

MTR Corporation Limited

**East Rail Extensions -  
Tai Wai to Ma On Shan**

Train Operational Noise Monitoring for  
8-car Train Operation

**Monthly Noise Monitoring Report No. 4**

(May 2017)

Verified by: Fredrick Leong 

Position: Independent Environmental Checker

Date: 24 May 17

MTR Corporation Limited



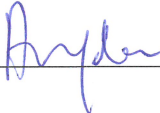
Consultancy Agreement No. C11033

**Ma On Shan Line**

**Train Operational Noise Monitoring for  
8-car Train Operation**

**Monthly Noise Monitoring Report No. 4**

May 2017

	Name	Signature
Prepared & Checked:	Isaac Chu	
Reviewed & Approved:	 Josh Lam	

Version: **A** Date: **22 May 2017**

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## **1 INTRODUCTION**

### **1.1 Background**

- 1.1.1 Ma On Shan Line (MOL), previously known as East Rail Extensions – Tai Wai to Ma On Shan (the Project), provides a railway system connecting Tai Wai and Ma On Shan. The Environmental Impact Assessment (EIA) Report (AEIAR-028/1999), which was prepared based upon the construction and operation of 8-car electric train mode, was approved by the Director of Environmental Protection (DEP) and the Environmental Permit (EP-039/2000) was granted to the Kowloon Canton Railway Corporation (KCRC) on 15 January 2000.
- 1.1.2 Subsequent to the issuance of the first EP, a number of Variation of Environmental Permits (VEPs) and Further Environmental Permits (FEPs) have been applied for and the latest Further Environmental Permit (FEP-05/039/2000/F) was granted on 1 June 2012 to transfer the responsibility of the MOL construction and operation from KCRC to MTR Corporation (MTRC).
- 1.1.3 MOL in 4-car train operation commenced in December 2004 and the Project Proponent conducted operational noise monitoring for 4-car train operation from December 2004 to July 2006. Monitoring results showed that the train operational noise continuously complies with the noise limit levels over the reporting period without any trend to cause exceedance. Field observations indicated that the major noise source contributed to the ambient noise were heavy vehicles (i.e. bus and public light bus) travelling along Sai Sha Road and Ma On Shan Road. Assessment and analysis of noise results collected throughout the operational noise monitoring periods also demonstrated the environmental acceptability of the Project. Therefore, the implemented mitigation measures were effective and efficient in controlling noise impacts during the train operation.
- 1.1.4 Modification works at MOL have been completed to allow the transition of current 4-car train operation to 8-car train operation. MOL will be joined with the Shatin to Central Link and West Rail Line to form the “East-West Corridor” in 8-car train operation. Beginning from early 2017, 4-car trains on the MOL will start being converted to 8-car trains by a mix of 4-car and 8-car trains in operation. The number of 8-car train will gradually increase and the conversion period is expected to last for around 9 months. It is therefore anticipated that the full 8-car train operation will be achieved in approximately end 2017.
- 1.1.5 Considering the conversion of 4-car trains to 8-car train operation, MTRC proposes to conduct additional operational noise monitoring for 8-car train configuration to demonstrate the environmental acceptability of the 8-car train operation. A Train Operational Noise Monitoring Plan for 8-car Train Operation (NMP) was prepared and submitted to Environmental Protection Department (EPD) on 23 December 2016.
- 1.1.6 AECOM Asia Co. Ltd (AECOM) was commissioned by MTRC to conduct operational noise monitoring for 8-car train operation of MOL according to the NMP.

### **1.2 Purpose of the Report**

- 1.2.1 The 8-car train operation on MOL commenced on 15 January 2017. This is the 4<sup>th</sup> monthly operational noise monitoring report, summarising the monitoring results obtained between 15 April 2017 and 14 May 2017.

## 2 TRAIN OPERATIONAL NOISE MONITORING

### 2.1 Monitoring Equipment

2.1.1 In accordance with Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM), sound level meters in compliance with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804: 1985 (Type 1) specifications were used for carrying out the noise monitoring. Immediately prior to and following each noise measurement, the accuracy of each sound level meter was checked using an acoustic calibrator generating a known sound pressure level at a known frequency. Measurements are considered to be valid with the calibration level from before and after the noise measurement within 1.0 dB. **Table 2.1** summarizes the noise monitoring equipment model used for monitoring.

**Table 2.1 Noise Monitoring Equipment**

Equipment	Model
Integrating Sound Level Meter	<ul style="list-style-type: none"> <li>• B&amp;K Brand Type 2270 (Serial No. 3007965)</li> <li>• B&amp;K Brand Type 2250-L (Serial No. 2681366)</li> <li>• B&amp;K Brand Type 2250 (Serial No. 3001291)</li> </ul>
Calibrator	<ul style="list-style-type: none"> <li>• Rion NC-73 (Serial No. 10307223)</li> <li>• Rion NC-74 (Serial No. 34246490)</li> </ul>

### 2.2 Monitoring Parameters

2.2.1 Night-time operation of 8-car train commenced in May 2017, and therefore one set of  $L_{eq\ 30min}$  as six consecutive  $L_{eq\ 5min}$  was taken once every week during the monitoring period in May according to NMP.

2.2.2 Given that the daytime noise monitoring results in the 1<sup>st</sup> and 2<sup>nd</sup> month of monitoring demonstrated full compliance with statutory noise limit, monthly monitoring was carried out for daytime noise monitoring since the 3<sup>rd</sup> monitoring month and will continue onwards. During the daytime noise monitoring period, one set of  $L_{eq\ 30min}$  as six consecutive  $L_{eq\ 5min}$  was taken once every month within the period of 8-car train operation.

### 2.3 Monitoring Locations and Dates

2.3.1 Two monitoring stations as shown in **Figure C11033/C/MOL/ACM/M62/001** were selected for noise monitoring.

2.3.2 Summary of the monitoring locations and monitoring dates during the reporting period are shown in **Table 2.2**.

**Table 2.2 Monitoring Locations and Schedule of Noise Monitoring**

Monitoring Location	ASR	Monitoring Dates
Villa Athena Block 5	B	- Daytime (0700 – 2300): 21 Apr 2017 - Night-time (2300 – 0700): 2 May, 11 May 2017
Ma On Shan Centre Block 2	B	- Daytime (0700 – 2300): 21 Apr 2017 - Night-time ((2300 – 0700): 2 May, 11 May 2017

2.3.3 Night-time operation of 8-car train commenced from 2<sup>nd</sup> May 2017 and therefore weekly night-time monitoring was carried out during the monitoring period in May. The night-time

noise monitoring frequency will be reviewed upon completion of 2<sup>nd</sup> month of night-time noise monitoring in accordance with the NMP.

2.3.4 Tentative monitoring schedule for the upcoming reporting periods is presented in **Appendix A**. The monitoring schedule is subject to change due to 8-car train service as and when necessary and weather condition.

## 2.4 Monitoring Procedures

2.4.1 Field Monitoring Procedures are summarised as below:

- All measurements were made in facade type. The microphone of the sound level meter was positioned 1m exterior of the sensitive receivers and lowered sufficiently so that the external wall of the building acts as a reflecting surface.
- Parameters such as frequency weighting, the time weighting and the duration of measurement were set as follows:
  - frequency weighting : A
  - time weighting : Fast
  - time measurement : Six consecutive five-minutes duration (with data being logged at every one second)
- Prior to and after each noise measurement, the meter was calibrated using the Calibrator for 94 dB at 1000 Hz. If the difference in the calibration level before and after measurement was more than 1 dB (A), the measurement would be considered invalid and repeat of noise measurement would be required after repair or re-calibration of the equipment.
- Details were recorded when intrusive noise was observed. Noise sources and duration were also recorded during the monitoring process.
- All the monitoring data within the sound level meter system were downloaded through the computer software. All these data were then checked and reviewed properly.
- The weather condition during the monitoring period was recorded by the monitoring staff. Wind speed was regularly checked using the anemometer.
- Noise monitoring would be suspended in the presence of fog, rain, and wind with a steady speed exceeding 5 m/s, or wind with gusts exceeding 10 m/s.

