



BOGNOR INVESTMENT CO. LTD

**PROPOSED RESIDENTIAL DEVELOPMENT
LAND TO THE SOUTH OF HIGHCROFT CLOSE,
BOGNOR REGIS**

NOISE IMPACT ASSESSMENT

TECHNICAL REPORT: RFE-0142-17-02

DATE: MAY 2017



PROJECT TITLE: LAND TO THE SOUTH OF HIGHCROFT CLOSE, BOGNOR REGIS

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For and on behalf of RF Environmental Ltd				

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**LAND TO THE SOUTH OF HIGHCROFT CLOSE,
BOGNOR REGIS
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1.0 INTRODUCTION

- 1.1 RF Environmental Ltd (RFE) was commissioned by Bognor Investment Co Ltd in April 2017 to undertake an acoustic assessment of a proposed development at the land to the South of Highcroft Close, Bognor Regis.
- 1.2 Planning permission is being sought for the development of a single 2 bedroom bungalow.
- 1.3 To support the application, a noise impact assessment has been requested by the Local Authority, to determine whether the site is suitable for residential development, with particular attention paid to the adjacent pumping station.
- 1.4 The objective of this noise assessment is firstly to establish the external ambient sound levels at the most exposed building facade of the development site. Then, based on the findings, a scheme of acoustic design will be provided to ensure that internal noise levels can comply with appropriate criteria.
- 1.5 The existing site and proposed development are described in the following section of this report, whilst the legislation and criteria used for the assessment are presented in Section 3. The noise survey is presented in Section 4, whilst the noise impact assessment is addressed in Section 5. Mitigation options are considered in Section 6 and the ceiling/floor specification is discussed in Section 7. Finally, the conclusions of this study are summarised in Section 7. A description of useful acoustic terms can be found in Appendix C.
- 1.6 The report has been produced by Richard Fenton (MIOA). Richard is experienced in the production of noise impact assessments following the criteria presented in BS8233:2014 and undertaking the calculations to produce the assessments. Richard has produced a significant number of noise assessments in consultancy roles, and reviewed them in local authority roles.



2.0 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Site Description

- 2.1 The development site is located on the land to the south of Highcroft Close, Bognor Regis, West Sussex.
- 2.2 The site lies in a residential cul-de-sac, which consists of 6 semi-detached bungalows. Additional residential properties lie to the north, east and west, while immediately to the south is an allotment.
- 2.3 An aerial plot of the site and immediate area is presented in Figure A1 of Appendix A.

Existing Noise Sources

- 2.4 The ambient noise climate in the immediate vicinity of the development site was quiet and noted to consist of contributions from bird song, local road traffic and work on the allotment.
- 2.5 The adjacent pumping station did not appear to contribute to the ambient noise. Some water movement and mechanical noise was just audible for a short period, when standing adjacent to the brick built building.
- 2.6 Southern Water provided the following, regarding the operating cycle of pumping stations:

'Generically we would expect any pumping station [to] operate on a daily basis pumping several times throughout the 24hr period and this will be a 24/7 operation.'

Proposed Development

- 2.7 The proposed development consists of '1no. detached two bedroom bungalow'.
- 2.8 An architect's drawing of the proposed development is presented in Figure A2 of Appendix A.

3.0 ASSESSMENT CRITERIA

Noise Policy Statement for England (NPSE)

- 3.1 The Noise Policy Statement for England (March 2010) [1], sets out the long term vision of Government noise policy.
- 3.2 The vision of the NPSE is to 'Promote good health and a good quality of life through the effective management and control of noise within the context of Government policy on sustainable development.' This vision is supported by three key aims:
- avoid significant adverse impacts on health and quality of life;
 - mitigate and reduce to a minimum other adverse impacts on health and quality of life; and
 - where possible, contribute to the improvement of health and quality of life.
- 3.3 The NPSE should apply to all forms of noise including environmental noise, neighbour noise and neighbourhood noise but does not apply to noise in the workplace (occupational noise).
- 3.4 The NPSE had adopted the following concepts, to help consider whether noise is likely to have 'significant adverse' or 'adverse' effects on health and quality of life:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

- 3.5 However the NPSE goes on to state that:

'it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.'

National Planning Policy Framework

- 3.6 The Department for Communities and Local Government introduced the National Planning Policy Framework (NPPF) in April 2012 [2]. This framework replaced most national planning policy, circulars and guidance, including Planning Policy Guidance 24: Planning and Noise.

3.7 The NPPF defines the Government's planning policy for England and sets out the framework, within which local authorities must prepare their local and neighbourhood plans, reflecting the needs and priorities of their communities. Paragraph 123 of the NPPF requires Local Authorities to develop local policies and make decisions which aim to:

- avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

Planning Practice Guidance - Noise

3.8 Planning Practice Guidance (PPG) on noise [3] was issued in March 2014. This web-based guidance advises local planning authorities to take into account the acoustic environment, and in doing so consider the following:

- whether or not a significant adverse effect is occurring or likely to occur;
- whether or not an adverse effect is occurring or likely to occur; and
- whether or not a good standard of amenity can be achieved.

3.9 The PPG includes examples of how to recognise when noise could be a concern and provides example outcomes to which the Observed Effect Levels can apply. The PPG noise exposure hierarchy is presented in Table 3.1, based on the likely average response, along with example outcomes.

