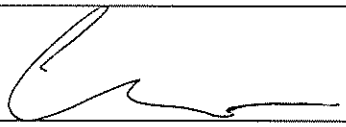
MTR Corporation Limited

Shatin to Central Link
Hung Hom to Admiralty Section

Ground-borne Railway Noise Performance Test Report

January 2022

Verified by:	Claudine Lee
Signature:	
Position:	Independent Environmental Checker
Date:	12 January 2022

MTR Corporation Limited

Shatin to Central Link
Hung Hom to Admiralty Section

Ground-borne Railway Noise Performance Test Report

January 2022

Certified by:	Lisa Poon
Signature:	
Position:	Environmental Team Leader
Date:	12 January 2022

AECOM

MTR Corporation Limited

Consultancy Agreement No. C11033B

Shatin to Central Link - Hung Hom to Admiralty [SCL (HUH-ADM)]

Ground-borne Railway Noise Performance Test Report

January 2022

	Name	Signature
Prepared & Checked:	Isaac Chu	
Reviewed & Approved:	Freeman Cheung	

Version:	A	Date: 7 January 2022

AECOM Asia Co. Ltd.
12/F, Grand Central Plaza, Tower 2, 138 Shatin Rural Committee Road, Shatin, NT, Hong Kong
Tel: (852) 3922 9000 Fax: (852) 3922 9797 www.aecom.com

Table of Content

Page

List of Tables

List of Figures

List of Annex

1 INTRODUCTION

1.1 Background

1.1.1 The Shatin to Central Link (SCL) is a 17km extension of the Ma On Shan Line (MOL) and East Rail Line (EAL) comprising (i) The East-West Corridor which extends the MOL from Tai Wai to Hung Hom via East Kowloon to connect with the West Rail Line (WRL) at Hung Hom Station (HUH) and Stabling Sidings at Hung Hom Freight Yard (HHS); and (ii) The North-South Corridor which is an extension of the EAL at Hung Hom across the harbour to Admiralty Station (ADM).

1.1.2 EIA Report for SCL – Hung Hom to Admiralty (HUH-ADM) Section (Register No.: AEIAR - 166/2012) was approved on 17 February 2012 under the Environmental Impact Assessment Ordinance (EIAO). Following the approval of the EIA Report, the Environmental Permit (EP) (EP No: EP-436/2012), covering the construction and operation of SCL (HUH-ADM), was granted on 22 March 2012. Variations of Environmental Permit (VEP) were subsequently applied for EP-436/2012 and the latest Environmental Permit (EP No: EP-436/2012/F) was issued by Director of Environmental Protection (DEP) on 29 January 2019.

1.1.3 Pursuant to EP Condition 2.30, at least one month before commencement of operation of the Project, the Permit Holder, MTR Corporation Ltd (MTR), shall carry out noise performance test and deposit with the Director four hard copies and one electronic copy of a Noise Performance Test Report to confirm the compliance of the operational ground-borne noise levels in accordance with the approved SCL (HUH-ADM) EIA Report (Register No. AEIAR-166/2012).

1.1.4 MTR Corporation Limited (MTR) therefore has commissioned AECOM Asia Co. Ltd to carry out the operational ground-borne railway noise performance test. Operational ground-borne performance tests were conducted at the selected ground-borne noise sensitive receivers (GBNSRs) on 27 November 2021.

1.2 Purpose of This Plan

1.2.1 This Report presents the measurement results of the performance tests at the selected measurement locations, and the operational ground-borne railway noise levels evaluated based on the measurement results to demonstrate the compliance of these noise levels with the relevant noise criteria in the approved SCL (HUH-ADM) EIA Report.

1.3 Structure of This Report

1.3.1 This Report comprises the following sections:

- Section 1 presents the background information.
- Section 2 presents the train operation parameters during performance tests.
- Section 3 presents the details of the performance tests on operational ground-borne railway noise.
- Section 4 presents the conclusion.

2 TRAIN OPERATION PARAMETERS DURING PERFORMANCE TEST

2.1 Train Operation Parameters

2.1.1 The operation parameters for the ground-borne railway noise performance test, including train configuration and train speed, aligns with those to be implemented for future operation of SCL(HUH-ADM).

2.1.2 As stipulated in EP Condition 2.27, the maximum train frequency operating on the Project from 0700 to 2300 hours and from 2300 to 0700 hours of the following day shall not exceed 30 trains and 24 trains per hour in each direction respectively. The difference of maximum train frequency between daytime and night-time is 6 trains per hour in each direction. As the other operation factors remain constant, and the daytime railway ground-borne noise level would be about 1 dB(A) higher than that during night-time operation, while the night-time noise criterion is 10 dB(A) more stringent than daytime, the compliance of night-time criterion would also represent the compliance of day-time noise criterion. In addition, considering that the intrusive noise and vibration from background vibration induced by road traffic and human activities is expected to be higher in daytime and evening period, the measurement was therefore conducted during night-time period only. Ground-borne noise impact during night-time period was be evaluated by the adoption of appropriate correction factors to account for train frequency.

2.1.3 According to various literatures (Ref: "*Track-Based Control Measures for Ground Vibration – The Influence of Quasi-Static Loads and Dynamic Excitation*", and "*Ground Vibration Induced by Railway Traffic – The Influence of Vehicle Parameters*", Noise and Vibration Mitigation for Rail Transit System, NNFM 118, Springer 2012), train loading has little effect on vibration in audible frequency range, and thus unloaded trains were employed for performance test, same testing approach as adopted for SCL- Tai Wai to Hung Hom Section [SCL (TAW-HUH)], South Island Line (East) and Kwun Tong Line Extension.

2.2 Evaluation of Railway Noise Levels from Measurement Results of Performance tests

2.2.1 Assumptions of train operation for evaluating ground-borne railway noise from noise measurement results of performance tests are same as those stipulated in EP Condition 2.27, i.e. the maximum train frequency operating in the Project from hours 0700 to 2300 shall not exceed 30 trains per hour in each direction. The maximum train frequency operating in the Project from hours 2300 to 0700 of the following day shall not exceed 24 trains per hour in each direction.

2.2.2 Details of the ground-borne railway noise performance tests are presented in **Section 3** of this Report.

2.3 Implementation of Noise Mitigation Measures

2.3.1 Final Operational Ground-borne Noise Mitigation Measures Plan (OGNMMP) was deposited to DEP in accordance with Section 2.28 of the EP (EP No: EP-436/2012/F) in October 2019 and was subsequently approved by EPD. The approved OGNMMP reviewed the assumptions adopted in the approved SCL(HUH-ADM) EIA Report and updated the ground-borne noise prediction based on the measured LSR results. The ground-borne noise levels predicted in the Final OGBNMMP have been reviewed (**Appendix A** refers) and the predicted ground-borne railway noise levels ($L_{eq,30min}$) at all representative GBNSRs are below 45dB(A) during daytime and night-time periods, comparing with the daytime noise criteria of 55dB(A) and night-time noise criteria of 45dB(A), no mitigation measures are therefore required.

3 OPERATIONAL GROUND-BORNE RAILWAY NOISE PERFORMANCE TEST

3.1 Operational Ground-borne Railway Noise Criteria

3.1.1 With reference to the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM) under the Noise Control Ordinance (NCO), the criteria for noise transmitted primarily through the structural elements of the building or buildings should be 10dB(A) less than the relevant acceptable noise level (ANL). The same criteria are applied to all residential buildings, schools, clinics, hospitals, temples and churches.

3.1.2 The operational ground-borne railway noise criteria for the representative ground-borne noise sensitive receivers (GBNSRs) along the Project alignment are presented in **Table 3.1** below

Table 3.1 Operational Ground-borne Railway Noise Criteria

GBNSR Description	Ground-borne Railway Noise Criteria ($L_{eq, 30min}$, dB(A))					
	Day and Evening Periods (0700 to 2300 hrs)			Night-time Period (2300 to 0700 hrs)		
	A	B	C	A	B	C
Churches/temples, schools, medical clinics, libraries, courts and performing arts centres	50	55	60	(a)		
Domestic premises, hotels and hospitals	50	55	60	40	45	50

Note:
(a) No sensitive use during this period.

3.2 Ground-borne Noise Measurement Locations

3.2.1 Representative GBNSRs (both existing and planned NSRs) within 300m of the Project boundary and at the most critical locations (e.g. on top of alignment/close to alignment where appropriate) have been selected and assessed in the approved SCL (HUH-ADM) EIA Report, and the Final Operation Ground-borne Noise Mitigation Measures Plan (OGNMMP) (October 2019), according to the criteria set out in the Annex 13 of *Technical Memorandum on Environmental Impact Assessment Process* (EIAO-TM).

3.2.2 Sensitive receivers along the alignment generally include hotels, The Hong Kong Academy for Performing Arts (HKAPA) and domestic premises. Domestic premises and hotels are taken into account during both the daytime and night-time periods, while HKAPA are considered to be noise sensitive during daytime and evening only.

3.2.3 The ground-borne noise levels predicted in the approved Final Operational Ground-borne Noise Mitigation Measures Plan (OGBNMMP) have been reviewed (**Appendix A** refers) and the predicted ground-borne railway noise levels ($L_{eq,30min}$) at all representative GBNSRs are below 45dB(A) during daytime and night-time periods, which comply with both the daytime noise criteria of 55dB(A) and night-time noise criteria of 45dB(A).

3.2.4 According to Section 8.3 of the approved EM&A Manual for SCL (HUH-ADM), a noise commissioning test should be conducted by the ET prior to the operation of the Project to confirm the compliance of the operational ground-borne railway noise levels with the NCO noise criteria. The noise commissioning test should be performed at selected GBNSRs as listed in Table 8.2 of the approved EM&A Manual for SCL (HUH-ADM). These GBNSRs include Hoi Kung Court (GOM1), The Hong Kong Academy For Performing Arts (HKAPA) (GOM2) and Island Shangri-La Hotel (GOM3).

3.2.5 However, access to Hoi Kung Court for ground-borne noise measurement had been rejected by the Owners' Corporation, and thus alternative operational ground-borne noise measurement location had been proposed to check the compliance of the operational ground-borne noise levels of the Project. Site findings revealed that storage room on the ground level was suitable for ground-borne noise measurement, and only access to storage room of Elizabeth House for ground-borne noise measurement had been obtained. The alternative ground-borne

operational noise monitoring location for Hoi Kung Court was therefore proposed to be Block C, Elizabeth House (i.e. AGOM1). The alternative measurement location was approved by the ER and agreed by the IEC.

3.2.6 The selected GBNSRs for commissioning test are summarised in **Table 3.2** with their locations shown in **Figure No. C11033B/C/SCL/ACM/M53/034 - 035**.

