Tritax Symmetry (Hinckley) Limited

HINCKLEY NATIONAL RAIL FREIGHT INTERCHANGE

The Hinckley National Rail Freight Interchange Development Consent Order

Project reference TR050007

Written Statement of Oral Case ISH6 [Appendix E - Survey of Wheel Rail Noise on Tight Curves - Hydrock, 12 June 2019]

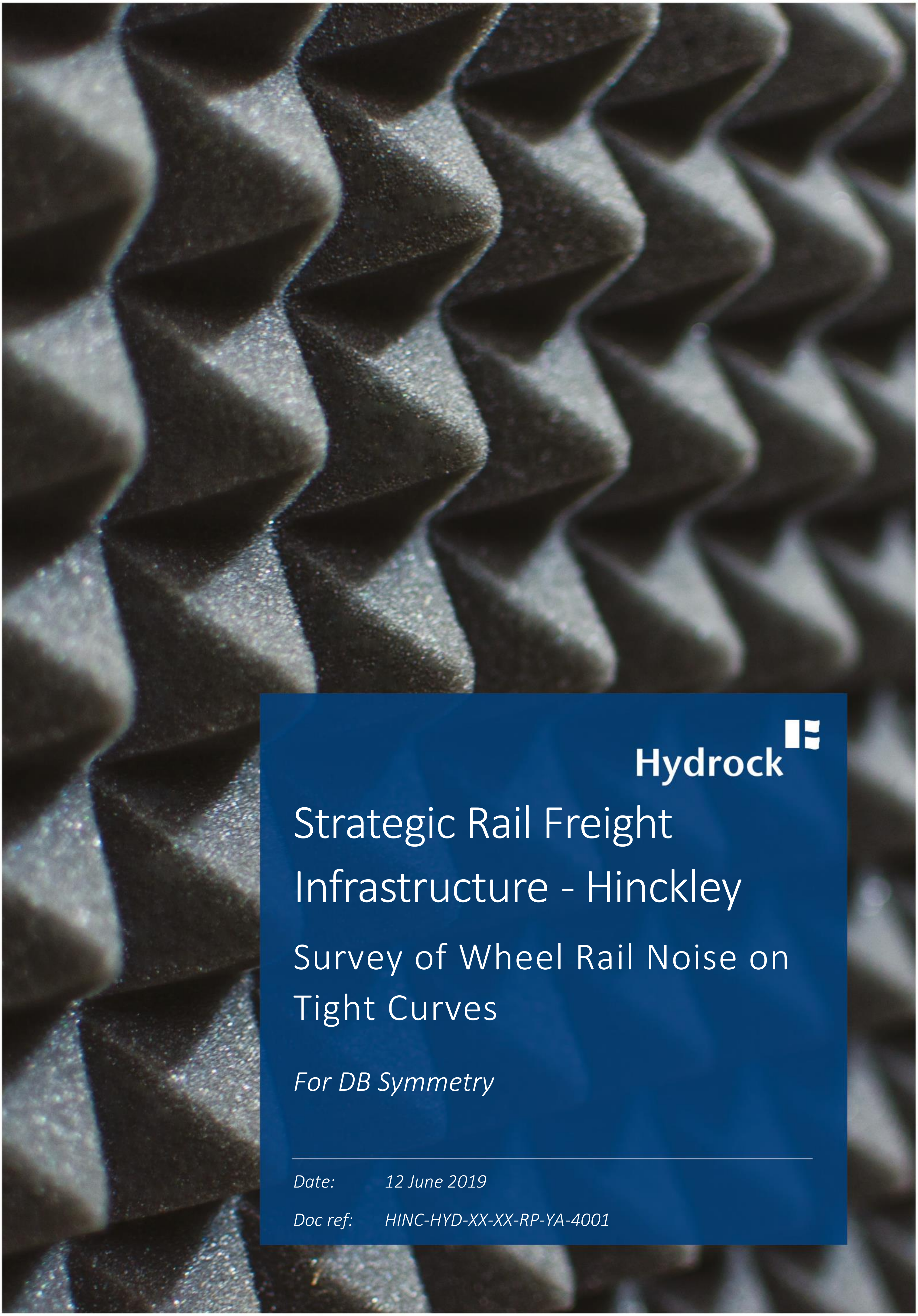
Document reference: 18.15.5

Revision: 01

9 February 2024

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5(2)(q)



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Strategic Rail Freight Infrastructure - Hinckley

Survey of Wheel Rail Noise on Tight Curves

For DB Symmetry

Date: *12 June 2019*

Doc ref: *HINC-HYD-XX-XX-RP-YA-4001*

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DOCUMENT CONTROL SHEET

Issued by	Hydrock Consultants Limited Merchants House North Wapping Road Bristol BS1 4RW United Kingdom	T +44 (0)117 9459225 E bristolcentral@hydrock.com www.hydrock.com
Client	DB Symmetry	
Project name	Strategic Rail Freight Infrastructure - Hinckley	
Title	Survey of Wheel Rail Noise on Tight Curves	
Doc ref	HINC-HYD-XX-XX-RP-YA-4001	
Project no.	C-07700	
Status	S2	
Date	12/06/2019	

Document Production Record		
Issue Number	01	Name
Prepared by		Chris Borak BSc Dip(IOA) MIOA
Checked by		Vince Taylor
Approved by		Ric Hampton

Document Revision Record			
Issue Number	Status	Date	Revision Details
01	S2	12/06/2019	First Issue

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Wheel Rail Noise Survey Report

1. INTRODUCTION

The current masterplan for the proposed Hinkley Rail Freight Interchange includes a tightly curved section of railway to the north east of the site. Detailed modelling of rail noise associated with the scheme is currently underway based on standard guidance and train noise levels from The Department of Transport document Calculation of Railway Noise (CRN) 1995.

A risk of higher than standard noise levels due to the interaction of train wheels with the track on the tightly curved section has been identified. To provide an objective assessment of this, freight trains have been measured at two other identified tightly curved sections of track at Arcow Quarry, Lancashire and Hadleigh Road Industrial Estate, Ipswich.

2. DESCRIPTION OF PROPOSALS

The proposed curved section of rail is shown in Figure 1, below. The closest residential receptors are identified.

