The Abergelli Power Gas Fired Generating Station Order

6.2 Environmental Statement Appendices - Volume E Noise

Planning Act 2008
The Infrastructure Planning
(Applications: Prescribed Forms and Procedure) Regulations 2009

PINS Reference Number:	EN010069
Document Reference:	6.2
Regulation Number:	5(2)(a) & Infrastructure Planning (Environmental Impact Assessment) Regulations 2009
Author:	AECOM

Revision	Date	Description
0	May 2018	Submission Version

Appendix 7.1

Noise Survey Report

Abergelli Power Project

Noise Survey Report

Abergelli Power Limited

6 March 2018

Quality information

Prepared by	Checked by	Approved by
Sarah Gilston Graduate Acoustic Engineer	Mike Hewett Regional Director	Natalie Williams Principal EIA Consultant

Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	07/03/18	Draft		Natalie Williams	Principal EIA Consultant

Distribution List

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Prepared for:

Abergelli Power Limted

Prepared by:

Sarah Gilston
Graduate Acoustic Engineer
T: 0161 601 1700
E: sarah.gilston@aecom.com

AECOM Limited
1 New York Street
Manchester M1 4HD
United Kingdom

T: +44 161 601 1700
aecom.com

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1. Introduction

This report describes a sound survey undertaken at noise sensitive receptors around the Abergelli Power Project site (hereafter referred to as the 'Project Site') on behalf of Abergelli Power Limited. The purpose of the survey was to provide baseline noise information, which will be used to inform an Environment Statement (ES) for the proposed Abergelli Power Station.

The 2018 Preliminary Environmental Impact Report (PEIR) Noise Assessment was based on a noise survey conducted by a previous consultant in 2014. It was considered that the scope of the previous survey had been too limited to provide fully representative data for the Project Site and that a more detailed, up to date survey would be required for the ES.

The survey was conducted following the background sound levels determination requirements of BS 4142:2014 *Measurement and assessment of industrial and commercial sound*. The following sections fulfil the reporting requirements of that standard.

A glossary of acoustics terminology is provided in Appendix A.

2. Baseline Survey

2.1 Site Description

The Project Site is situated in a rural area to the south east of Abergelli Farm. The Project Site is surrounded by agricultural land and scattered farms in all directions, with small clusters of housing. To the south is the M4 motorway corridor at a distance of approximately 1 km. Road traffic noise from the surrounding local roads and M4 motorway, and noise from farming activities were the dominant sources in the area.

Figure 1 below locates the Noise Sensitive Receptors around the Project Site.