2.4.2 Maintenance and calibration of sound level meter is stated below:

- The microphone of the sound level meter and calibrator were cleaned with a soft cloth at quarterly interval.
- The meter was sent to the supplier for checking and calibration at yearly interval.

2.4.3 Calibration certificates for the equipment employed for monitoring (**Table 2.1** refers) are presented in **Appendix B**.

## 2.5 Data Analysis

2.5.1 Ambient noise levels were evaluated by discarding logged data for the period when the train passed in front of the monitoring stations. The ambient noise level for each of the six five-minute noise data was averaged to appraise the overall ambient noise level,  $L_{Aeq}$  30mins (ambient).

2.5.2 The noise level contributed by train pass-by,  $L_{Aeq}$  30mins (event) was calculated by subtracting the ambient noise level  $L_{Aeq}$  30mins (ambient) from the overall noise level  $L_{Aeq}$  30mins (overall) (average of six five-minute noise data).

2.5.3 In the event of  $L_{Aeq}$  30mins (overall) is lower than  $L_{Aeq}$  30mins (ambient),  $L_{Aeq}$  30mins (event) would be evaluated by applying a correction of -12 dB(A) to  $L_{Aeq}$  30mins (overall), following

same approach as adopted during 4-car train operation noise monitoring conducted between 2004 and 2006.

2.5.4 **Appendix C** is the Action and Limit Levels, and the Event/Action Plan extracted from Tables 2.3 and 2.4, Appendix A of NMP respectively.

## 2.6 Results and Observations

2.6.1 All monitoring data and graphical presentation of the monitoring results are provided in **Appendix D**, with summary of monitoring levels during daytime and night-time periods presented in **Tables 2.3** and **Table 2.4** respectively.

**Table 2.3 Summary of Daytime Impact Noise Monitoring Results**

Monitoring Date	Monitoring Location	No. of 8-car train passby <sup>(1)</sup>	Noise Level, L <sub>eq</sub> , 30 min dB(A)			
			L <sub>Aeq</sub> 30min (event)	ASR	Limit Level	Compliance
21 April 2017	Villa Athena Block 5	6	61	B	65	Yes
	Ma On Shan Centre Block 2	6	55	B	65	Yes

Note:

(1) The number of 8-car train passby during the monitoring period.

**Table 2.4 Summary of Night-time Impact Noise Monitoring Results**

Monitoring Date	Monitoring Location	No. of 8-car train passby <sup>(1)</sup>	ASR	Noise Level, L <sub>eq</sub> , 30 min dB(A)			Noise Level, L <sub>max</sub> dB(A)		
				L <sub>Aeq</sub> 30min (event)	Limit Level	Compliance	L <sub>max</sub>	Limit Level	Compliance
2 May 2017	Villa Athena Block 5	4	B	52	55	Yes	68	85	Yes
	Ma On Shan Centre Block 2	4	B	51	55	Yes	69	85	Yes
11 May 2017	Villa Athena Block 5	4	B	54	55	Yes	70	85	Yes
	Ma On Shan Centre Block 2	4	B	51	55	Yes	77	85	Yes

Note:

(1) The number of 8-car train passby during the monitoring period.

2.6.2 According to site observation, apart from the operational train noise, the major noise source identified was heavy vehicles (i.e. bus and public light bus) travelling along Sai Sha Road and Ma On Shan Road.

2.6.3 All recorded noise levels during the reporting period complied with the Limit Level.

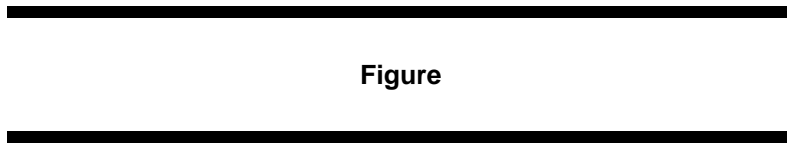
## 2.7 Record of Noise Complaints

2.7.1 No noise complaint was received during the reporting period and therefore no Action Level was required.

### **3 CONCLUSION**

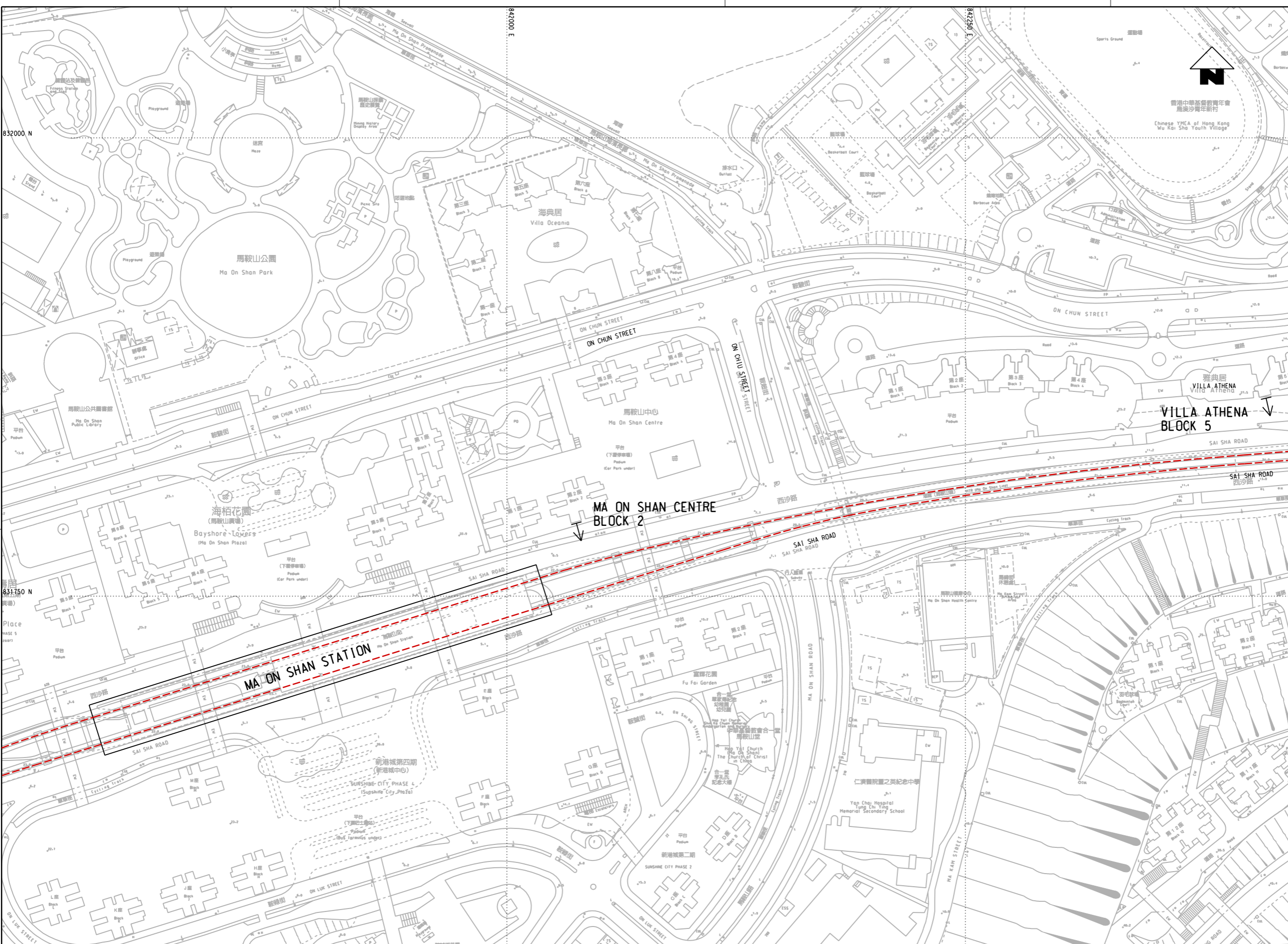
- 3.1.1 Night-time 8-car train operation commenced in May 2017. Monthly Daytime and weekly night-time noise monitoring were conducted according to NMP. Background noise levels without train pass-by were derived from the monitoring data for the two monitoring stations. By comparing the noise levels with and without pass-by, all recorded daytime and night-time noise levels for train operation noise monitoring complied with the Limit Level. It was observed that noise generated from road traffic along Sai Sha Road and Ma On Shan Road was the dominant noise source during the monitoring period.





