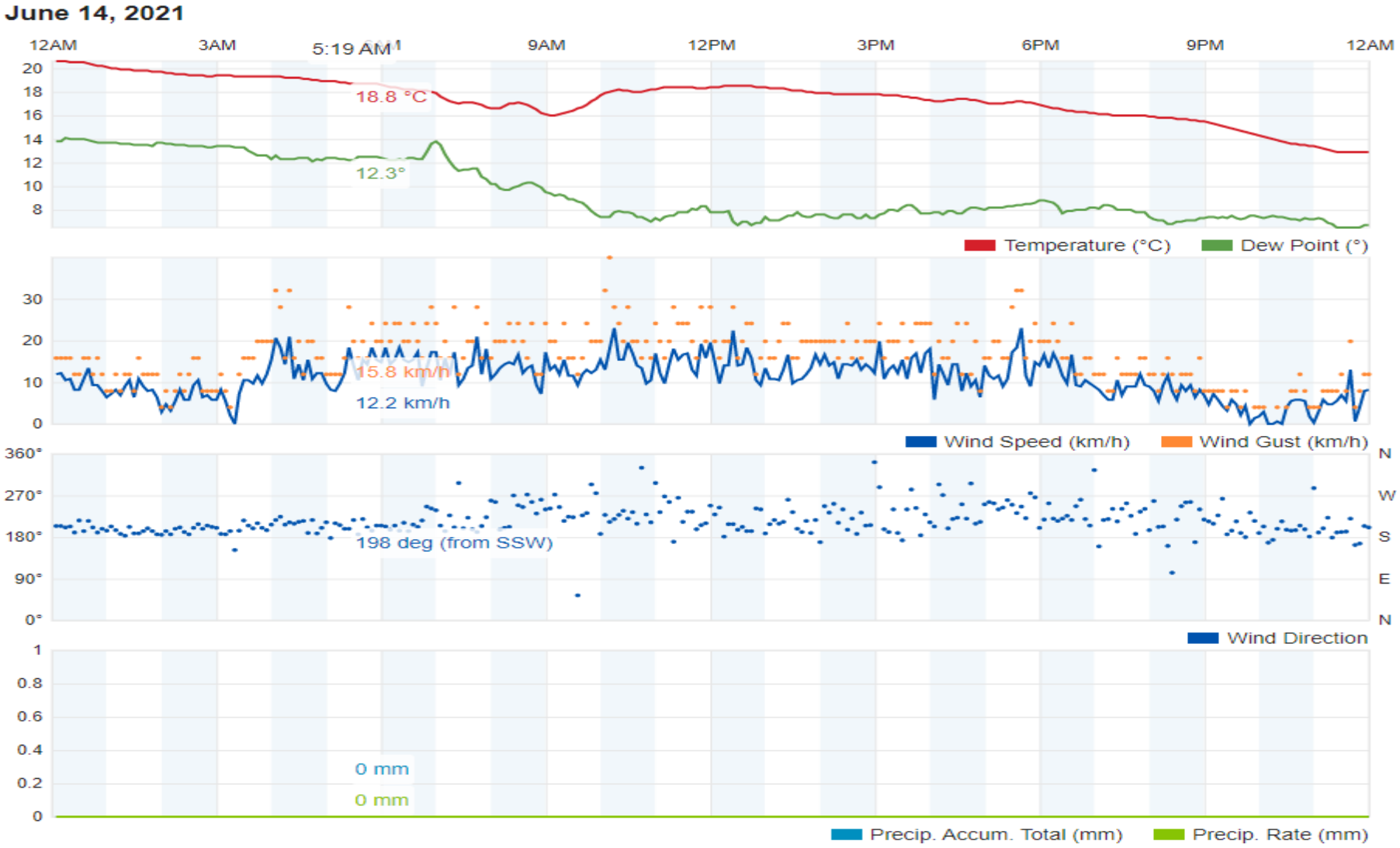
