A63 Castle Street Improvements, Hull
Environmental Statement

Volume 3, Appendix 7.1

NOISE AND VIBRATION – SURVEY METHODOLOGY AND RESULTS

TR010016/APP/6.3
HE514508-MMSJV-ENV-S0-RP-LA-000003
31 July 2018

A63 Castle Street Improvements, Hull

Environmental Statement

Appendix 7.1 Survey methodology and results

Revision Record

Rev No	Date	Originator	Checker	Approver	Status	Suitability
P01.1	18.04.18	J Edhouse	A Monk-Steel	J McKenna	S0	For review
P02	31.087.18	A Monk Steel	S Dyne	J McKenna	Shared	S4

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1. Survey methodology and results

1.1 Noise measurement survey

1.1.1 This appendix describes the methodology of the baseline noise survey carried out as part of the noise and vibration assessment, and presents the results.

1.2 Methodology

Overview

1.2.1 Noise measurement surveys were conducted in the period Tuesday 28 February to Monday 6 March 2017.

1.2.2 Attended short term measurements were taken at six positions (identified as ST1-2, 4-7; ST3 was replaced by a long term measurement).

1.2.3 Unattended long term measurements were taken at three positions which ran continuously over night-time periods and included three consecutive hourly periods in the period 10:00 to 17:00.

1.2.4 The survey locations were chosen to be representative of noise sensitive receptors that are immediately adjacent to the Scheme boundary particularly residential receptors. The locations were discussed and agreed in consultation with Hull City Council (HCC).

1.2.5 The survey methodology followed the procedures and guidance set out in CRTN, Annex 4 of DMRB HD 213/11[1] and BS 7445[2].

1.2.6 For this measurement survey, the attended measurements were conducted in 1 hour intervals and the $L_{A10,1hour}$ noise index was measured. The road traffic noise index $L_{A10,18h}$ can then be estimated from the attended measurements at each position using the CRTN shortened measurement procedure.

1.2.7 Based on the known traffic distributions on the A63 the CRTN shortened measurement procedure is considered appropriate and would represent the $L_{A10,18hr}$ accurately.

1.2.8 During each attended noise measurement, the conditions on site were noted including the main sources affecting the noise climate and the weather conditions.

1.2.9 All personnel conducting the noise measurements were qualified in acoustics/environmental noise monitoring.

[1] Design Manual for Roads and Bridges Volume 11 Section 3 Part 7 HD 213/11 Noise and Vibration REVISION 1. November 2011.

[2] British Standard BS 7445 Description and Measurement of Environmental Noise – Part 2: Guide to the Acquisition of Data Pertinent to Land Use 1991

Survey limitations

1.2.10 It is not practically or economically possible to monitor noise during all periods of the day and week at all the sensitive receptors that are in proximity to the Scheme boundary. Priority was therefore given to characterising the baseline noise climate at the most sensitive times of day within the periods of construction phase working hours.

1.2.11 Wherever possible, individual measurement positions were selected to provide a suitable overall representation of the groups of sensitive receptors where the noise climate was not observed to vary significantly. For example: at the façade of a row of terraced houses that is parallel and at a reasonably constant distance from a road link that is a significant source of traffic noise.

1.3 Instrumentation

1.3.1 All attended noise measurements were carried out using a Rion NL-52 type sound level meter. Unattended noise measurements were carried out using either a Rion NL-52 type sound level meter or a Larson Davis 820 type sound level meter. All instrumentation was designed to be in compliance with the requirements of the Class 1 standard for accuracy as defined within IEC 61672-1:2003[3].

1.3.2 Laboratory calibration of both sound level meters was conducted no more than two years before the period of the survey. Before and after each measurement session, the sensitivity of the measurement systems was checked using a Larson Davis CAL 200 field calibrator, designed to comply with the Class 1 standard for accuracy set out in IEC 60942 – 2003[4]. Variations of no greater than 0.1 dB were noted over the measurement sessions. Details of the noise equipment used are provided in Table A7.1.1.

Table A7.1.1: Details of the noise measurement equipment used for the baseline noise survey

Item	Serial number
Equipment used for the unattended measurements	
Larson Davis 820 sound level meter	1500
Larson Davis 820 microphone	102562
Larson Davis 820 sound level meter	1699
Larson Davis 820 microphone	108183
Rion NL-52 sound level meter	01143538
Rion UC-59 microphone	10450
Equipment used for the attended measurements	

[3] International Standard IEC 61672 Electroacoustics – Sound level meters – Part 1: Specifications 2003

[4] International Standard IEC 60942 Electroacoustics – Sound calibrators 2003

Item	Serial number
Rion NL-52 sound level meter	00231672
Rion UC-59 microphone	04717
Rion NL-52 sound level meter	00745168
Rion UC-59 microphone	08530
Equipment used for all measurements	
Larson Davis CAL200 field Calibrator	12460
Larson Davis CAL200 field Calibrator	12461

1.3.3 In all cases, the microphone was supported using a tripod to be at a height of 1.2m to 1.6m above local ground level and fitted with a windshield suitable for outdoor use.

1.3.4 The sound level meters were configured to measure a range of acoustic parameters averaged over the measurement interval. The following parameters were recorded as a minimum:

- L_{Aeq} dB — The A-weighted equivalent continuous noise level in decibels
- $L_{A(max)F}$ dB — The A-weighted maximum sound pressure level using the fast time weighting
- L_{A10} dB — The A-weighted noise level exceeded for 10% of the measurement interval
- L_{A90} dB — The A-weighted noise level exceeded for 90% of the measurement interval

1.4 Results

General observations

1.4.1 The dominant source of ambient noise that was observed at survey positions was road traffic using the A63, which varied in nature due to the characteristics of idling, slow moving, braking/accelerating and free-flowing traffic conditions.

1.4.2 Other sources of noise included emergency vehicle sirens, vehicle horns, wind in the trees and pedestrian noise.

1.4.3 Weather conditions at the start of the unattended noise survey at the Myton Centre around 15:00 on Tuesday 27 February 2017 were overcast and damp with minimal wind. Short periods of rain occurred during the survey period however windspeeds remained low. Daytime temperatures varied between 5 and 10°C.

Position ST1 – 5/6 Castle Street

1.4.4 Short term (ST), attended noise measurements were made at 2m from the façade of residential properties on Castle Street adjacent to numbers 5 and 6.

1.4.5 The dominant source of ambient noise was road traffic on the A63 Castle Street, which was generally free flowing.

1.4.6 The results of the measurements at position ST1 are presented in Table A7.1.2.

Table A7.1.2: Results of the noise measurement at position ST1 – 5/6 Castle Street (2m from façade)

Start time	$L_{Aeq,1hour}$ dB	$L_{A10,1hour}$ dB	$L_{A90,1hour}$ dB	$L_{A(max)Fast}$ dB	Comments
10:10 01/03/17	76.2	78.5	70.4	99.9	A63 free flowing
11:10 01/03/17	75.7	78.1	69.3	101.4	A63 free flowing
12:10 01/03/17	75.9	78.1	68.2	101.0	A63 free flowing

Position ST2 – Castle Street/Vicar Lane

1.4.7 Short term, attended noise measurements were made at 5m from the carriageway edge on Castle Street in free field conditions and adjacent to the corner of Vicar Lane.