3.10 While it is acknowledged that planning and nuisance regimes are separate entities, the hierarchy table does provide useful information regarding how the concept of SOAELs and LOAELs, introduced through the NPSE, could be applied and does allow for subjective observations to be considered in the context of potential effect levels. The presence of an "Effect Level" does not infer whether a nuisance is or is not present.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not Noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	

Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

TABLE 3.1: PPG NOISE EXPOSURE HIERARCHY

(Source –Planning Practice Guidance)

British Standard 8233:2014

- 3.11 BS 8233:2014 Guidance on sound insulation and noise reduction for buildings [4] gives recommendations for the control of noise in and around buildings. The Standard suggests appropriate criteria and limits for different situations to guide the design of new or refurbished buildings undergoing a change of use.
- 3.12 Desirable upper noise levels inside residential habitable rooms are specified in the Standard and are reproduced below in Table 3.1.

Activity	Room	Ambient Indoor Noise Level 07:00 to 23:00 hrs, dB L _{Aeq,10hr}	Ambient Indoor Noise Level 23:00 to 07:00 hrs, dB L _{Aeq,5hr}
Resting	Living Room	35	-
Dining	Dining room/ area	40	-
Sleeping (daytime resting)	Bedroom	35	30

TABLE 3.1: BS8233 INDOOR AMBIENT NOISE LEVELS FOR DWELLING

- 3.13 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

World Health Organisation

- 3.14 Guideline values for community noise in specific environments are presented in the WHO's Guidelines for Community Noise [5] document. The guideline values pertinent to this noise assessment are presented in Table 3.2.

Specific Environment	Critical Health Effect(s)	dB Leq,LT	Time Base hours	dB Leq,LT
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45

TABLE 3.2: WHO GUIDELINE NOISE VALUES

Local Authority Criteria

- 3.15 Local Authorities in Sussex, including Wealden District Council, have produced a planning guidance document 'Planning Noise Advice Document – Sussex [6] which sets out the required approach for undertaking a noise assessment, for certain types of development.
- 3.16 For new residential development, the following is presented in the document, '*where it is apparent to the LPA that existing noise from an existing industrial, commercial, entertainment premises, ports and air ports is likely to cause disturbance or a statutory nuisance to new residents, the development is unlikely to be supported unless clear evidence can be shown that adequate noise attenuation to the existing noise sources can and will be provided*'.
- 3.17 The Environmental Health Team Leader of Arun District Council made the following comments:

'I note the pumping station next to the site is in very close proximity to the two bedrooms of the proposed new bungalow and the applicants have not provided any information on noise from the pumping station. There is a potential for noise disturbance from the pumping station and therefore I would ask that the applicants provide a noise impact assessment which determines the noise from the pumping station and any mitigation required to protect future residents.'

4.0 ENVIRONMENTAL NOISE SURVEY

Continuous Baseline Noise Survey

- 4.1 Unattended continuous monitoring of existing noise levels was undertaken at the monitoring location shown as LT1 on Figure A1 of Appendix A. The equipment used during the survey is presented in Table 4.1 below.

Manufacturer	Model No.	Description	Serial No.	Calibration Due Date
Larson Davis	LxT	Sound Level Meter	0004968	April 2018
Larson Davis	LxTPRM1L	Microphone Preamplifier	042703	April 2018
Larson Davis	337B02	½" Electret microphone	161390	April 2018
Casella CEL	CEL-284/2	Calibrator	3/05717282	April 2018

TABLE 4.1: SOUND MONITORING EQUIPMENT

- 4.2 The sound level meter was powered by dry cell batteries and stored inside a weatherproof security box.
- 4.3 Measurements were obtained using the 'F' time weighting and A-weighting frequency network. The equipment was calibrated before and after the survey to generate a calibration level of 114.0 dB at 1 kHz.
- 4.4 15-minute measurements of $L_{Amax,F}$, $L_{Aeq,15min}$, and $L_{A90,15min}$ noise levels were obtained at this monitoring location between 12:45 hrs Tuesday 4th April 2017 and 14:30 hrs Thursday 6th April 2017, with the microphone position set at a high of approximately 2m above local ground level. A photograph of the monitoring equipment can be seen in Figure A3 of Appendix A.
- 4.5 The dominant noise sources observed during site visits are discussed in section 2. Local road traffic noise and bird song were the main contributors at the unattended monitoring position.

Weather Conditions

- 4.6 A history of the weather conditions during the continuous survey period has been obtained from an internet source (www.wunderground.com Greenwood Avenue, Bognor Regis IENGLAND885), which is the closest weather station to the development site, with rainfall data. Analysis of the data shows acceptable weather conditions during the survey, with no periods of rain noted.
- 4.7 The weather conditions obtained for the survey period are presented in Figure A4 of Appendix A.

Continuous Noise Survey Results

- 4.8 The results of the unattended sound measurement survey are presented graphically in

Figure A5 of Appendix A and summarised in Table 4.2 below. Full results are presented in Table B1 of Appendix B.