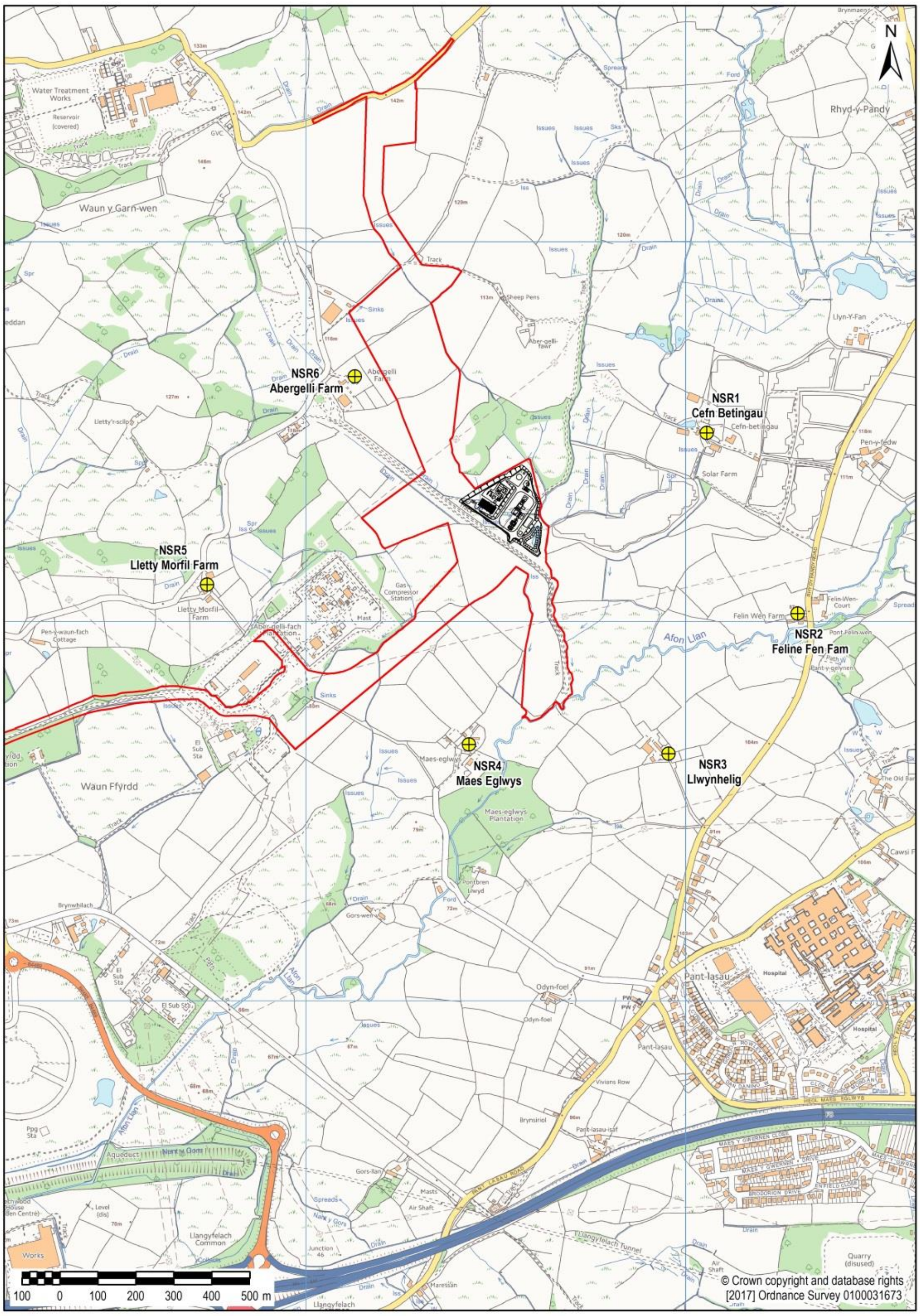

Figure 1. Map of the NSRs surrounding the Project Site

2.2 Noise Sensitive Receptors

Six Noise Sensitive Receptors (NSRs) were identified for the project. On this occasion access was only possible to use four of these for the detailed survey. However the four locations monitored covered all compass directions around the Project Site.

The NSRs are listed in Table 1 below.

Table 1. Noise Sensitive Receptors

NSR	Name of NSR
1	Cefn Betingau Farm
4	Maes Eglwys
5	Lletty Morfil Farm
6	Abergelli Farm

2.3 Subjective impressions of noise sources

Descriptions of noise sources heard on site at the measurement locations are included in Table 2 below. As well as noise sources being observed at the time of set-up and collection of the loggers, each of the sites was attended around 01:00 on 21st February to determine the noise sources during the night-time period.

In general, during the daytime, the noise climate had audible contributions from the following sources:

M4 motorway traffic noise, low but audible, a distant rotary engine noise, possibly a drone (as advised by the property owner of NSR 6), animal noises including wild birds, hens and far cattle, and wind through the trees.

Table 2. Noise sources

NSR Location	Day / Night	
1 – Cefn Betingau Farm	Day	Distant rotary engine noise. M4 motorway traffic noise, low but audible. Bird noise and cattle noises heard from the nearby area. On collection there was additional noise from farm activities as well as a low frequency plant hum which started up around 10:00.
	Night	Low level plant hum. Road traffic was audible to both the south and the east. Very quiet site.
4 - Maes Eglwys	Day	M4 motorway traffic noise and rotary engine noise low but audible. On collection dogs were barking at the nearby property.
	Night	Low level plant hum, accompanied by a low level continuous tone. Very faint traffic noise. Water could be heard flowing along the nearby Afon Llan river. Quiet site.
5 - Lletty Morfil Farm	Day	On site hen noise and dogs barking. Wind rustled through the trees. Distant M4 traffic and rotary engine noises heard, low but audible. On collection a low level plant hum could be heard.
	Night	Low level plant hum. Distant M4 traffic noise, low but audible. Very quiet site.
6 - Abergelli Farm	Day	Wind rustled through the trees. Birds heard in nearby trees. Dogs barking in the distance. Distant M4 traffic and rotary engine noises heard, low but audible. Rotary engine noise, advised to be a drone, low but audible.
	Night	Low level plant hum. Distant road traffic noise heard. Very quiet site.

2.4 Measurement Locations

On this occasion access was only possible to monitor four of the NSRs. The four locations monitored covered all directions around the Project Site. The measurement locations are listed in Table 3 below.

Table 3. Noise Sensitive Receptors, measurement locations and distance to Generating Equipment Site

NSR	Name of NSR	Measurement Location	Distance to Generating Equipment Site
1	Cefn Betingau Farm	At the end of the back garden	410
4	Maes Eglwys	In the field adjacent to the front of The Old Barn at Maes Eglwys	560
5	Lletty Morfil Farm	In the back garden of the main building	680
6	Abergelli Farm	Secured to a tree near to the row of residences on the farm	420

The unattended logger measurement locations were chosen in agreement with the property owners. The monitoring location setup for each NSR is shown is Figures 2 to 5 below.