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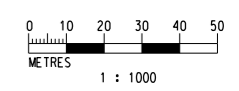
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**LEGEND:**

→ OPERATIONAL NOISE MONITORING STATION

--- MA ON SHAN RAIL ALIGNMENT



REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	ZFX
DESIGNED	LCLL
CHECKED	LCLL
APPROVED	IMW
DATE	18/MAY/2009

**MTR**

SHATIN TO CENTRAL LINK

**AECOM**

ORIGINATOR

CADD REF. C11033\_C\_MOL\_ACM\_M62\_001.dgn

TITLE	C11033 MOL - MA ON SHAN LINE LOCATIONS OF NOISE MONITORING STATIONS
SCALE	1 : 1000 (A1)
FIGURE NO.	C11033/C/MOL/ACM/M62/001
REV.	A

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**Appendix A**

**Tentative Monitoring Schedule for the Upcoming Reporting  
Period**

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**Tai Wai to Ma On Shan Rail  
Tentative Train Noise Monitoring Schedule for 8-car Train Operation (May 2017)**

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30-Apr	1-May	2-May	3-May	4-May	5-May	6-May
7-May	8-May	9-May	10-May	11-May	12-May	13-May
14-May	15-May	16-May	17-May	18-May	19-May	20-May
				Noise Monitoring (Daytime and Night time)		
21-May	22-May	23-May	24-May	25-May	26-May	27-May
				Noise Monitoring (Night time)		
28-May	29-May	30-May	31-May			

The schedule is subject to change due to unforeseeable circumstances (e.g. adverse weather, etc)

**Tai Wai to Ma On Shan Rail  
Tentative Train Noise Monitoring Schedule for 8-car Train Operation (Jun 2017)**

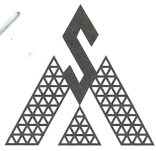
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
28-May	29-May	30-May	31-May	1-Jun	2-Jun	3-Jun
				Noise Monitoring (Night time)		
4-Jun	5-Jun	6-Jun	7-Jun	8-Jun	9-Jun	10-Jun
				Noise Monitoring (Night time)		
11-Jun	12-Jun	13-Jun	14-Jun	15-Jun	16-Jun	17-Jun
18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun
25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	

The schedule is subject to change due to unforeseeable circumstances (e.g. adverse weather, etc)

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**Appendix B**  
**Calibration Records of Monitoring Equipment**

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## CERTIFICATE OF CALIBRATION

Certificate No.: 16CA0929 04 Page 1 of 2

### Item tested

Description:	Sound Level Meter (Type 1)	Microphone	Preamp
Manufacturer:	B & K	B & K	B & K
Type/Model No.:	2250	4189	ZC0032
Serial/Equipment No.:	3001291 (N 001.05)	3005374	23853
Adaptors used:	-	-	-

### Item submitted by

Customer Name: AECOM ASIA CO. LTD.  
Address of Customer: -  
Request No.: -  
Date of receipt: 29-Sep-2016

Date of test: 05-Oct-2016

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	18-Jun-2017	CIGISMEC
Signal generator	DS 360	33873	18-Apr-2017	CEPREI
Signal generator	DS 360	61227	18-Apr-2017	CEPREI

### Ambient conditions

Temperature: 21 ± 1 °C  
Relative humidity: 60 ± 10 %  
Air pressure: 1000 ± 5 hPa

### Test specifications

- 1, The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- 2, The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
- 3, The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsiveness of the Sound Level Meter.

### Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

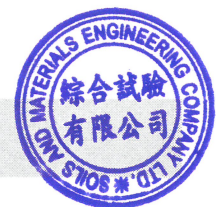
Actual Measurement data are documented on worksheets.

Approved Signatory:

Huang Jian Min/Feng Jun Qi

Date: 06-Oct-2016

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



## CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 16CA0929 04 Page 2 of 2

### 1, Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

Test:	Subtest:	Status:	Expanded Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	A	Pass	0.3	
	C	Pass	0.3	
Frequency weightings	Lin	Pass	0.3	
	Time weightings	Single Burst Fast	Pass	0.3
	Single Burst Slow	Pass	0.3	
Peak response	Single 100µs rectangular pulse	Pass	0.3	
	R.M.S. accuracy	Crest factor of 3	Pass	0.3
Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
Time averaging	1 ms burst duty factor 1/10 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> at 4kHz	Pass	0.3	
Pulse range	Single burst 10 ms at 4 kHz	Pass	0.4	
Sound exposure level	Single burst 10 ms at 4 kHz	Pass	0.4	
Overload indication	SPL	Pass	0.3	
	Leq	Pass	0.4	

### 2, Acoustic tests

The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

Test:	Subtest	Status	Expanded Uncertainty (dB)	Coverage Factor
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
	Weighting A at 8000 Hz	Pass	0.5	

### 3, Response to associated sound calibrator

N/A

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Fung Chi Yip

Date: 05-Oct-2016

Checked by:

Lam Tze Wai

Date: 06-Oct-2016

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.





## CERTIFICATE OF CALIBRATION

Certificate No.: 16CA0606 03 Page 1 of 2

### Item tested

Description:	Sound Level Meter (Type 1)	,	Microphone
Manufacturer:	B & K	,	B & K
Type/Model No.:	2270	,	4189
Serial/Equipment No.:	3007965 / N.012.02	,	3005374
Adaptors used:	-	,	-

### Item submitted by

Customer Name: AECOM ASIA CO. LTD.  
Address of Customer: -  
Request No.: -  
Date of receipt: 06-Jun-2016

Date of test: 07-Jun-2016

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	19-Jun-2016	CIGISMEC
Signal generator	DS 360	33873	18-Apr-2017	CEPREI
Signal generator	DS 360	61227	18-Apr-2017	CEPREI

### Ambient conditions

Temperature: 22 ± 1 °C  
Relative humidity: 55 ± 10 %  
Air pressure: 1005 ± 5 hPa

### Test specifications

- The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
- The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responses of the Sound Level Meter.

### Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

Actual Measurement data are documented on worksheets.