Date	Measured Noise Levels, dB re. 2×10^{-5} Pa					
	Daytime (07:00 - 23:00)			Night-time (23:00 - 07:00)		
	$L_{Aeq,16hr}$	$L_{Aeq,8hr}$	$L_{Aeq,1hr}$	$L_{Aeq,16hr}$	$L_{Aeq,8hr}$	$L_{Aeq,1hr}$
Tue 25/04/17	65(51-83)	48(41-55)	40(36-44)	55(43-79)	50(31-59)	35(27-44)
Wed 26/04/17	69(53-98)	57(41-73)	42(38-46)	58(46-77)	48(34-57)	36(30-46)
Thu 27/04/17	71(61-88)	54(45-60)	42(39-47)			
<i>Average</i>	68(65-71)	53(48-57)	41(40-42)	57(55-58)	49(48-50)	36(35-36)

TABLE 4.2: SUMMARY OF DAYTIME UNATTENDED NOISE MEASUREMENTS, LT1

*Note: * denotes incomplete period. Shaded area removed due to heavy rainfall.*

- 4.9 The results of the unattended noise measurement show that ambient day time $L_{Aeq,16hr}$ sound levels ranged from 48 to 57 dB, with an arithmetic average of 53dB $L_{Aeq,16hr}$. The night time $L_{Aeq,8hr}$ sound levels ranged 48 to 50 dB, with an arithmetic average of 49dB $L_{Aeq,8hr}$.

5.0 ASSESSMENT OF NOISE LEVELS

BS 8233:2014 – Assessment of Internal Noise Levels

- 5.1 BS 8233:2014 contains recommended guideline levels of 35 dB $L_{Aeq,T}$ for resting inside bedrooms and living rooms during the daytime, 40 dB $L_{Aeq,T}$ for dining areas and 30 dB $L_{Aeq,T}$ for sleeping inside bedrooms at night.
- 5.2 The approximate sound reduction value provided in Annex G of BS 8233 for a closed insulating glass window unit is 33 dB R_w . With a window open to provide background ventilation, the sound insulation of the window reduces to approximately 15 dB from a free-field level.
- 5.3 Taking this typical sound reduction performance into consideration, internal noise levels have been predicted, assuming windows are fully closed or partially open for ventilation purposes. Results are presented in Table 5.1 below.

Receptor	Predicted Daytime Facade Noise Level $L_{Aeq,10hr}$	Predicted Daytime Internal Noise Level, dB $L_{Aeq,10hr}$		Predicted Night-Time Facade Noise Level $L_{Aeq,8hr}$	Predicted Night-Time Internal Noise Level, dB $L_{Aeq,8hr}$	
		Windows Partially Open	Windows Closed		Windows Partially Open	Windows Closed
R1	53	38	20	49	34	16

TABLE 5.1: ASSESSMENT OF ESTIMATED DAYTIME NOISE LEVELS

Note: [1] assuming a 15dB(A) reduction for windows partially open

[2] assuming a 33dB(A) reduction for windows closed

[3] red text indicates exceedance of criteria for living room/bedroom (daytime) and bedrooms (night time).

- 5.4 Based on the assumed typical facade reductions, the noise predictions show that internal noise levels fall below the daytime and night-time criterion of 35 and 30 dB $L_{Aeq,T}$ respectively, with closed insulating windows, assuming a sound reduction of 33dB R_w .
- 5.5 With windows partially open for ventilation, the criteria is exceeded by 3 and 4dB for daytime and night time periods respectively. The requirement to keep windows closed and the provision of alternative ventilation is therefore considered further in the following chapter.

World Health Organisation $L_{Amax,f}$ Noise Levels

- 5.6 Maximum $L_{Amax,F}$ noise levels generated at night have also been considered at the proposed development site.
- 5.7 WHO guideline noise criteria sets an internal sleep disturbance noise limit of 45 dB $L_{Amax,F}$ for the onset of critical health effects, which is a level which should not be exceeded on a regular basis. Based on an interpretation that for a noise to be regular, it needs to occur several (i.e. more than two) times per hour, the $L_{Amax,F}$ noise needs to be based upon an average of at least 10-15 events that are typical in nature.



- 5.8 On this basis, the aim of protecting against maximum noise levels is to ensure protection against typical intermittent noise rather than one-off events, whereby an arithmetic average of the typical maximum events across the survey period has been used to determine the $L_{Amax, F}$ value presented in Table 5.2 below.

Location	Typical External Noise Levels	Estimated Internal Noise Level		BS 6233 Internal Noise Criterion Achieved	
		Windows Partially Open	Windows Closed	Windows Partially Open	Windows Closed
		Bedroom			
Worst Affected Facade	71	56	38	N	Y

TABLE 5.2: ASSESSMENT OF ESTIMATED $L_{Amax, F}$ CRITERIA BASED ON TYPICAL MAXIMUM EVENTS

Note: [1] assuming a 15dB(A) reduction for windows partially open

[2] assuming a 33dB(A) reduction for windows closed

- 5.9 The results indicate that the $L_{Amax, F}$ criteria would be exceeded by up to 11dB with windows open for ventilation. With windows closed, assuming a sound reduction of 33dB R_w the levels are expected to fall below the criteria by approximately 7dB.

Uncertainty

- 5.10 All reasonable skill and care has been taken to accurately measure the ambient sound levels at the assessment location.
- 5.11 The level of uncertainty in the ambient noise survey is minimised by measuring over a 3-day period whilst avoiding adverse weather conditions and in a location representative of the proposed residential receptor.
- 5.12 Rounding has been used in the derivation of the ambient sound level and calculations, to avoid an impression of precision to decimal places. Rounding has been to integer values with 0.5 being rounded up on completion of the statistical analysis.



6.0 MITIGATION OPTIONS

Glazing Options

- 6.1 Based on the noise assessment it is considered that standard double glazing with a R_w value of 30dB will be sufficient for all habitable rooms of the bungalow to ensure the daytime and night time criteria set out in BS 8233:2014 is achieved.
- 6.2 Glazing such as 4 mm glass / 16 mm air gap / 4 mm glass should be suitable.