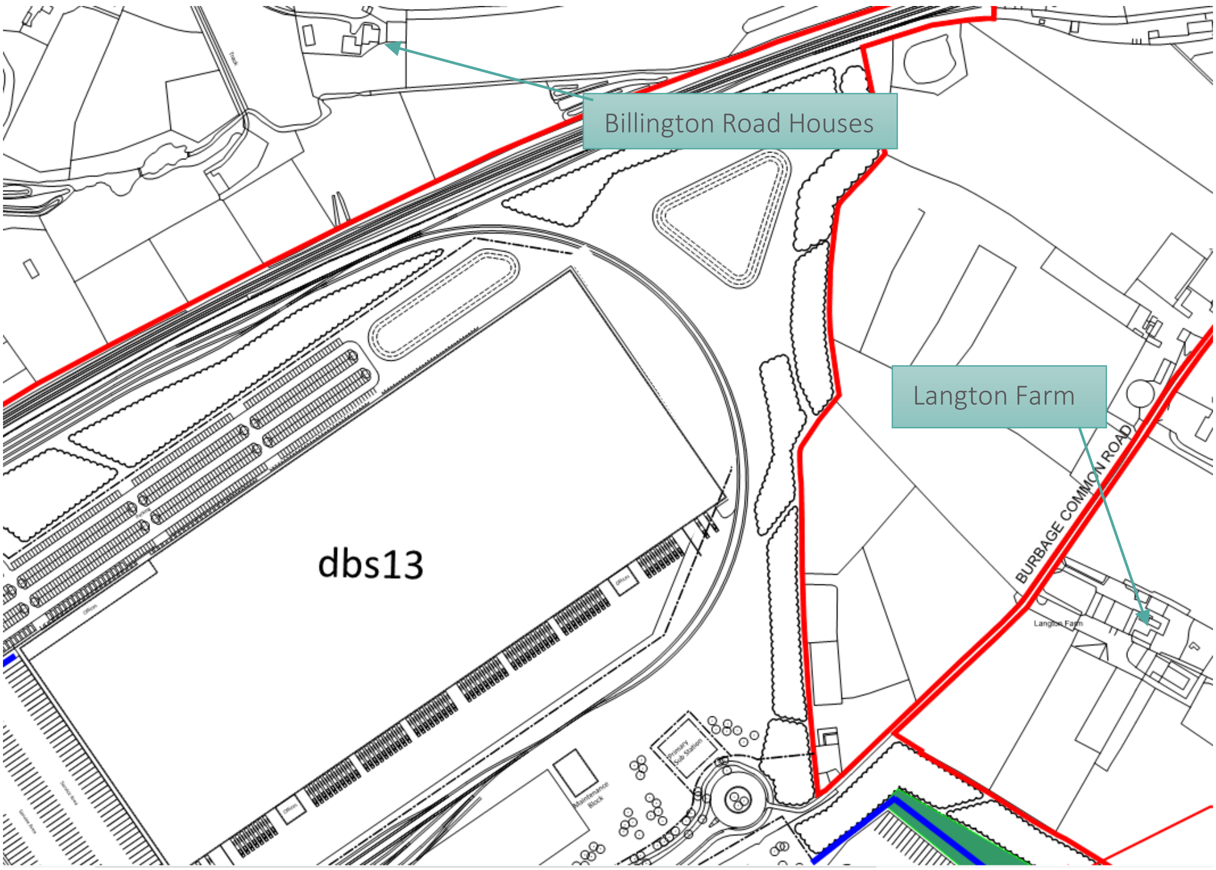


Figure 1: Extract from masterplan showing curved section of rail and closest residential receptors

The distances from the curved section of rail to the two closest receptors is provide below:

- Billington Road Houses – 126m
- Langton Farm – 220m

3. SIGNIFICANCE CRITEIRA AND GUIDANCE

3.1 Calculation of Railway Noise (CRN) 1995

This Department or Transport memorandum provides the standard procedures for the calculation and prediction of noise from moving railway vehicles as defined within the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996.

CRN provides a method for estimating the reference sound exposure noise level of a train (SEL_{ref}). The sound exposure level (SEL) is defined as the noise level in decibels that has the same total energy in one second as the original noise event.

Therefore, the sound exposure level depends on the noise level during the event, usually measured in terms of the A-weighted equivalent continuous noise level (L_{Aeq}), and the duration of the event. The equivalent continuous noise level (L_{Aeq}) is defined as the steady-state noise level with the same energy as the actual fluctuating sound over the same time period. It is effectively the average level for the time period. The A-weighting is a frequency filter which imitates the actual response of the human ear. The reference sound exposure noise level of a train (SEL_{ref}) is the A-weighted sound exposure level (SEL) in decibels at 25m from the track.

CRN also provides methods for predicted the attenuation of railway noise over distance and obstructions such as noise barriers. The document does not provide any significance criteria or means of assessment other than with reference to the Noise Insulation Regulations 1996.

3.2 Significance Criteria

The impact of rail traffic noise is similar to that of road traffic and therefore the noise impact can be assessed in terms of the noise change at a receptor. Criteria suitable for the assessment of railway noise associated with the proposed development are presented in Table 1. These have been derived from criteria set out in The Design Manual for Roads and Bridges (DMRB)[1].

Table 1: Significance Criteria in Terms of Noise Change

Level of magnitude	Noise change L_{Aeq} dB short term	Noise change $L_{Aeq,}$ dB long term	Magnitude of impact – as described in DMRB
High	5+	10+	Major
Moderate	3-4.9	5-9.9	Moderate
Low	1-2.9	3-4.9	Minor
Negligible	0.1-0.9	0.1-2.9	Negligible
	0	0	No change

The noise change is assessed in terms of the average daytime or night-time noise levels. However, short terms noise events which may have an insignificant effect on long term average can impact sleeping conditions at residential receptors. Therefore, in addition to the above, it is proposed to consider night-time maximum noise level (L_{Amax}). The maximum noise levels (L_{Amax}) is simply the highest noise level that occurs over the time period. This may be from a train’s brakes, engine under acceleration, or wheel rail interaction noise on the curve.

[1] The Design Manual for Roads and Bridges (DMRB) Volume 11: Environmental Assessment (and updates), Highways Agency

The World Health Organisation (WHO) "Guidelines for Community Noise" provides a review of studies on sleep disturbance and noise and concludes that an internal noise level of 45 dB L_{Amax} should not normally be exceeded at night for a good night's sleep. This is not intended to be an absolute limit but it is recommended that the number of individual noise events over this level is controlled. In terms of the number of times this might be exceeded before sleep is significantly affected: "*For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10–15 times per night*" (Vallet & Vernet 1991).

The level difference between outside and inside a room with the window slightly open for ventilation is approximately 15 dB. Therefore, the WHO guideline criterion (45 dB L_{Amax}) is exceeded by noise events louder than 60 dB L_{Amax} externally. It is proposed that regular night time exceedances of this level at a residential receptor are assessed as a high noise impact.

4. SURVEY METHODOLOGY

Noise surveys were carried out at two locations where freight trains navigate an existing tightly curved section of track. The location and distance from the track to the measurement location are shown below:

- Arcow Quarry, Lancashire – 6.75m
- Hadleigh Road Industrial Estate, Ipswich – 12m

The measurement locations and the track sections are shown in the aerial photographs in Figures 2 & 3.

Figure 2: Curved Section of track at Hadleigh Road Industrial Estate, Ipswich – showing measurement location

Figure 3: Curved Section of track at Arcow Quarry, Lancashire – showing measurement location

In both cases the measurement locations were slightly below the track level but the microphones had a clear line of sight to the noise sources including: locomotive engine exhaust, track and wheels. A Rion NL52 Sound Level Meter was used for both surveys. At both sites the meter was left unattended to log the noise of trains over an extended period including an entire night. Measurements were made in various parameters including: $L_{Aeq\ 1\ minute}$, $L_{Aeq\ 100ms}$, $L_{Amax\ 1\ minute}$, $L_{Amax\ 100ms}$. One third octave band measurement were also made and full audio was recorded by the meter.