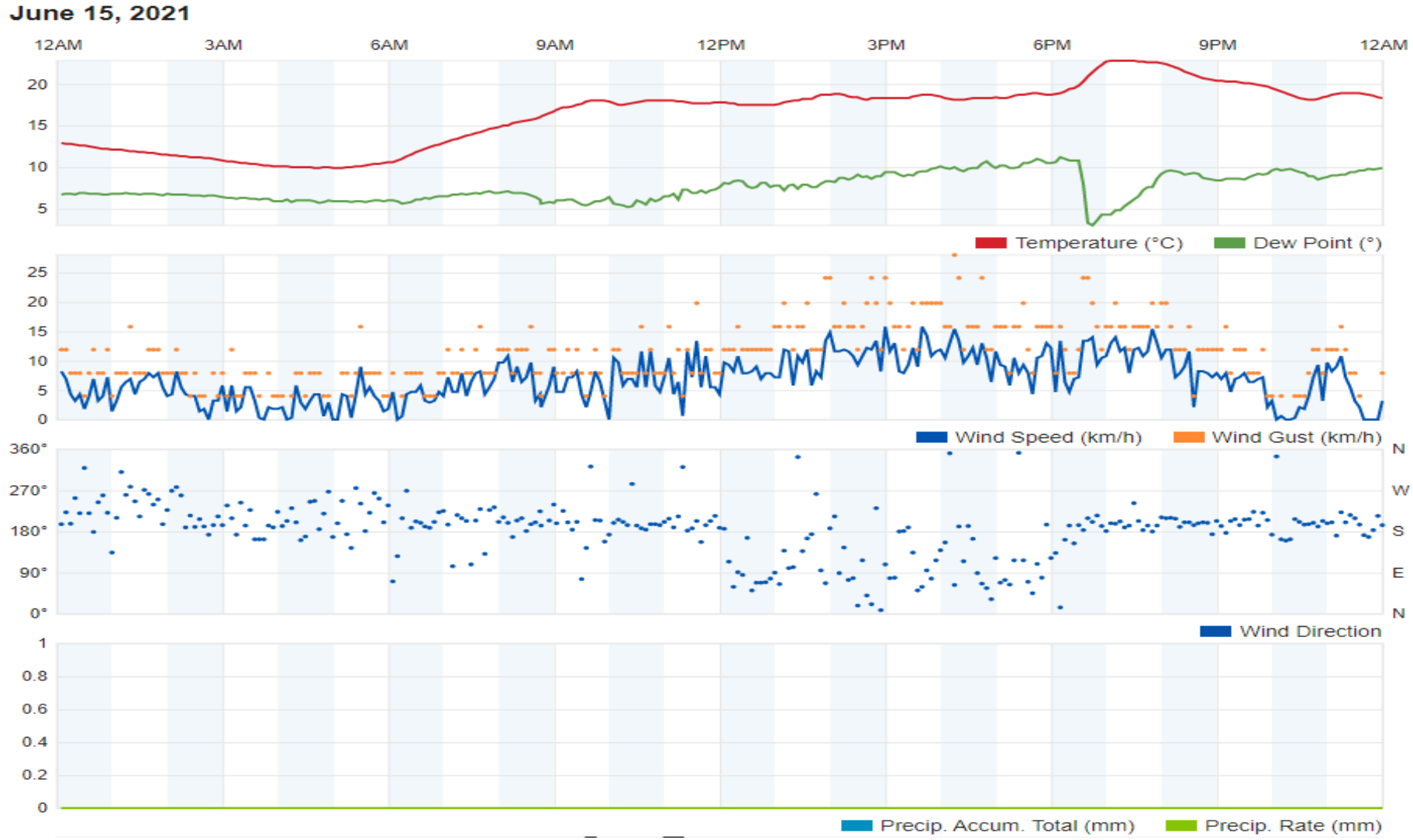