Ventilation Strategy

- 6.3 Where windows need to remain closed to achieve the criteria, alternative ventilation needs to be considered.
- 6.4 Ventilation could take the form of acoustic passive ventilation or whole house ventilation systems such as Mechanical Ventilation Heat Recovery so that windows can remain closed if the occupier wishes.
- 6.5 Acoustic passive ventilators such as those provided by Rytons or Renson would be suitable, see:
http://www.vents.co.uk/pdf/BROCH_Rytons_Acoustic_Ventilators.pdf ; or
http://www.rensonuk.net/window-vents-trickle-vents-united-kingdom_4.html
- 6.6 With these mitigation measures in place all internal rooms will meet the noise criteria and no further measures are required.



7.0 CONCLUSIONS

- 7.1 RFE was commissioning to undertake a noise impact assessment at Highcroft Close, Bognor Regis, West Sussex
- 7.2 The assessment was required to accompany a planning application for the development of a detached 2 bedroom bungalow, which is proposed on land adjacent to an existing Southern Water pumping station.
- 7.3 Continuous noise monitoring was undertaken to establish the existing ambient noise levels at the development site.
- 7.4 An assessment of internal noise levels have indicated that recommended guideline levels prescribed in BS8233:2014 and WHO $L_{Amax, F}$ guidelines will be achieved if standard double glazing is used for the bungalow.
- 7.5 Alternative forms of ventilation have been presented, which, if implemented will ensure that windows can remain closed if required and that internal noise criteria can be met.
- 7.6 With the recommended measures in place it is therefore concluded that there should be no reason on noise grounds why the application should be refused planning permission.



8.0 REFERENCES

1. Department for Environment, Food and Rural Affairs (DEFRA). *Noise Policy Statement for England (NPSE)*, 2010.
2. Department of Communities and Local Government. *National Planning Policy Framework*, 2012.
3. Department for Communities and Local Government: *Planning Practice Guidance – Noise*. March, 2014.
4. British Standard BS 8233: 2014: *Guidance on Sound Insulation and Noise Reduction for Buildings*.
5. Sussex Pollution Working Group: 2014. *Planning Noise Advice Document – Sussex*