Approved Signatory:

Huang Jian Min/Feng Jun Qi

Date: 08-Jun-2016

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



## CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 16CA0606 03 Page 2 of 2

### 1, Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

Test:	Subtest:	Status:	Uncertainty (dB) / Coverage Factor	
Self-generated noise	A	Pass	0.3	
	C	Pass	1.0	2.1
	Lin	Pass	2.0	2.2
Linearity range for Leq	At reference range , Step 5 dB at 4 kHz	Pass	0.3	
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range , Step 5 dB at 4 kHz	Pass	0.3	
	Frequency weightings			
Time weightings	A	Pass	0.3	
	C	Pass	0.3	
	Lin	Pass	0.3	
Peak response	Single Burst Fast	Pass	0.3	
	Single Burst Slow	Pass	0.3	
R.M.S. accuracy	Single 100µs rectangular pulse	Pass	0.3	
	Crest factor of 3	Pass	0.3	
Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
Time averaging	1 ms burst duty factor 1/10 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> at 4kHz	Pass	0.3	
Pulse range	Single burst 10 ms at 4 kHz	Pass	0.4	
Sound exposure level	Single burst 10 ms at 4 kHz	Pass	0.4	
Overload indication	SPL	Pass	0.3	
	Leq	Pass	0.4	

### 2, Acoustic tests


The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

Test:	Subtest	Status	Uncertainty (dB) / Coverage Factor	
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
	Weighting A at 8000 Hz	Pass	0.5	

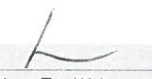
### 3, Response to associated sound calibrator

N/A

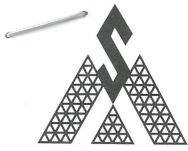
The uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95 %. A coverage factor of 2 is assumed unless explicitly stated.

Calibrated by:   
Date: 07-Jun-2016

- End -

Checked by:   
Date: 08-Jun-2016

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



## CERTIFICATE OF CALIBRATION

Certificate No.: 17CA0303 01-01 Page 1 of 2

### Item tested

Description:	Sound Level Meter (Type 1)	Microphone	Preamp
Manufacturer:	B & K	B & K	B & K
Type/Model No.:	2250-L	4950	ZC0032
Serial/Equipment No.:	2681366	2665582	17190
Adaptors used:	-	-	-

### Item submitted by

Customer Name: AECOM ASIA CO LTD  
Address of Customer: -  
Request No.: -  
Date of receipt: 03-Mar-2017

Date of test: 07-Mar-2017

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	18-Jun-2017	CIGISMEC
Signal generator	DS 360	33873	18-Apr-2017	CEPREI
Signal generator	DS 360	61227	18-Apr-2017	CEPREI

### Ambient conditions

Temperature:  $21 \pm 1$  °C  
Relative humidity:  $60 \pm 10$  %  
Air pressure:  $1010 \pm 5$  hPa

### Test specifications

- 1, The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- 2, The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of  $\pm 20\%$ .
- 3, The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responses of the Sound Level Meter.

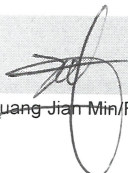
### Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

Actual Measurement data are documented on worksheets.

Approved Signatory:

  
Huang Jian Min/Feng Jun Qi

Date: 08-Mar-2017

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



## CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 17CA0303 01-01

Page 2 of 2

### 1, Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

Test:	Subtest:	Status:	Expanded Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	Frequency weightings			
Time weightings	A	Pass	0.3	
	C	Pass	0.3	
	Lin	Pass	0.3	
Peak response	Single Burst Fast	Pass	0.3	
	Single Burst Slow	Pass	0.3	
R.M.S. accuracy	Single 100µs rectangular pulse	Pass	0.3	
	Crest factor of 3	Pass	0.3	
Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
Time averaging	1 ms burst duty factor 1/10 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> at 4kHz	Pass	0.3	
Pulse range	Single burst 10 ms at 4 kHz	Pass	0.4	
	Sound exposure level	Pass	0.4	
Overload indication	SPL	Pass	0.3	
	Leq	Pass	0.4	

### 2, Acoustic tests

The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

Test:	Subtest	Status	Expanded Uncertainty (dB)	Coverage Factor
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
	Weighting A at 8000 Hz	Pass	0.5	

### 3, Response to associated sound calibrator

N/A

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Date:

Fung Chi Yip  
07-Mar-2017

Checked by:

Date:

Lam Tze Wai  
08-Mar-2017

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



## CERTIFICATE OF CALIBRATION

Certificate No.: 16CA1201 01

Page: 1 of 2

### Item tested

Description: Acoustical Calibrator (Class 1)  
Manufacturer: Rion Co., Ltd.  
Type/Model No.: NC-73  
Serial/Equipment No.: 10307223 (CN.004.08)  
Adaptors used: -

### Item submitted by

Customer: AECOM ASIA CO. LTD.  
Address of Customer: -  
Request No.: -  
Date of receipt: 01-Dec-2016

Date of test: 05-Dec-2016

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Lab standard microphone	B&K 4180	2412857	14-Apr-2017	SCL
Preamplifier	B&K 2673	2239857	28-Apr-2017	CEPREI
Measuring amplifier	B&K 2610	2346941	26-Apr-2017	CEPREI
Signal generator	DS 360	61227	18-Apr-2017	CEPREI
Digital multi-meter	34401A	US36087050	18-Apr-2017	CEPREI
Audio analyzer	8903B	GB41300350	19-Apr-2017	CEPREI
Universal counter	53132A	MY40003662	19-Apr-2017	CEPREI

### Ambient conditions

Temperature: 22 ± 1 °C  
Relative humidity: 55 ± 10 %  
Air pressure: 1005 ± 5 hPa

### Test specifications

- The Sound Calibrator has been calibrated in accordance with the requirements as specified in IEC 60942 1997 Annex B and the lab calibration procedure SMTP004-CA-156.
- The calibrator was tested with its axis vertical facing downwards at the specific frequency using insert voltage technique.
- The results are rounded to the nearest 0.01 dB and 0.1 Hz and have not been corrected for variations from a reference pressure of 1013.25 hectoPascals as the maker's information indicates that the instrument is insensitive to pressure changes.

### Test results

This is to certify that the sound calibrator conforms to the requirements of annex B of IEC 60942: 1997 for the conditions under which the test was performed. This does not imply that the sound calibrator meets IEC 60942 under any other conditions.

Details of the performed measurements are presented on page 2 of this certificate.

Approved Signatory:

  
Huang Jian Min/Feng Jun Qi

Date: 08-Dec-2016

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



## CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 16CA1201 01

Page: 2 of 2

**1, Measured Sound Pressure Level**

The output Sound Pressure Level in the calibrator head was measured at the setting and frequency shown using a calibrated laboratory standard microphone and insert voltage technique. The results are given in below with the estimated uncertainties.