Table 3.2 Measurement Locations for Operational Ground-borne Railway Noise Performance Test

Measurement Station ID	NSR ID in EIA	Location	Floor with Measurement Equipment	Use	Criterion, dB(A)	
					$L_{eq, 30min}$ (day)	$L_{eq, 30min}$ (night)
AGOM 1	CH3	Elizabeth House, Block B	G/F (Lowest Sensitive Floor at 8/F)	Residential	55	45
GOM 2	EX4	HKAPA (inside Amphitheatre)	G/F (Lowest Sensitive Floor)	Educational	55	- (1)
GOM 3	AD4	Island Shangri-La Hotel	39/F (Lowest Sensitive Floor)	Hotel	55	45

Note:
(1) No sensitive use during this period.

3.3 Measurement Instrumentation and Procedures

3.3.1 According to the requirements of the Technical Memorandum (TM) issued under the NCO, sound level meters adopted for measurement comply with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804: 1985 (Type 1) specifications and other noise measuring and analysis instrumentation are of a comparable professional quality. Immediately prior to and following each noise measurement the accuracy of the sound level meter was checked using an acoustic calibrator generating a known sound pressure level at a known frequency. Measurements were accepted as valid with the difference between the calibration levels obtained before and after each noise measurement was less than 1.0 dB.

3.3.2 The measurement instruments adopted for the ground-borne noise commissioning test met the above requirements and are listed in **Table 3.3**. The calibration records of the instruments are provided in **Appendix B**.

Table 3.3 Measurement Instrumentation

Instrument	Model No.
Integrating Sound Level Meter	Svantek SVAN 958(Serial No.: 20890)
	Svantek SVAN 958A (Serial No.: 59120)
	Svantek SVAN 958A (Serial No.: 59121)
Acoustic Calibrator	Svantek SV30A (Serial No.: 10814)
Vibration Calibrator	IMI Sensors 699B02 (Serial No.: 2775)

3.3.3 All ground-borne noise measurements were conducted indoor inside the buildings, with microphones and an accelerometer set up at each selected monitoring location. The microphones were placed inside the building/a room at around 1.2m above floor level at all selected GBNSR locations. The vibration levels collected from accelerometer were used to determine the train passby. Photographs showing measurement setup at each of selected GBNSR locations are provided in **Appendix C**.

3.4 Measurement Parameters

3.4.1 Noise levels (including L_{eq}) and vibration levels were measured and logged at 1 second interval for the necessary periods at each GBNSR location. The periods need to cover at least three passbys of uptrack trains, three passbys of downtrack trains (i.e. no less than 6 passbys in total) and representative background noise level before/after each passby. Site observation was carried out during background and train passby noise measurement in order to detect whether the noise measurements were affected by other extraneous noise and to determine the representative of the measured noise levels.

3.4.2 Typically, train passby duration including head-tail period was determined when train noise was being perceived. However, if noise of train passby could not be perceived, it would be determined when there was an increase of vibration levels recorded by the accelerometer placed at the testing location. Vibration levels above background generally indicate train passby and its duration was checked against the train running schedule provided by MTR. Vibration levels were therefore extracted for identification of train passby time and duration when train noise could not be perceived.

3.5 Data Analysis and Evaluation of Ground-borne Railway Noise Impact

3.5.1 The collected noise data of train passbys and the evaluation of ground-borne noise impact ($L_{eq,30min}$) followed the steps as presented below.

i. Train passby data was extracted according to the recorded vibration levels and train running schedule provided by MTR. Noise level during a passby event was considered representative if the noise measurement was not affected by other extraneous noise.

ii. Background noise level was determined from averaging the noise level of over a representative period that was not affected by train GBN and extraneous noise.

iii. As the measured event noise levels would be used for further evaluation of $L_{Aeq,30min}$ to check against the relevant noise criteria, the measured event noise level should be corrected to account for the contribution from background. If the difference between the noise level during a passby event and the corresponding background noise level is equal to or greater than 3.0 dB(A), the measurements indicate that the event noise level is equal to or above the background noise level. In this case, the background corrected noise level could be determined by the following equation:

$$L_{eq,passby} = 10 \times log\left(10^{Leq,during\ passby/10} - 10^{Leq,background/10}\right)$$

Where $L_{eq,during\ passby}$ is the noise level during train passby, dB(A)
$L_{eq,background}$ is the background noise level, dB(A)
$L_{eq,passby}$ is the background corrected noise level, dB(A)

If the difference between the noise level during the passby event and the background noise level is less than 3.0 dB(A), the measurements indicate that the event noise level is below the background noise level and the accuracy of the above equation would be reduced and any background correction, if made, should only be regarded as approximate. In such case, as a conservative approach, no background correction would be applied for the measured noise level during the passby event.

iv. Sound Exposure Level (SEL) for uptrack and downtrack trains in 30 minutes was determined by the following equation:

$$SEL_{Up} = L_{eq,passby,Up} + 10 \times log\left(T_{Up}\right) + 10 \times log\left(N_{Up}\right)$$
$$SEL_{Down} = L_{eq,passby,Down} + 10 \times log(T_{Down}) + 10 \times log(N_{Down})$$

Where $T_{up/Down}$ is the train passby duration, second
$N_{Up/Down}$ is number of train passby in 30 minutes

v. Ground-borne railway noise level ($L_{eq,30min}$) for compliance check was determined by the following equations:

$$L_{eq,30min} = 10 \times log\left(10^{SEL_{Up}/10} + 10^{SEL_{Down}/10}\right) - 10 \times log(1800)$$

vi. A floor-to-floor attenuation of 2 dB reduction per floor should be applied to the predicted ground-borne railway noise level ($L_{eq,30min}$) for the measurement was not conducted at the lowest noise sensitive floor.

3.6 Evaluation Results of Performance test

3.6.1 As discussed in **Section 3.5.1 (iii)**, correction for background noise would generally be adopted to account for the contribution of background noise. During the course of measurement, train noise could not be perceived at the measurement locations during train passby. As shown in the time history and noise measurement results recorded at the measurement locations (**Appendix D** refers), the measured noise levels during train passby were in general similar to the background noise levels. In such cases, the change of noise levels during train passby were likely due to fluctuation of background noise instead of the ground-borne railway noise. Since all measured noise levels during train passby were less than 3 dB(A) above the background noise levels, as a conservative approach, all the measured noise levels during train passby were not corrected for background noise in evaluating the ground-borne railway noise level (i.e. with inclusion of background noise) for noise criteria compliance check. It is anticipated that the actual operational ground-borne railway noise levels at the GBNSRs would be substantially lower than the evaluation results. Based on this conservative approach, the evaluated operational ground-borne railway noise levels, with the inclusion of background noise, at all the selected GBNSRs comply with the noise criteria in both daytime/evening and night-time periods.

3.6.2 The evaluation results during daytime/evening and night-time periods are summarised in **Table 3.4** and **Table 3.5** respectively. Measurement results and detailed calculations are provided in **Appendix D**.

Table 3.4 Ground-borne Railway Noise Calculation Results during Daytime/Evening Period (0700-2300 hrs)

Measurement Station ID. / NSR ID in EIA	Location	Train Frequency per 30 minutes	Ground-borne Railway Noise Level[(1)(2)], $L_{eq\ 30min}$, dB(A)	Noise Criterion, $L_{eq\ 30min}$, dB(A)	Compliance (Y/N)
AGOM 1 / -	Elizabeth House, Block B	15 up and 15 down	<20 [(3)]	55	Y
GOM 2 / EX4	HKAPA (inside Amphitheatre)		<38	55	Y
GOM 3 / AD4	Island Shangri-La Hotel		<38	55	Y

Notes:
(1) Train passby data was extracted according to the recorded vibration levels and train running schedule provided by MTR. Noise level during a passby event was considered representative if the noise measurement was not affected by other extraneous noise. Background noise level was determined from averaging the noise levels of a representative period (approx. 1 minute) before or after the train passby that was not affected by train GBN and extraneous noise. Since all measured noise levels during train passby were less than 3dB(A) above the background noise levels, as a conservative approach, all the measured noise levels during train passby were not corrected for background noise in evaluating the $L_{eq,\ 30min}$. It is therefore anticipated that the actual operational ground-borne railway noise levels at the GBNSRs would be substantially lower than the evaluation results.
(2) A worst-case scenario with the adoption of maximum SEL measured for prediction has been considered.
(3) The ground-borne noise level was measured on G/F while 8/F is the lowest sensitive floor. It is anticipated that the ground-borne noise railway level on 8/F would be lower than that on G/F due to floor-to-floor attenuation.

Table 3.5 Ground-borne Railway Noise Calculation Results during Daytime/Evening Period (2300 – 0700 hrs)

Measurement Station ID. / NSR ID in EIA	Location	Train Frequency per 30 minutes	Ground-borne Railway Noise Level[(1)(2)], $L_{eq\ 30min}$, dB(A)	Noise Criterion, $L_{eq\ 30min}$, dB(A)	Compliance (Y/N)
AGOM 1 / -	Elizabeth House, Block B	12 up and 12 down	<19 [(3)]	45	Y
GOM 2 / EX4	HKAPA (inside Amphitheatre)		- [(4)]	45	Y
GOM 3 / AD4	Island Shangri-La Hotel		<37	45	Y

Notes:
(1) Train passby data was extracted according to the recorded vibration levels and train running schedule provided by MTR. Noise level during a passby event was considered representative if the noise measurement was not affected by other extraneous noise. Background noise level was determined from averaging the noise levels of a representative period (approx. 1 minute) before or after the train passby that was not affected by train GBN and extraneous noise. Since all measured noise levels during train passby were less than 3dB(A) above the background noise levels, as a conservative approach, all the measured noise levels during train passby were not corrected for background noise in evaluating the $L_{eq,\ 30min}$. It is therefore anticipated that the actual operational ground-borne railway noise levels at the GBNSRs would be substantially lower than the evaluation results.
(2) A worst-case scenario with the adoption of maximum SEL measured for prediction has been considered.
(3) The ground-borne noise level was measured on G/F while 8/F is the lowest sensitive floor. It is anticipated that the ground-borne noise railway level on 8/F would be lower than that on G/F due to floor-to-floor attenuation.
(4) N.A.- Not Applicable as there is no sensitive use at performance arts centre and educational institution during night-time period.

3.7 Cumulative Ground-borne Railway Noise Impact

3.7.1 Based on the performance test results in **Tables 3.4** and **3.5** above, the cumulative ground-borne railway noise levels at Island Shangri-La Hotel have been evaluated to check the compliance of noise criteria and the prediction results are presented in **Table 3.7**.