1.4.8 The dominant source of ambient noise was road traffic on the A63 Castle Street. Traffic was generally free flowing.

1.4.9 The results of the measurements at position ST2 are presented in Table A7.1.3.

Table A7.1.3: Results of the noise measurement at position ST2 – Castle Street/Vicar Lane (1m façade)

Start time	$L_{Aeq,1hour}$ dB	$L_{A10,1hour}$ dB	$L_{A90,1hour}$ dB	$L_{A(max)Fast}$ dB	Comments
14:00 01/03/17	76.4	78.7	70.4	97.4	A63 free flowing
15:00 01/03/17	75.5	78.3	67.6	95.3	A63 free flowing
16:00 01/03/17	74.9	77.9	68.0	92.6	A63 free flowing

Position ST4 – Porter Street

1.4.10 Short term, attended noise measurements were made close to the western end of Porter Street. The nearest receptors are residential properties on Porter Street.

1.4.11 The dominant source of ambient noise was road traffic on the A63 Hessle Road. Other environmental noise sources contributed to noise measurements including from birdsong at this location.

1.4.12 The results of the measurements at position ST4 are presented in Table A7.1.4.

Table A7.1.4: Results of the noise measurement at position ST4 – Porter Street (free field)

Start time	$L_{Aeq,1hour}$ dB	$L_{A10,1hour}$ dB	$L_{A90,1hour}$ dB	$L_{A(max)Fast}$ dB	Comments
10:20 28/02/17	73.2	75.6	69.2	86.5	A63 free flowing
11:20 28/02/17	73.0	75.3	69.1	86.6	A63 free flowing
12:20 28/02/17	73.3	75.6	69.1	92.8	A63 free flowing

Position ST5 – Humber Dock

1.4.13 Short term, attended noise measurements were made on the western edge of Humber Dock as shown in Figure A7.1.1. The nearest sensitive receptor is the Holiday Inn hotel.

Figure A7.1.1: Photograph of the measurement position ST5 – Humber Dock

1.4.14 The dominant source of ambient noise was road traffic on the A63 Castle Street.

1.4.15 The results of the measurements at position ST5 are presented in Table A7.1.5.

Table A7.1.5: Results of the noise measurement at position ST5 – Humber Dock (free field)

Start time	$L_{Aeq,1hour}$ dB	$L_{A10,1hour}$ dB	$L_{A90,1hour}$ dB	$L_{A(max)Fast}$ dB	Comments
10:10 01/03/17	73.7	76.5	67.9	96.5	A63 free flowing
11:10 01/03/17	73.3	75.9	67.0	95.4	A63 free flowing

Start time	$L_{Aeq,1hour}$ dB	$L_{A10,1hour}$ dB	$L_{A90,1hour}$ dB	$L_{A(max)Fast}$ dB	Comments
12:10 01/03/17	72.8	75.4	66.3	95.8	A63 free flowing

Position ST6 – Marina Court, Castle Street

1.4.16 Short term, attended noise measurements were made close to commercial receptors at Marina Court on the south side of A63 Castle Street as shown in Figure A7.1.2.

Figure A7.2.2: Photograph of the measurement position ST6 – Marina Court

1.4.17 The dominant source of ambient noise was road traffic on the A63 Castle Street which was generally free flowing during all measurements.

1.4.18 The results of the measurements at position ST6 are presented in Table A7.1.6.

Table A7.1.6: Results of the noise measurement at position ST6 – Marina Court Castle Street (free field)

Start time	$L_{Aeq,1hour}$ dB	$L_{A10,1hour}$ dB	$L_{A90,1hour}$ dB	$L_{A(max)Fast}$ dB	Comments
13:55 01/03/17	75.8	78.1	70.0	99.3	A63 free flowing
14:55 01/03/17	74.5	76.2	67.4	103.5	A63 free flowing
15:55 01/03/17	72.9	75.6	67.0	94.3	A63 free flowing

Position ST7 – Commercial Road

1.4.19 Short term, attended noise measurements were made at the south west corner of the Mytongate roundabout near to the Whittington and Cat public house.

1.4.20 The dominant source of ambient noise was road traffic on the A63.

1.4.21 The results of the measurements at position ST7 are presented in Table A7.1.7.

Table A7.1.7: Results of the noise measurement at position ST7 – Whittington and Cat public house, Commercial Road

Start time	$L_{Aeq,1hour}$ dB	$L_{A10,1hour}$ dB	$L_{A90,1hour}$ dB	$L_{A(max)Fast}$ dB	Comments
13:55 28/02/17	75.2	78.1	67.1	90.8	A63 free flowing
14:55 28/02/17	75.9	78.2	67.2	101.9	A63 free flowing
15:55 28/02/17	75.8	78.6	67.0	90	A63 free flowing

