MTR Corporation Limited

Shatin to Central Link –
Tai Wai to Hung Hom Section

Final Operational Ground-borne Noise Mitigation Measures Plan

(June 2017)

Verified by: _____Fredrick Leong____________

Position: Independent Environmental Checker

Date: ___________7 June 2017_____________

MTR Corporation Limited

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(June 2017)

Certified by: Felice Wong

Position: Environmental Team Leader

Date: 7 June 2017

AECOM

MTR Corporation Limited

Consultancy Agreement No. C11033

Shatin to Central Link - Tai Wai to Hung Hom Section [SCL(TAW – HUH)] and Stabling Sidings at Hung Hom Freight Yard [SCL(HHS)]

Final Operational Ground-borne Noise Mitigation Measures Plan

June 2017

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Table of Content

List of Tables

List of Figures

Appendices

1 INTRODUCTION

1.1 Background

1.1.1 The Shatin to Central Link (SCL) is a 17km extension of the existing 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 Reports for SCL – Tai Wai to Hung Hom Section [SCL (TAW-HUH)] (Register No. AEIAR-167/2012) and SCL Stabling Sidings at Hung Hom Freight Yard [SCL (HHS)] (Register No. AEIAR-164/2012) were approved on 17 February 2012 under the *Environmental Impact Assessment Ordinance (*EIAO). Following the approval of the EIA Reports, the Environmental Permit (EP) (EP No: EP-438/2012), covering the construction of both SCL (TAW-HUH) and SCL (HHS), was granted on 22 March 2012. Variations of Environmental Permit (VEP) were subsequently applied for EP-438/2012 and the latest Environmental Permit (EP No: EP-438/2012/K) was issued by Director of Environmental Protection (DEP) on 4 October 2016.

1.1.3 Pursuant to EP Condition 2.27, the Permit Holder, MTR Corporation Ltd (MTR), shall deposit with the Director of Environmental Protection (DEP), no later than one month after completion of corresponding parts of the tunnel excavation of the SCL(TAW-HUH) Section (hereinafter referred to as “the Project”), an Operational Ground-borne Noise Mitigation Measures Plan (OGNMMP) to justify the adequacy of the operational ground-borne noise mitigation measures for the Project. The OGNMMP shall include the review and verification of the assumptions adopted in the approved SCL(TAW-HUH) EIA Report (Register No. AEIAR-167/2012) and SCL(HHS) EIA Report (Register No. AEIAR-164/2012), such as line source response (LSR) and ground vibration conditions, and shall also include justifications and recommendations for any contingency noise mitigation measures found necessary, including but not limited to resilient baseplates (type 1) and isolated slab track (type 4).

1.1.4 Since the tunnel excavation of the Project will be completed in different phases, testing on the LSR and ground vibration conditions will be conducted in phases according to the excavation programme.

1.1.5 The prediction methodology recommended by the FTA Manual[1] was adopted in the EIA studies and most of correction factors are based on the international guideline except LSR of which values are site specific and are subject to the ground materials, depth of the tunnel and the rock head. During the EIA stage, in situ line source response measurement was not conducted. As part of the review and verification of the assumptions adopted in the ground-borne railway noise impact assessment, it is proposed that line source response and ground vibration conditions will be reviewed and verified by the on-site measurement.

1.1.6 AECOM Asia Co. Ltd was commissioned by the MTR to conduct the LSR test according to the Testing and Review Methodology Plan (T&RMP) (**Annex A**). The LSR test results conducted at the four measurement locations as recommended in T&RMP were presented in the following OGNMMPs:

- OGNMMP (Batch 1 – Kai Ching Estate, Mung Ching House) (Jun 2016);
- OGNMMP (Batch 2 – Kai Tak Planned Development) (Jun 2016);
- OGNMMP (Batch 3 - Upper Wong Tai Sin Estate) (Sept 2016); and
- OGNMMP (Batch 4 – Lee Wing Building) (Mar 2017).