APPENDIX A: FIGURES



FIGURE A1: LOCATION OF PROPOSED DEVELOPMENT SITE

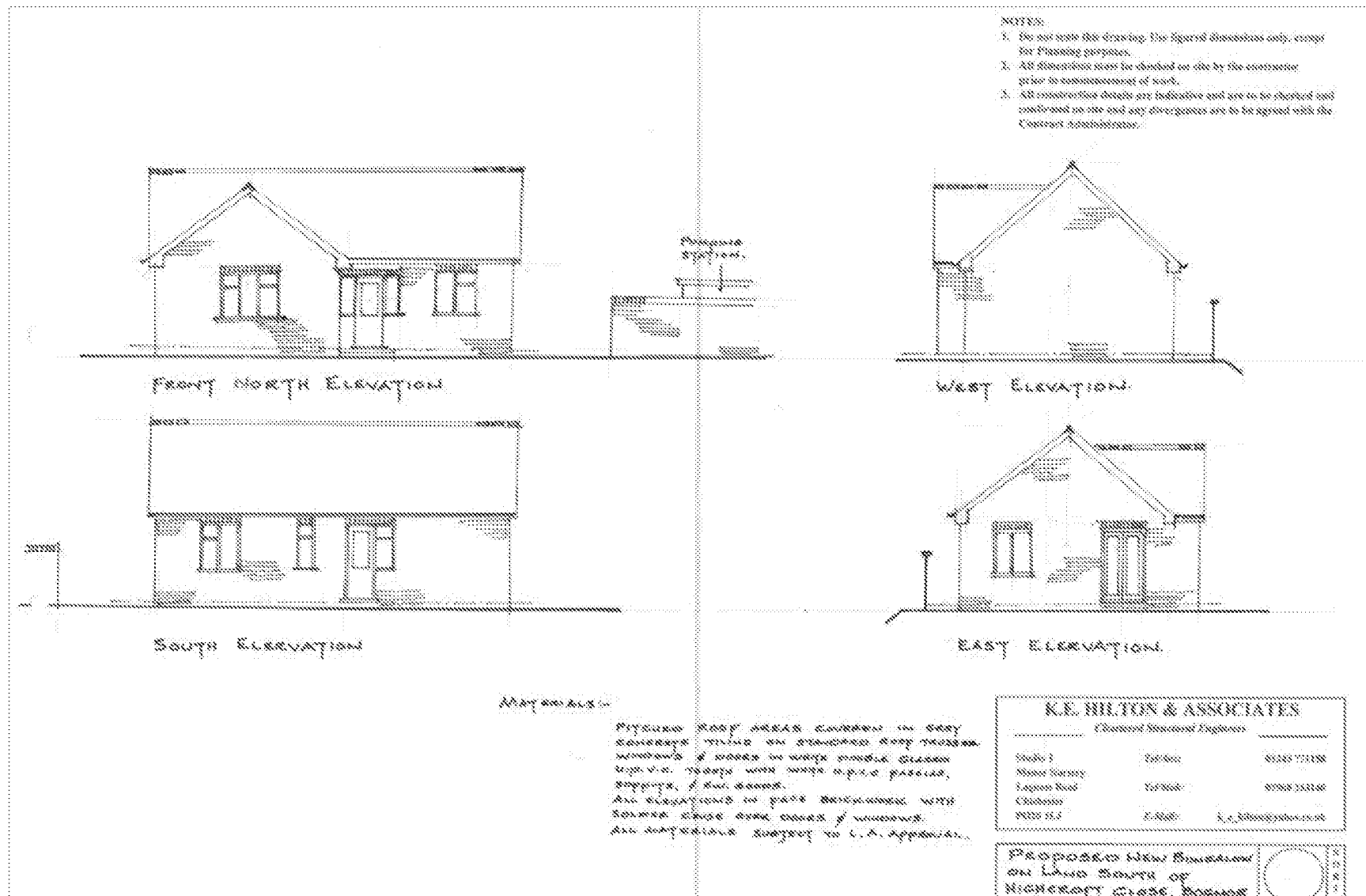


FIGURE A2: ARCHITECT'S DRAWING OF THE PROPOSED LAYOUT



FIGURE A3: PHOTOGRAPH SHOWING MONTIORING LOCATION

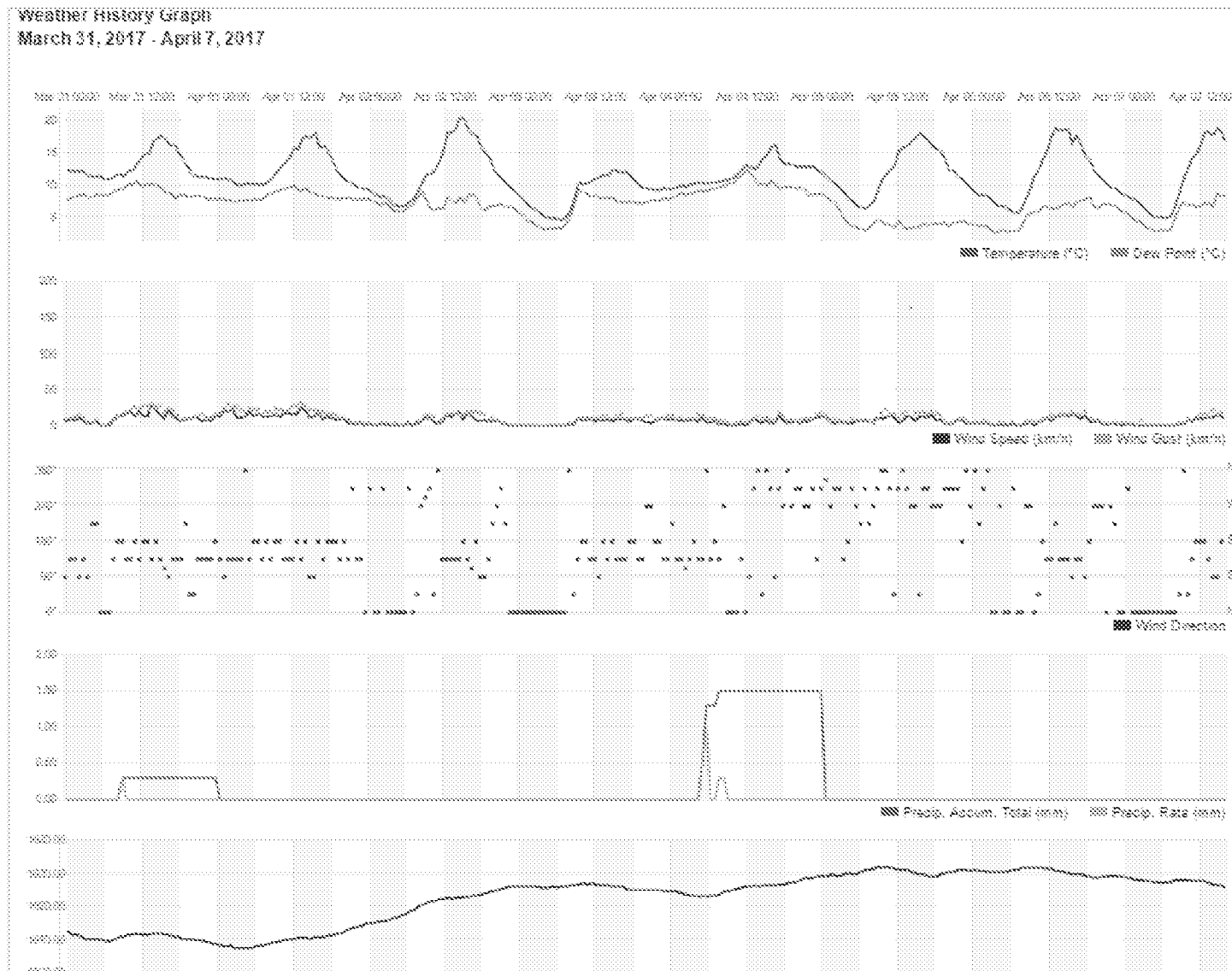


FIGURE A4: WEATHER DATA FOR PERIOD 4TH TO 6TH APRIL 2017 (BOGNOR REGIS IENGLAND 885)