Figure 2. Monitoring location at NSR 1 - Cefn Betingau Farm

Figure 3. Monitoring location at NSR 4 - The Old Barn, Maes Eglwys

Figure 4. Monitoring location at NSR 5 - Lletty Morfil Farm

Figure 5. Monitoring location at NSR 6 - Abergelli Farm

2.5 Sound Measuring System

The equipment used at each of the monitoring locations is listed below in Table 4.

Table 4. Noise measurement equipment

NSR	Equipment	Equipment Type	Serial Number
1	Rion NL-52	Integrating Sound Level Meter – Unattended Logger	00620964
4	B&K 2250	Integrating Sound Level Meter – Unattended Logger	2827270
5	Rion NL-52	Integrating Sound Level Meter – Unattended Logger	00821105
6	Rion NL-52	Integrating Sound Level Meter – Unattended Logger	01143556
-	Norsonic 1251	Sound Calibrator	34393

These instruments are all within calibration and calibration certificates can be provided on request.

The sound level meters at NSRs 1, 5 and 6 were mounted on a stainless steel pole, and the sound level meter at NSR 4 was mounted on a tripod. All were at a height of approximately 1.2 m from the ground and wind shields were used. There were no vertical reflecting surfaces within 3.5 m of the measurement locations.

2.6 Operational Test

The sound level meters and associated microphones were field calibrated at the beginning and end of their respective measurement periods in accordance with recommended practice. No significant drift in calibration was observed during the measurement periods. The accuracy of the calibrator can be traced to the National Physical Laboratory Standards.

2.7 Weather conditions

Weather conditions during the survey were within the parameters set out in BS 4142 and had no adverse effect on the levels measured.

Weather data for local weather stations was obtained from public sources for the duration of the survey. Wind speeds were generally below 5 m/s throughout the survey. During the day, the temperature ranged between 1 and 11 degrees with an average of 7 degrees Celsius, and during the night it ranged between 1 and 7 with an average of 5 degrees Celsius. There were no significant periods of rain.

The favourable wind conditions for gathering suitable data at each NSR are stated in the first half of Tables 5 and 6 below which details the downwind direction and range necessary for use in the assessment for both the day and night-time periods. Periods with downwind conditions for each receptor are shown in green.

Table 5. Daytime wind conditions at each NSR

Session		Wind		NSR Location			
		Average Direction (°)	Speed Range (m/s)	1	4	5	6
Downwind direction (°)				225	45	90	135
Wind direction range				165	345	30	75
				285	105	150	195
Date and Session Average weather							
16/02/2018	Friday	180	<5				
17/02/2018	Saturday	240	<5				
18/02/2018	Sunday	130	<5				
19/02/2018	Monday	300	<5				
20/02/2018	Tuesday	360	5+				

Table 6. Night-time wind conditions at each NSR

Session		Wind		NSR Location			
		Average Direction (°)	Speed Range (m/s)	1	4	5	6
Downwind direction (°)				225	45	90	135
Wind direction range				165	345	30	75
				285	105	150	195
Date and Session Average weather (for following morning)							
16/02/2018	Friday	270	<5				
17/02/2018	Saturday	170	<5				
18/02/2018	Sunday	115	<5				
19/02/2018	Monday	240	~0				
20/02/2018	Tuesday	300	<5				
21/02/2018	Wednesday	360	<5				

2.8 Date and Time of Measurement

Unattended logged measurements were made between the afternoon of Thursday 15th February and the morning of Wednesday 21st February 2018 at each of the NSR locations. They were chosen as being representative of the background levels at that NSR.

The background sound levels were measured in general accordance with the methodology set out in BS 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142). In addition, measurements were in general accordance with BS 7445-2:1991 'Description and measurement of environmental noise, Part 2: Guide to the acquisition of data pertinent to land use' which defines parameters, procedures and instrumentation required for noise measurement and analysis.

2.9 Measurement time intervals

All measurements were made over 5 minute logging periods.

2.10 Background sound level

BS 4142 states gives guidance on how a representative background sound level can be derived from a sound measurement data set.

Section 8.1.1 states that background sound level should be determined in "*weather conditions that are representative or comparable to the weather conditions when the specific sound occurs".* The propagation of sound from outdoor sources is significantly influenced by the weather. In particular the propagation down wind of a source can be 10 to 15 dB greater than that upwind. The prediction methodology used to derive the specific sound level for the proposed power station (based on ISO 9613) assumed downwind conditions for each receptor. Therefore the predicted specific sound levels will only occur at each receptor when that receptor is downwind of the source. Representative background sound levels must therefore by measured in similar conditions. Therefore, for each receptor the data set was filtered so that only measurements sessions were the average wind direction was within a 120° arc (60°s each side) of the downwind condition.

Section 8.1.4 states that the data set should be analysed statistically to obtain a representative value. It clearly states that the lowest measured level should not be taken as representative. Therefore, after filtering for wind direction as described above the mean and modal values of the remaining results for each receptor were obtained. Both of these are presented in the results section of this report. They were generally with one or two dB of each other.