1.1.7 These OGNMMPs were submitted to EPD and the measurement results were accepted by EPD. Excerpt of these OGNMMP are presented in Annexes B1 to B4.

(1) Federal Transit Administration of U.S. Department of Transportation “Transit Noise and Vibration Impact Assessment ”, 2006

1.2 Purpose of This OGNMMP

1.2.1 This Final OGNMMP presents a summary of LSR analysis based on the results of the impact test at the four designated measurement locations and the updated operational ground-borne noise prediction results based on measurement results and the latest available information.

1.3 Report Structure

1.3.1 This Test Proposal comprises the following sections:

- Section 1 presents the background information.
- Section 2 presents the summary of impact test and the measured LSR results.
- Section 3 presents the operational ground-borne noise prediction results.
- Section 4 presents the conclusion.

2 IMPACT TESTING AND LSR RESULTS

2.1 Testing Locations

2.1.1 A summary of the information of testing locations are presented in **Table 2.1** with their locations shown in **Figure C11033/C/SCL/ACM/M53/004** to **007**. Details of testing and measurement procedures at the testing locations are provided in **Annexes B1** to **B4**.

Table 2.1 Measurement and Testing Locations

NSR		Predicted Night-time Ground-borne Noise Levels in the EIA Report, dB(A)	Measurement Location[(1)]		Ground Type	Location of Hammer Impact Test (Approx. Tunnel Depth)	Testing Date
ID	Description		Approx. Hori. Distance from the Tunnel, m	Approx. Slant Distance (From Ground Level to Track Level), m			
KAT-P1-5[(1)]	Kai Ching Estate – Mun Ching House	40	13 (down track)	19 (down track)	Soil	Down Track Tunnel (-8.1mPD)	1 & 2 Feb 2016
KAT-P1-7[(2)]	Residential premises near Kai Tak Station	45	0 (up track) 0 (down track)	18	Mixed rock	Down Track Tunnel (-13mPD)	15 April 2016
DIH-P1-1[(3)]	Upper Wong Tai Sin Estate – Wing Sin House	32	7 (down track)	31 (down track)	Mixed rock	Down Track Tunnel (-2.2mPD)	11 & 12 Aug 2016
HOM-2-2	Lee Wing Building	41	8 (up track)	24 (up track)	Rock	Up Track Tunnel (-11mPD)	10 Feb 2017

Notes:
(1) KAT-P1-5 is a planned NSR during EIA stage. Assumptions were made on the horizontal building setback distance from tunnels (i.e. 10m from up track and 20m from down track) and noise levels were predicted based on this assumption.
(2) KAT-P1-7 is a planned NSR during EIA stage. Assumptions were made on the vertical distance from tunnels (i.e. 15m from up track and 17m from down track) and noise levels were predicted based on this assumption.
(3) DIH-P1-1 is a planned NSR during EIA stage. Assumptions were made on the horizontal distance from tunnels (i.e. 0m from up track and 5m from down track) and noise levels were predicted based on this assumption.

2.2 Prediction of Line Source Response

2.2.1 The vibration response induced by a unit point source impact was obtained from the hammer impact test and the best fit curves were calculated to determine the LSR at the testing locations. The post-processing of measurement data was taken to determine the best fit curves of PSR with respect to the setback distances, and the depth between the impact source and the receivers. The calculation of LSR follows the calculation outlined in paragraph 11.3.2 Analysis of Transfer Mobility Data in FTA Manual[(2)]. The determined LSRs at the testing locations are presented in **Annexes B1 to B4**.

[(2)] Federal Transit Administration of U.S. Department of Transportation “Transit Noise and Vibration Impact Assessment ”, 2006

3 REVIEW OF OPERATIONAL GROUND-BORNE NOISE PREDICTION

3.1 Summary of Review of LSR Values

3.1.1 The LSR values adopted in ground-borne noise assessment of SCL (TAW-HUH) and SCL (HHS) EIA Report were referenced from the data of the West Island Line (WIL) EIA Study (EIA Register No. AEIAR-126/2008). The LSR for WIL EIA Study were determined based on the results of borehole impact tests performed in rock, soil and close to the rock head both on the soil side and the rock side, with receiver vibration data taken on surface at various setback distances.