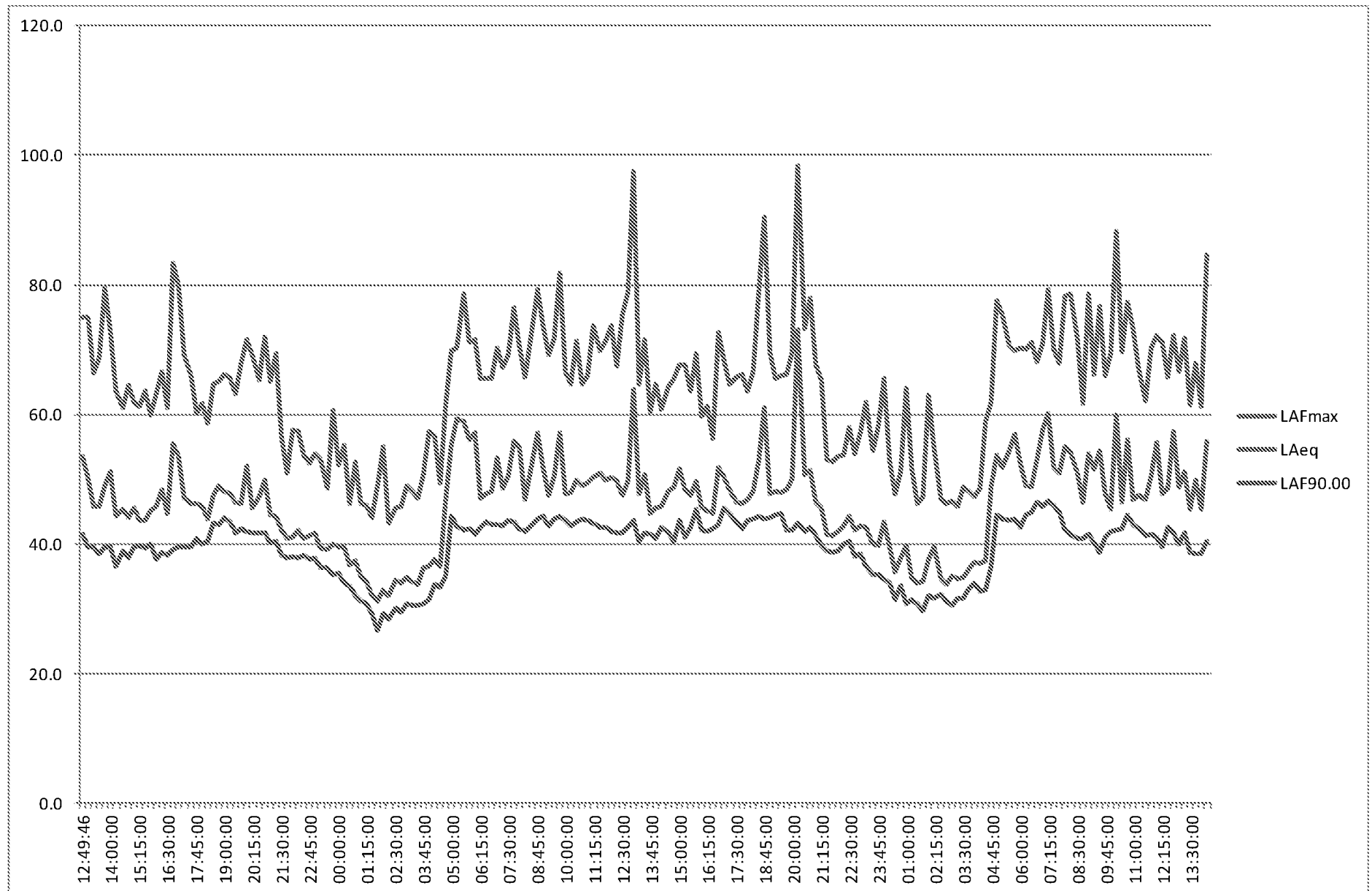


FIGURE A5: CONTINUOUS SOUND MONITORING RESULTS AT LT1, TUESDAY 4TH APRIL TO THURSDAY 6TH APRIL 2017

APPENDIX B: TABLES

Date of Meas.	Start Time	Measured Noise Levels, dB re. 2×10^{-5} Pa		
		$L_{max,1min}$	$L_{eq,15min}$	$L_{90,15min}$
Tuesday 4th April 2017	13:00:00	75.0	49.9	39.6
	13:15:00	66.4	45.8	39.6
	13:30:00	68.6	45.8	38.5
	13:45:00	79.5	49.1	39.5
	14:00:00	72.7	51.2	39.5
	14:15:00	63.6	44.1	36.4
	14:30:00	60.9	45.3	38.9
	14:45:00	64.4	44.0	37.7
	15:00:00	61.8	45.4	39.5
	15:15:00	61.1	43.6	39.7
	15:30:00	63.5	43.7	39.4
	15:45:00	59.9	45.1	39.9
	16:00:00	63.2	45.7	37.6
	16:15:00	66.6	48.3	38.6
	16:30:00	60.9	44.7	38.2
	16:45:00	83.4	55.4	39.1
	17:00:00	79.8	53.5	39.5
	17:15:00	69.1	47.1	39.5
	17:30:00	66.0	46.2	39.6
	17:45:00	60.1	46.1	40.9
	18:00:00	61.5	45.7	40.0
	18:15:00	58.7	43.9	40.3
	18:30:00	64.6	47.5	43.1
	18:45:00	65.0	49.0	42.9
	19:00:00	66.2	48.1	44.0
	19:15:00	65.5	47.6	43.3
	19:30:00	63.1	46.5	41.7
	19:45:00	68.0	46.1	42.2
	20:00:00	71.6	51.9	41.9
	20:15:00	69.2	45.6	41.6
	20:30:00	65.2	47.2	41.7
	20:45:00	71.9	49.8	41.7
	21:00:00	65.1	44.5	40.2
	21:15:00	69.4	44.3	40.4
	21:30:00	56.6	42.0	38.3
	21:45:00	50.8	40.8	37.9
	22:00:00	57.6	41.0	38.0
	22:15:00	57.3	42.1	37.9
	22:30:00	53.7	40.9	38.2
	22:45:00	52.3	41.2	37.5
	23:00:00	54.0	41.7	37.7