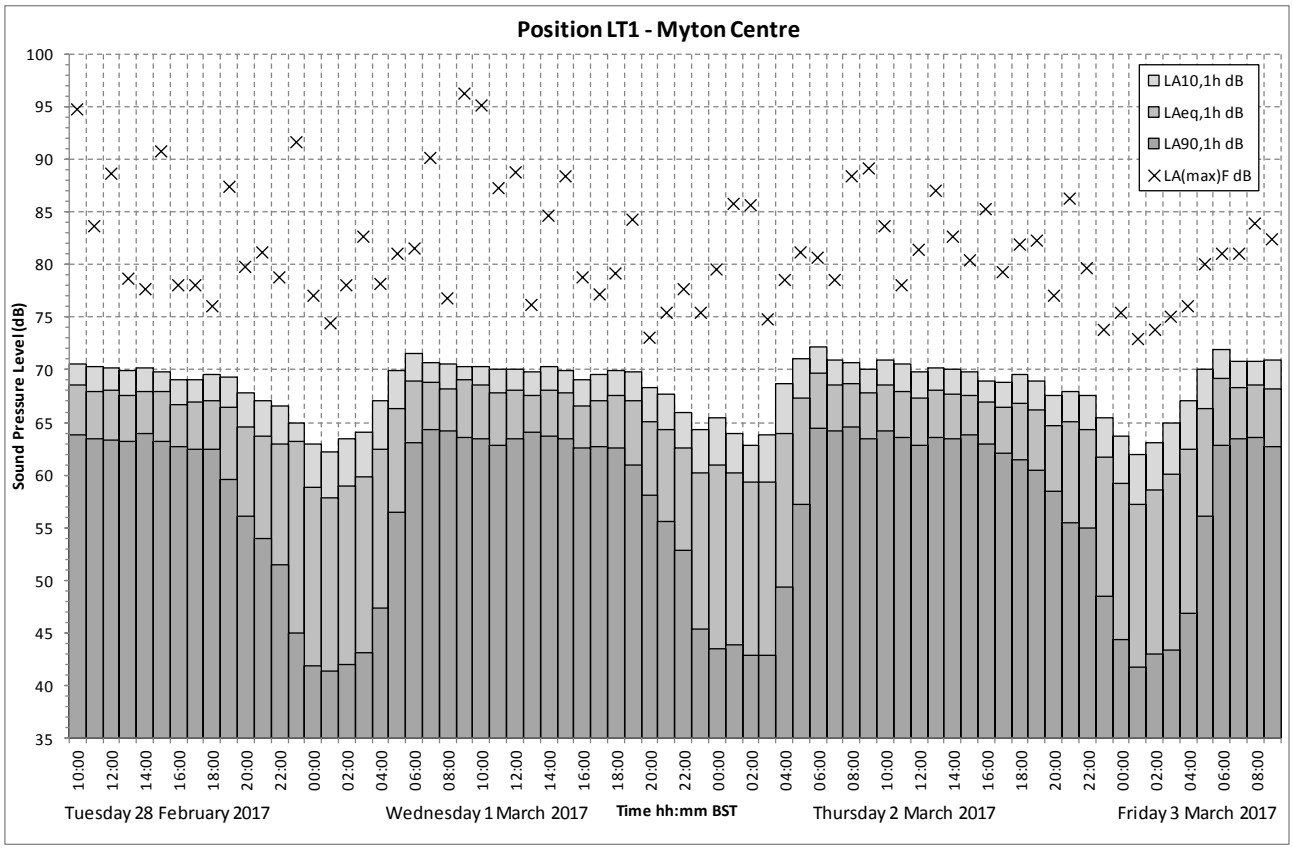
Position LT1 – Myton Centre

1.4.22 A long term (LT), unattended noise measurement was made on a grassed area within the grounds of the Myton Centre. The equipment was secured to the Myton Centres boundary fence and the microphone was 19m from the nearest edge of the A63. The measurement ran from 10:00 on Tuesday 28 February to 10:00 on Friday 3 March 2017.

1.4.23 The dominant source of ambient noise was road traffic on the A63.

1.4.24 The measured hourly noise levels are presented in the chart shown at Figure A7.1.3. The calculated $L_{A10,18h}$ dB values are 69.3 to 69.4 dB(A).

Figure A7.1.3: Hourly noise levels measured at the measurement position LT1 – Myton Centre (free-field)



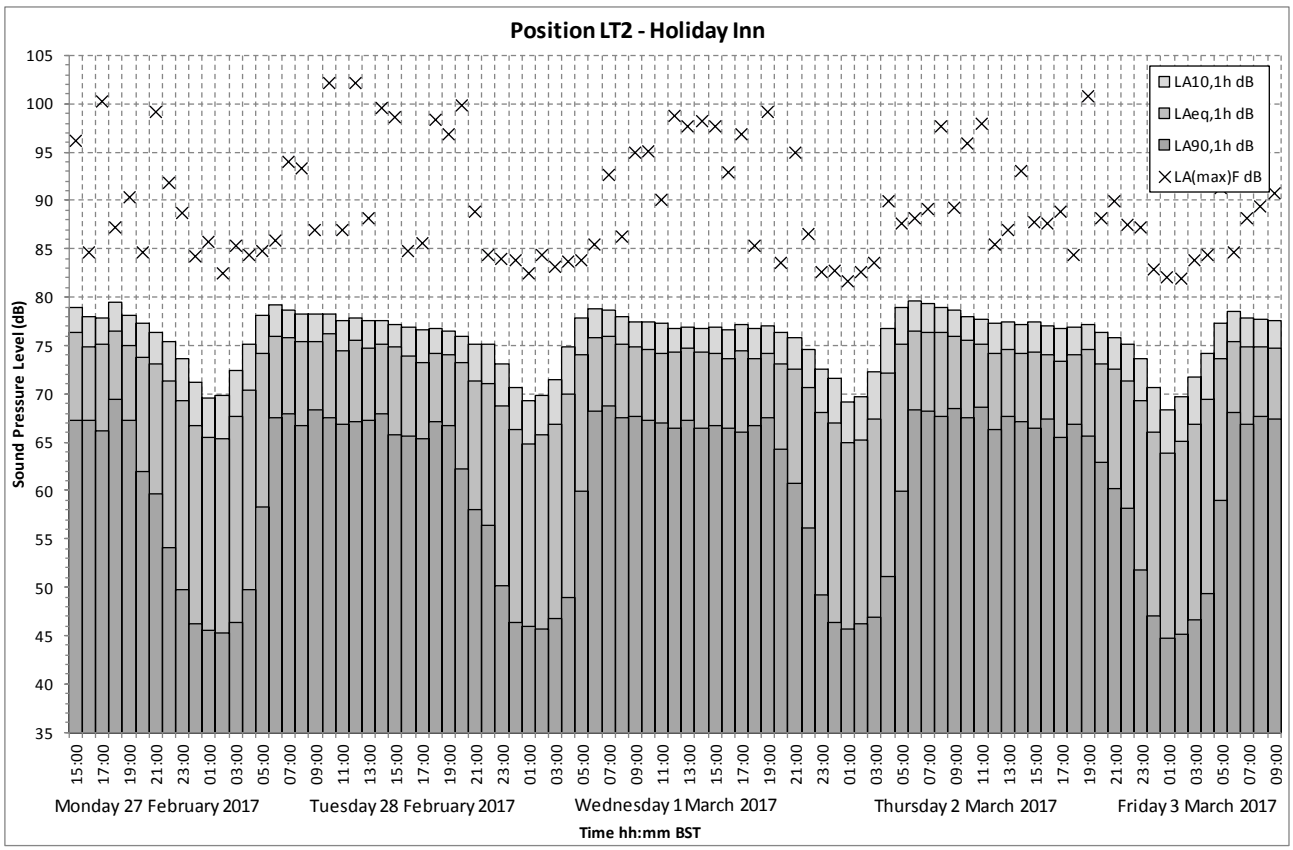
Position LT2 – Holiday Inn

1.4.25 A long term, unattended noise measurement was on a grassed area between the Holiday Inn and the A63 Castle Street. The measurement ran from 14:55 on Tuesday 27 February to 09:40 on Friday 3 March 2017.

1.4.26 The dominant source of ambient noise was road traffic on the A63.

1.4.27 Figure A7.1.4 presents the hourly noise levels measured between 15:00 on Monday 27 February and 09:00 on Friday 3 March 2017. The $L_{A10,18h}$ dB values were found to be 77.0, 76.8 and 77.3 dB(A) for respective days (28 February to 2 March 2017)

Figure A7.1.4: Hourly noise levels measured at the measurement position LT2 – Holiday Inn Hotel (free field)