3.1.2 The LSR values determined at testing locations (**Table 2.1** refers) were compared with those used in the SCL EIA study for the same area and the same ground conditions with summary of findings presented in **Table 3.1**. Details of comparison are provided in **Annexes B1** to **B4**.

Table 3.1 Comparison between Measurement Data and WIL Data

ID	Location	LSR data adopted in EIA Study	Observation
KAT-P1-5	Kai Ching Estate – Mun Ching House	WIL D018 Rockhead Depth=28m Hole Depth=15m Slant Distance=18m & 26m	Measured LSR values at 18m are about at least 10dB lower than the EIA LSR values in all frequency bands. Measured LSR values at 26m are also lower than the EIA LSR values in all frequency bands.
KAT-P1-7	Planned Residential Premises near KAT	WIL D018 Rockhead Depth=28m Hole Depth=15m Slant Distance=15m & 17m	Measured LSR values at both 15m and 17m are at least 8dB lower than the EIA LSR values in all frequency bands.
DIH-P1-1	Upper Wong Tai Sin Estate – Wing Sin House	WIL D002 Rockhead Depth=24m Hole Depth=34m & 20m Slant Distance=37m & 28m	Measured LSR values at both 37m & 28m are in general lower than the EIA LSR values at most frequency bands and are of similar magnitude at 63Hz and 160Hz.
HOM-2-2	Lee Wing Building	Up track: WIL D012 Rockhead Depth=34m Hole Depth=18m Slant Distance=19m Down track: WIL D002 Rockhead Depth=24m Hole Depth=20m Slant Distance=30m	Measured LSR values at both 19m & 30m are lower than the EIA LSR values at low frequency bands below 63Hz and are of similar magnitude at 100Hz to 200Hz. At high frequency band 315Hz, the measured LSR are slightly higher than the EIA LSR.

3.2 Operational Ground-borne Noise Prediction

3.3 Review of Other Assumptions

3.3.1 The following assumptions adopted in the EIA Reports have been reviewed for updating the ground-borne noise prediction for SCL(TAW-HUH) and SCL(HHS):

- Tunnel Coupling Loss (TCL) and Building Coupling Loss (BCL) – updated information on whether the tunnel and building (or building piles) are in rock or soft ground;
- Geological Profile – updated geological profile along the alignment;

- Speed – no update and therefore follows those adopted in the approval of EIA Reports;
- Turnout Adjustment – updated information on the type of turnouts to be used and the adjustment of position corresponding to the type of turnouts; and
- Building information – updated information including building name, position and layout in Kai Tak and Diamond Hill areas.

3.3.2 Ground-borne noise assessment at the representative operational ground-borne noise sensitive receivers (OGBNSRs) (**Figures C11033/C/SCL/ACM/M53/013** to **018** 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 Reports. The prediction results are summarised in **Table 3.2** and **Annex C**, with detailed sample calculation provided in **Annex D**. Cumulative operational ground-borne noise levels have also been updated with results indicate compliance with the stipulated noise limits (**Annex E** refers).