For both surveys weather conditions were conducive to the noise measurement exercise with no precipitation and winds of less than 5m/s at the microphone.

5. SURVEY RESULTS

The full survey results are presented on the noise time history plots in Figure 4 & 5, below.

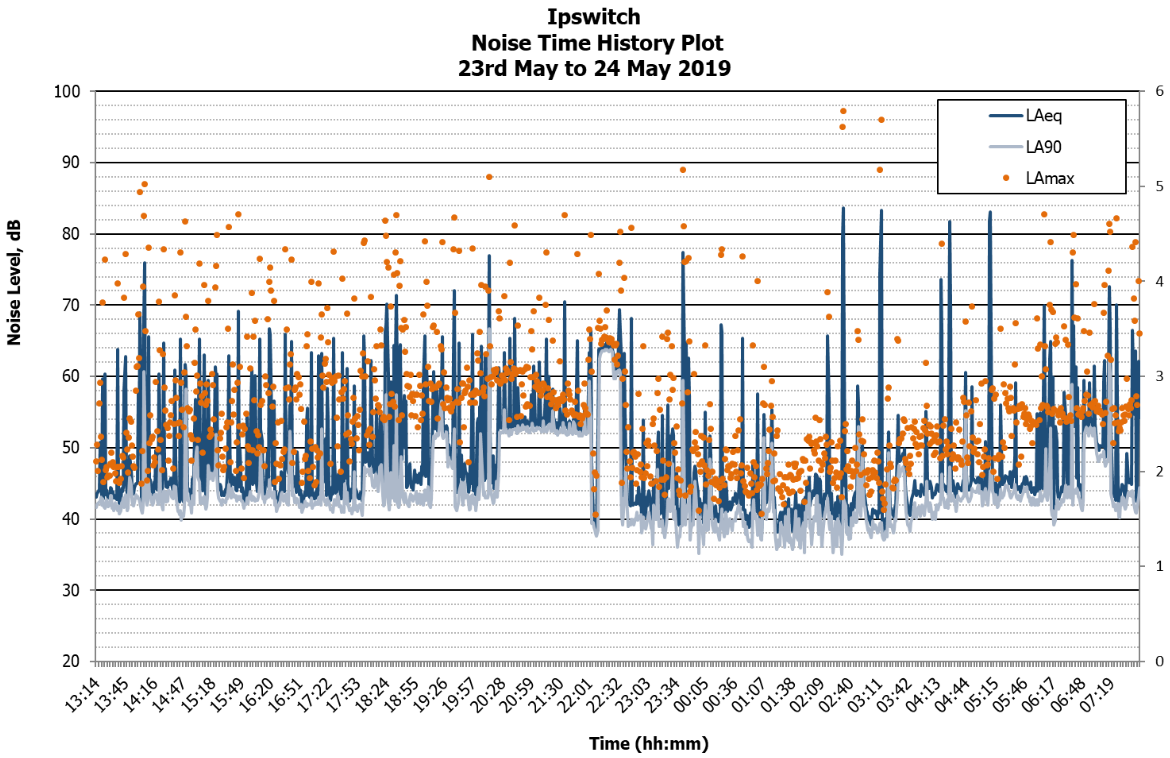


Figure 4: Noise Time History Plot Hadleigh Road Industrial Estate Railway Curve

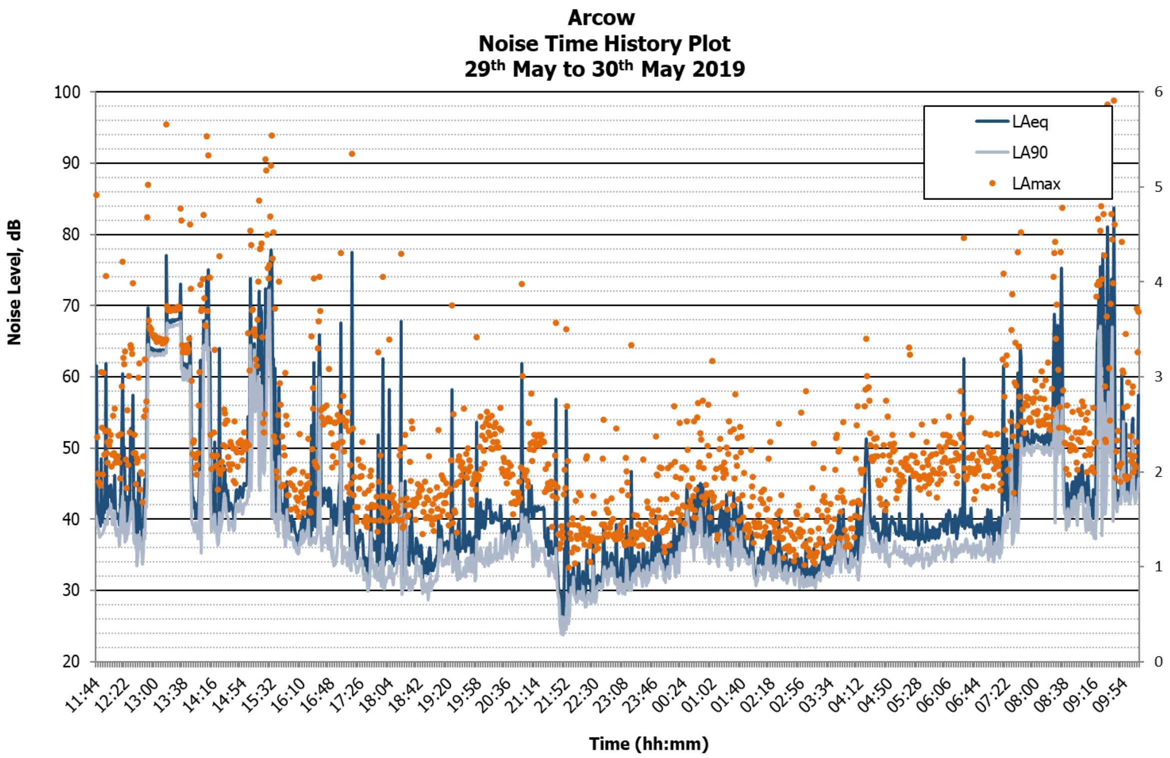


Figure 5: Noise Time History Plot Arcow Quarry Railway Curve

A high frequency noise from wheel rail interaction was noted by the surveying engineer and is apparent on the audio recordings. It is more notable when trains pass-by faster. However, trains which pass slowly or come to a stop on the curve exhibit similar high frequency noise when under braking.