Frequency Shown Hz	Output Sound Pressure Level Setting dB	Measured Output Sound Pressure Level dB	Estimated Expanded Uncertainty dB
1000	94.00	94.22	0.10

(Output level in dB re 20  $\mu$ Pa)

**2, Sound Pressure Level Stability - Short Term Fluctuations**

The Short Term Fluctuations was determined by measuring the maximum and minimum of the fast weighted DC output of the B&K 2610 measuring amplifier over a 20 second time interval as required in the standard. The Short Term Fluctuation was found to be:

**At 1000 Hz** **STF = 0.002 dB**  
 Estimated expanded uncertainty 0.005 dB

**3, Actual Output Frequency**

The determination of actual output frequency was made using a B&K 4180 microphone together with a B&K 2673 preamplifier connected to a B&K 2610 measuring amplifier. The AC output of the B&K 2610 was taken to an universal counter which was used to determine the frequency averaged over 20 second of operation as required by the standard. The actual output frequency at 1 KHz was:

**At 1000 Hz** **Actual Frequency = 986.6 Hz**  
 Estimated expanded uncertainty 0.1 Hz Coverage factor k = 2.2

**4, Total Noise and Distortion**

For the Total Noise and Distortion measurement, the unfiltered AC output of the B&K 2610 measuring amplifier was connected to an Agilent Type 8903 B distortion analyser. The TND result at 1 KHz was:

**At 1000 Hz** **TND = 0.5 %**  
 Estimated expanded uncertainty 0.7 %

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Fung Chi Yip

Date: 05-Dec-2016

Checked by:

Lam Tze Wai

Date: 08-Dec-2016

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



## CERTIFICATE OF CALIBRATION

Certificate No.: 16CA0428 02 Page: 1 of 2

### Item tested

Description: Acoustical Calibrator (Class 1)  
Manufacturer: Rion Co., Ltd.  
Type/Model No.: NC-74  
Serial/Equipment No.: 34246490  
Adaptors used: Yes

### Item submitted by

Customer: AECOM ASIA CO., LTD.  
Address of Customer: -  
Request No.: -  
Date of receipt: 28-Apr-2016

Date of test: 10-May-2016

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Lab standard microphone	B&K 4180	2412857	14-Apr-2017	SCL
Preamplifier	B&K 2673	2239857	28-Apr-2017	CEPREI
Measuring amplifier	B&K 2610	2346941	26-Apr-2017	CEPREI
Signal generator	DS 360	61227	18-Apr-2017	CEPREI
Digital multi-meter	34401A	US36087050	18-Apr-2017	CEPREI
Audio analyzer	8903B	GB41300350	19-Apr-2017	CEPREI
Universal counter	53132A	MY40003662	19-Apr-2017	CEPREI

### Ambient conditions

Temperature:  $21 \pm 1$  °C  
Relative humidity:  $50 \pm 10$  %  
Air pressure:  $1005 \pm 5$  hPa

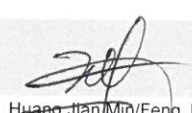

### Test specifications

- The Sound Calibrator has been calibrated in accordance with the requirements as specified in IEC 60942 1997 Annex B and the lab calibration procedure SMTP004-CA-156.
- The calibrator was tested with its axis vertical facing downwards at the specific frequency using insert voltage technique.
- The results are rounded to the nearest 0.01 dB and 0.1 Hz and have not been corrected for variations from a reference pressure of 1013.25 hectoPascals as the maker's information indicates that the instrument is insensitive to pressure changes.

### Test results

This is to certify that the sound calibrator conforms to the requirements of annex B of IEC 60942: 1997 for the conditions under which the test was performed. This does not imply that the sound calibrator meets IEC 60942 under any other conditions.

Details of the performed measurements are presented on **page 2** of this certificate.

Approved Signatory:  Date: 11-May-2016 Company Chop: 

Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



## CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 16CA0428 02 Page: 2 of 2

**1, Measured Sound Pressure Level**

The output Sound Pressure Level in the calibrator head was measured at the setting and frequency shown using a calibrated laboratory standard microphone and insert voltage technique. The results are given in below with the estimated uncertainties.

Frequency Shown Hz	Output Sound Pressure Level Setting dB	Measured Output Sound Pressure Level dB	(Output level in dB re 20 µPa) Estimated Expanded Uncertainty dB
1000	94.00	94.07	0.10

**2, Sound Pressure Level Stability - Short Term Fluctuations**

The Short Term Fluctuations was determined by measuring the maximum and minimum of the fast weighted DC output of the B&K 2610 measuring amplifier over a 20 second time interval as required in the standard. The Short Term Fluctuation was found to be:

**At 1000 Hz** **STF = 0.002 dB**  
Estimated expanded uncertainty 0.005 dB

**3, Actual Output Frequency**

The determination of actual output frequency was made using a B&K 4180 microphone together with a B&K 2673 preamplifier connected to a B&K 2610 measuring amplifier. The AC output of the B&K 2610 was taken to an universal counter which was used to determine the frequency averaged over 20 second of operation as required by the standard. The actual output frequency at 1 KHz was:

**At 1000 Hz** **Actual Frequency = 1001.9 Hz**  
Estimated expanded uncertainty 0.1 Hz Coverage factor k = 2.2

**4, Total Noise and Distortion**

For the Total Noise and Distortion measurement, the unfiltered AC output of the B&K 2610 measuring amplifier was connected to an Agilent Type 8903 B distortion analyser. The TND result at 1 KHz was:

**At 1000 Hz** **TND = 1.2 %**  
Estimated expanded uncertainty 0.7 %

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:   
Date: 10-May-2016

Checked by:   
Date: 11-May-2016

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



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**Appendix C**

**Excerpt of Train Operational Noise Monitoring Plan for 8-car  
Train Operation**

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## Appendix C –

### Excerpt of Train Operational Noise Monitoring Plan for 8-car Train Operation

**Table 2.3 Train Operational Noise Monitoring Location**

Train Operational Noise Monitoring Location	Area Sensitivity Rating (ASR)	Noise Criterion/Limit Level, dB(A)		
		Leq, 30 mins		L <sub>max</sub>
		Day (0700 – 2300 hrs)	Night (2300 – 0700 hrs)	Night (2300 – 0700 hrs)
Villa Athena Block 5, Rooftop	B	65	55	85
Ma On Shan Centre Block 2, Rooftop	B	65	55	85

**Table 2.4 Action and Limit Levels for Train Operational Noise Monitoring**

Time Period	Action Level	Limit Level <sup>(1)</sup>
Day (0700 – 2300 hours)	On receiving one documented valid complaint	L <sub>eq, 30 mins</sub> = 65dB(A)
Night (2300 – 0700 hours)		L <sub>eq, 30 mins</sub> = 55dB(A) L <sub>max</sub> = 85dB(A)

Note:

- (1) Rail Noise is under control of the Noise Control Ordinance and should comply with Acceptable Noise Levels laid down in the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites.

## Appendix C - Except of Train Operational Noise Monitoring Plan for 8-car Train Operation

### Appendix A Event/Action Plans for Train Operational Noise

Event	Monitoring Team Action
Action Level - Complaint received <sup>(1)</sup>	<ol style="list-style-type: none"> <li>1) Inform MTRC and IEC;</li> <li>2) Conduct investigation to identify source(s) of Impact;</li> <li>3) Check monitoring data and determine the validity of complaint;</li> <li>4) Conduct follow up action if the complaint is confirmed to be valid. If not, record the investigation findings and close case.</li> </ol>
Action Level – Confirmed as Valid Complaint	<ol style="list-style-type: none"> <li>1) Conduct noise measurement where necessary;</li> <li>2) Check monitoring data;</li> <li>3) Investigate and discuss mitigation measures with MTRC;</li> <li>4) MTRC to implement mitigation measures as appropriate so as not to affect the train services and operation;</li> <li>5) Conduct noise measurement where necessary to review the adopted measures;</li> <li>6) Document the event/action and close case.</li> </ol>
Limit Level	<ol style="list-style-type: none"> <li>1) Identify source(s) of Impact;</li> <li>2) Inform MTRC, IEC and EPD;</li> <li>3) Repeat measurement to confirm findings;</li> <li>4) Check monitoring data;</li> <li>5) Investigate and discuss mitigation measures with MTRC;</li> <li>6) MTRC to implement mitigation measures as appropriate so as not to affect the train services and operation;</li> <li>7) Conduct noise measurement where necessary to review the adopted measures;</li> <li>8) Repeat Steps 3) to 7) if exceedance continues;</li> <li>9) Document the event/action if exceedance stops.</li> </ol>