The modal value was selected as representative for each receptor.

The full survey results for the day and night-time periods are given below in Tables 7 and 8.

Table 7. Daytime survey results

		NSR Location			
Data	**Type**	**1**	**4**	**5**	**6**
L_{AF90}	Filtered data mean	42	35	41	41
	Filtered data mode	40	36	43	40
	Value in previous report (ex PB)	*41*	*40*	*39*	*40*
	Representative value in site context	**40**	**36**	**43**	**40**
	Change	-1	-4	4	0
L_{Aeq}	Filtered overall	46	43	54	47
	Value in previous report (ex PB)	*49*	*51*	*42*	*41*
	Representative value in site context	**46**	**43**	**54**	**47**
	Change	-3	-8	12	6

Table 8. Night-time survey results

		NSR Location			
Data	**Type**	**1**	**4**	**5**	**6**
L_{AF90}	Filtered data mean	34	33	37	36
	Filtered data mode	34	35	38	36
	Value in previous report (ex PB)	*25*	*37*	*40*	*28*
	Representative value in site context	**34**	**35**	**38**	**36**
	Change	9	-2	-2	8
L_{Aeq}	Filtered overall	40	38	40	39

Data	Type	NSR Location 1	4	5	6
	Value in previous report (ex PB)	*28*	*47*	*40*	*28*
	Representative value in site context	**40**	**38**	**40**	**39**
	Change	12	-9	0	11

Graphs of the full set of data results for each NSR are provided in Appendix B.

2.11 Comparison with Previous Survey Results

The assessments in the 2018 PEIR were based upon the results of a brief survey undertaken in 2014. The 2014 survey was so brief that the number of measurements for each location was small and it was not possible to undertake any statistical analysis to derive representative values for the background and residual sound levels. As a result, the levels used in the 2018 PEIR were subject to specific conditions and noise sources present during the brief measurement period and did not give a representation of the full range of appropriate conditions and sources.

The assessment made using that data are summarised in Table 9 below.

Table 9. Assessment summary based on 2014 survey

	Location 1	4	5	6
Daytime *background sound level* (L_{AF90})	41	40	39	40
Daytime *residual sound level* (L_{Aeq})	49	51	42	41
Night time *background sound level* (L_{AF90})	25	37	40	28
Night time *residual sound level* (L_{Aeq})	28	47	40	28
Predicted power station *specific sound level* (L_{Aeq})	35	32	29	34
Rating level (+3 dB character correction)	38	35	32	36
Daytime BS 4142 comparison	**-3**	**-5**	**-7**	**-4**
Compliance with daytime BS4124 criterion (+5 dB)	Y	Y	Y	Y
Night time BS 4142 comparison	**13**	**-2**	**-8**	**8**
Compliance with night time BS4124 criterion (+5 dB)	N	Y	Y	N
Daytime *ambient sound level* (L_{Aeq} with power station)	49	51	42	42
Daytime residual to ambient change	0	0	0	1
Night time *ambient sound level* (L_{Aeq} with power station)	**36**	**47**	**40**	**35**
Night time residual to ambient change	8	0	0	7
Compliance with night time WHO ambient sound criterion (45 dB L_{Aeq} outdoors)	Y	N*	Y	Y

* *Non compliance due to residual sound sources not power station operation – power station non contributory*

The completion of the detailed survey and the resulting statistically derived representative levels allow a more robust assessment to be made. The results are show in Table 10.

Table 10. Assessment summary based on February 2018 detailed survey

	Location			
	1	4	5	6
Daytime *background sound level* (L_{AF90})	40	36	43	40
Daytime *residual sound level* (L_{Aeq})	46	43	54	47
Night time *background sound level* (L_{AF90})	34	35	38	36
Night time *residual sound level* (L_{Aeq})	40	38	40	39
Predicted power station *specific sound level* (L_{Aeq})	35	32	29	34
Rating level (+3 dB character correction)	38	35	32	36
Daytime BS 4142 comparison	**-2**	**-1**	**-11**	**-4**
Compliance with daytime BS4124 criterion (+5 dB)	Y	Y	Y	Y
Night time BS 4142 comparison	**4**	**0**	**-6**	**0**
Compliance with night time BS4124 criterion (+5 dB)	Y	Y	Y	Y
Daytime *ambient sound level* (L_{Aeq} with power station)	46	43	54	47
Daytime residual to ambient change	0	0	0	0
Night time *ambient sound level* (L_{Aeq} with power station)	**41**	**39**	**40**	**40**
Night time residual to ambient change	1	1	0	1
Compliance with night time WHO ambient sound criterion (45 dB L_{Aeq} outdoors)	Y	Y	Y	Y

* *Non compliance due to residual sound sources not power station operation – power station non contributory*

The tables show that the predicted plant levels noise comply with the limits derived from both B 4142 and WHO.

2.12 The potential impact of uncertainty

There are several potential sources of uncertainty in the result obtained. These are listed in Table 11 along with the measures taken to mitigate them.