	23:15:00	53.1	39.3	36.3
	23:30:00	48.4	39.1	36.3
	23:45:00	60.5	40.0	35.2
Wednesday 5th April 2017	00:00:00	52.2	39.5	35.4
	00:15:00	55.2	39.5	33.9
	00:30:00	46.2	36.7	33.6
	00:45:00	52.6	37.3	32.0
	01:00:00	46.2	35.0	31.2
	01:15:00	45.9	34.2	30.8
	01:30:00	43.9	32.0	29.1
	01:45:00	48.9	31.2	26.7
	02:00:00	55.0	32.8	29.1
	02:15:00	43.2	32.0	28.4
	02:30:00	45.5	34.4	30.0
	02:45:00	45.8	33.8	29.4
	03:00:00	49.0	34.8	30.8
	03:15:00	48.1	34.1	30.4
	03:30:00	47.1	33.8	30.5
	03:45:00	50.7	36.2	30.7
	04:00:00	57.3	36.5	31.4
	04:15:00	56.6	37.6	33.7
	04:30:00	49.4	36.6	33.3
	04:45:00	61.5	46.8	34.9
	05:00:00	69.7	55.2	44.3
	05:15:00	70.2	59.4	42.7
	05:30:00	78.5	58.9	42.0
	05:45:00	71.2	56.1	42.4
	06:00:00	71.4	57.0	41.4
	06:15:00	65.5	47.0	42.5
	06:30:00	65.6	47.8	43.3
	06:45:00	65.4	48.1	42.9
	07:00:00	70.2	53.2	42.9
	07:15:00	67.2	48.6	42.7
	07:30:00	69.1	50.5	43.5
	07:45:00	76.5	55.8	43.4
	08:00:00	70.6	54.8	42.4
	08:15:00	65.7	46.7	41.8
	08:30:00	73.1	52.3	42.9
	08:45:00	79.2	57.1	43.9
	09:00:00	73.6	51.8	44.3
	09:15:00	69.1	47.5	42.7
	09:30:00	71.7	50.5	43.9
	09:45:00	81.8	57.2	44.2
	10:00:00	66.5	47.6	43.5

	10:15:00	64.6	47.9	42.8
	10:30:00	71.3	49.9	43.4
	10:45:00	64.6	48.9	43.8
	11:00:00	65.9	49.4	43.6
	11:15:00	73.7	50.4	43.2
	11:30:00	69.9	50.8	42.6
	11:45:00	71.3	49.9	42.5
	12:00:00	73.6	50.3	41.8
	12:15:00	67.5	49.5	41.7
	12:30:00	75.4	47.5	41.7
	12:45:00	78.8	49.6	42.5
	13:00:00	97.6	63.7	43.5
	13:15:00	64.7	47.7	40.4
	13:30:00	71.5	50.6	41.7
	13:45:00	60.3	44.6	41.4
	14:00:00	64.6	45.5	40.7
	14:15:00	60.7	45.8	42.5
	14:30:00	64.2	48.2	41.6
	14:45:00	65.5	48.8	40.3
	15:00:00	67.6	51.6	43.7
	15:15:00	67.6	48.3	41.1
	15:30:00	63.6	47.4	42.5
	15:45:00	69.4	49.6	45.3
	16:00:00	59.8	45.5	42.0
	16:15:00	61.1	45.1	41.9
	16:30:00	56.2	44.8	42.2
	16:45:00	72.6	51.8	42.9
	17:00:00	68.2	50.3	45.5
	17:15:00	64.7	48.3	44.7
	17:30:00	65.8	46.3	43.4
	17:45:00	66.2	46.2	42.4
	18:00:00	63.5	46.8	43.5
	18:15:00	66.6	48.2	43.9
	18:30:00	78.9	52.9	44.2
	18:45:00	90.4	61.0	43.8
	19:00:00	69.5	47.7	44.1
	19:15:00	65.6	48.2	44.4
	19:30:00	66.0	47.9	44.7
	19:45:00	66.2	48.4	42.1
	20:00:00	69.6	50.1	42.0
	20:15:00	98.3	73.1	43.1
	20:30:00	73.3	50.6	41.9
	20:45:00	78.0	51.4	42.5
	21:00:00	67.7	46.4	41.2