Position LT3 – William Street

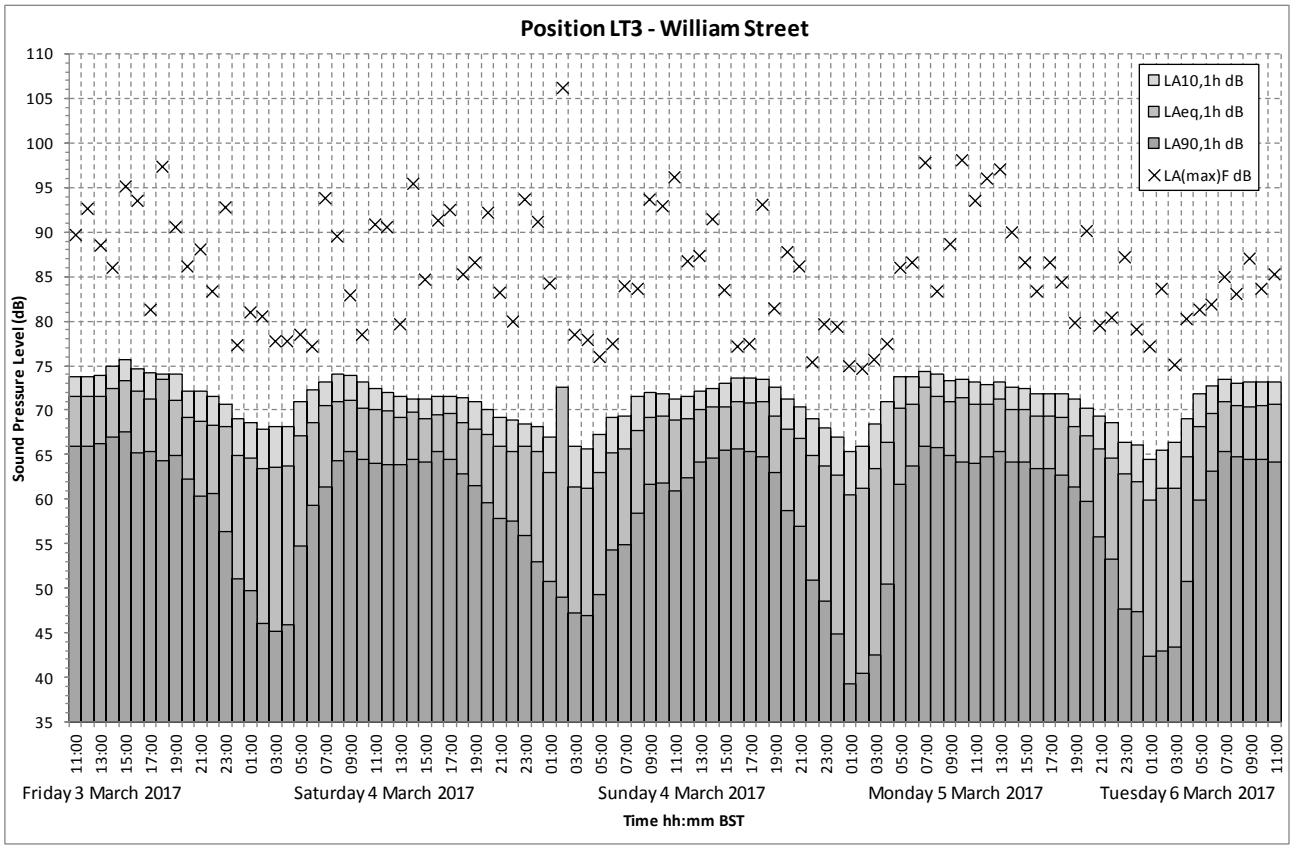
1.4.28 Long term, unattended noise measurements were made on the balcony of a residential property at the eastern end of William Street. This location is shown in Figure A7.1.5 and is representative of the nearest residential properties on William Street and Cogan Street.

Figure A7.3.5: Photograph of the measurement position LT3 – William Street

1.4.29 The dominant source of ambient noise was road traffic on the A63.

1.4.30 Figure A7.1.6 presents the hourly noise levels measured between 15:00 on 09:00 on Friday 3 March and Tuesday 7 March 2017. The calculated $L_{A10,18h}$ dB values were found to be 71.5, 71.4 and 71.9 dB(A) for each respective daytime period (4 to 6 March 2017).

Figure A7.1.6: Hourly noise levels measured at the measurement position LT3 – William Street (free field)



1.5 Summary

1.5.1 The results of the noise survey in terms of UK traffic noise index ($L_{A10,18h}$) are summarised in Table A7.1.8. All results have been corrected where necessary to be presented as façade noise levels. The estimated traffic noise nuisance is also given using the curve for steady state noise that is presented in Figure A6.1 within Annex 6 of HD 213/11.

Table A7.1.8: Summary of the baseline daytime noise levels (façade) and estimated nuisance levels

Position	$L_{A10,18h}$ dB	Estimated Nuisance Level (% bothered very much or quite a lot by traffic noise)
ST1 – 5/6 Castle Street	77	54%
ST2 – Castle Street/Vicar Lane	77	54%
ST4 – Porter Street	75	48%
ST5 – Princes Dock	75	48%
ST6 – Marina Court	76	51%
ST7 – Whittington and Cat	77	54%
LT1 – Myton Centre (non-residential)	69	31%
LT2 – Holiday Inn	77	54%
LT3 – William Street/Cogan Street	72	39%

1.5.2 This shows that existing noise levels are reasonably high due to road traffic noise from the A63 where in some places the estimated nuisance level indicates that the percentage of people bothered is over 50%.

1.5.3 Night time noise levels from the LT1, LT2 and LT3 measurement positions are presented in Table A7.1.9. It should be noted that the value given for $L_{Aeq,8hr}$ is based on the levels measured over a number of night-time periods at each location and not an annual average.

Table A7.1.9: Summary of the baseline daytime noise levels (façade)

Position	$L_{A10,1h}$ dB 23:00 to 07:00	L_{Night} dB 23:00 to 07:00
LT1 – Myton Centre (non-residential)	62 to 72	64
LT2 – Holiday Inn	68 to 79	71
LT3 – William Street/Cogan Street	65 to 74	65

1.5.4 The results of the night-time measurements indicate that the baseline noise levels were significantly above the Night Noise Guideline of 55 dB L_{Night}.

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Volume 3, Appendix 7.2

NOISE AND VIBRATION – NOISE SURVEY INSTRUMENTATION CALIBRATION CERTIFICATES

TR010016/APP/6.3
HE514508-MMSJV-ENV-S0-RP-LA-000002
31 July 2018

A63 Castle Street Improvements, Hull

Environmental Statement

Appendix 7.2 Noise survey instrumentation calibration certificates

Revision Record

Rev No	Date	Originator	Checker	Approver	Status	Suitability
P01.1	18.04.18	J Edhouse	A Monk Steel	J McKenna	S0	For review
P02	31.087.18	A Monk Steel	S Dyne	J McKenna	Shared	S4

Prepared for:
Highways England
Lateral
8 City Walk
Leeds
LS11 9AT

Prepared by:
Mott MacDonald Sweco JV
Stoneham Place, Stoneham Lane
Southampton, Hampshire
SO50 9NW

1. Calibration certificates

CERTIFICATE OF CALIBRATION

Issued by: MTS Calibration Ltd.

Telephone: +44 (0)1642 876 410

Laboratory address: 17 Elvington Close, Billingham TS23 3YS, England

Please note delivery address below

UKAS CALIBRATION 0607

Date of Issue: 22 August 2016 **Certificate Number:** 29113U

Sound Calibrator

Client: Mott Macdonald
Stoneham Place
Stoneham Lane, Eastleigh
Southampton, SO50 9NW

Larson Davis **Model CAL200** **Serial Number 12460**

Two Reference Calibrators, each calibrated by the National Physical Laboratory, were used to establish the sensitivity of the measurement chain. The same measurement chain is then used to determine the output level of the Object Calibrator by the difference between its output and that of the nominated Reference Calibrator. Four independent measurements of the third-octave band sound pressure levels produced by the Reference Calibrators and the Object Calibrator are averaged to minimise uncertainties of the calibration. The measurement chain consists of an NPL-Calibrated Reference Microphone and internally calibrated Reference Preamplifier and Reference Analyser.