Table 3.6 Cumulative Ground-borne Railway Noise Calculation

Time Period	Location	Ground-borne Railway Noise Level, $L_{eq\ 30min}$, dB(A)		Predicted Cumulative Noise Level, dB(A)	NCO Noise Criteria, dB(A) (ANL)	Compliance (Y/N)
		SCL (HUH-ADM)	SIL(E)[(2)]			
Daytime/ Evening (0700-2300 hrs)	Island Shangri-La Hotel	<38 [(1)]	19	<38	55	Y
Night-time (2300-0700hrs)		<37 [(1)]	16	<37	45	Y

Notes:
(1) Since the measured noise levels during train passby were less than 3dB(A) above the background noise levels, as a conservative approach, the measured noise levels during train passby were not corrected for background noise in evaluating the Leq, 30min. It is therefore anticipated that the actual operational ground-borne railway noise levels and the actual cumulative noise levels would be substantially lower than the evaluation results and comply with the NCO noise criteria.
(2) Reference is made to the approved SIL(E) EIA Report (Register No. AEIAR-155/2010).

3.7.2 Cumulative ground-borne railway noise impact arising from SCL (HUH-ADM) and the existing Tsuen Wan Line is also expected at HKAPA. Since the predicted ground-borne railway noise at HKAPA is less than 38 dB(A) which is at least 17 dB(A) below the noise criterion. Hence, adverse cumulative ground-borne noise impact from the existing Tsuen Wan Line is not anticipated.

4 CONCLUSION

4.1.1 Ground-borne noise performance test was conducted at 3 representative GBNSRs in November 2021.

4.1.2 The results show that ground-borne railway noise levels at all selected GBNSRs comply with the stipulated noise criteria in daytime/evening and night-time period. Based on the findings of the ground-borne railway noise performance test, there would be no adverse railway noise impact arising from the operation of the Project to GBNSRs.

Figure

836000 E
836500 E
837000 E
837500 E
816500 N
816000 N
815500 N

EXH
AGOM 1
GOM 2
FOR CONTINUATION SEE DWG.C11033B/C/SCL/ACM/M53/035
MATCH LINE

VICTORIA HARBOUR
HARBOUR
CAUSEWAY BAY TYPHOON SHELTER

0 30 60 90 120 150
METRES
1 : 6000

LEGEND:

- SCL ALIGNMENT
- 300m STUDY BOUNDARY
- STATION OF SCL
- LOCATION OF SELECTED GROUND-BORNE NOISE MEASUREMENT STATION

ABBREVIATIONS:

SCL	SHATIN TO CENTRAL LINK
EXH	EXHIBITION STATION
SCL (HUH - ADM)	SHATIN TO CENTRAL LINK - HUNG HOM TO ADMIRALTY SECTION

MEASUREMENT STATION ID:

- AGOM 1 - BLOCK B, ELIZABETH HOUSE
- GOM2 - ISLAND SHANGRI-LA HOTEL

PLOT DRV: V:\ustnse1\MTR\PLOTDRIVER\WINDOWS\A3 COLOUR.pltr
MODELNAME: DeFault
FILENAME: P:\PROJECTS\60280235\DRAWING\REPORT\ENV\C11033B_C_SCL_ACM_M53_034A.dgn
PRINTED BY: ZHLZ 2020/12/30 14:06:03

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	ZLZ
DESIGNED	---
CHECKED	LCR
APPROVED	---
DATE	29/DEC/2021

MTR

SHATIN TO CENTRAL LINK

ORIGINATOR

AECOM

CADD REF. C11033B_C_SCL_ACM_M53_034A.dgn

TITLE

SCL 11033B

SCL (HUH - ADM)

MEASUREMENT LOCATIONS FOR OPERATIONAL GROUND-BORNE RAILWAY NOISE PERFORMANCE TEST (SHEET 1 OF 2)

SCALE	FIGURE NO.	REV.
1 : 6000 (A3)	C11033B/C/SCL/ACM/M53/034	A

834000 E
834500 E
835000 E
835500 E
815500 N
815000 N

VICTORIA HARBOUR
ROBINSON GARDEN APARTMENTS
UPPER ALBERT ROAD
BANK OF CHINA TOWER
HONGKONG ELECTRIC CENTRE
TREGUNTER
QUEEN'S ROAD EAST
ADM
GOM 2
GOM 3
MATCH LINE
FOR CONTINUATION SEE DWG C11033B/C/SCL/ACM/M53/034

LEGEND:

- SCL ALIGNMENT
- 300m STUDY BOUNDARY
- STATION OF SCL
- LOCATION OF SELECTED GROUND-BORNE NOISE MEASUREMENT STATION

ABBREVIATIONS:

SCL	SHATIN TO CENTRAL LINK
ADM	ADMIRALTY STATION
SCL (HUH - ADM)	SHATIN TO CENTRAL LINK - HUNG HOM TO ADMIRALTY SECTION

MEASUREMENT STATION ID:

- GOM 2 - HKAPA
- GOM 3 - ISLAND SHANGRI-LA HOTEL

0 30 60 90 120 150
METRES
1 : 6000

PLOT DRV: V:\ustnet\MTRPLOTDRIVER\WINDOWS\A3 COLOUR.pltr
MODEL NAME: Default PRINTED BY: ZWLZ 2021/12/31 11:38:29
FILENAME: P:\PROJECTS\60282033\DRAWING\REPORT\ENVCHO\3B\C_SCL_ACM_M53_035A.dgn

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	ZLZ
DESIGNED	---
CHECKED	LCR
APPROVED	---
DATE	29/DEC/2021

MTR

SHATIN TO CENTRAL LINK

ORIGINATOR
AECOM

CADD REF.
C11033B_C_SCL_ACM_M53_035A.dgn

TITLE
SCL 11033B
SCL (HUH - ADM)
MEASUREMENT LOCATIONS FOR OPERATIONAL GROUND-BORNE RAILWAY NOISE PERFORMANCE TEST (SHEET 2 OF 2)

SCALE	FIGURE NO.	REV.
1 : 6000 (A3)	C11033B/C/SCL/ACM/M53/035	A

Appendix A

Excerpt of Final Operation Ground-borne Noise Mitigation Measures Plan (October 2019)

rock type, and the up track and down track tunnel near CH3 are on rock and soil type respectively. According to Transit Noise and Vibration Impact Assessment Manual[3], vibration in rock would have lower attenuation as compared to soil. As a conservative approach, the measured LSR data at AD4 where the tunnels are located in rock type will be adopted for updating operational ground-borne noise predictions at those NSRs where the tunnels in soil type.

3.3.3 Ground-borne noise assessment at the representative OGBNSRs (**Figure Nos. C11033B/C/SCL/ACM/M53/021** to **023** refer) has been updated according to the LSR measurement results. Assessment methodology follows the prediction methodology recommended by the FTA Manual, which was adopted in the EIA Report. The prediction results are summarised in **Table 3.2** and **Annex D**, with detailed sample calculation provided in **Annex E**. Cumulative operational night-time ground-borne noise level at AD4 has also been updated with results indicate compliance with the stipulated noise limit (**Table 3.3** refers).

3.3.4 Results indicate that the updated operational ground-borne noise levels are all below the noise criteria. As such, no additional mitigation measures such as trackform upgrade is required for SCL(HUH-ADM), and EIA conclusion remains unchanged.

Table 3.2 Ground-borne Noise Prediction Results

NSR ID	NSR Description	Adoption of Measured LSR Data	Day and Evening Period (0700 - 2300 hours)			Night-time Period (2300 - 0700 hours)		
			Criteria, $L_{eq,30min}$, dB(A)	Updated Prediction(1), $L_{eq,30min}$, dB(A)	Comply with NCO (Y/N)	Criteria, $L_{eq,30min}$, dB(A)	Updated Prediction(1), $L_{eq,30min}$, dB(A)	Comply with NCO (Y/N)
Kowloon Side								
HH9b(2)	Habourfront Horizon	AD4	55	<20	Y	45	<20	Y
Hong Kong Side								
CH2	Hoi Kung Court	CH2(3)	55	41	Y	45	40	Y
CH3	Elizabeth House, Block C	AD4	55	<20	Y	45	<20	Y
EX2(2)	Renaissance Harbour View Hotel	AD4	55	<20	Y	45	<20	Y
EX3(2)	Grand Hyatt Hotel	AD4	55	<20	Y	45	<20	Y
EX4	The Hong Kong Academy for Performing Arts (HKAPA)	AD4	55	<20	Y	N/A	<20	Y
AD4	Island Shangri-la Hotel	AD4	55	<20	Y	45	<20	Y

Notes:
(1) The prediction is based on train frequency at peak hours as follow:
- 30 trains per hour per direction during daytime/evening (0700-2300).
- 24 trains per hour per direction at night (2300-0700).

(2) As discussed in **Section 3.3.2**, as a conservative approach, the measured LSR data at AD4 where the tunnels are located in rock type will be adopted for updating operational ground-borne noise predictions at those NSRs where the tunnels in soil type.

(3) The impact test signal was not noticeable at the measurement location (i.e. CH2) during the testing and thus there was no measurement results with impact test signal. Under these circumstances, acoustic principles dictate that the test signal would be less than background minus 10dB. Nevertheless, as a very conservative approach for this particular LSR prediction, the signal was taken as recorded background vibration levels minus 3dB to determine the LSR values. The LSR determined at CH2 therefore will not be applicable for other noise impact assessment purpose.

[3] U.S. Department of Transportation, Transit Noise and Vibration Impact Assessment Manual (September 2018).

Table 3.3 Cumulative Ground-borne Noise Prediction Result

NSR ID	Night-time Period (2300 - 0700 hours)				
	Ground-Borne Noise Level, $L_{eq,30min}$ dB(A)			Criteria, $L_{eq,30min}$, dB(A)	Comply with NCO (Y/N)
	SCL(1) (HUH-ADM)	SIL(E)(2)	Cumulative		
AD4	15	16	<20	45	Y

Notes:
(1) Detailed ground-borne noise prediction at AD4 is presented in **Annex E**.
(2) Predicted ground-borne noise level as extracted in Table 10.12 of approved SCL(HUH-ADM) EIA Report (Register No.: AEIAR-166/2012).