Figure B.2 – Approximate Weather History for Tuesday, 15 June 2021



Note: Taken from www.wunderground.com **Weather Station ID: ISOUTHTY4 Station Name:**urban , housing estate **Latitude / Longitude:**54.97° N, 1.443° W **Elevation:**7 **City:**South Tyneside

Figure B.3 – Time History at Position A (Monday, 14 June 2021 to Tuesday, 15 June 2021)

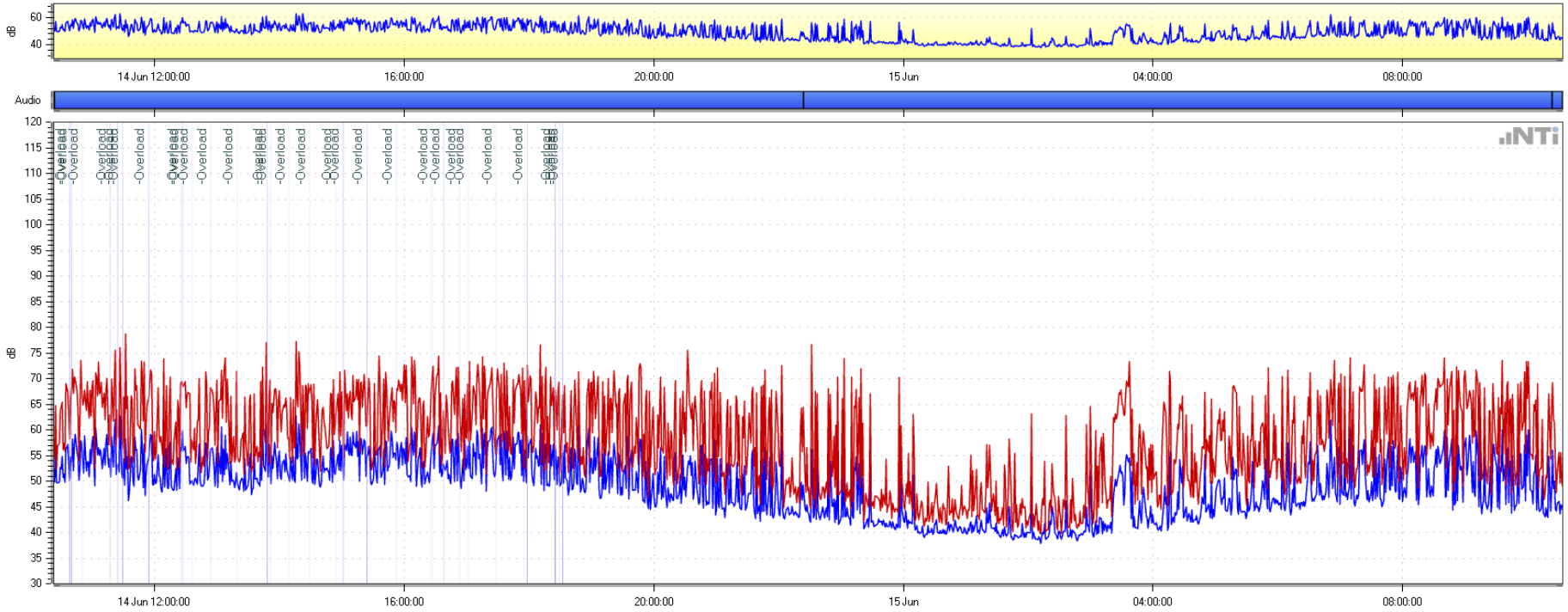


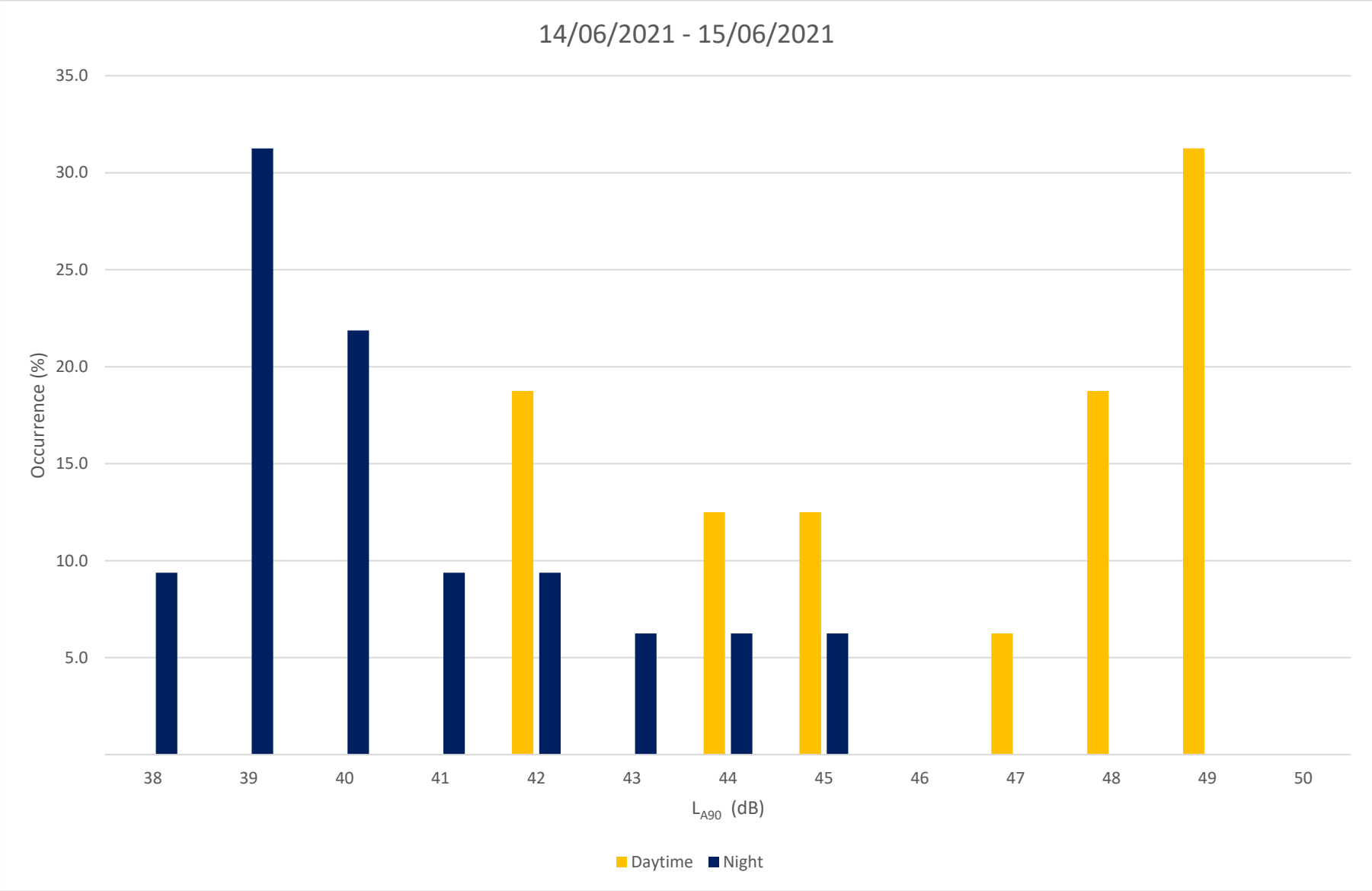
Table B.1 - Daytime Results

Time (hh:mm)	$L_{Aeq,1hr}$	$L_{A90,1hr}$	$L_{Amax,F}$
10:23	54.8	48.5	73.5
11:00	55.8	47.5	78.7
12:00	53.6	47.6	73.8
13:00	53.8	47.7	77.0
14:00	54.9	48.6	77.2
15:00	55.9	49.3	74.4
16:00	55.1	48.6	74.4
17:00	56.5	48.9	74.2
18:00	54.4	47.4	76.5
19:00	53.1	45.0	72.9
20:00	51.2	43.8	75.5
21:00	50.1	42.2	72.1
22:00	48.5	41.6	76.6
07:00	52.7	44.6	74.0
08:00	54.1	44.3	74.0
09:00	50.9	43.2	73.5
10:00	54.8	42.1	73.3

Table B.2 - Night-time Results

Time (hh:mm)	$L_{Aeq,15mins}$	$L_{A90,15mins}$	$L_{Amax,F}$
23:00	51.8	41.5	73.9
23:15	50.3	40.4	71.9
23:30	41.7	40.2	54.3
23:45	46.9	40.0	70.2
00:00	43.6	39.7	63.0
00:15	40.2	38.8	49.8
00:30	40.7	39.0	52.9
00:45	40.8	39.3	49.2
01:00	41.1	39.2	55.0
01:15	41.8	39.3	57.1