Note:

- (1) Please refer to the MTR hotline and contact information via [http://www.mtr.com.hk/en/customer/main/contact\\_us.html](http://www.mtr.com.hk/en/customer/main/contact_us.html)

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**Appendix D**  
**Train Operation Noise Monitoring Results**

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### Appendix D Train Operation Noise Monitoring Results

Location : Villa Athena Block 5(Daytime)

Date	Start Time	Train Noise Level, dB(A) Laeq 30mins (event)	Overall Noise Level, dB(A)		Ambient Noise Level, dB(A)		LAeq Limit Level, dB(A)	Compliance (Yes/No)	Wind speed during monitoring lower than 5m/s? (Yes/No)
			LAeq 30 mins (overall)	LAeq 5mins (overall)	LAeq 30mins (ambient)	LAeq 5mins (ambient)			
21-Apr-2017	11:00	61	64.8	64.5	62.8	63.0	65	Yes	Yes
				64.6		63.4			
				64.8		63.5			
				64.2		63.0			
				65.5		60.9			
				65.2		62.4			
				65.2		62.4			

All readings are taken as façade measurement

Appendix D Train Operation Noise Monitoring Results

Location : Villa Athena Block 5(Night-time)

Date	Start Time	Train Noise Level, dB(A) Laeq 30mins (event)	Train Noise Level, dB(A) Lmax (event)	Overall Noise Level, dB(A)			Ambient Noise Level, dB(A)			Lmax Limit Level, dB(A)	Compliance (Yes/No)	Lmax Limit Level, dB(A)	Compliance (Yes/No)	Wind speed during monitoring lower than 5m/s? (Yes/No)
				LAeq 30 mins (overall)	LAeq 5mins (overall)	Lmax 5mins	LAeq 30mins (ambient)	LAeq 5mins (ambient)	Lmax 5mins					
2-May-2017	6:30	52	68	60.7	60.8	65.7	60.1	60.6	68.7	55	Yes	85	Yes	Yes
					59.7	66.1		59.4	64.6					
					60.9	68.0		59.0	63.4					
					60.6	67.3		59.7	64.8					
					60.8	65.2		60.3	65.3					
					61.5	66.2		61.1	66.1					
					62.1	68.5		61.2	66.1					
					61.5	66.8		61.1	68.7					
					62.3	68.8		61.5	72.2					
					61.8	70.2		60.5	68.0					
11-May-2017	6:30	54	70	61.8	61.0	67.5	61.1	60.7	66.0	55	Yes	85	Yes	Yes
					62.0	67.8		61.5	66.0					

All readings are taken as façade measurement

### Appendix D Train Operation Noise Monitoring Results

Location : Ma On Shan Centre Block 2 (Daytime)

Date	Start Time	Train Noise Level, dB(A) Laeq 30mins (event)	Overall Noise Level, dB(A)		Ambient Noise Level, dB(A)		LAeq Limit Level, dB(A)	Compliance (Yes/No)	Wind speed during monitoring lower than 5m/s? (Yes/No)
			LAeq 30 mins (overall)	LAeq 5mins (overall)	LAeq 30mins (ambient)	LAeq 5mins (ambient)			
21-Apr-2017	11:00	55	63.1	63.4	62.4	62.8	65	Yes	Yes
				63.1		62.6			
				63.1		62.5			
				63.2		62.5			
				63.3		62.4			
				62.3		61.4			

All readings are taken as façade measurement

Appendix D Train Operation Noise Monitoring Results

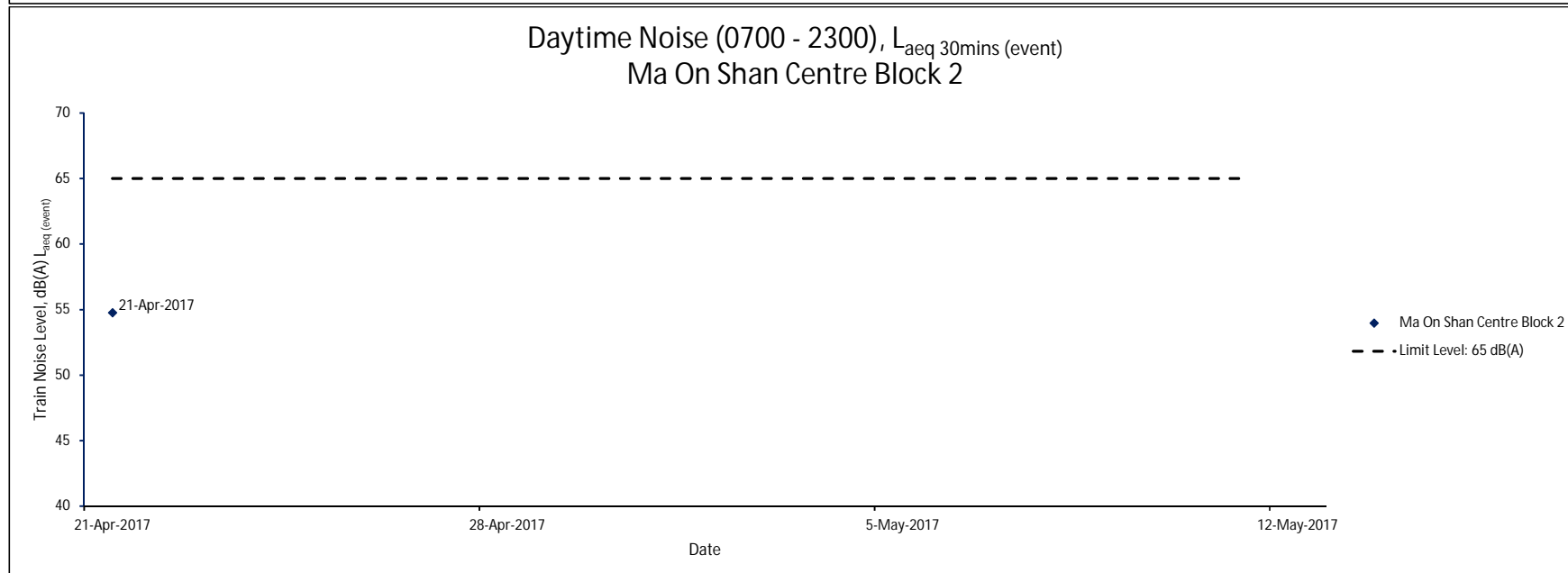
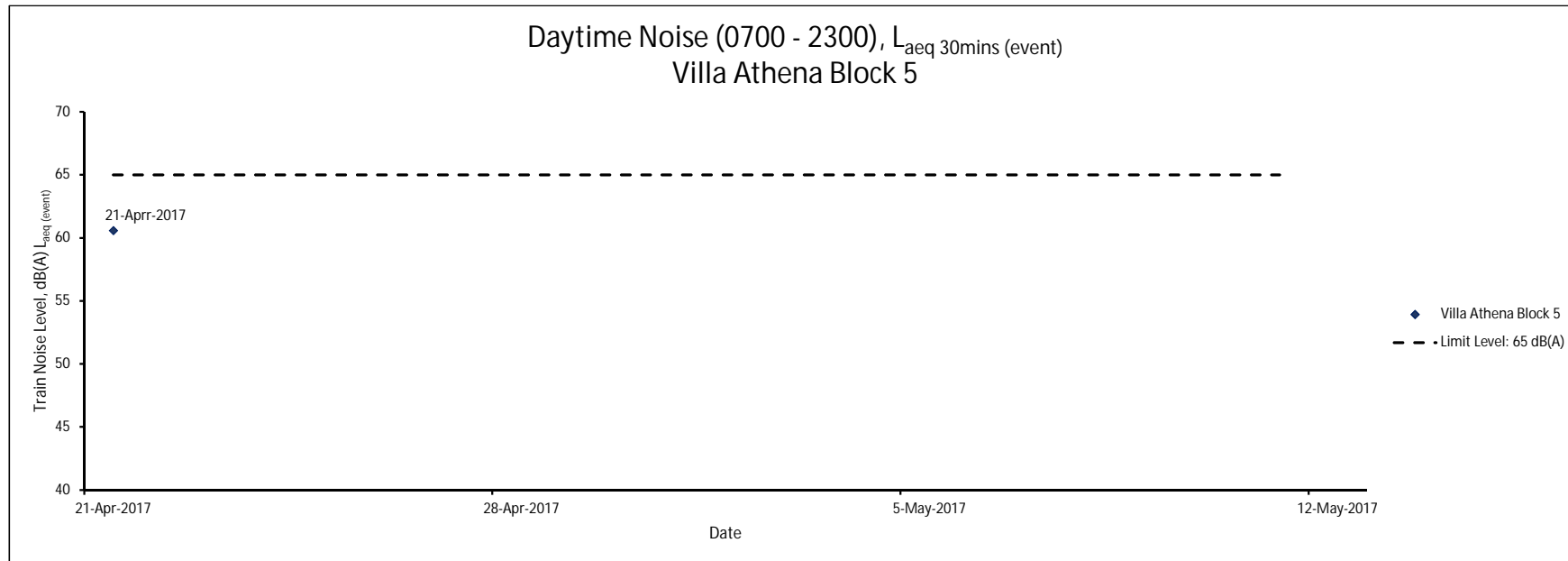
Location : Ma On Shan Centre Block 2 (Night-time)