Table 11. Sources of uncertainty

Source	Mitigation
Effects of wind due to wind generated noise	The survey period was selected with low predicted windspeeds. Weather information was noted at the time of set-up and collection, and public weather sources were used so that measurements affected by unsuitable wind conditions could therefore be excluded.
Effects of wind on propagation of background sound sources	Survey period chosen at a time of low wind speed (<5 m/s). Weather information was noted at the time of set-up and collection, and historic weather data was obtained so that measurements affected by unsuitable wind conditions could therefore be excluded. Attendance at site for the setup and collection of the noise monitors, and during the night-time period allowed observations of noise sources in the area.
Possibility of unrepresentative activities contributing to background sound	Study of site prior to survey and drive-around inspection before and after survey indicated no major road or rail disruption or major construction projects in the area. Undertaking survey over a longer and continuous period gave a fuller picture of the general levels of activity.
Uncertainties in measurement procedure	Minimised by following standard procedure (BS 4142).

Appendix A Glossary of Acoustic Terminology

This document provides a layperson's explanation of the acoustics terms that commonly appear in reports. It is not intended to give full scientific definitions and explanations or go into detail on how and why things are as they are. Some obsolete terms and abbreviations have been included as they still appear in documents from time to time.

Many words have more specific meanings when used in acoustics than in every-day language.	
sound	is used to describe the physical phenomenon of the transmission of energy through gaseous or liquid media via rapid fluctuations in pressure.
level	used solely to describe values measured in decibels
loudness	is the human perception of the level of sound
noise	has no strict definition and is often used interchangeably with sound however it is usually taken to mean unwanted sound
index	a value based on the mathematical processing of raw data
indicator	a value used to indicate the likelihood of a particular response of effect eg. $L_{10,18hr}$ is an index based on statistical processing of sound pressure data that is used as an indicator for road traffic noise response.
weighted	values modified to reflect sensitivities at particular frequencies.
directivity	the amount by which a source radiates more sound in one direction than another.
decibels dB	The decibel is not a true measurement unit nor is it exclusive to acoustics. The decibel is a logarithmic ratio of two values of a variable. Decibels are used because they can represent very wide ranges of ratios (from trillionths and billionths to billions and trillions) with a small range of decibel values. Decibels can be used to represent measured values by using a known reference value in the ratio. When using decibels to measure something it is therefore important to specify what variable is actually being measured and what reference level has been used. This is done by adding a reference value statement in the form "dB re x units", where the units indicate the variable being measured and x is the reference value. Decibels are used in acoustics because the human ear responds to sound in a logarithmic way and the quantities measured in acoustics vary over wide ranges. However, decibels are used in acoustics to measure several different things which it is important not to confuse with each other. To avoid confusion there is a notation system that identifies what a decibel value is for. The notations take the form of an italic capital letter and some subscript characters. The capital identifies the general type of value and the subscripts give specific details of what is being represented. L_{xxx} denotes a level (ie a value measured in dB by comparison with a reference value); D_{xxx} denotes a difference between two levels; R_{xxx} denotes a rating (or index), which is measure of the generalised acoustic performance of a material or construction based on a difference between two levels; C_{xxx} denotes a correction (or constant) Of these only those with *L* notations require a reference value statement. Those with *D* or *R* notations are effectively ratios of two measured values not one measured value and a reference value and those with *C* notations are not based on reference values at all. A reference value statement therefore has no meaning when describing *D*, *R* and *C* decibels. Because decibels are logarithmic they have to be added, subtracted, multiplied, divided and averaged using different techniques from normal numbers.
Sound Pressure Level L_p obsolete – SPL	This is the basic measure of how much sound there is at a given location. It is a measure of the size of the pressure fluctuations in the air that we perceive as sound. Sound Pressure Level is expressed in decibels with a reference level of 20 μPa (L_p in dB re 20 μPa)