836000 E
836500 E
837000 E
837500 E
838000 E
818500 N
818000 N
817500 N

TSIM SHA TSUI
CHATHAM ROAD SOUTH
HUH
SCL (MKK - HUH)
SCL (HUH - ADM)
HH9b

REPRESENTATIVE NSR FOR OPERATIONAL GROUNDBORNE NOISE ASSESSMENT

HH9b	HARBOURFRONT HORIZON

LEGEND:

	PROPOSED SCL ALIGNMENT
	300m STUDY BOUNDARY
	PROPOSED STATION OF SCL
HH9b	NSRs FOR OPERATIONAL GROUNDBORNE NOISE ASSESSSMENT

ABBREVIATIONS:

SCL	SHATIN TO CENTRAL LINK
HUH	HUNG HOM STATION
SCL (MKK - HUH)	SHATIN TO CENTRAL LINK - MONG KOK EAST TO HUNG HOM SECTION
SCL (HUH - ADM)	SHATIN TO CENTRAL LINK - HUNG HOM TO ADMIRALTY SECTION

0 30 60 90 120 150
METRES
1 : 6000

REV	DESCRIPTION	BY	DATE	APPROVED

REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	ZFX
DESIGNED	---
CHECKED	LCR
APPROVED	---
DATE	29/JUL/2016

MTR

SHATIN TO CENTRAL LINK

ORIGINATOR
AECOM

CADD REF.
C11033B_C_SCL_ACM_M53_021A.dgn

TITLE
SCL 11033B
SCL (HUH - ADM)
LOCATIONS OF NOISE SENSITIVE RECEIVERS (GROUNDBORNE)
(SHEET 1 OF 3)

SCALE	FIGURE NO.	REV.
1 : 6000 (A3)	C11033B/C/SCL/ACM/M53/021	A

PLOT DRV: v:\ustrset\MTR\PLOTDRIVER\WINDOWS\A3 COLOUR.plt
MODEL NAME: Default PRINTED BY: AWEL 2016/8/25 17:06
FILENAME: P:\projects\60280223\DRAWING\REPORT\ENV\C11033B_C_SCL_ACM_M53_021A.dgn

836000 E
836500 E
837000 E
837500 E
816500 N
816000 N
815500 N

UP TRACK TUNNEL ON ROCK
UP TRACK TUNNEL ON ROCK
UP TRACK TUNNEL ON ROCK
UP TRACK TUNNEL ON ROCK
DOWN TRACK TUNNEL ON ROCK
DOWN TRACK TUNNEL ON ROCK

EXH
EX2
EX3
EX4
CH2
CH3

MATCH LINE
FOR CONTINUATION
C11033B/C/SCL/ACM/M53/023

VICTORIA HARBOUR
HARBOUR
CAUSEWAY BAY TYPHOON SHELTER

0 30 60 90 120 150
METRES
1 : 6000

NOTE:
1. FOR THOSE SECTIONS WITHOUT INDICATION OF GEOLOGICAL CONDITION, THESE TUNNEL SECTIONS ARE LOCATED IN SOIL.

REPRESENTATIVE NSRS FOR OPERATIONAL GROUNDBORNE NOISE ASSESSMENT	
CH2	HOI KUNG COURT
CH3	ELIZABETH HOUSE, BLOCK C
EX2	RENAISSANCE HARBOUR VIEW HOTEL
EX3	GRAND HYATT HOTEL
EX4	THE HONG KONG ACADEMY FOR PERFORMING ARTS

LEGEND:

- PROPOSED SCL ALIGNMENT
- 300m STUDY BOUNDARY
- PROPOSED STATION OF SCL
- EX2 — NSRS FOR OPERATIONAL GROUNDBORNE NOISE ASSESSMENT

ABBREVIATIONS:

SCL	SHATIN TO CENTRAL LINK
EXH	EXHIBITION STATION
SCL (HUH - ADM)	SHATIN TO CENTRAL LINK - HUNG HOM TO ADMIRALTY SECTION

PLOT DRV: v:\usrfrset\MTR\PLOTDRIVER\WINDOWS\A3_COLOUR.pltPRINTED BY: ZENGFX 2016/8/29 14:23:46
MODELNAME: Default
FILENAME: P:\projects\602B023\DRAWING\REPORT\VIEW\C11033B_C_SCL_ACM_M53_022B.dgn

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	ZFX
DESIGNED	---
CHECKED	LCR
APPROVED	---
DATE	29/JUL/2016

MTR

SHATIN TO CENTRAL LINK

ORIGINATOR
AECOM

CADD REF.
C11033B_C_SCL_ACM_M53_022B.dgn

TITLE
SCL 11033B
SCL (HUH - ADM)
LOCATIONS OF NOISE SENSITIVE RECEIVERS (GROUNDBORNE)
(SHEET 2 OF 3)

SCALE 1 : 6000 (A3)
FIGURE NO. C11033B/C/SCL/ACM/M53/022
REV. B

834000 E
834500 E
835000 E
835500 E
815500 N
815000 N

VICTORIA HARBOUR
UP TRACK TUNNEL ON ROCK
UP TRACK TUNNEL ON ROCK
UP TRACK TUNNEL ON ROCK
DOWN TRACK TUNNEL ON ROCK
DOWN TRACK TUNNEL ON ROCK
EX3
EX4
ADM
AD4
MATCH LINE
FOR CONTINUATION SEE DWG C11033B/C/SCL/ACM/M53/022
BANK OF CHINA TOWER
ROBINSON GARDEN APARTMENTS
UPPER ALBERT ROAD
QUEEN'S ROAD EAST
HONGKONG ELECTRIC CENTRE
TREGUNTER

0 30 60 90 120 150
METRES
1 : 6000

NOTE:

1. FOR THOSE SECTIONS WITHOUT INDICATION OF GEOLOGICAL CONDITION, THESE TUNNEL SECTIONS ARE LOCATED IN SOIL.

REPRESENTATIVE NSRS FOR OPERATIONAL GROUNDBORNE NOISE ASSESSMENT	
EX3	GRAND HYATT HOTEL
EX4	THE HONG KONG ACADEMY FOR PERFORMING ARTS
AD4	ISLAND SHANGRI-LA HOTEL

LEGEND:

- PROPOSED SCL ALIGNMENT
- 300m STUDY BOUNDARY
- PROPOSED STATION OF SCL
- AD4 — NSRS FOR OPERATIONAL GROUNDBORNE NOISE ASSESSMENT

ABBREVIATIONS:

SCL	SHATIN TO CENTRAL LINK
ADM	ADMIRALTY STATION
SCL (HUH - ADM)	SHATIN TO CENTRAL LINK - HUNG HOM TO ADMIRALTY SECTION

PLOT DRV: v:\ustmset\MTR\PLOTDRIVER\WINDOWS\A3 COLOUR.pltPRINTED BY: ZENKFMODELNAME: Default2009/8/29 14:43:45
FILENAME: P:\projects\602802\3\GRAPHICS\REPORT\ENV\C11033B_C_SCL_ACM_M53_023B.dgn

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	ZFX
DESIGNED	---
CHECKED	LCR
APPROVED	---
DATE	29/JUL/2016

MTR

SHATIN TO CENTRAL LINK

ORIGINATOR

AECOM

CADD REF. C11033B_C_SCL_ACM_M53_023B.dgn

TITLE

SCL 11033B

SCL (HUH - ADM)

LOCATIONS OF NOISE SENSITIVE RECEIVERS (GROUNDBORNE) (SHEET 3 OF 3)

SCALE	FIGURE NO.	REV.
1 : 6000 (A3)	C11033B/C/SCL/ACM/M53/023	B

Annex D

Summary of Updated Operational Ground-borne Noise Assessment Results

Summary of Operational Ground-borne Noise Prediction Results

NSR ID.	Tunnel Ground Type		Adoption of Measured LSR Data[1][2]	Southbound			Northbound			Predicted Day/Evening Ground-Borne Noise, $Leq_{,30min}$, dB(A)			Predicted Night-time Ground-Borne Noise, $Leq_{,30min}$, dB(A)		
	South-bound	North-bound		Horizontal Dist, m	Track Depth, m	Slant Dist[3], m	Horizontal Dist, m	Track Depth, m	Slant Dist[3], m	EIA Prediction	Updated Prediction	Difference	EIA Prediction	Updated Prediction	Difference
HH9b	Soil	Soil	AD4	150	11	150	155	11	155	3.5	-2.7	-6.1	2.5	-3.6	-6.1
CH2	Rock	Rock	CH2	60	17	62	65	25	70	37.6	41.3	+3.6	36.7	40.3	+3.6
CH3	Soil	Rock	AD4	60	15	62	65	28	71	18.2	8.5	-9.7	17.3	7.6	-9.7
EX2	Soil	Soil	AD4	30	20	36	30	27	40	9.3	6.0	-3.3	8.3	5.0	-3.3
EX3	Soil	Soil	AD4	30	27	40	30	34	45	7.6	5.2	-2.3	6.6	4.3	-2.3
EX4	Rock	Rock	AD4	40	33	52	50	35	61	16.2	10.6	-5.6	15.2	9.6	-5.6
AD4	Rock	Rock	AD4	0	48	48	15	49	51	20.3	15.8	-4.4	19.3	14.9	-4.4

Remark:

(1) Range of calculated distance for measured LSR at AD4 is between 20m to 50m.

(2) Range of calculated distance for measured LSR at CH2 is between 100m to 130m.

(3) Underlined slant distance indicates the adoption of extrapolation for determination of LSR.

(4) A very conservative approach was adopted for the LSR prediction at CH2. Details please refer to Annex B2 of this OGNMMP.

Appendix B

Calibration Certificates of Monitoring Equipment

MAXLAB

CALIBRATION CERTIFICATE

Certificate Information

Date of Issue	23-Jul-2021	**Certificate Number**	MLCN211814S

Customer Information

Company Name	Wilson Ho and Associates Limited
Address	Unit 601, Block A, Shatin Industrial Centre, Yuen Shun Circuit, Shatin, NT

Equipment-under-Test (EUT)

Description	Sound & Vibration Analyser
Manufacturer	Svantek
Model Number	SVAN 958
Serial Number	20890
Equipment Number	--

Calibration Particular

Date of Calibration	23-Jul-2021		
Calibration Equipment	4231(MLTE008) / AV200063 / 23-Jun-2023		
Calibration Procedure	MLCG00, MLCG15		
Calibration Conditions	Laboratory	Temperature	23 °C ± 5 °C
		Relative Humidity	55% ± 25%
	EUT	Stabilizing Time	Over 3 hours
		Warm-up Time	10 minutes
		Power Supply	Internal battery
Calibration Results	Calibration data were detailed in the continuation pages.		

Approved By & Date

K.O. Lo 23-Jul-2021

Statements

* Calibration equipment used for this calibration are traceable to national / international standards.
* The results on this Calibration Certificate only relate to the values measured at the time of the calibration and the uncertainties quoted will not include allowance for the EUT long term drift, variation with environmental changes, vibration and shock during transportation, overloading, mishandling, misuse, and the capacity of any other laboratory to repeat the measurement.
* MaxLab Calibration Centre Limited shall not be liable for any loss or damage resulting from the use of the EUT.
* The copy of this Certificate is owned by MaxLab Calibration Centre Limited. No part of this Certificate may be reproduced without the prior written approval of MaxLab Calibration Centre Limited.