Noise levels for individual freight train movements on the curved sections of track have been identified using the audio recordings. The noise levels for train events are presented in Table 2 in terms of the $L_{Aeq, event}$, SEL_{ref} and L_{Amax}. The duration of the event is also shown. All noise levels have been corrected to the standard CRN reference distance of 25m using standard formulae for distance attenuation due to geometric divergence. Other attenuation factors such as air absorption are not significant over small distances.

The attenuation method described in CRN is applicable to a line source and therefore to railway noise averaged over the duration of a train movement or longer (L_{Aeq} and SEL_{ref}). However, maximum noise level (L_{Amax}) emanate from a point source and therefore sound intensity diverges at twice the rate assumed by the standard CRN formula.

Table 2: Noise Measurement Results

ID	From	To	Duration (s)	$L_{Aeq\ event}$, dB	L_{Amax}, dB	SEL_{ref}
Arcow 1	29/05/2019 12:51	29/05/2019 13:45	3220	61	84	96
Arcow 2	29/05/2019 15:03	29/05/2019 15:41	2280	64	83	97
Arcow 3	30/05/2019 07:20	30/05/2019 08:40	4800	54	77	91
Arcow 4	30/05/2019 09:18	30/05/2019 09:51	1980	67	87	99
Hadleigh 1	23/05/2019 12:29	23/05/2019 12:32	174	67	72	89
Hadleigh 2	23/05/2019 20:25	23/05/2019 22:04	5910	55	76	92
Hadleigh 3	24/05/2019 02:33	24/05/2019 02:34	60	82	91	100
Hadleigh 4	24/05/2019 03:13	24/05/2019 03:14	57	81	90	98
Hadleigh 5	24/05/2019 04:18	24/05/2019 04:19	33	73	82	88
Hadleigh 6	24/05/2019 04:27	24/05/2019 04:28	59	79	89	97
Hadleigh 7	24/05/2019 05:10	24/05/2019 05:11	64	82	91	100
Average*				65	84	95

*L_{Aeq} and SEL_{ref} values are logarithmically averaged. The L_{Amax} values are arithmetically averaged.

Some freight train movements led to elevated noise levels for over an hour and others pass by in a minute or less. At Hadleigh Road Industrial Estate is was noted that freight trains would typically be held at a signal just to the north of the curve during the day. However, during the night all trains passed within approximately 1 minute. All the train movements at Arcow led to elevated noise levels for 30 minutes or more.

Spectral results for each of the rail movements in Table 2 are presented graphically in the Appendix. Predicted, unmitigated, average noise levels at the two closest receptors are presented in Table 3.

Table 3: Predicted Noise Levels at Receptors

Receptor	Distance (m)	$L_{Aeq\ event}$, dB	L_{Amax}, dB
Reference Distance	25	65	84
Billington Road Houses	126	58	70
Langton Farm	220	55	65

The predicted maximum (L_{Amax}) noise levels from train movements on the curve represent a high noise impact and exceed the threshold derived from WHO Guidelines by 5 to 10 dB.

Note the $L_{Aeq\ event}$ levels presented in Table 3 are for the period that a train is passing only and are not directly comparable to the measured baseline noise levels. The noise change will be assessed based on the day time and night-time average noise levels. These will depend on the number of train movements and will be predicted by the modelling exercise which is currently underway. The SEL_{ref} noise levels presented in Table 2 will be used as an input into the noise model.

6. MITIGATION

A noise barrier is recommended around the curve. The barrier should be 4m above the level of the rail. A bund, fence or combination of the two would be suitable. If a fence is used it should have no gaps and have a surface mass of at least 10Kg/m^2. It is also recommended that the side facing the rail is lined with an acoustically absorbent material.

With reference to Chart 6(a) of CRN a 4m barrier can reduce noise levels by 6 dB to 21 dB depending on the path difference achieved. The lower figure (6 dB) is achieved if the top of the barrier is at grazing incidence when the source is viewed from the receptor. This is likely to be the case for engine noise from diesel locomotives as the source height for engine noise is assumed to be 4m above the rail. However, noise from wheel rail interaction and from braking, which determined the maximum (L_{Amax}) noise levels, will be attenuated by closer to 20dB. Therefore, we would expect a suitable 4m barrier around the curve to reduce maximum noise levels at the closest receptors to below the high noise impact threshold derived from WHO Guidelines.

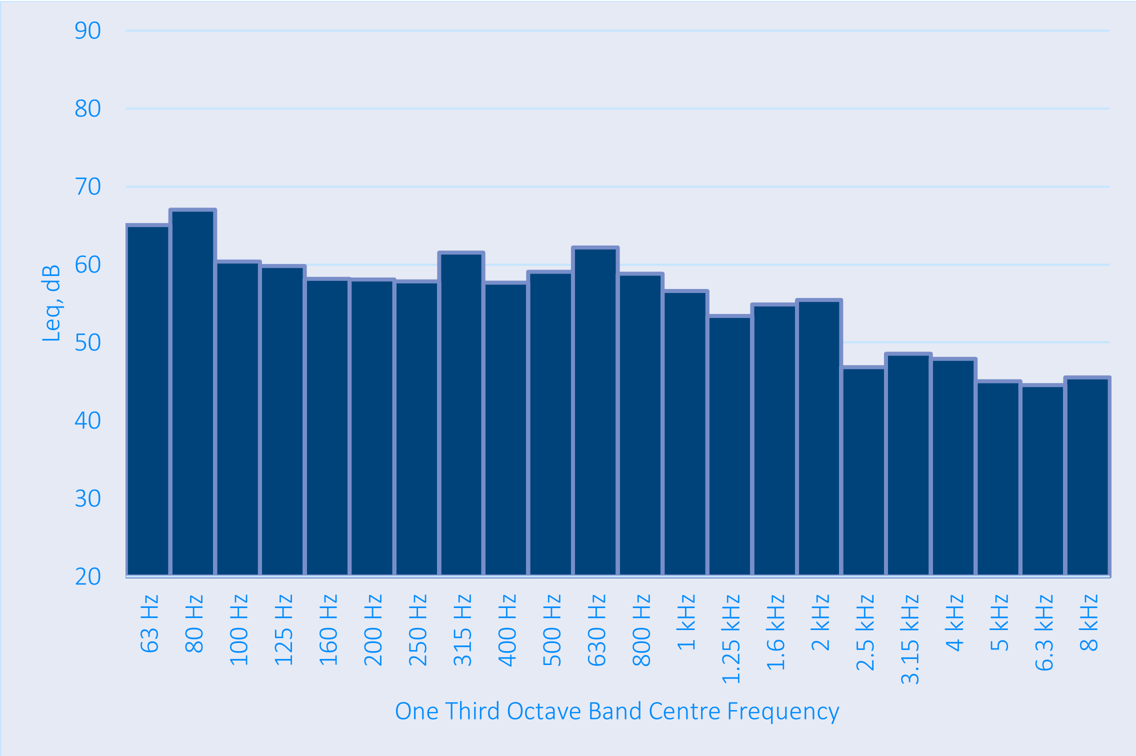
7. SUMMARY

A noise survey has been carried out of freight train movements at two tightly curved sections of rail. Noise from trains on these tightly curved sections of track exhibit wheel rail interaction noise which is not typical of trains on straight sections of track and not captured by standard prediction methodologies. The measurements data will be used as an input to the noise model for the proposed scheme to accurately predict noise levels from trains on a proposed curved section of track, and on approach to the curved section of track.