	21:15:00	65.2	45.6	39.8
	21:30:00	53.1	41.4	38.9
	21:45:00	52.7	41.2	38.7
	22:00:00	53.4	41.8	38.8
	22:15:00	53.8	42.8	39.9
	22:30:00	58.0	44.2	40.4
	22:45:00	54.0	42.0	38.1
	23:00:00	57.2	42.6	38.5
	23:15:00	61.8	42.4	36.4
	23:30:00	54.3	39.9	35.3
	23:45:00	58.1	39.7	35.2
Thursday 6th April 2017	00:00:00	65.5	43.4	34.6
	00:15:00	52.7	39.5	34.0
	00:30:00	47.6	35.7	31.3
	00:45:00	51.1	37.7	33.5
	01:00:00	63.9	39.7	30.8
	01:15:00	51.4	34.5	31.3
	01:30:00	46.2	33.9	30.7
	01:45:00	47.2	34.1	29.6
	02:00:00	62.8	37.7	31.9
	02:15:00	54.7	39.5	31.6
	02:30:00	46.8	34.5	32.3
	02:45:00	46.1	33.8	31.2
	03:00:00	46.6	35.0	30.4
	03:15:00	45.7	34.6	31.5
	03:30:00	48.6	34.9	31.5
	03:45:00	48.1	36.0	33.0
	04:00:00	47.2	37.1	33.9
	04:15:00	48.4	37.0	32.7
	04:30:00	59.0	37.4	32.9
	04:45:00	61.8	48.6	36.5
	05:00:00	77.4	53.6	44.5
	05:15:00	75.3	51.7	43.8
	05:30:00	70.6	54.3	43.7
	05:45:00	69.8	57.0	43.8
	06:00:00	70.1	52.4	42.6
	06:15:00	69.9	49.0	44.4
	06:30:00	71.2	48.8	44.8
	06:45:00	68.1	53.1	46.3
	07:00:00	70.9	57.5	45.8
	07:15:00	79.4	60.2	46.7
	07:30:00	70.0	51.8	45.9
	07:45:00	67.9	51.0	44.8
	08:00:00	78.2	55.1	42.0

	08:15:00	78.6	54.1	41.4
	08:30:00	71.8	50.9	40.8
	08:45:00	61.7	46.4	40.8
	09:00:00	78.6	54.0	41.4
	09:15:00	66.2	51.5	40.1
	09:30:00	76.6	54.3	38.7
	09:45:00	65.9	47.7	41.1
	10:00:00	69.4	45.4	41.8
	10:15:00	88.2	60.0	42.1
	10:30:00	69.6	46.4	42.3
	10:45:00	77.3	56.1	44.5
	11:00:00	73.3	46.9	42.9
	11:15:00	67.0	47.5	42.2
	11:30:00	62.0	46.7	41.3
	11:45:00	70.3	50.4	41.5
	12:00:00	72.2	55.6	41.1
	12:15:00	71.1	47.7	39.5
	12:30:00	65.8	48.6	42.6
	12:45:00	72.1	57.4	41.7
	13:00:00	66.5	48.8	39.9
	13:15:00	71.7	51.2	41.6
	13:30:00	61.4	45.3	38.7
	13:45:00	67.9	49.9	38.5
	14:00:00	61.2	45.2	38.5
	14:15:00	84.6	55.8	40.3

TABLE B1: CONTINUOUS NOISE DATA 4TH TO 6TH APRIL 2017

APPENDIX C: GLOSSARY OF ACOUSTIC TERMS

Noise

Noise is defined as unwanted sound. The range of audible sound is from 0 to 140 dB. The frequency response of the ear is usually taken to be around 18 Hz (number of oscillations per second) to 18000 Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and because of this, the low and high frequency components of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most widely used and which correlates best with subjective response to noise is the dBA weighting. This is an internationally accepted standard for noise measurements.

For variable sources, such as traffic, a difference of 3 dBA is just distinguishable. In addition, a doubling of traffic flow will increase the overall noise by 3 dBA. The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/decrease of 10 dBA corresponds to a doubling/ halving in perceived loudness. Noise is measured on a logarithmic scale in decibels (dB) because of the ears' sensitivity to a wide range of pressure changes. The sound pressure level (SPL) of a signal is denoted by the symbol L_p and defined by the equation $L_p = 10 \log (p/p_o)^2$ where p is the root mean square pressure of the signal and p_o is the reference sound pressure (2×10^{-5} Pa).

An indication of the range of sound pressure levels commonly found in the environment is given below:

<u>Location</u>	<u>L_{pA} dB(A)</u>
Normal threshold of hearing	-10 to 20
Music halls and theatres	20 to 30
Living rooms and offices	30 to 50
Inside motor vehicles	50 to 70
Industrial premises	70 to 100
Burglar alarms at 1 m	100 to 110
Jet aircraft on take-off	110 to 130
Threshold of pain	130 to 140

External noise levels are rarely steady, but rise and fall according to activities within an area. In attempt to produce a figure that relates this variable noise level to subjective response, a number of noise indices have been developed. These include:

i) The L_{Amax} noise level

This is the maximum noise level recorded over the measurement period.

ii) The L_{Aeq} noise level

This is "equivalent continuous A-weighted sound pressure level, in decibels" and is defined in British Standard BS 7445 [2] as the "value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T , has the same

mean square sound pressure as a sound under consideration whose level varies with time”.

It is a unit commonly used to describe construction noise and noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. In more straightforward terms, it is a measure of energy within the varying noise.

iii) The L_{A10} noise level

This is the noise level that is exceeded for 10% of the measurement period and gives an indication of the noisier levels. It is a unit that has been used over many years for the measurement and assessment of road traffic noise.

iv) The L_{A90} noise level

This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during the quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.

Community response to environmental noise sources is dependent on both acoustic and non-acoustic factors. The acoustic factors include absolute noise level, changes or exceedances of background and ambient levels as well as the characteristics, time, duration and frequency of noise.