As well as providing a traceable measurement of the sound pressure level in the cavity of the Object Calibrator, the Calibrator's frequency and total harmonic distortion are also measured. Frequency is determined from the average of four independent measurements using a multimeter with a current UKAS-accredited calibration. The total harmonic distortion is measured from the average of three independent measurements by third octave analysis, subtracting the level of the fundamental frequency from the sum of the combined harmonics in the frequency band to 20kHz. The complete procedure is detailed in the MTS Calibration Ltd work procedure WP01.

The sound pressure level generated by the calibrator in its WS2 configuration was measured by reference to Brüel & Kjær Model 4133 Microphone and referance Sound Calibrator as shown in the Test Equipment section below. The measured values were:

Output Level 1:	**93.89**	**dB re 20µPa**	**+/- 0.14 dB (k= 2.00)**
Fundamental Frequency 1:	**1000.33**	**Hz**	**+/- 0.11 Hz (k= 2.00)**
Total Harmonic Distortion 1:	**0.401**	**%**	**+/- 0.010 % (k= 2.00)**
Output Level 2:	**113.95**	**dB re 20µPa**	**+/- 0.14 dB (k= 2.00)**
Fundamental Frequency 2:	**1000.33**	**Hz**	**+/- 0.11 Hz (k= 2.00)**
Total Harmonic Distortion 2:	**0.506**	**%**	**+/- 0.010 % (k= 2.00)**

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k (individually calculated as above), providing a coverage probability of approximately 95%. The uncertainty evaluation has been calculated in accordance with the current version of UKAS publication M3003.

Measurement Conditions:

Temperature	23.2	°C
Atmospheric Pressure	1013.3	mBar
Relative Humidity	48.3	%

This measurement is valid only for the above device configured for calibration of a WS-2 microphone under the above environmental conditions. For deviation of prevailing conditions, the manufacturer's literature for the calibrator should be referred to.

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Calibration Due
Reference Microphone	Brüel & Kjær	4133	810486	TE 155	Sep-16
Reference Calibrator	Brüel & Kjær	4231	2326247	TE 129	Oct-17
Real-Time Frequency Analyser	Larson Davis	2900	0492	TE 108	Oct-16

Date of Receipt: 17 August 2016
Date of Measurement: 22 August 2016

Approved Signatory: [redacted] *tuart Cowling*

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This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to recognised national standards and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This Certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

PLEASE SEND ALL DELIVERIES TO:

MTS Calibration Ltd

Company Registration Number: 04184703 England and Wales

The Grange Business Centre, Belasis Avenue, Billingham TS23 1LG, England

Telephone: 0044 1642 876410 Fax: 0044 1642 876411 E-Mail: dmarsh@slmcal.co.uk or tsherris@slmcal.co.uk http\\www.slmcal.co.uk

CERTIFICATE OF CALIBRATION

Issued by: MTS Calibration Ltd.

Telephone: +44 (0)1642 876 410

Laboratory address: 17 Elvington Close, Billingham TS23 3YS, England

Please note delivery address below

UKAS CALIBRATION 0607

Date of Issue: 07 September 2016 **Certificate Number:** 29181U

Sound Calibrator

Client: Mott Macdonald
Stoneham Place
Stoneham Lane, Eastleigh
Southampton, SO50 9NW

Larson Davis **Model CAL200** **Serial Number 12461**

Two Reference Calibrators, each calibrated by the National Physical Laboratory, were used to establish the sensitivity of the measurement chain. The same measurement chain is then used to determine the output level of the Object Calibrator by the difference between its output and that of the nominated Reference Calibrator. Four independent measurements of the third-octave band sound pressure levels produced by the Reference Calibrators and the Object Calibrator are averaged to minimise uncertainties of the calibration. The measurement chain consists of an NPL-Calibrated Reference Microphone and internally calibrated Reference Preamplifier and Reference Analyser.

As well as providing a traceable measurement of the sound pressure level in the cavity of the Object Calibrator, the Calibrator's frequency and total harmonic distortion are also measured. Frequency is determined from the average of four independent measurements using a multimeter with a current UKAS-accredited calibration. The total harmonic distortion is measured from the average of three independent measurements by third octave analysis, subtracting the level of the fundamental frequency from the sum of the combined harmonics in the frequency band to 20kHz. The complete procedure is detailed in the MTS Calibration Ltd work procedure WP01.

The sound pressure level generated by the calibrator in its WS2 configuration was measured by reference to Brüel & Kjær Model 4133 Microphone and referance Sound Calibrator as shown in the Test Equipment section below. The measured values were:

Output Level 1:	**93.91**	**dB re 20µPa**	**+/- 0.14 dB (k= 2.00)**
Fundamental Frequency 1:	**1000.38**	**Hz**	**+/- 0.11 Hz (k= 2.00)**
Total Harmonic Distortion 1:	**0.865**	**%**	**+/- 0.021 % (k= 2.00)**
Output Level 2:	**113.96**	**dB re 20µPa**	**+/- 0.14 dB (k= 2.00)**
Fundamental Frequency 2:	**1000.36**	**Hz**	**+/- 0.11 Hz (k= 2.00)**
Total Harmonic Distortion 2:	**0.886**	**%**	**+/- 0.021 % (k= 2.00)**

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k (individually calculated as above), providing a coverage probability of approximately 95%. The uncertainty evaluation has been calculated in accordance with the current version of UKAS publication M3003.

Measurement Conditions:

Temperature	23.3	°C
Atmospheric Pressure	1016	mBar
Relative Humidity	43.9	%

This measurement is valid only for the above device configured for calibration of a WS-2 microphone under the above environmental conditions. For deviation of prevailing conditions, the manufacturer's literature for the calibrator should be referred to.

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Calibration Due
Reference Microphone	Brüel & Kjær	4133	810486	TE 155	Sep-16
Reference Calibrator	Brüel & Kjær	4231	2326247	TE 129	Oct-17
Real-Time Frequency Analyser	Larson Davis	2900	0492	TE 108	Oct-16

Date of Receipt: 06 September 2016
Date of Measurement: 07 September 2016

Approved Signatory [redacted] *Stuart Cowling*

Page 1 of 1

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to recognised national standards and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This Certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

PLEASE SEND ALL DELIVERIES TO:

MTS Calibration Ltd

Company Registration Number: 06588525 England and Wales

The Grange Business Centre, Belasis Avenue, Billingham TS23 1LG, England

Telephone: 0044 1642 876410 Fax: 0044 1642 876411 E-Mail: dmarsh@slmcal.co.uk or tsherris@slmcal.co.uk http\\www.slmcal.co.uk

PC Environmental Ltd
Calibration Centre
The Grange Business Centre
Belasis Avenue
Billingham TS23 1LG

Phone: +44 (0) 1489 891853
Fax: +44 (0) 1642 876411
E-Mail: tsherris@slmcal.co.uk
Web: www.pcenvironmental.co.uk

Calibration Certificate

Sound Level Meter

Certificate Number: 28059

Client: Mott Macdonald
Stoneham Place
Stoneham Lane, Eastleigh
Southampton, SO50 9NW