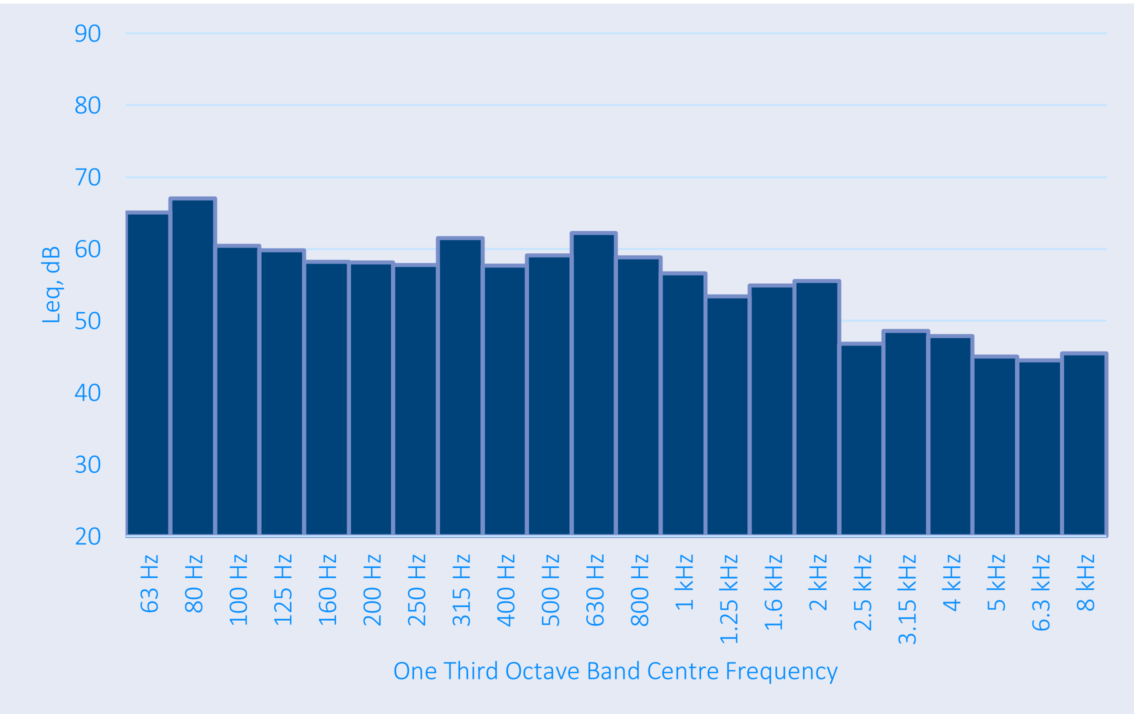
High maximum noise levels were identified from wheel rail interaction noise on curved sections of rail and under braking on approach to these sections. A noise barrier is recommended to control these high maximum noise levels at night to below the WHO guideline criterion for sleep effects at the closest residential dwellings.