Sound Power Level L_W obsolete – SWL	This is the total amount of sound produced by a source. It cannot be measured directly but it can be calculated from Sound Pressure Level measurements in known conditions. It can be used to predict the Sound Pressure Level at any point. Sound Power Level is expressed in decibels with a reference level of 1 pW (L_W in dB re 1 pW). In the US a reference of 100 fW is sometimes used
Pitch, frequency tonal sound broadband sound impulsive sound frequency analysis	The sound we perceive can have different characteristics. These can range from low-pitched hums to high-pitched squeals and impulsive sounds. In engineering acoustics the word frequency rather than pitch tends to be used when describing the characteristics of a sound. The unit of frequency is the Hertz (Hz), which is the number of pressure fluctuations per second. Any sound can be defined by its frequency content. Some sounds comprise just one discrete frequency (tonal sounds). Others are distributed over wide frequency ranges (broad band sound). Impulsive sounds are made up short pulses of high frequency components. Sources often produce all of these types of sound at the same time. There are different ways of analysing and displaying the frequency content of a sound: Octave Band Analysis – is the simplest method. The audible range of frequencies is divided into 10 bands. Third-Octave Band Analysis – more detailed with 30 bands Narrow Band Analysis – 12^{th} Octave (120 bands), 24^{th} Octave (240), Fast Fourier (FFT) Analysis – a high resolution technique that can give extremely detailed information on frequency content
A-weighting L_A or L_{pA}, L_{WA}, obsolete – dBA, dB(A) similar – C-weighting L_C or L_{pC}, L_{WC}	The human ear does not sense all frequencies of sound equally. Our sensitivity is at a maximum at around 2 kHz and steadily decreases above and below. Below 20 Hz and above about 20 kHz we can't hear at all. Within its operating limits a precision measurement microphone measures all frequencies the same so the output it produces does not reflect what we would actually hear. The A-weighting is an electronic filter that matches the response of a sound level meter to that of the human ear. When A-weighted the Sound Pressure Level L_p becomes L_{pA} (or L_A) and the Sound Power Level L_W becomes L_{WA}. It used to be common to identify that a level was A-weighted by writing dB(A) or dBA instead of dB. These terms are now obsolete and should not be used as they conflict with other, non-acoustic, uses of decibels The response of the human ear varies depending on how loud the sound is. A-weighting matches the response of a sound level meter to human hearing at low levels (~ 40-90 dB). For higher levels there are other weightings the most common of which is the C-weighting.

Different types of decibels commonly used in acoustics

L_p L_{pA} (or L_A) L_{AF}, L_{AS}	*The instantaneous sound pressure level* (L_p) *The A-weighted instantaneous sound pressure level* (L_{pA} or L_A) This is the root mean square size of the pressure fluctuations in the air. This level can fluctuate wildly even for seemingly steady sounds. To make sound level meters easier to read the values on the display are smoothed or damped out. This is effectively done by taking a rolling average of the previous 0.125 s (FAST time constant) or the previous 1 s (SLOW time constant). The letters F or S are added to the subscripts in the notation to indicate when the FAST or SLOW time constant has been used. These are often omitted but it is good practice to include them.
L_{max} L_{Amax} L_{AFmax} L_{min} , L_{Fmin}	*The maximum instantaneous sound pressure level* (L_{max}), *The A-weighted maximum instantaneous sound pressure level (*L_{Amax}) *The A-weighted maximum instantaneous sound pressure level with a FAST time constant (*L_{AFmax}). This is the highest instantaneous sound pressure level reached during a measurement period. The opposite of the L_{max} is the *minimum instantaneous sound pressure level* or L_{min} etc. It is good practice to include the letter which identifies the time constant used as this can make a significant difference to the value.

$L_{N,T}$ $L_{AN,T}$ $L_{AFN,T}$ $_N$ = %age value, 0-100 $_T$ = measurement time eg. L_{A90}, L_{A10}, $L_{AF90,\ 5\ min}$	*The percentage exceedence sound pressure level ($L_{N,T}$),* *The A-weighted percentage exceedence sound pressure level ($L_{AN,T}$), the A-weighted percentage exceedence sound pressure level with a FAST time constant ($L_{AFN,T}$).* This is the sound pressure level exceeded for *N*% of time period *T*. eg. If an A-weighted level of x dB is exceeded for a total of 6 minutes within one hour, the level will have been above x dB for 10% of the measurement period. This is written as $L_{A10,1hr}$ = x dB. L_{A0} (the level exceeded for 0 % of the time) is equivalent to the L_{Amax} and L_{A100} (the level exceeded for 100 % of the time) is equivalent to the L_{Amin}. It is good practice to include the letter which identifies the time constant used as this can make a significant difference to the value.
$L_{eq,T}$ $L_{Aeq,T}$ $_T$ = measurement time eg. $L_{Aeq,5min}$	The *equivalent continuous sound pressure level over period T ($L_{eq,T}$),* *The A-weighted equivalent continuous sound pressure level over period T ($L_{Aeq,T}$).* This is effectively the average sound pressure level over a given period. As the decibel is a logarithmic quantity the L_{eq} is not a simple arithmetic mean value. The L_{eq} is calculated from the raw sound pressure data. It is not appropriate to include a reference to the FAST and SLOW time constants in the notation