Date	Start Time	Train Noise Level, dB(A) Laeq 30mins (event)	Train Noise Level, dB(A) Lmax (event)	Overall Noise Level, dB(A)			Ambient Noise Level, dB(A)			Lmax Limit Level, dB(A)	Compliance (Yes/No)	Lmax Limit Level, dB(A)	Compliance (Yes/No)	Wind speed during monitoring lower than 5m/s? (Yes/No)
				LAeq 30 mins (overall)	LAeq 5mins (overall)	Lmax 5mins	LAeq 30mins (ambient)	LAeq 5mins (ambient)	Lmax 5mins					
2-May-2017	6:30	51	69	60.7	59.9	67.4	60.2	59.1	69.8	55	Yes	85	Yes	Yes
					60.3	67.4		59.7	63.5					
					60.5	66.0		59.8	63.6					
					60.7	66.3		60.3	65.2					
					60.0	67.8		59.8	64.3					
					62.4	68.8		61.9	65.4					
					61.3	70.5		60.9	66.0					
					61.2	71.0		60.6	66.1					
					62.6	66.8		62.4	73.8					
					60.7	66.7		60.3	64.0					
11-May-2017	6:30	51	77	61.6	61.2	76.9	61.2	60.6	66.3	55	Yes	85	Yes	Yes
					62.3	67.3		62.1	66.6					

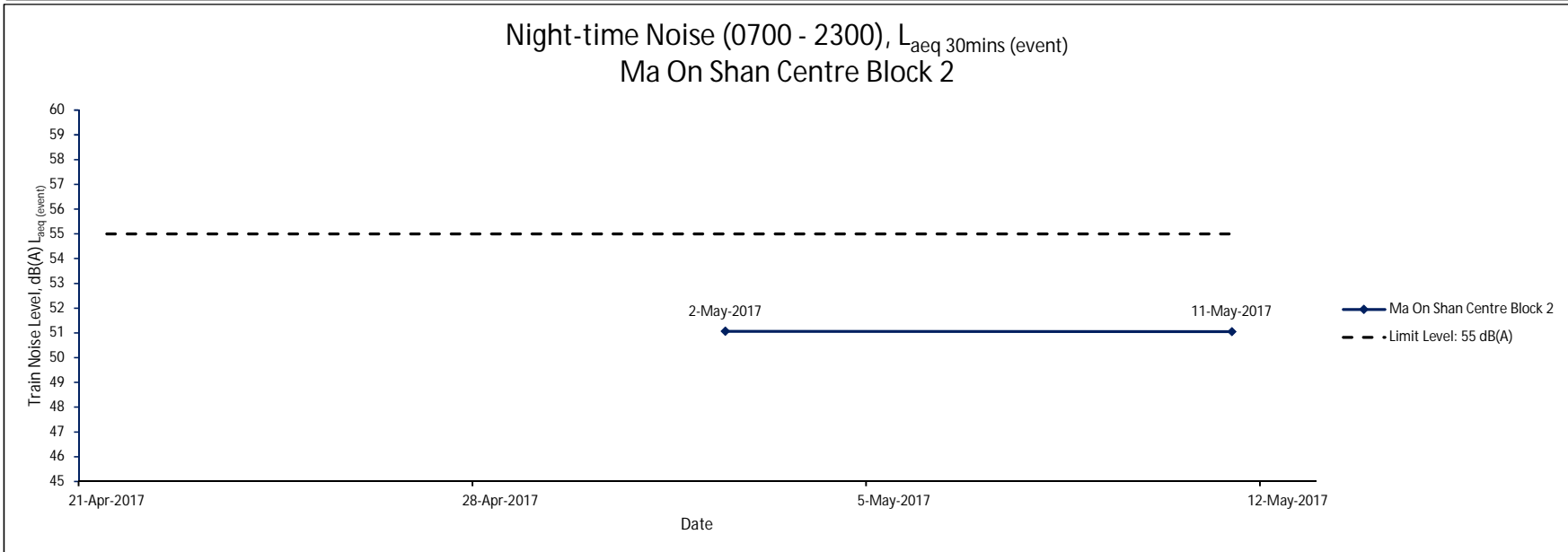
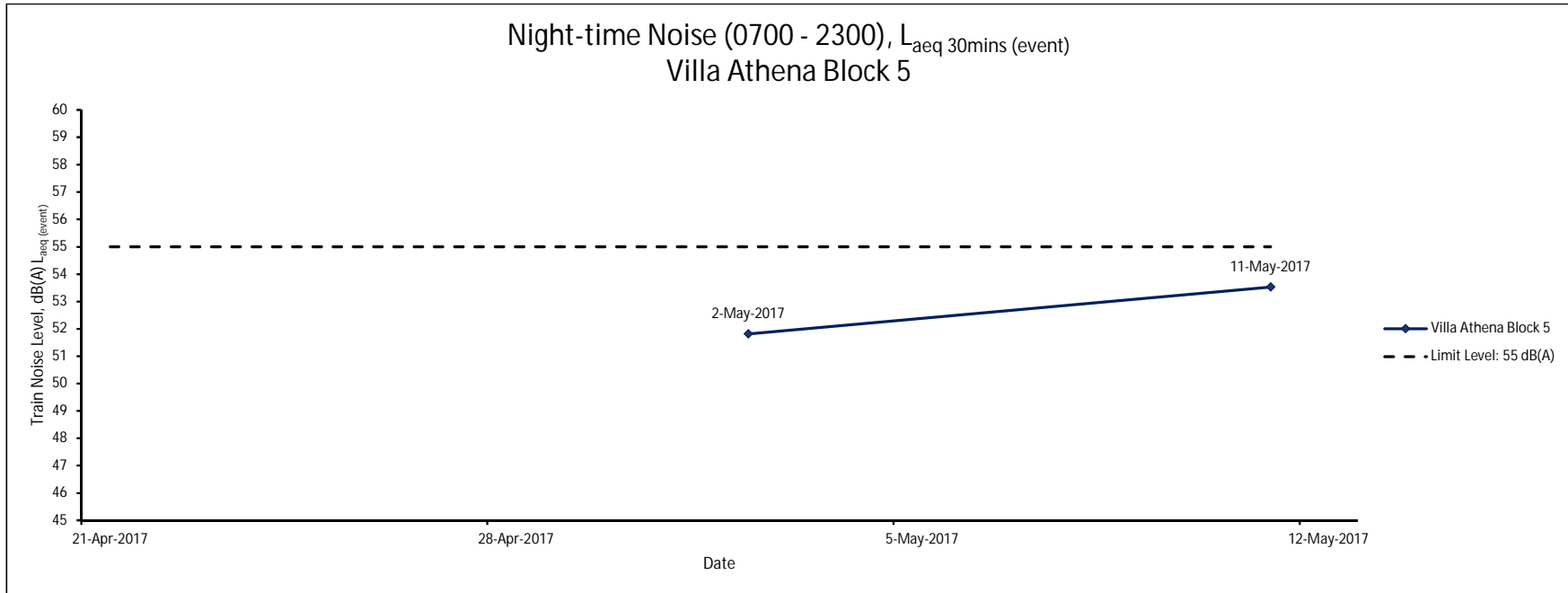
All readings are taken as façade measurement