Appendix A Spectral Noise Measurement Results

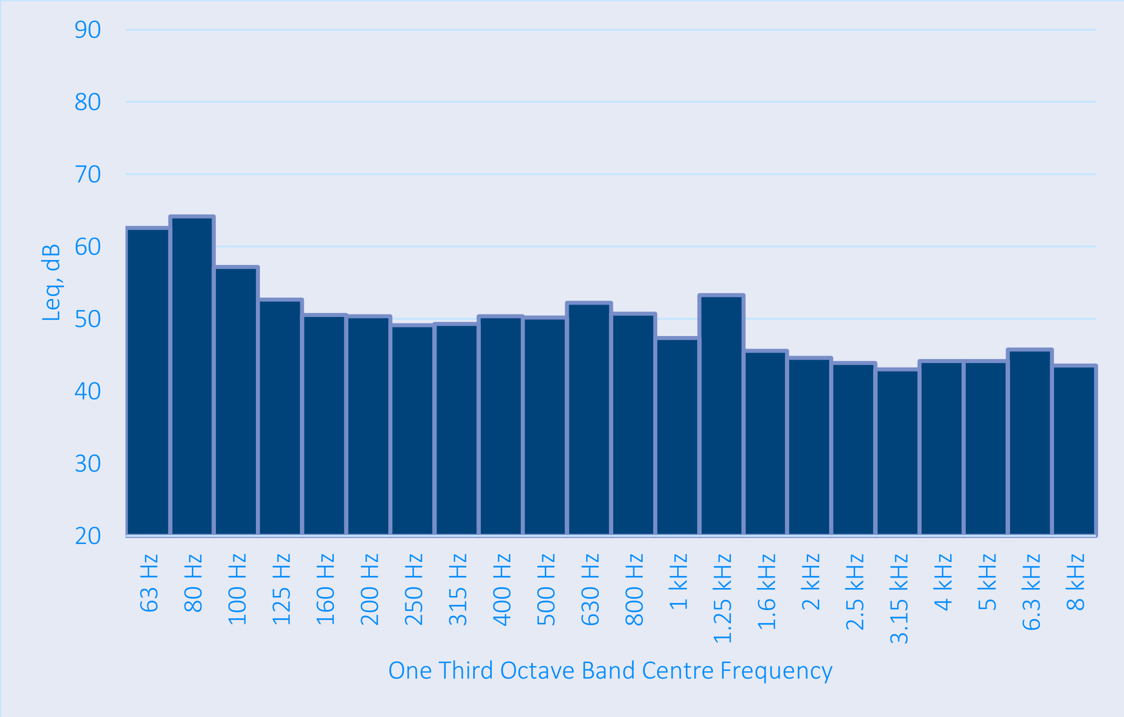
Arcow 1



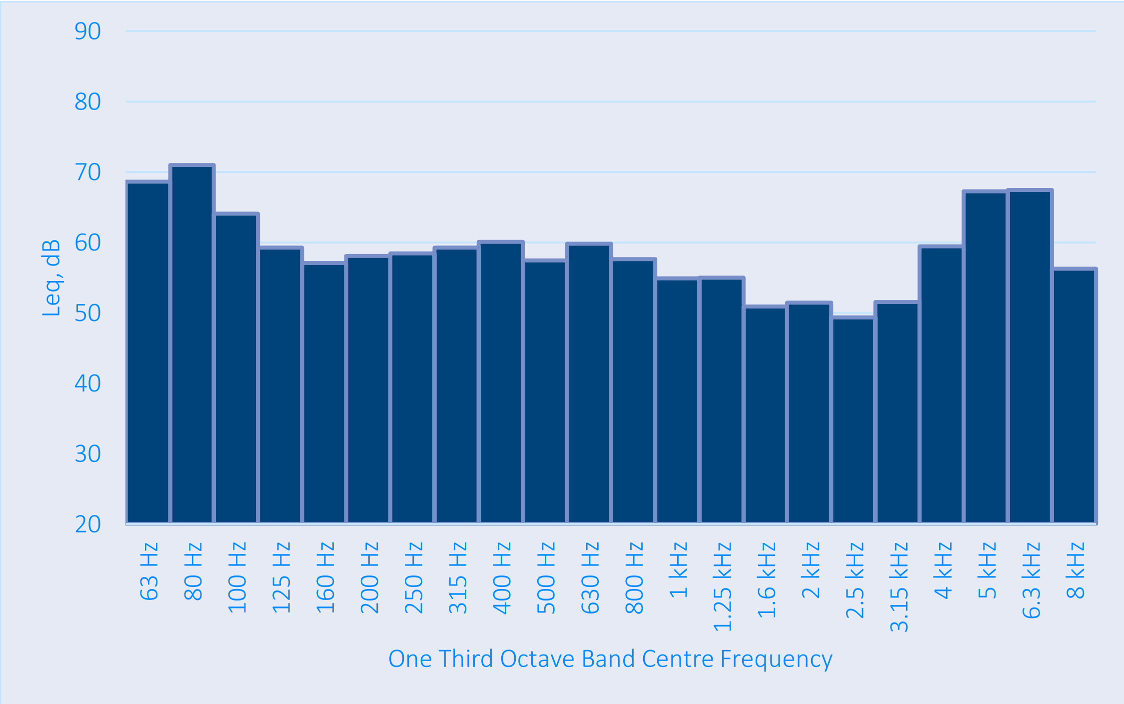
Arcow 2



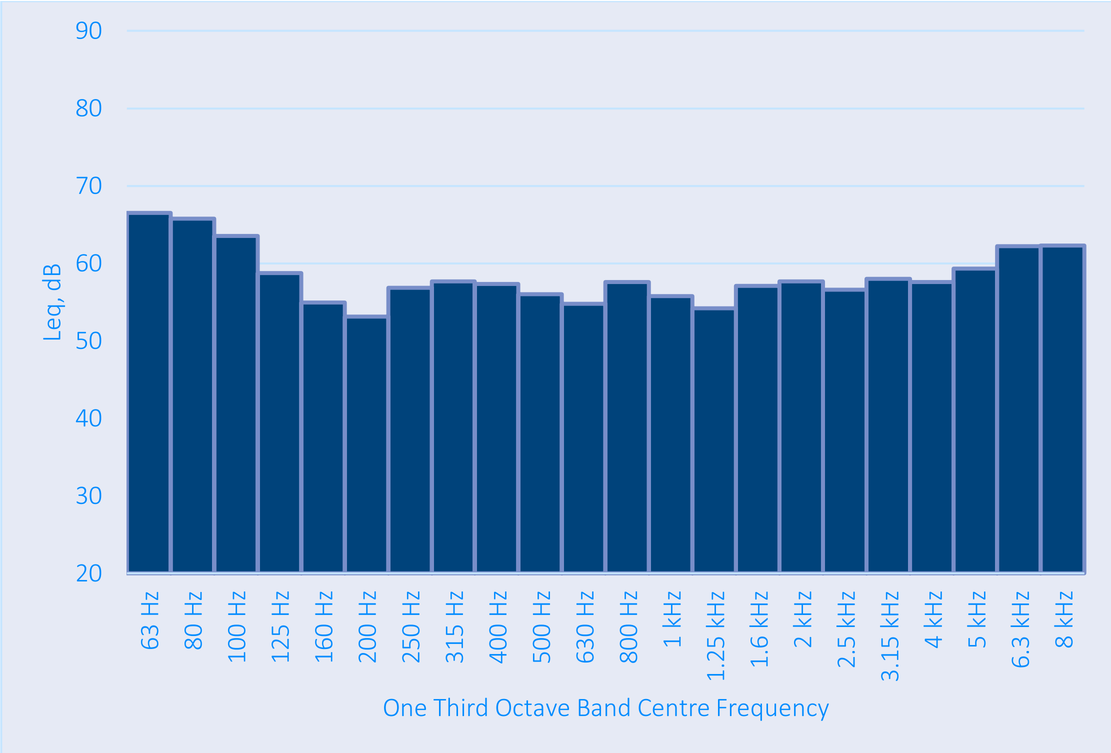
Arcow 3



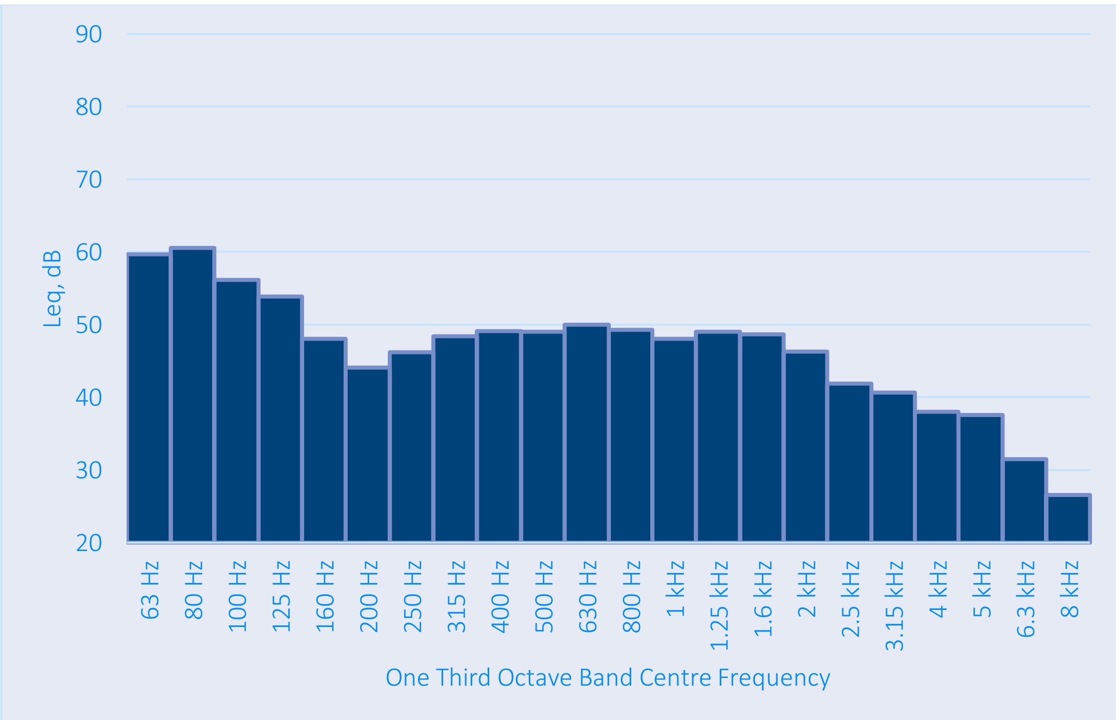
Arcow 4



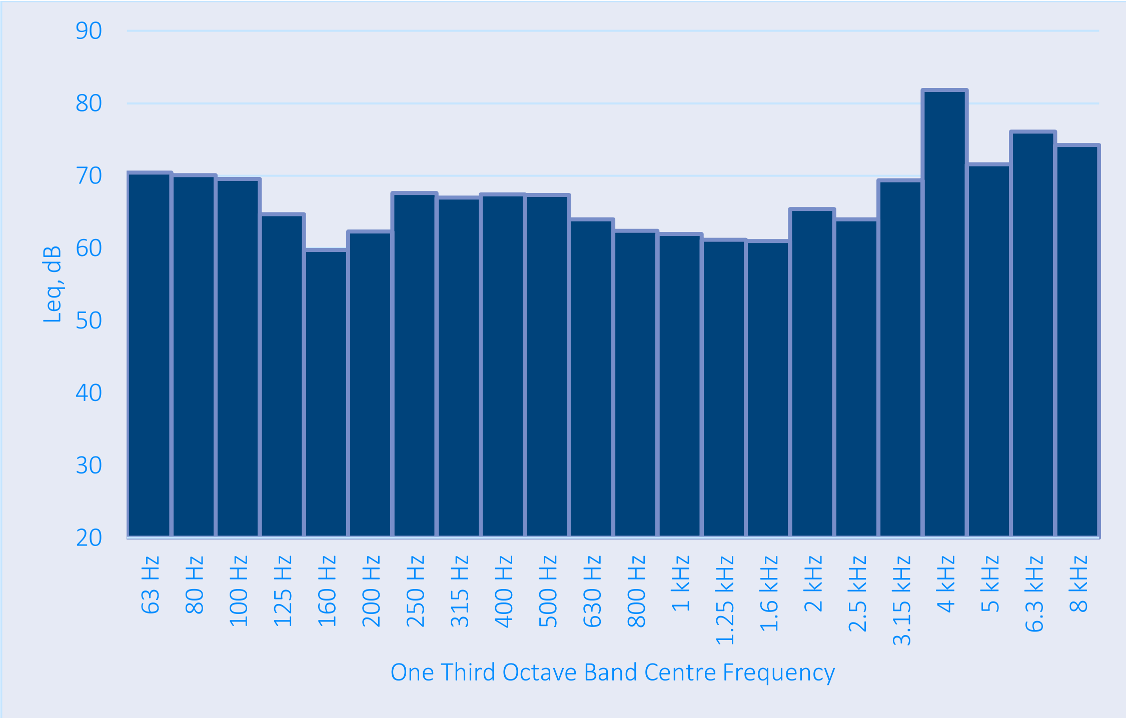