萬儀校正中心有限公司
MaxLab Calibration Centre Limited
香港新界葵涌華星街 16-18 號保盈工業大廈 9 樓 B 室
Unit B, 9/F., Boldwin Industrial Bldg., 16-18 Wah Sing Street, Kwai Chung, N.T., Hong Kong Tel: (852) 2116 1380 Fax: (852) 2264 6480 Email: info@maxlab.com.hk

MAXLAB

Certificate No. MLCN211814S

Calibration Data

Channel / Mode	Filter / Detector	Range	EUT Reading	Standard Reading	EUT Error	Calibration Uncertainty
CH4 / Sound	A / FAST (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
			114.0 dB	114.0 dB	0.0 dB	0.2 dB
	C / FAST (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
			114.0 dB	114.0 dB	0.0 dB	0.2 dB
	LIN / FAST (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
			114.0 dB	114.0 dB	0.0 dB	0.2 dB
	A / SLOW (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	C / SLOW (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	LIN / SLOW (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	A / IMPULSE (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	C / IMPULSE (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	LIN / IMPULSE (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB

- END -

Calibrated By : Kenneth
Date : 23-Jul-2021

Checked By : K.O. Lo
Date : 23-Jul-2021

萬儀校正中心有限公司
MaxLab Calibration Centre Limited
香港新界葵涌華星街 16-18 號保盈工業大廈 9 樓 B 室
Unit B, 9/F., Boldwin Industrial Bldg., 16-18 Wah Sing Street, Kwai Chung, N.T., Hong Kong Tel: (852) 2116 1380 Fax: (852) 2264 6480 Email: info@maxlab.com.hk

MAXLAB

CALIBRATION CERTIFICATE

Certificate Information

Date of Issue	17-Nov-2020	**Certificate Number**	MLCN203076S

Customer Information

Company Name	Wilson Accoustics Limited
Address	Unit 601, Block A, Shatin Industrial Centre, Yuen Shun Circuit, Shatin, N. T., Hong Kong

Equipment-under-Test (EUT)

Description	Sound & Vibration Analyser
Manufacturer	Svantek
Model Number	SVAN 958A
Serial Number	59120
Equipment Number	--

Calibration Particular

Date of Calibration	17-Nov-2020		
Calibration Equipment	4231(MLTE008) / AV200063 / 23-Jun-2023		
Calibration Procedure	MLCG00, MLCG15		
Calibration Conditions	Laboratory	Temperature	23 °C ± 5 °C
		Relative Humidity	55% ± 25%
	EUT	Stabilizing Time	Over 3 hours
		Warm-up Time	10 minutes
		Power Supply	Internal battery
Calibration Results	Calibration data were detailed in the continuation pages.		

Approved By & Date

K.O. Lo 17-Nov-2020

Statements

* Calibration equipment used for this calibration are traceable to national / international standards.
* The results on this Calibration Certificate only relate to the values measured at the time of the calibration and the uncertainties quoted will not include allowance for the EUT long term drift, variation with environmental changes, vibration and shock during transportation, overloading, mishandling, misuse, and the capacity of any other laboratory to repeat the measurement.
* MaxLab Calibration Centre Limited shall not be liable for any loss or damage resulting from the use of the EUT.
* The copy of this Certificate is owned by MaxLab Calibration Centre Limited. No part of this Certificate may be reproduced without the prior written approval of MaxLab Calibration Centre Limited.

萬儀校正中心有限公司
MaxLab Calibration Centre Limited
香港新界葵涌華星街 16-18 號保盈工業大廈 9 樓 B 室
Unit B, 9/F., Boldwin Industrial Bldg., 16-18 Wah Sing Street, Kwai Chung, N.T., Hong Kong Tel: (852) 2116 1380 Fax: (852) 2264 6480 Email: info@maxlab.com.hk

MAXLAB

Certificate No. MLCN203076S

Calibration Data

Channel / Mode	Filter / Detector	Range	EUT Reading	Standard Reading	EUT Error	Calibration Uncertainty
CH4 / Sound	A / FAST (1 kHz Input)	105 dB	93.9 dB	94.0 dB	-0.1 dB	0.2 dB
		130 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
			114.0 dB	114.0 dB	0.0 dB	0.2 dB
	C / FAST (1 kHz Input)	105 dB	93.9 dB	94.0 dB	-0.1 dB	0.2 dB
		130 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
			114.0 dB	114.0 dB	0.0 dB	0.2 dB
	LIN / FAST (1 kHz Input)	105 dB	93.9 dB	94.0 dB	-0.1 dB	0.2 dB
		130 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
			114.0 dB	114.0 dB	0.0 dB	0.2 dB
	A / SLOW (1 kHz Input)	105 dB	93.9 dB	94.0 dB	-0.1 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	C / SLOW (1 kHz Input)	105 dB	93.9 dB	94.0 dB	-0.1 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	LIN / SLOW (1 kHz Input)	105 dB	93.9 dB	94.0 dB	-0.1 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	A / IMPULSE (1 kHz Input)	105 dB	93.9 dB	94.0 dB	-0.1 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	C / IMPULSE (1 kHz Input)	105 dB	93.9 dB	94.0 dB	-0.1 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	LIN / IMPULSE (1 kHz Input)	105 dB	93.9 dB	94.0 dB	-0.1 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB

- END -

Calibrated By : Dan
Date : 17-Nov-2020

Checked By : K.O. Lo
Date : 17-Nov-2020

萬儀校正中心有限公司
MaxLab Calibration Centre Limited
香港新界葵涌華星街 16-18 號保盈工業大廈 9 樓 B 室
Unit B, 9/F., Boldwin Industrial Bldg., 16-18 Wah Sing Street, Kwai Chung, N.T., Hong Kong Tel: (852) 2116 1380 Fax: (852) 2264 6480 Email: info@maxlab.com.hk

MAXLAB

CALIBRATION CERTIFICATE

Certificate Information

Date of Issue	31-Oct-2020	**Certificate Number**	MLCN202867S

Customer Information

Company Name	Wilson Accoustics Limited
Address	Unit 601, Block A, Shatin Industrial Centre, Yuen Shun Circuit, Shatin, N. T., Hong Kong

Equipment-under-Test (EUT)

Description	Sound & Vibration Analyser
Manufacturer	Svantek
Model Number	SVAN 958A
Serial Number	59121
Equipment Number	--

Calibration Particular

Date of Calibration	31-Oct-2020		
Calibration Equipment	4231(MLTE008) / AV200063 / 23-Jun-2023		
Calibration Procedure	MLCG00, MLCG15		
Calibration Conditions	Laboratory	Temperature	23 °C ± 5 °C
		Relative Humidity	55% ± 25%
	EUT	Stabilizing Time	Over 3 hours
		Warm-up Time	10 minutes
		Power Supply	Internal battery
Calibration Results	Calibration data were detailed in the continuation pages.		

Approved By & Date

K.O. Lo 31-Oct-2020

Statements

* Calibration equipment used for this calibration are traceable to national / international standards.
* The results on this Calibration Certificate only relate to the values measured at the time of the calibration and the uncertainties quoted will not include allowance for the EUT long term drift, variation with environmental changes, vibration and shock during transportation, overloading, mishandling, misuse, and the capacity of any other laboratory to repeat the measurement.
* MaxLab Calibration Centre Limited shall not be liable for any loss or damage resulting from the use of the EUT.
* The copy of this Certificate is owned by MaxLab Calibration Centre Limited. No part of this Certificate may be reproduced without the prior written approval of MaxLab Calibration Centre Limited.

萬儀校正中心有限公司
MaxLab Calibration Centre Limited
香港新界葵涌華星街 16-18 號保盈工業大廈 9 樓 B 室
Unit B, 9/F., Boldwin Industrial Bldg., 16-18 Wah Sing Street, Kwai Chung, N.T., Hong Kong Tel: (852) 2116 1380 Fax: (852) 2264 6480 Email: info@maxlab.com.hk

MAXLAB

Certificate No. MLCN202867S

Calibration Data

Channel / Mode	Filter / Detector	Range	EUT Reading	Standard Reading	EUT Error	Calibration Uncertainty
CH4 / Sound	A / FAST (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
			114.0 dB	114.0 dB	0.0 dB	0.2 dB
	C / FAST (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
			114.0 dB	114.0 dB	0.0 dB	0.2 dB
	LIN / FAST (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
			114.0 dB	114.0 dB	0.0 dB	0.2 dB
	A / SLOW (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	C / SLOW (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	LIN / SLOW (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	A / IMPULSE (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	C / IMPULSE (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB
	LIN / IMPULSE (1 kHz Input)	105 dB	94.0 dB	94.0 dB	0.0 dB	0.2 dB
		130 dB	114.0 dB	114.0 dB	0.0 dB	0.2 dB

- END -

Calibrated By : Dan
Date : 31-Oct-2020

Checked By : K.O. Lo
Date : 31-Oct-2020

萬儀校正中心有限公司
MaxLab Calibration Centre Limited
香港新界葵涌華星街 16-18 號保盈工業大廈 9 樓 B 室
Unit B, 9/F., Boldwin Industrial Bldg., 16-18 Wah Sing Street, Kwai Chung, N.T., Hong Kong Tel: (852) 2116 1380 Fax: (852) 2264 6480 Email: info@maxlab.com.hk

MAXLAB

CALIBRATION CERTIFICATE

Certificate Information

Date of Issue	28-Sep-2021	**Certificate Number**	MLCN212726S

Customer Information

Company Name	Wilson Accoustics Limited
Address	Unit 601, Block A, Shatin Industrial Centre, Yuen Shun Circuit, Shatin, N. T., Hong Kong

Equipment-under-Test (EUT)

Description	Acoustic Calibrator
Manufacturer	Svantek
Model Number	SV 30A
Serial Number	10814
Equipment Number	--

Calibration Particular

Date of Calibration	28-Sep-2021		
Calibration Equipment	4231(MLTE008) / AV200063 / 23-Jun-23 1351(MLTE049) / MLEC21/06/02 / 5-Jun-22		
Calibration Procedure	MLCG00, MLCG15		
Calibration Conditions	Laboratory	Temperature	23 °C ± 5 °C
		Relative Humidity	55% ± 25%
	EUT	Stabilizing Time	Over 3 hours
		Warm-up Time	Not applicable
		Power Supply	Internal battery
Calibration Results	Calibration data were detailed in the continuation pages. All calibration results were within EUT specification.		

Approved By & Date

K.O. Lo 28-Sep-2021

Statements

* Calibration equipment used for this calibration are traceable to national / international standards.
* The results on this Calibration Certificate only relate to the values measured at the time of the calibration and the uncertainties quoted will not include allowance for the EUT long term drift, variation with environmental changes, vibration and shock during transportation, overloading, mishandling, misuse, and the capacity of any other laboratory to repeat the measurement.
* MaxLab Calibration Centre Limited shall not be liable for any loss or damage resulting from the use of the EUT.
* The copy of this Certificate is owned by MaxLab Calibration Centre Limited. No part of this Certificate may be reproduced without the prior written approval of MaxLab Calibration Centre Limited.