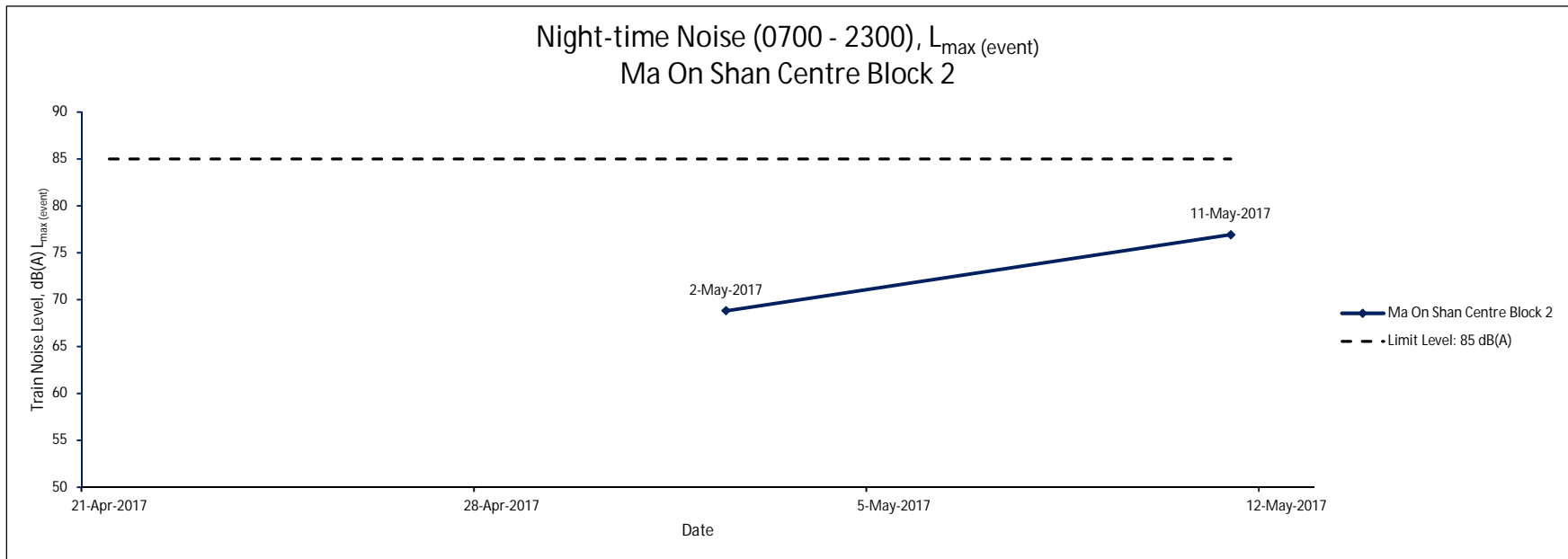
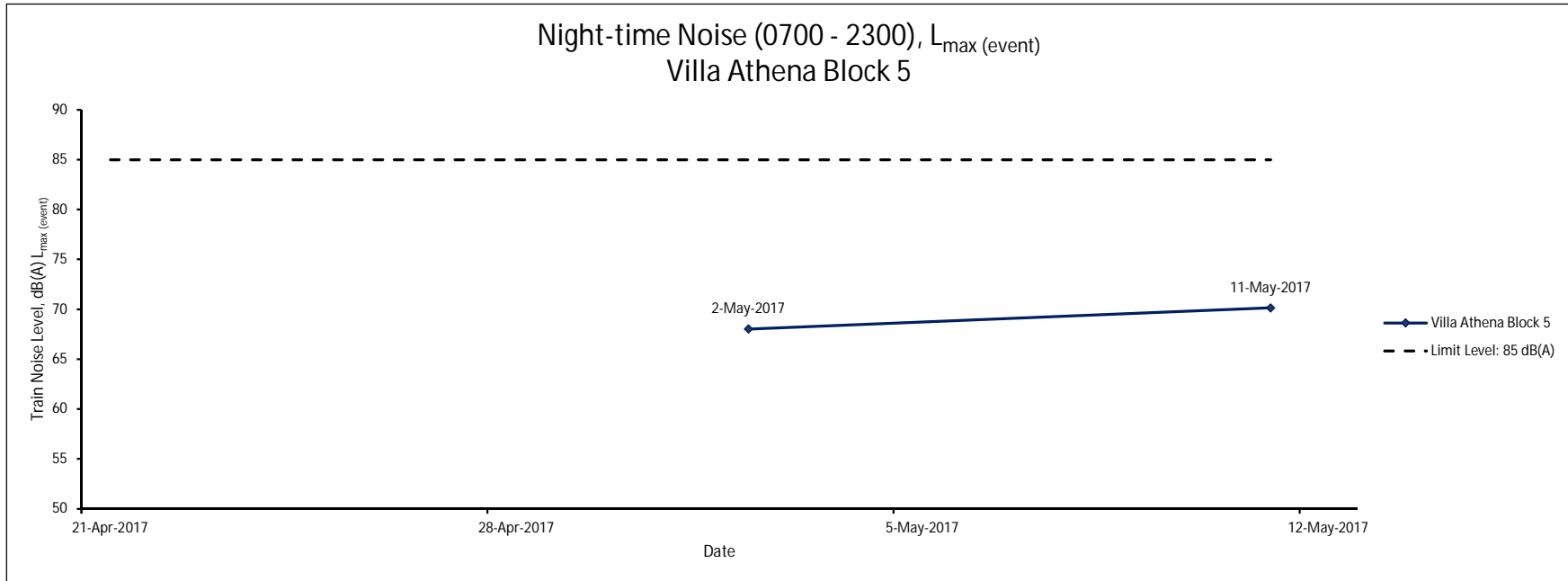
Appendix D Train Operation Noise Monitoring Results



Appendix D Train Operation Noise Monitoring Results



Appendix D Train Operation Noise Monitoring Results



Appendix D Train Operation Noise Monitoring Results