Instrument Make:	Larson Davis	***Microphone Make:***	PCB
Instrument Model:	820	***Microphone Model:***	377B02
Serial Number:	1500	***Serial Number:***	102562
Preamplifier Make:	Larson Davis	***Calibrator Make:***	Larson Davis
Preamplifier Model:	828	***Calibrator Model:***	CAL250
Serial Number:	2327	***Calibrator Serial Number:***	4483
		Calibrator Adaptor:	none
Extension Cable:	cable not supplied	***Calibrator Certification Ref:***	S6559

This is to certify that the above instrument was calibrated according to MTS Calibration Ltd. Measurement Procedures and was found to comply as summarised below. The measurements were carried out using the Test Equipment listed below, all of whose calibrations are traceable to UK National Standards. The management controls of MTS Calibration Ltd. are registered in its current Quality Manual, and are designed to be in compliance with BS EN ISO/IEC 17025: 2005. Copies of the relevant certificates, test procedures and test results, together with the traceability of test equipment are filed with MTS Calibration Ltd. and extracts are available on request

This instrument was tested in accordance with the recommendations of BS 7580: Part 1 1997 (not all tests were performed) with the following results:

	Manufacturer's Specification	*BS EN 60651 Type 1*
Self-Generated Noise:	**Complies**	**no specification – measured 16.7 dB(A)**
Dynamic Linearity – electrical response:	**Complies**	**Complies between 21.8 and 129.7 dB(A)**
Frequency Weighting A - electrical response:	**Complies**	**Complies**
Frequency Weighting A - acoustic response:	**Complies**	**Complies**
Frequency Weighting C - electrical response:	**Fails**	**Complies**
Burst (RMS accuracy):	**Complies**	**Complies**
Time Weightings F, S, I (Detector):	**Complies**	**Complies**
Microphone Response:	**Complies**	**Complies** (assessed as overall acoustic specification)

The Preamplifier required repair in order to achieve the above specification

Calibrated at 114.12 dB re 20µPa, 250 Hz – calibration offset = 8.0 dB

Polarisation Voltage 200 V

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Condenser Microphone	Larson Davis	2541	7300	TE 157	October 2017
Acoustic Calibrator 250Hz	Larson Davis	CAL250	4483	TE 116	September 2018
Real-Time Frequency Analyser	Larson Davis	2900	0510	TE 165	October 2016
Digital Multimeter	Agilent	34401A	MY41046986	TE 152	September 2016
Signal Generator	Agilent	33120A	MY40007806	TE 160	September 2016

Date of Receipt: 6th January 2016
Date of Calibration: 18th to 19th January 2016
Date of Certificate Issue: 19th January 2016

Authorised Signatory: [redacted]

Tony Sherris

PC Environmental Ltd
Calibration Centre
The Grange Business Centre
Belasis Avenue
Billingham TS23 1LG

Phone: +44 (0) 1489 891853
Fax: +44 (0) 1642 876411
E-Mail: tsherris@slmcal.co.uk
Web: www.pcenvironmental.co.uk

Calibration Certificate

Sound Level Meter

Certificate Number: 28581

Client: Mott Macdonald
Stoneham Place
Stoneham Lane, Eastleigh
Southampton, SO50 9NW

Instrument Make:	Larson Davis	***Microphone Make:***	PCB
Instrument Model:	820	***Microphone Model:***	377B02
Serial Number:	1699	***Serial Number:***	108183
Preamplifier Make:	Larson Davis	***Calibrator Make:***	not supplied
Preamplifier Model:	828	***Calibrator Model:***	
Serial Number:	2658	***Calibrator Serial Number:***	
		Calibrator Adaptor:	
Extension Cable:	No cable supplied	***Calibrator Certification Ref:***	

This is to certify that the above instrument was calibrated according to MTS Calibration Ltd. Measurement Procedures and was found to comply as summarised below. The measurements were carried out using the Test Equipment listed below, all of whose calibrations are traceable to UK National Standards. The management controls of MTS Calibration Ltd. are registered in its current Quality Manual, and are designed to be in compliance with BS EN ISO/IEC 17025: 2005. Copies of the relevant certificates, test procedures and test results, together with the traceability of test equipment are filed with MTS Calibration Ltd. and extracts are available on request

This instrument was tested in accordance with the recommendations of BS 7580: Part 1 1997 (not all tests were performed) with the following results:

	Manufacturer's Specification	*BS EN 60651 Type 1*
Self-Generated Noise:	**Complies**	**no specification – measured 16.5 dB(A)**
Dynamic Linearity – electrical response:	**Complies**	**Complies between 24.4 and 128.2 dB(A)**
Frequency Weighting A - electrical response:	**Complies**	**Complies**
Frequency Weighting A - acoustic response:	**Complies**	**Complies**
Frequency Weighting C - electrical response:	**Complies**	**Complies**
Burst (RMS accuracy):	**Complies**	**Complies**
Time Weightings F, S, I (Detector):	**Complies**	**Complies**
Microphone Response:	**Complies**	**Complies** (assessed as overall acoustic specification)

No modifications were necessary in order to achieve the above specification

Calibrated at 114.12 dB re 20µPa, 250 Hz – calibration offset = 7.4 dB

Polarisation Voltage 0 V

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Condenser Microphone	Larson Davis	2541	7300	TE 157	October 2017
Acoustic Calibrator 250Hz	Larson Davis	CAL250	4483	TE 116	September 2018
Real-Time Frequency Analyser	Larson Davis	2900	0510	TE 165	October 2016
Digital Multimeter	Agilent	34401A	MY41046986	TE 152	September 2016
Signal Generator	Agilent	33120A	MY40007806	TE 160	September 2016

Date of Receipt: 6th April 2016
Date of Calibration: 11th April 2016
Date of Certificate Issue: 11th April 2016

Authorised Signatory: [redacted]

Tony Sherris

CERTIFICATE OF CALIBRATION

Date of Issue: 14 October 2015 **Certificate Number: TCRT15/1271**

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory [redacted]

M. Breslin [ ] K. Mistry [ ] J. Harriman [✓]

Customer	Mott MacDonald Limited Stoneham Place Stoneham Lane Southampton SO50 9NW
Order No.	warranty
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification

Manufacturer	*Instrument*	*Type*	*Serial No. / Version*
Rion	Sound Level Meter	NL-52	00231672
Rion	Firmware		1.5
Rion	Pre Amplifier	NH-25	21617
Rion	Microphone	UC-59	04717
Rion	Calibrator	NC-74	34536109
	Calibrator adaptor type if applicable		NC-74-002

Performance Class 1

Test Procedure TP 2.SLM 61672-3 TPS-49

Procedures from IEC 61672-3:2006 were used to perform the periodic tests.

Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02

If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003

Date Received 13 October 2015 ANV Job No. TRAC15/10147

Date Calibrated 14 October 2015

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	18 March 2014	TCRT14/1095	ANV Measurement Systems

CERTIFICATE OF CALIBRATION

Certificate Number
TCRT15/1271

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52
SLM instruction manual ref / issue		11-03
SLM instruction manual source		Manufacturer
Internet download date if applicable		N/A
Case corrections available		Yes
Uncertainties of case corrections		Yes
Source of case data		Manufacturer
Wind screen corrections available		Yes
Uncertainties of wind screen corrections		Yes
Source of wind screen data		Manufacturer
Mic pressure to free field corrections		Yes
Uncertainties of Mic to F.F. corrections		Yes
Source of Mic to F.F. corrections		Manufacturer
Total expanded uncertainties within the requirements of IEC 61672-1:2002		Yes
Specified or equivalent Calibrator		Specified
Customer or Lab Calibrator		Lab Calibrator
Calibrator adaptor type if applicable		NC-74-002
Calibrator cal. date		08 October 2015
Calibrator cert. number		UCRT15/1260
Calibrator cal cert issued by		ANV Measurement Systems
Calibrator SPL @ STP	94.03 dB	Calibration reference sound pressure level
Calibrator frequency	1001.90 Hz	Calibration check frequency
Reference level range	25 - 130 dB	

Accessories used or corrected for during calibration - Wind Shield WS-10
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End	
Temperature	22.62	23.03	± 0.20 °C
Humidity	44.8	46.7	± 3.00 %RH
Ambient Pressure	101.24	101.23	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.2 dB		Adjusted indicated level	94.0	dB
The uncertainty of the associated calibrator supplied with the sound level meter ±				0.10	dB

Self Generated Noise — This test is currently not performed by this Lab.

Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	

Microphone replaced with electrical input device - UR = Under Range indicated

Weighting	A			C			Z		
	10.3	dB	UR	15.3	dB	UR	20.9	dB	UR
Uncertainty of the electrical self generated noise ±						0.12		dB	

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

..... END .....

Calibrated by: J Harriman R 1

Additional Comments
Instrument's PCB was replaced and unit re-aligned prior to calibration.

MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue	**19 October 2016**
Customer	**Mott MacDonald Limited**
Certificate Number	**CONF101605**

	Manufacturer	**Type**	**Serial Number**
Sound Level Meter	Rion	NL-52	00754168
Preamplifier	Rion	NH-25	54237
Microphone	Rion	UC-59	08530

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 61672-1:2002 Class 1.
IEC 61672-1:2013 Class 1.

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Signed. [redacted] Position. Lab Manager Date. 19 October 2016

A Patel

BEAUFORT COURT, 17 ROEBUCK WAY, MILTON KEYNES, MK5 8HL
☎ 01908 642846 🖷 01908 642814
✉ info@noise-and-vibration.co.uk 🖳 www.noise-and-vibration.co.uk

CERTIFICATE OF CALIBRATION

ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Date of Issue: 23 February 2017

Certificate Number: TCRT17/1040

Approved Signatory [redacted]

M. Breslin [ ] K. Mistry [✓] J. Harriman [ ]

Customer	Mott MacDonald Limited Spring Bank House 33 Stamford Street Altrincham WA14 1ES
Order No.	HWX0010EHNE01
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification	*Manufacturer*	*Instrument*	*Type*	*Serial No. / Version*
	Rion	Sound Level Meter	NL-52	01143538
	Rion	Firmware		1.8
	Rion	Pre Amplifier	NH-25	43555
	Rion	Microphone	UC-59	10450
	Rion	Calibrator	NC-74	34536109
		Calibrator adaptor type if applicable		NC-74-002

Performance Class	1		
Test Procedure	TP 2.SLM 61672-3 TPS-49		
	Procedures from IEC 61672-3:2006 were used to perform the periodic tests.		
Type Approved to IEC 61672-1:2002	YES	Approval Number	21.21 / 13.02
	If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003		
Date Received	22 February 2017	ANV Job No.	TRAC17/02026
Date Calibrated	23 February 2017		

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	Initial Calibration		

CERTIFICATE OF CALIBRATION

Certificate Number
TCRT17/1040

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52
SLM instruction manual ref / issue		11-03
SLM instruction manual source		Manufacturer
Internet download date if applicable		N/A
Case corrections available		Yes
Uncertainties of case corrections		Yes
Source of case data		Manufacturer
Wind screen corrections available		Yes
Uncertainties of wind screen corrections		Yes
Source of wind screen data		Manufacturer
Mic pressure to free field corrections		Yes
Uncertainties of Mic to F.F. corrections		Yes
Source of Mic to F.F. corrections		Manufacturer
Total expanded uncertainties within the requirements of IEC 61672-1:2002		Yes
Specified or equivalent Calibrator		Specified
Customer or Lab Calibrator		Lab Calibrator
Calibrator adaptor type if applicable		NC-74-002
Calibrator cal. date		02 February 2017
Calibrator cert. number		UCRT17/1050
Calibrator cal cert issued by		ANV Measurement Systems
Calibrator SPL @ STP	93.99 dB	Calibration reference sound pressure level
Calibrator frequency	1001.94 Hz	Calibration check frequency
Reference level range	25 - 130 dB	

Accessories used or corrected for during calibration - None
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End	
Temperature	22.83	23.02	± 0.20 °C
Humidity	36.5	35.0	± 3.00 %RH
Ambient Pressure	97.84	97.06	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.0	dB	Adjusted indicated level	94.0	dB
The uncertainty of the associated calibrator supplied with the sound level meter ±				0.10	dB

Self Generated Noise — This test is currently not performed by this Lab.

Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	

Microphone replaced with electrical input device - UR = Under Range indicated

Weighting	A			C			Z		
	10.5	dB	UR	15.0	dB	UR	20.6	dB	UR
Uncertainty of the electrical self generated noise ±							0.12	dB	

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with the Guide to the Expression of Uncertainty in Measurement published by ISO.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

..... END .....

Calibrated by: A Patel R 1

Additional Comments

Prior to calibration, instrument's microphone was replaced.

A63 Castle Street Improvements, Hull
Environmental Statement

Volume 3, Appendix 7.3

NOISE AND VIBRATION – CONSTRUCTION SOURCE NOISE LEVELS

TR010016/APP/6.3
HE514508-MMSJV-ENV-S0-RP-LA-000004
31 July 2018

A63 Castle Street Improvements, Hull

Environmental Statement

Appendix 7.3 Construction source noise levels

Revision Record

Rev No	Date	Originator	Checker	Approver	Status	Suitability
P01.1	18.04.18	J Edhouse	A Monk Steel	J McKenna	S0	For review
P02	31.087.18	A Monk Steel	S Dyne	J McKenna	Shared	S4

Prepared for:
Highways England
Lateral
8 City Walk
Leeds
LS11 9AT

Prepared by:
Mott MacDonald Sweco JV
Stoneham Place, Stoneham Lane
Southampton, Hampshire
SO50 9NW

1. Construction source noise levels

1.1 Noise measurement survey

1.1.1 The source sound levels used in the construction noise calculations reported in the Chapter 7 Noise and vibration are given in the various tables below for phase 0 to phase 7.