萬儀校正中心有限公司
MaxLab Calibration Centre Limited
香港新界葵涌華星街 16-18 號保盈工業大廈 9 樓 B 室
Unit B, 9/F., Boldwin Industrial Bldg., 16-18 Wah Sing Street, Kwai Chung, N.T., Hong Kong Tel: (852) 2116 1380 Fax: (852) 2264 6480 Email: info@maxlab.com.hk

MAXLAB

Certificate No. MLCN212726S

Calibration Data

EUT Setting	Standard Reading	EUT Error from Setting	Calibration Uncertainty	EUT Specification
94 dB	94.0 dB	0.0 dB	0.15 dB	± 0.3 dB
114 dB	114.0 dB	0.0 dB	0.15 dB	± 0.3 dB

- END -

Calibrated By : Dan
Date : 28-Sep-21

Checked By : K.O. Lo
Date : 28-Sep-21

萬儀校正中心有限公司
MaxLab Calibration Centre Limited
香港新界葵涌華星街 16-18 號保盈工業大廈 9 樓 B 室
Unit B, 9/F., Boldwin Industrial Bldg., 16-18 Wah Sing Street, Kwai Chung, N.T., Hong Kong Tel: (852) 2116 1380 Fax: (852) 2264 6480 Email: info@maxlab.com.hk

~ Calibration Certificate ~

Model Number:	699B02	Customer:	
Serial Number:	2775	P.O. :	
Description:	Portable Handheld Shaker		
Manufacturer:	IMI	Method :	Back-to-Back Comparison (AT701-1)

Calibration Data

Operating Frequency:	159.3	Hz.	Test Point Voltage:	101.4	mVAC
Acceleration Level:	1.00	g's rms			
	9.842	m/s^2			
Temperature:	74	°F (23 °C)	Relative Humidity:	43	%

Condition of Unit

As Found: n/a
As Left: New Unit, In Tolerance

Notes

1. Calibration is N.I.S.T. Traceable through Project 684/O-0000000851 and PTB Traceable through Project 17016.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Measurement uncertainty (95% confidence level with coverage factor of 2) for amplitude at operating frequency is +/-1.6%.

Equipment Used For Calibration

Manufacturer	Description	Model#	Serial No.	Cal Date	Due Date
PCB Piezotronics	Accelerometer	353B34	NC802	4/15/2021	4/15/2022
PCB Piezotronics	ICP Signal Conditioner	442A103	NC896	10/02/2020	10/01/2021
National Instruments	Acquisition	PCI-6351	NC1428	12/21/2020	12/21/2021

Technician: *Darius Story* DS Date: 09/10/21

Due Date:

ilac-MRA ACCREDITED
CALIBRATION CERT #1862.02

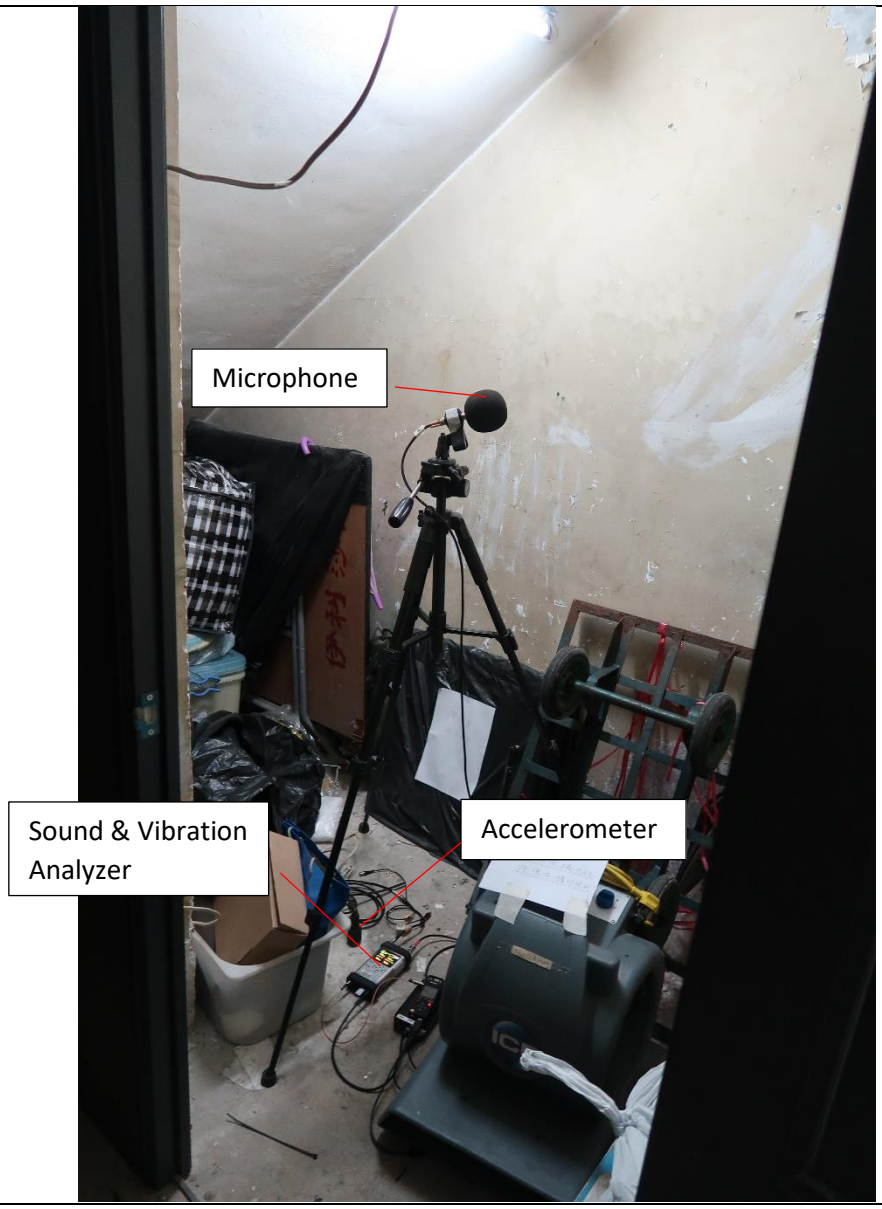
IMI SENSORS
A PCB PIEZOTRONICS DIV.
Headquarters: 3425 Walden Avenue, Depew, NY 14043
Calibration Performed At: 10869 Highway 903, Halifax, NC 27839
TEL: 888-684-0003 FAX: 716-684-3823 www.imi-sensors.com hh1 2021170733.50

Page 1 of 1

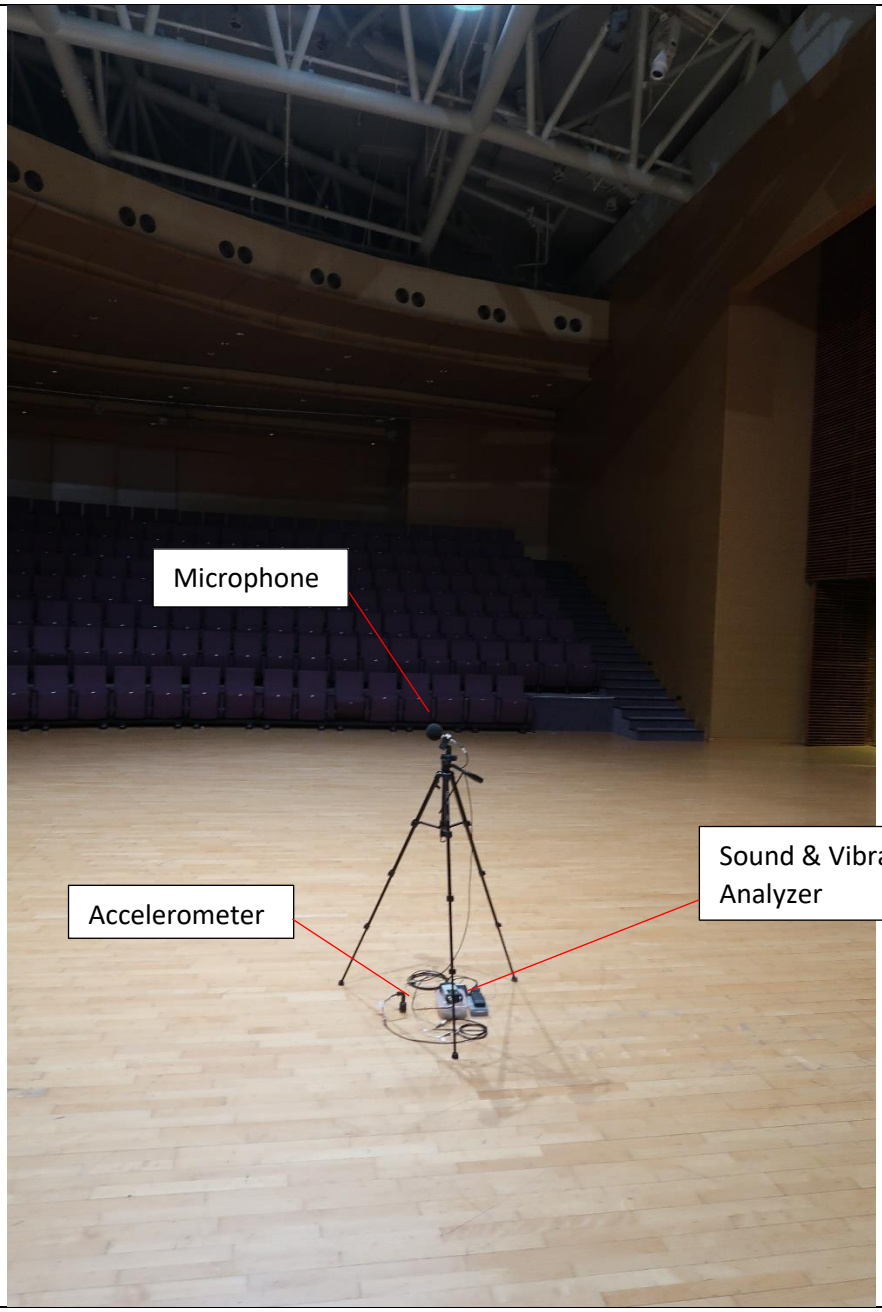
Appendix C

Ground-borne Noise Measurement – Photographs of Measurement Setup

Appendix C Ground-borne Railway Noise Measurement - Photographs of Measurement Setup



AGOM 1- Elizabeth House, Block B



GOM 2 - HKAPA

GOM 3 - Island Shangri-La Hotel

Appendix D

Ground-borne Railway Noise Measurement Results and Detailed Calculation

Appendix D Ground-borne Railway Noise Measurement Results and Detailed Calculation

Ground-borne Noise Measurement Results and Detailed Calculation (Without Background Correction)

Measurement Location: **Elizabeth House, Block B (G/F)**
Measurement Date and Time: **11/27/2021 03:00 to 03:40**

GBNSR	Train&Direction	Passby No.	Measured Event[2] Leq, dB(A) [A]	Background Noise Level, dB(A) [B]	[A] - [B], dB(A)	Event Duration, s	Correction for Event Duration, dB(A)	SEL[3], dB(A)	Max SEL, dB(A)
AGOM 1	Uptrack	U1	40.5	40.1	0.3	20	13.0	53.5	53.5
		U3	30.3	30.2	0.0	20	13.0	43.3	
		U4	35.9	29.9	6.0	20	13.0	48.9	
	Downtrack	D1	26.6	30.2	-3.7	20	13.0	39.6	53.3
		D2	31.1	28.4	2.7	20	13.0	44.1	
		D3	40.3	40.1	0.2	20	13.0	53.3	

Notes:

(1) The train type adopted for the commissioning test is the same as the train type for future operation.