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

Table 3.2 Ground-borne Noise Prediction Results

NSR ID	NSR Description	Lmax	Day and Evening Period (0700 - 2300 hours)			Night-time Period (2300 - 0700 hours)		
		Updated Results, L_{max}, dB(A)	Criteria, $L_{eq,30min}$, dB(A)	Updated Prediction, $L_{eq,30min}$, dB(A)	Comply with NCO (Y/N)	Criteria, $L_{eq,30min}$, dB(A)	Updated Prediction, $L_{eq,30min}$, dB(A)	Comply with NCO (Y/N)
SCL (TAW - HUH)								
DIH-1-1	Tsui Chuk Garden Block 5	45	55	34	Y	45	31	Y
DIH-2-1	Pak Yuen House	39	55	29	Y	45	26	Y
DIH-3-1	Wah Yuen House	42	55	32	Y	45	29	Y
DIH-3-2	Nga Yuen House	40	55	31	Y	45	28	Y
DIH-3-3	Kwai Yuen House	44	55	35	Y	45	32	Y
DIH-3-4	Chui Yuen House	42	55	33	Y	45	30	Y
DIH-4-1	Pang Ching Court	40	55	30	Y	45	27	Y
DIH-4-2	Carbo Anglo-Chinese Kindergarden	43	55	36	Y	-	-	Y
DIH-5-1	Rainbow Home	47	55	37	Y	45	34	Y
DIH-5-2	Residential premises	45	55	36	Y	45	33	Y
DIH-5-5	Our Lady's Kindergarden	43	55	36	Y	-	-	Y
DIH 6-1	WTS Fire Station and Quarters Block A	48	55	38	Y	45	35	Y
DIH-7-1	Tropicana Gardens Block 2	39	55	29	Y	45	26	Y
DIH-7-2	Tropicana Gardens Block 3	40	55	30	Y	45	27	Y
DIH-8-1	Redemption Lutheran Church	43	55	33	Y	45	30	Y

NSR ID	NSR Description	Lmax	Day and Evening Period (0700 - 2300 hours)			Night-time Period (2300 - 0700 hours)		
		Updated Results, L_{max}, dB(A)	Criteria, $L_{eq,30min}$, dB(A)	Updated Prediction, $L_{eq,30min}$, dB(A)	Comply with NCO (Y/N)	Criteria, $L_{eq,30min}$, dB(A)	Updated Prediction, $L_{eq,30min}$, dB(A)	Comply with NCO (Y/N)
DIH-9-1	Shek On Building	43	55	36	Y	-	-	Y
DIH-10-1	Hong Kong Sheung Keung Hui Nursing Home	39	55	30	Y	45	27	Y
DIH-11-1	Lung Wan House	35	55	29	Y	45	26	Y
DIH-12-1	Galaxia Tower B	23	55	<20	Y	45	<20	Y
DIH-12-2	Galaxia Tower E	21	55	<20	Y	45	<20	Y
DIH-13-1	Canossa Primary School	42	55	35	Y	-	-	Y
DIH-14-1	Rhythm Garden Block 2	41	55	33	Y	45	30	Y
DIH-14-2	Rhythm Garden Block 5	32	55	24	Y	45	21	Y
DIH-14-3	Rhythm Garden Block 8	13	55	<20	Y	45	<20	Y
DIH-14-4	Canossa Primary School (San Po Kong)	37	55	32	Y	-	-	Y
DIH-14-5	Rhythm Garden Block 1	41	55	33	Y	45	30	Y
DIH-14-6	Rhythm Garden Block 3	41	55	32	Y	45	29	Y
DIH-15-1	Kam Wan House	41	55	32	Y	45	29	Y
DIH-15-2	Pik Hoi House	41	55	33	Y	45	30	Y
DIH-16-1	Wong Tai Sin Temple	46	55	36	Y	45	33	Y
DIH-17-1	Chuk Yuen United Village	46	55	36	Y	45	33	Y
DIH-18-1	Upper Wong Tai Sin Estate Po Sin House	45	55	36	Y	45	33	Y
DIH-18-2	Upper Wong Tai Sin Estate Tat Sin House	45	55	35	Y	45	32	Y
DIH-19-1	Lung Cheung Gov. Secondary School	46	55	39	Y	-	-	Y
DIH-20-1	Baptist Rainbow Primary School	45	55	38	Y	-	-	Y
DIH-21-1	Tin Wang Court Wang King House	46	55	36	Y	45	33	Y
DIH-22-1	Price Memorial Catholic Primary School	45	55	38	Y	-	-	Y
DIH-23-1	Tin Ma Court Chun On House	42	55	32	Y	45	29	Y
DIH-24-1	Shing Wong Temple	46	55	37	Y	45	34	Y