Table A7.3.1: List of plant items assumed in BS5228 calculations - phase 0

Plant item	BS5228 Ref	Sound level at 10m
Hiab lorry	C.4.53	77
Mini tracked excavator	C.4.68	65
40 tonne crawler crane	C.4.46	67
Articulated dump truck	C.6.26	79
Backhoe with hydraulic breaker	C.5.1	88
5t dumper	C.4.08	56
40 tonne crawler crane	C.4.46	67
vibratory piling rig	C.3.8	88
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
Mini tracked excavator	C.4.68	65
5t dumper	C.4.08	56
Hiab lorry	C.4.53	77
Mini tracked excavator	C.4.68	65
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
vibratory piling rig	C.3.8	88
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
Mini tracked excavator	C.4.68	65
Road breaker (hand held pneumatic)	C.5.3	82
Mini tracked excavator	C.4.68	65
Road breaker (hand held pneumatic)	C.5.3	82
Mini tracked excavator	C.4.68	65
Road breaker (hand held pneumatic)	C.5.3	82

Table A7.3.2: List of plant items assumed in BS5228 calculations - phase 1

Plant item	BS5228 Ref	Sound level at 10m
Backhoe with hydraulic breaker	C.5.1	88
Hiab lorry	C.4.53	77
Wheeled excavator	C.5.11	73
vibratory piling rig	C.3.8	88
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
40 tonne crawler crane	C.4.46	67
Diaphragm wall trenching grab	D.4.101	86
40 tonne crawler crane	C.4.46	67
40 tonne crawler crane	C.4.46	67
Articulated dump truck	C.6.26	79
Backhoe with hydraulic breaker	C.5.1	88
Asphalt paver + tipper lorry	C.5.33	75
Small vibratory roller	C.5.26	77
Large vibratory roller	C.5.20	75
35t tracked excavator	C.5.18	80
Concrete mixer truck	C.4.20	80
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
Small cement mixer	C.4.23	61
Mini tracked excavator	C.4.68	65
40 tonne crawler crane	C.4.46	67
Construction flight auger piling – cast in situ	C.3.22	80
Construction flight auger piling – cast in situ	C.3.22	80
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
40 tonne crawler crane	C.4.46	67
Articulated dump truck	C.6.26	79
Backhoe with hydraulic breaker	C.5.1	88
Backhoe with hydraulic breaker	C.5.1	88
Hiab lorry	C.4.53	77
Wheeled excavator	C.5.11	73
40 tonne crawler crane	C.4.46	67
Articulated dump truck	C.6.26	79
Backhoe with hydraulic breaker	C.5.1	88
5t dumper	C.4.08	56
40 tonne crawler crane	C.4.46	67
Articulated dump truck	C.6.26	79
40 tonne crawler crane	C.4.46	67
Articulated dump truck	C.6.26	79

Table A7.3.3: List of plant items assumed in BS5228 calculations - phase 2

Plant item	BS5228 Ref	Sound level at 10m
Diaphragm wall trenching grab	D.4.101	86
Mixing and pumping grout	D.5.13	80
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
Master paver	C.5.31	77
Backhoe with hydraulic breaker	C.5.1	88
Large vibratory roller	C.5.20	75
Small vibratory roller	C.5.26	77
8 tonne dead weight roller	C.5.20	75
Diaphragm wall trenching grab	D.4.101	86
Mixing and pumping grout	D.5.13	80
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
40 tonne crawler crane	C.4.46	67
Articulated dump truck	C.6.26	79
Backhoe with hydraulic breaker	C.5.1	88
Asphalt paver + tipper lorry	C.5 33	75
Small vibratory roller	C.5.26	77
Backhoe with hydraulic breaker	C.5.1	88
Hiab lorry	C.4.53	77
Wheeled excavator	C.5 11	73
Construction flight auger piling – cast in situ	C.3.22	80

Table A7.3.4: List of plant items assumed in BS5228 calculations - phase 3

Plant item	BS5228 Ref	Sound level at 10m
Diaphragm wall trenching grab	D.4.101	86
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
Small cement mixer	C.4.23	61
Mini tracked excavator	C.4.68	65
40 tonne mobile crane	C.4.47	68
Construction flight auger piling – cast in situ	C.3.22	80
Hiab lorry	C.4.53	77
Diaphragm wall trenching grab	D.4.101	86
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
40 tonne crawler crane	C.4.46	67
Articulated dump truck	C.6.26	79
Backhoe with hydraulic breaker	C.5.1	88
Asphalt paver + tipper lorry	C.5.33	75
Small vibratory roller	C.5.26	77
Large vibratory roller	C.5.20	75
35t tracked excavator	C.5.18	80
Concrete mixer truck	C.4.20	80
40 tonne crawler crane	C.4.46	67
40 tonne crawler crane	C.4.46	67
Articulated dump truck	C.6.26	79
Backhoe with hydraulic breaker	C.5.1	88
Asphalt paver + tipper lorry	C.5.33	75
Small vibratory roller	C.5.26	77

Table A7.3.5: List of plant items assumed in BS5228 calculations - phase 4

Plant item	BS5228 Ref	Sound level at 10m
Diaphragm wall trenching grab	D.4.101	86
Mixing and pumping grout	D.5.13	80
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
40 tonne crawler crane	C.4.46	67
Concrete mixer truck	C.4.20	80
Poker vibrator	C.4.34	78
Diaphragm wall trenching grab	D.4.101	86
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
40 tonne crawler crane	C.4.46	67
Articulated dump truck	C.6.26	79
Backhoe with hydraulic breaker	C.5.1	88
Asphalt paver + tipper lorry	C.5.33	75
Small vibratory roller	C.5.26	77
40 tonne crawler crane	C.4.46	67
Backhoe with hydraulic breaker	C.5.1	88
5t dumper	C.4.08	56

Table A7.3.6: List of plant items assumed in BS5228 calculations - phase 5

Plant item	BS5228 Ref	Sound level at 10m
Diaphragm wall trenching grab	D.4.101	86
Mixing and pumping grout	D.5.13	80
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
40 tonne crawler crane	C.4.46	67
Concrete mixer truck	C.4.20	80
Poker vibrator	C.4.34	78
Diaphragm wall trenching grab	D.4.101	86
Mixing and pumping grout	D.5.13	80
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
Asphalt paver + tipper lorry	C.5.33	75
Small vibratory roller	C.5.26	77
Hiab lorry	C.4.53	77
Wheeled excavator	C.5.11	73

Table A7.3.7: List of plant items assumed in BS5228 calculations - phase 6

Plant item	BS5228 Ref	Sound level at 10m
Articulated dump truck	C.6.26	79
Diaphragm wall trenching grab	D.4.101	86
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
40 tonne crawler crane	C.4.46	67
Diaphragm wall trenching grab	D.4.101	86
40 tonne mobile crane	C.4.47	68
Hiab lorry	C.4.53	77
40 tonne mobile crane	C.4.47	68
Asphalt paver + tipper lorry	C.5.33	75
1.5t vibratory roller	C.5.28	77
Mini tracked excavator	C.4.68	65

Table A7.3.8: List of plant items assumed in BS5228 calculations - phase 7

Plant Item	BS5228 Ref	Sound Level at 10m
Master paver	C.5.31	77
Large vibratory roller	C.5.20	75
Small vibratory roller	C.5.26	77
8 tonne dead weight roller	C.5.20	75
Master paver	C.5.31	77
Large vibratory roller	C.5.20	75
Small vibratory roller	C.5.26	77
8 tonne dead weight roller	C.5.20	75
Hiab lorry	C.4.53	77
Asphalt paver + tipper lorry	C.5.33	75
Small vibratory roller	C.5.26	77
Hiab lorry	C.4.53	77
Wheeled excavator	C.5.11	73
1.5t vibratory roller	C.5.28	77
Mini tracked excavator	C.4.68	65
Asphalt paver + tipper lorry	C.5.33	75
Wheeled excavator	C.5.34	70