Appendix B Results

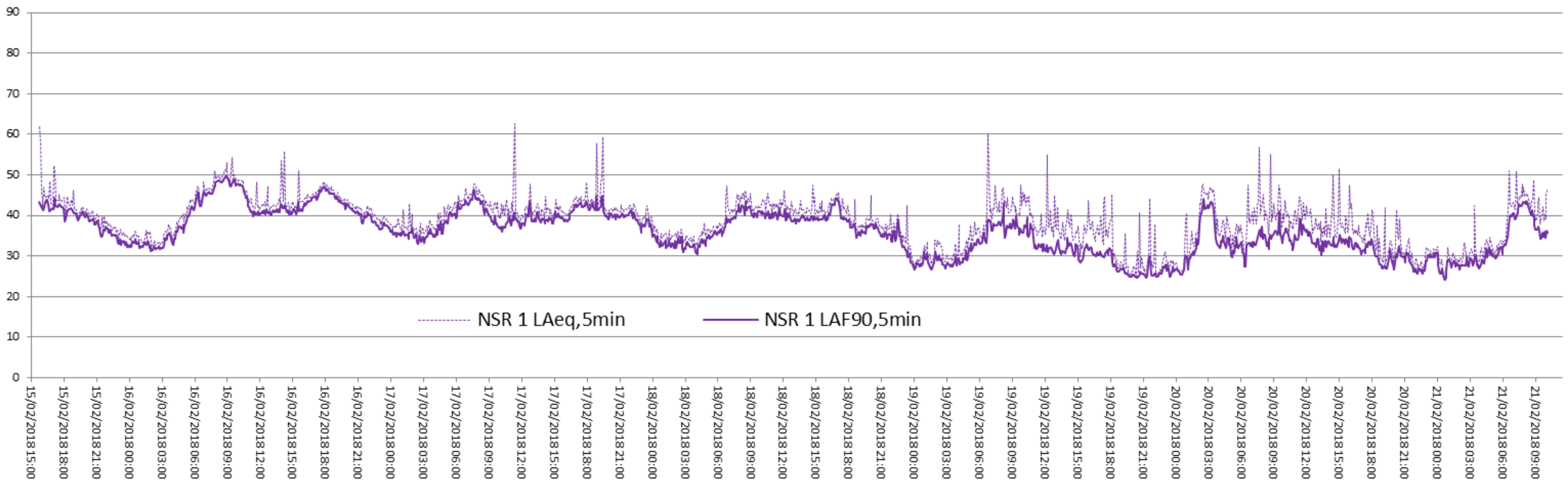

Figure 6. Results for the survey period at NSR 1

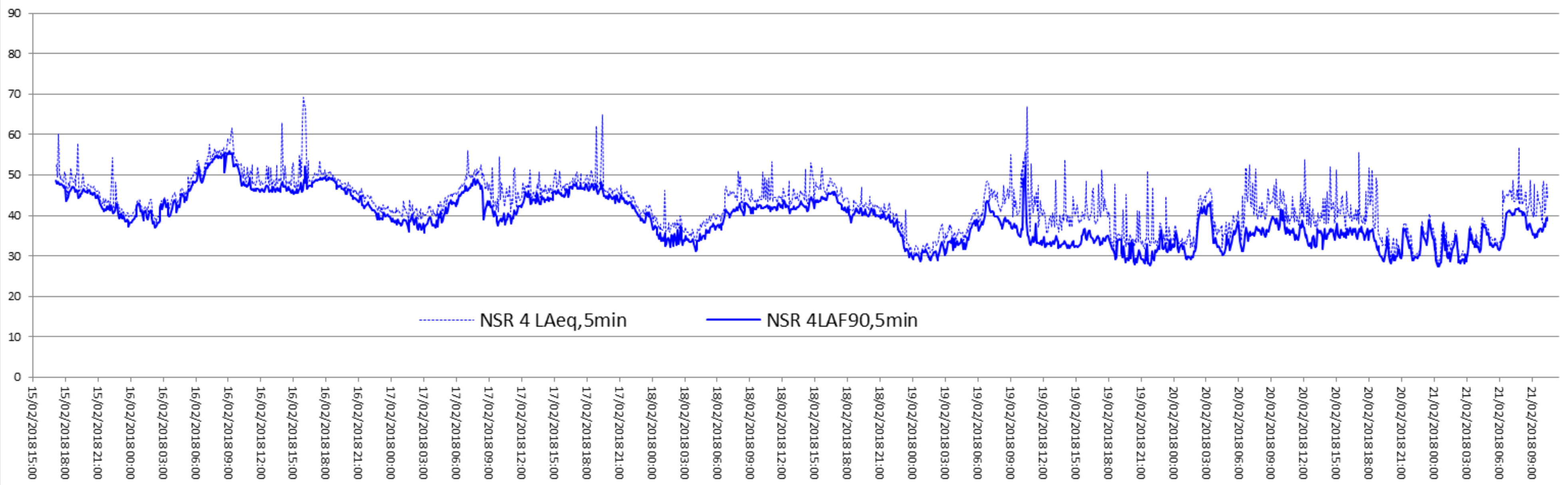

Figure 7. Results for the survey period at NSR 4