(2) Event duration includes the head-tail time period.

(3) As a conservative approach, the measured event noise levels without background correction were adopted to determine the SEL.

Prediction of Groundborne Railway Noise Level During Daytime/Evening Time Period

GBNSR	Train & Direction	Max SEL, dB(A)	Time Period	Train Frequency per 30mins	Correction for Train Frequency, dB(A)	Conversion Factor to LAeq 30mins, dB(A)	BCF Correction[1]	Att_{floor} Correction[2]	LAeq 30mins, dB(A)
AGOM 1	Uptrack	53.5	Daytime & Evening (0700-2300)	15	11.8	-32.6	0.0	-16.0	16.7
	Downtrack	53.3		15	11.8	-32.6	0.0	-16.0	16.5
								Predicted Noise Level, LAeq 30mins, dB(A)	**<20**
								GBN Criterion, dB(A)	**55**
								Compliance	**Yes**

Notes:

(1) Measurement was conducted inside the building and thus there is no correction of buidling coupling factor (BCF).

(2) 8/F of AGOM 1 is the lowest noise sensitive floor, and thus floor-to-floor attenuation of -16 dB(A) was applied to the measurement result.

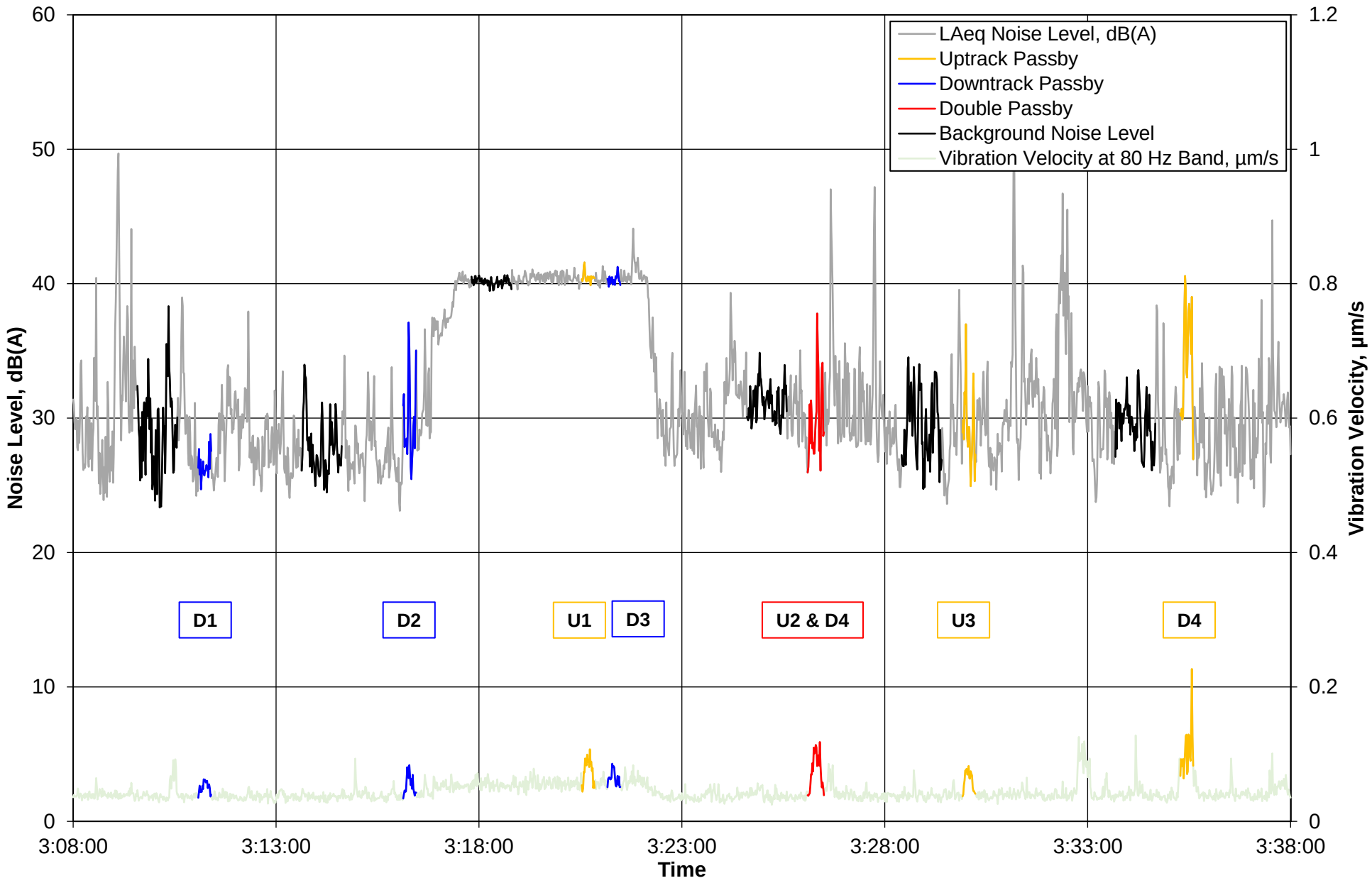
Prediction of Groundborne Railway Noise Level During Night-time Period

GBNSR	Train & Direction	Max SEL, dB(A)	Time Period	Train Frequency per 30mins	Correction for Train Frequency, dB(A)	Conversion Factor to LAeq 30mins, dB(A)	BCF Correction[1]	Att_{floor} Correction[2]	LAeq 30mins, dB(A)
AGOM 1	Uptrack	53.5	Daytime & Evening (0700-2300)	12	10.8	-32.6	0.0	-16.0	15.7
	Downtrack	53.3		12	10.8	-32.6	0.0	-16.0	15.6
								Predicted Noise Level, LAeq 30mins, dB(A)	**<19**
								GBN Criterion, dB(A)	**45**
								Compliance	**Yes**

Notes:

(1) Measurement was conducted inside the building and thus there is no correction of buidling coupling factor (BCF).

(2) 8/F of AGOM 1 is the lowest noise sensitive floor, and thus floor-to-floor attenuation of -16 dB(A) was applied to the measurement result.


LAeq Noise Level, dB(A)
Uptrack Passby
Downtrack Passby
Double Passby
Background Noise Level
Vibration Velocity at 80 Hz Band, µm/s
Noise Level, dB(A)
Vibration Velocity, µm/s
Time
60
50
40
30
20
10
0
1.2
1
0.8
0.6
0.4
0.2
0
3:08:00
3:13:00
3:18:00
3:23:00
3:28:00
3:33:00
3:38:00
D1
D2
U1
D3
U2 & D4
U3
D4

Appendix D Ground-borne Railway Noise Measurement Results and Detailed Calculation

Ground-borne Noise Measurement Results and Detailed Calculation (Without Background Correction)

Measurement Location: **HKAPA (G/F)**
Measurement Date and Time: **11/27/2021 03:00 to 03:40**

GBNSR	Train&Direction	Passby No.	Measured Event[2] Leq, dB(A) [A]	Background Noise Level, dB(A) [B]	[A] - [B], dB(A)	Event Duration, s	Correction for Event Duration, dB(A)	SEL[3], dB(A)	Max SEL, dB(A)
GOM 2	Uptrack	U2	43.7	43.7	0.0	15	11.8	55.5	55.6
		U3	43.9	43.7	0.2	15	11.8	55.6	
		U4	43.7	43.7	0.0	15	11.8	55.5	
	Downtrack	D1	43.7	43.7	0.0	15	11.8	55.5	55.5
		D3	43.7	43.7	0.0	15	11.8	55.5	
		D4	43.7	43.7	0.0	15	11.8	55.5	

Notes:

(1) The train type adopted for the commissioning test is the same as the train type for future operation.

(2) Event duration includes the head-tail time period.

(3) As a conservative approach, the measured event noise levels without background correction were adopted to determine the SEL.