Hadleigh 1



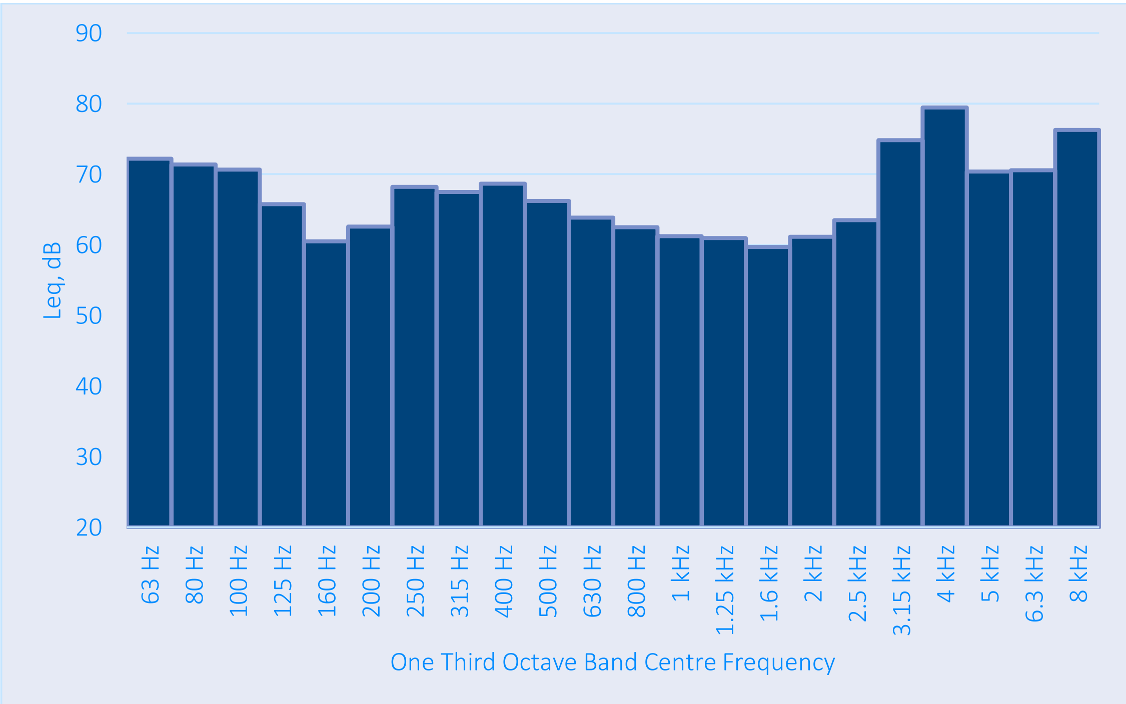
Hadleigh 2



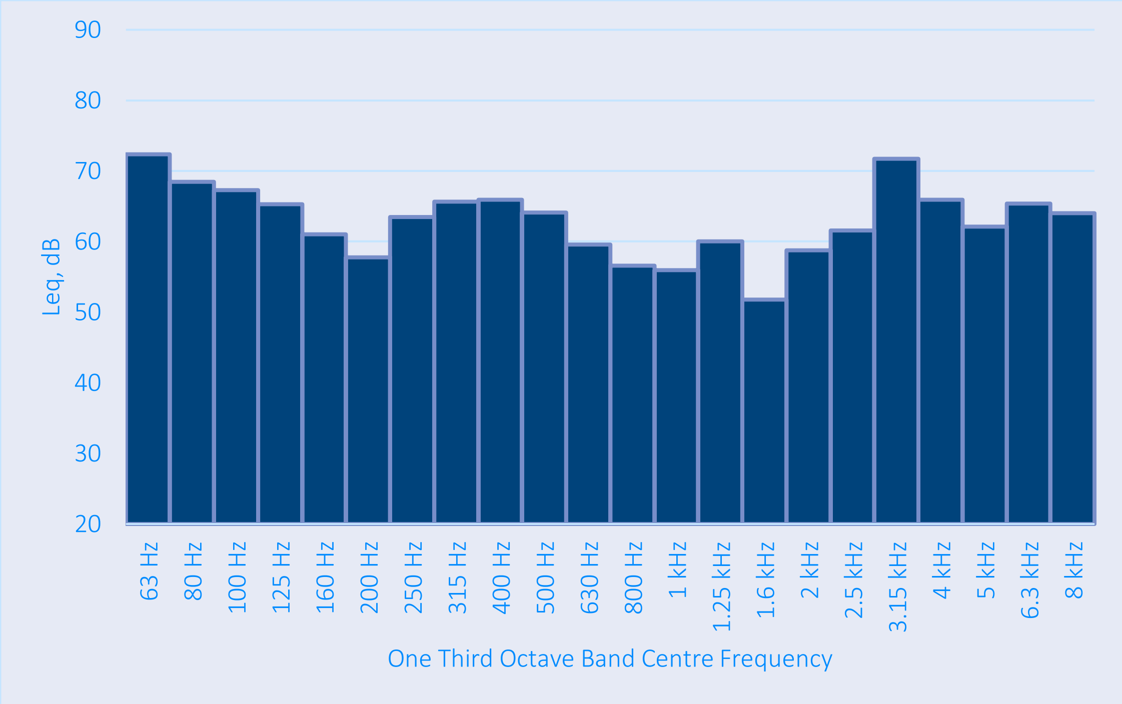
Hadleigh 3



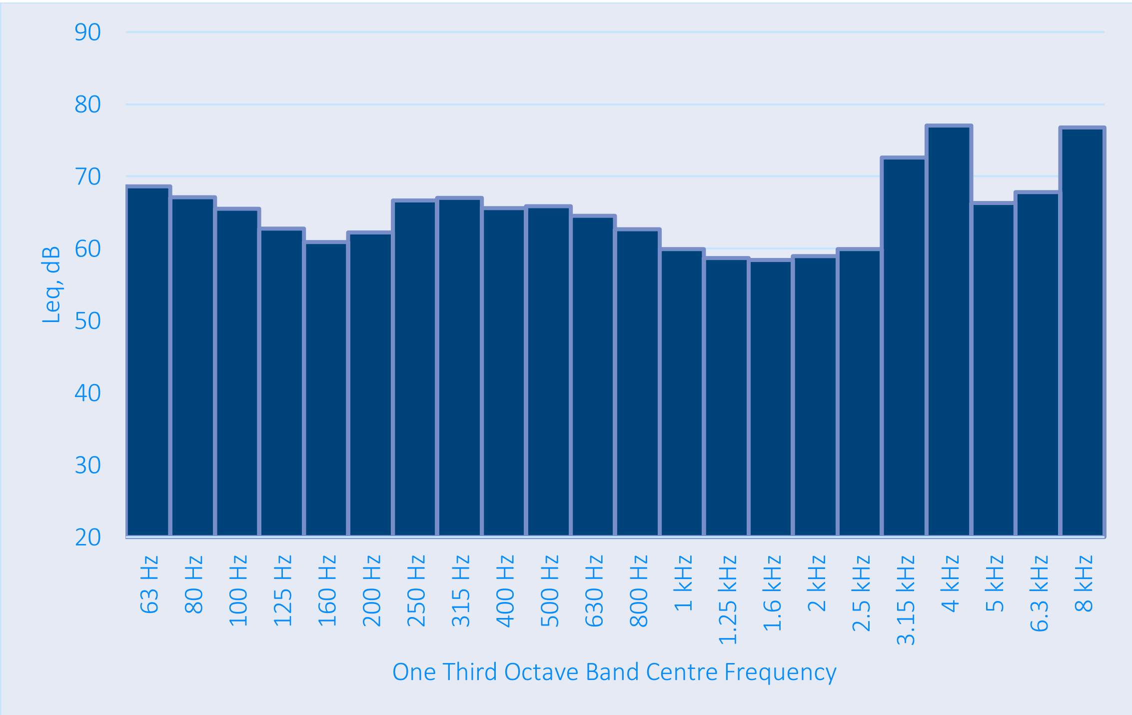
Hadleigh 4



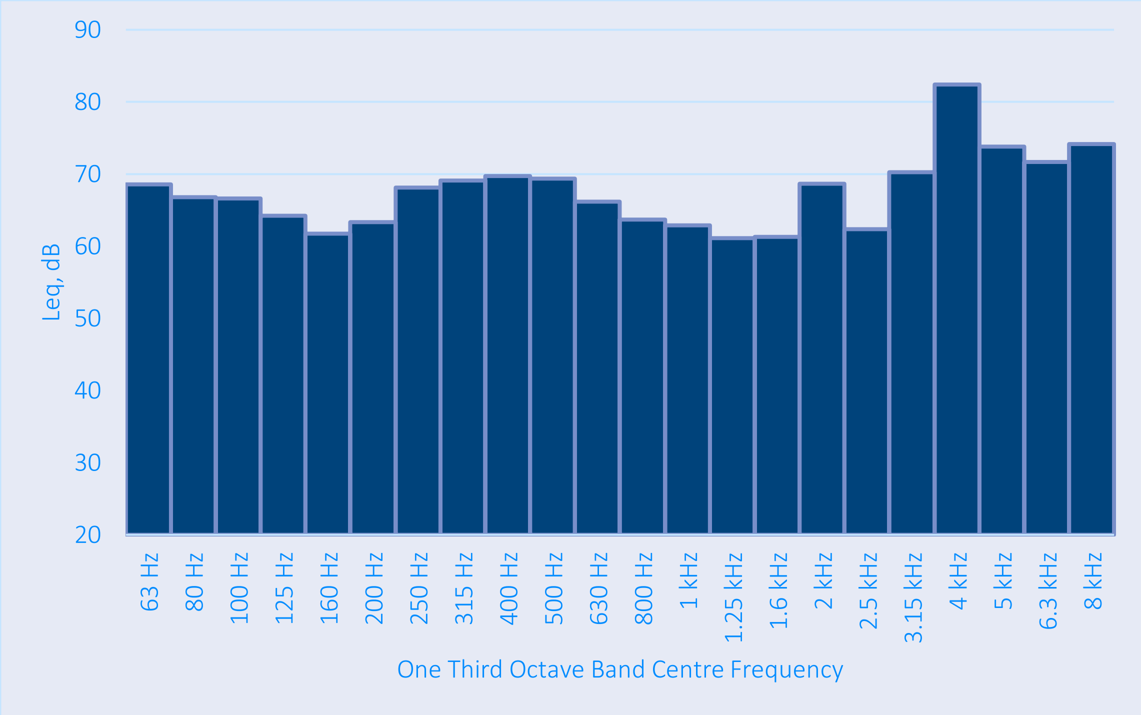
Hadleigh 5



Hadleigh 6



Hadleigh 7


90
80
70
60
50
40
30
20
Leq, dB
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80 Hz
100 Hz
125 Hz
160 Hz
200 Hz
250 Hz
315 Hz
400 Hz
500 Hz
630 Hz
800 Hz
1 kHz
1.25 kHz
1.6 kHz
2 kHz
2.5 kHz
3.15 kHz
4 kHz
5 kHz
6.3 kHz
8 kHz
One Third Octave Band Centre Frequency