01:30	40.3	38.3	58.2
01:45	39.6	38.3	55.4
02:00	42.6	38.1	63.1
02:15	41.3	38.6	53.9
02:30	40.6	38.6	62.8
02:45	43.2	38.5	64.5
03:00	41.1	38.8	59.9
03:15	48.9	39.7	67.8
03:30	50.5	40.0	73.3
03:45	44.6	40.2	61.1
04:00	43.7	39.4	65.4
04:15	49.2	40.5	71.4
04:30	43.1	40.6	62.9
04:45	47.4	41.2	67.3
05:00	47.6	42.0	64.1
05:15	48.4	42.0	68.6
05:30	47.2	42.9	66.6
05:45	49.9	43.5	72.1
06:00	50.1	43.4	71.6
06:15	48.9	43.7	66.5
06:30	50.9	44.6	71.1
06:45	54.0	44.9	73.5

Figure B.4 – Statistical Analysis of Background Sound Levels at Position A (Monday, 14 June 2021 to Tuesday, 15 June 2021)



APPENDIX C – DOCUMENTS AND DRAWINGS LISTS

The following drawings and documents have been used in our assessment;

Table C.1 – Murphy Philipps Associates Drawings & Documents List

Drawing / Document Title	Drawing Number	Rev	Date
RIBA Stage 3 Design Report	-	-	10th June '21
Proposed Site Plan	AIC-MPA-ZZ-ZZ-DR-A-01010	P5	04/06/21
Proposed Floor Plan	AIC-MPA-ZZ-00-DR-A-01100	P11	28/05/21

Table C.2 – Consilium SG Drawings & Documents List

Drawing / Document Title	Drawing / Document Number	Rev	Date
MEP Stage 3 Report	J01112	01	6th June '21
Level 00 Proposed Plant	J01112-CSG-XX-00-DR-M-590001	P01	Apr '21