Prediction of Groundborne Railway Noise Level During Daytime/Evening Time Period

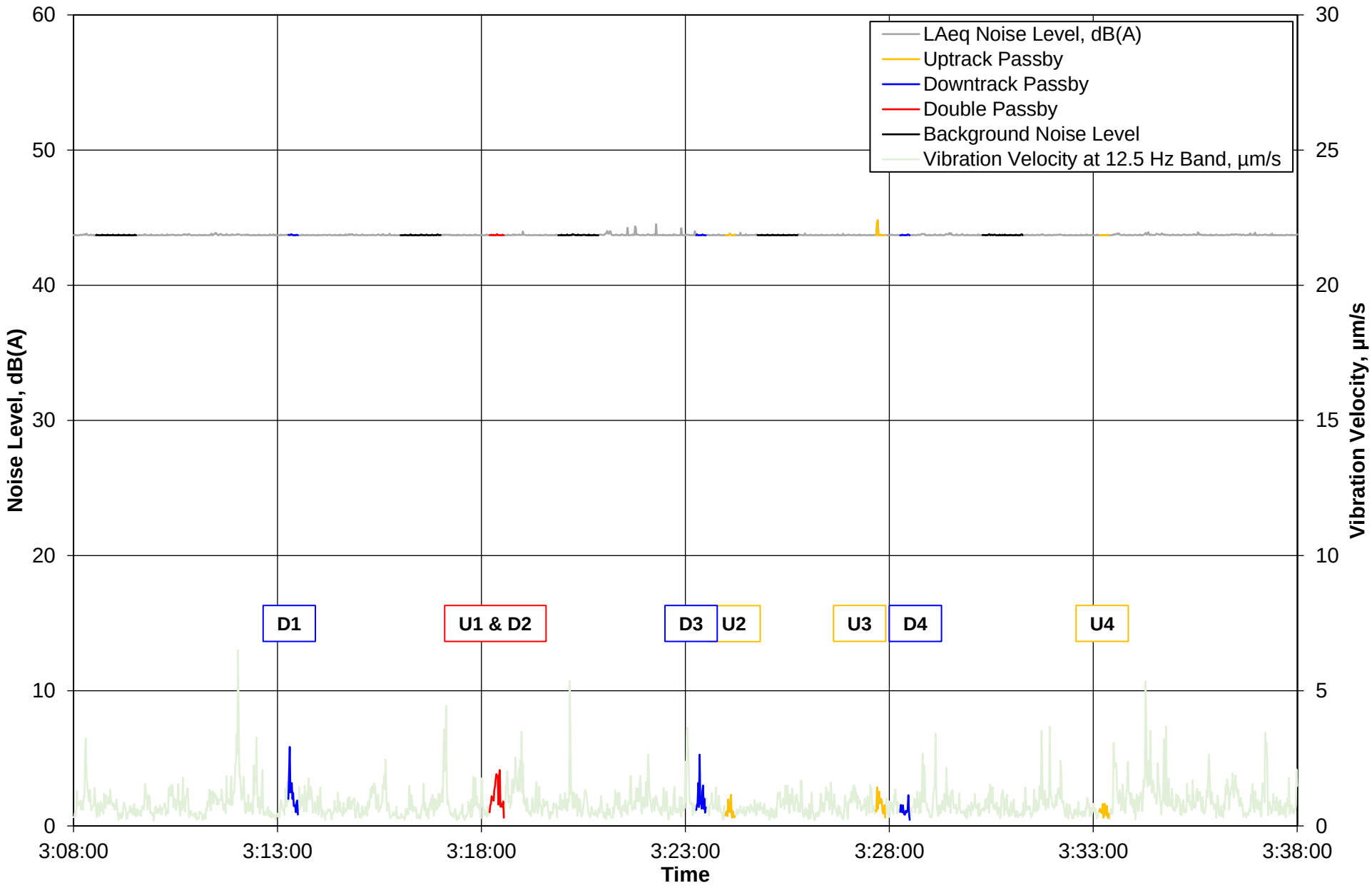
GBNSR	Train & Direction	Max SEL, dB(A)	Time Period	Train Frequency per 30mins	Correction for Train Frequency, dB(A)	Conversion Factor to LAeq 30mins, dB(A)	BCF Correction[1]	Att_{floor} Correction[2]	LAeq 30mins, dB(A)
GOM 2	Uptrack	55.6	Daytime & Evening (0700-2300)	15	11.8	-32.6	0.0	0.0	34.8
	Downtrack	55.5		15	11.8	-32.6	0.0	0.0	34.7
								Predicted Noise Level, LAeq 30mins, dB(A)	**<38**
								GBN Criterion, dB(A)	**55**
								Compliance	**Yes**

Notes:

(1) Measurement was conducted inside the building and thus there is no correction of buidling coupling factor (BCF).

(2) G/F of GOM2 is the lowest noise sensitive floor, and thus no floor-to-floor attenuation was applied to the measurement result.

(3) As there is no sensitive use at GOM-2 during night-time period, only daytime/evening predicted noise level is presented.


LAeq Noise Level, dB(A)
Uptrack Passby
Downtrack Passby
Double Passby
Background Noise Level
Vibration Velocity at 12.5 Hz Band, µm/s
D1
U1 & D2
D3
U2
U3
D4
U4
Noise Level, dB(A)
Vibration Velocity, µm/s
Time
60
50
40
30
20
10
0
30
25
20
15
10
5
0
3:08:00
3:13:00
3:18:00
3:23:00
3:28:00
3:33:00
3:38:00

Appendix D Ground-borne Railway Noise Measurement Results and Detailed Calculation

Ground-borne Noise Measurement Results and Detailed Calculation (Without Background Correction)

Measurement Location: **Island Shangri-La Hotel (39/F)**
Measurement Date and Time: **11/27/2021 03:00 to 03:40**

GBNSR	Train&Direction	Passby No.	Measured Event[2] Leq, dB(A) [A]	Background Noise Level, dB(A) [B]	[A] - [B], dB(A)	Event Duration, s	Correction for Event Duration, dB(A)	SEL[3], dB(A)	Max SEL, dB(A)
GOM 3	Uptrack	U1	40.7	40.6	0.1	32	15.1	55.7	55.8
		U2	40.7	40.3	0.4	32	15.1	55.8	
		U3	40.7	40.3	0.4	32	15.1	55.7	
		U4	40.6	40.6	0.0	32	15.1	55.7	
	Downtrack	D1	40.9	40.6	0.3	32	15.1	55.9	55.9
		D2	40.4	40.3	0.1	32	15.1	55.5	
		D3	40.2	40.3	-0.1	32	15.1	55.3	
		D4	40.7	40.6	0.0	32	15.1	55.7	

Notes:

(1) The train type adopted for the commissioning test is the same as the train type for future operation.

(2) Event duration includes the head-tail time period.

(3) As a conservative approach, the measured event noise levels without background correction were adopted to determine the SEL.

Prediction of Groundborne Railway Noise Level During Daytime/Evening Time Period

GBNSR	Train & Direction	Max SEL, dB(A)	Time Period	Train Frequency per 30mins	Correction for Train Frequency, dB(A)	Conversion Factor to LAeq 30mins, dB(A)	BCF Correction[1]	Att_{floor} Correction[2]	LAeq 30mins, dB(A)
GOM 3	Uptrack	55.8	Daytime & Evening (0700-2300)	15	11.8	-32.6	0.0	0.0	35.0
	Downtrack	55.9		15	11.8	-32.6	0.0	0.0	35.1
Predicted Noise Level, LAeq 30mins, dB(A)									**<38**
GBN Criterion, dB(A)									**55**
Compliance									**Yes**

Notes:

(1) Measurement was conducted inside the building and thus there is no correction of buidling coupling factor (BCF).

(2) 39/F of GOM3 is the lowest noise sensitive floor, and thus no floor-to-floor attenuation was applied to the measurement result.

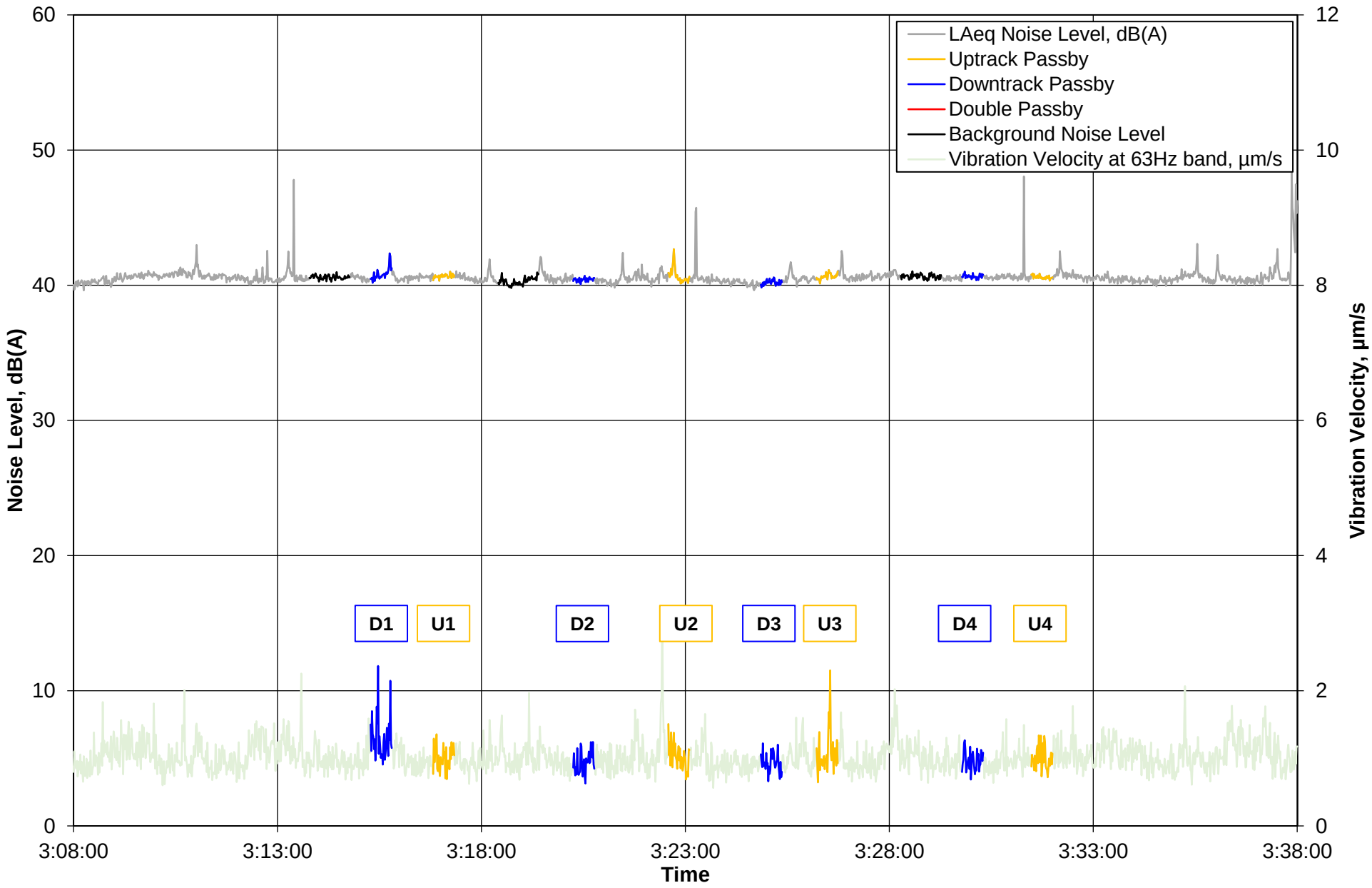
Prediction of Groundborne Railway Noise Level During Night-time Period

GBNSR	Train & Direction	Max SEL, dB(A)	Time Period	Train Frequency per 30mins	Correction for Train Frequency, dB(A)	Conversion Factor to LAeq 30mins, dB(A)	BCF Correction[1]	Att_{floor} Correction[2]	LAeq 30mins, dB(A)
GOM 3	Uptrack	55.8	Daytime & Evening (0700-2300)	12	10.8	-32.6	0.0	0.0	34.0
	Downtrack	55.9		12	10.8	-32.6	0.0	0.0	34.2
Predicted Noise Level, LAeq 30mins, dB(A)									**<37**
GBN Criterion, dB(A)									**45**
Compliance									**Yes**

Notes:

(1) Measurement was conducted inside the building and thus there is no correction of buidling coupling factor (BCF).

(2) 39/F of GOM3 is the lowest noise sensitive floor, and thus no floor-to-floor attenuation was applied to the measurement result.


LAeq Noise Level, dB(A)
Uptrack Passby
Downtrack Passby
Double Passby
Background Noise Level
Vibration Velocity at 63Hz band, µm/s
D1
U1
D2
U2
D3
U3
D4
U4
Noise Level, dB(A)
Vibration Velocity, µm/s
Time
60
50
40
30
20
10
0
12
10
8
6
4
2
0
3:08:00
3:13:00
3:18:00
3:23:00
3:28:00
3:33:00
3:38:00