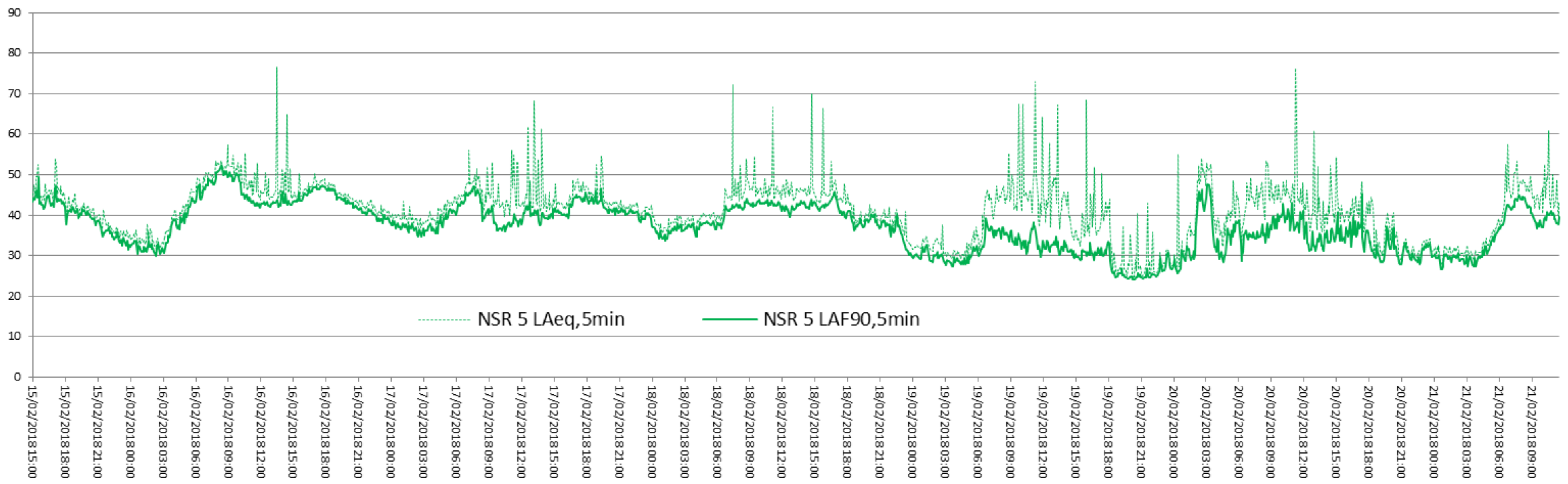

Figure 8. Results for the survey period at NSR 5

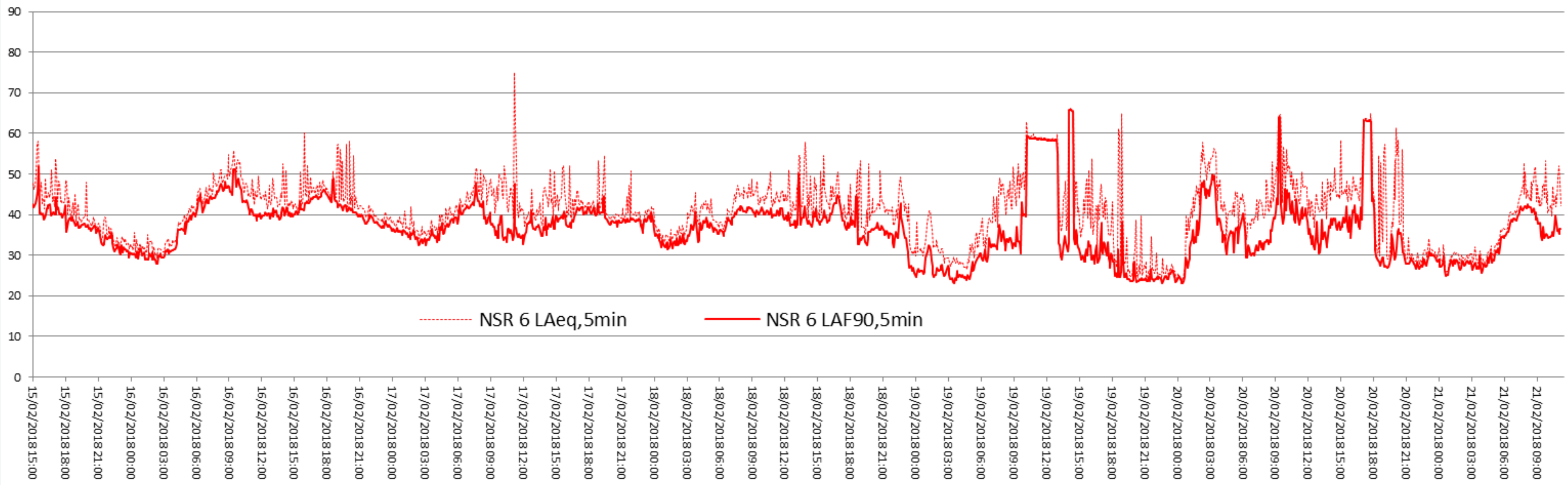

Figure 9. Results for the survey period at NSR 6

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