NSR ID	NSR Description	Lmax	Day and Evening Period (0700 - 2300 hours)			Night-time Period (2300 - 0700 hours)		
		Updated Results, L_{max}, dB(A)	Criteria, $L_{eq,30min}$, dB(A)	Updated Prediction, $L_{eq,30min}$, dB(A)	Comply with NCO (Y/N)	Criteria, $L_{eq,30min}$, dB(A)	Updated Prediction, $L_{eq,30min}$, dB(A)	Comply with NCO (Y/N)
DIH-P1-1	Upper Wong Tai Sin Estate Phase 3	44	55	34	Y	45	31	Y
DIH-P3-1A	Planned receivers in the CDA site(2)	35	55	27	Y	45	24	Y
DIH-P3-2A	Planned receivers in the CDA site(2)	38	55	30	Y	45	27	Y
DIH-P3-4	Planned receivers in the CDA site(2)(3)	45	55	34	Y	-	-	Y
KAT-P1-1	Residential premises near Kai Tak Station	15	55	<20	Y	45	<20	Y
KAT-P1-2	One Kai Tak	8	55	<20	Y	45	<20	Y
KAT-P1-3	Residential premises near Kai Tak Station	21	55	<20	Y	45	<20	Y
KAT-P1-4	Residential premises near Kai Tak Station	16	55	<20	Y	45	<20	Y
KAT-P1-5	Mun Ching House, Kai Ching Estate	42	55	34	Y	45	31	Y
KAT-P1-6	Tower H3, De Novo	26	55	<20	Y	45	<20	Y
KAT-P1-7	Residential premises near Kai Tak Station	48	55	39	Y	45	36	Y
TKW-1-1	Parc 22	37	55	28	Y	45	25	Y
TKW-1-2	Sanford Mansion	37	55	28	Y	45	25	Y
TKW-2-1	Skytower Tower 1	28	55	<20	Y	45	<20	Y
TKW-2-2	Skytower Tower 2	28	55	<20	Y	45	<20	Y
TKW-2-3	Skytower Tower 7	24	55	<20	Y	45	<20	Y
TKW-3-1	Prince Ritz	13	55	<20	Y	45	<20	Y
TKW-3-2	Prosperity House	26	55	<20	Y	45	<20	Y
TKW-P1-1	Residential premises near To Kwa Wan Station	35	55	28	Y	45	25	Y
MTW-6-1	Fok On Building	42	55	34	Y	45	31	Y
MTW-6-2	HK Society for the Protection of Children	47	55	41	Y	-	-	Y
MTW-6-3	Chung Nam Mansion	42	55	33	Y	45	30	Y
MTW-6-4	Pok Oi Lau	46	55	38	Y	45	35	Y
MTW-7-1	Geranium House	46	55	37	Y	45	34	Y
MTW-8-1	Horae Palace	43	55	35	Y	45	32	Y
MTW-9-1	Majestic Park	40	55	32	Y	45	29	Y
MTW-10-1	18 Farm Road	43	55	35	Y	45	32	Y

NSR ID	NSR Description	Lmax	Day and Evening Period (0700 - 2300 hours)			Night-time Period (2300 - 0700 hours)		
		Updated Results, L_{max}, dB(A)	Criteria, $L_{eq,30min}$, dB(A)	Updated Prediction, $L_{eq,30min}$, dB(A)	Comply with NCO (Y/N)	Criteria, $L_{eq,30min}$, dB(A)	Updated Prediction, $L_{eq,30min}$, dB(A)	Comply with NCO (Y/N)
MTW-11-1	Farm Road Government Primary School	44	55	38	Y	-	-	Y
MTW-12-1	Yuet Fai Mansion	47	55	38	Y	45	35	Y
MTW-12-2	Delight Court	41	55	32	Y	45	29	Y
MTW-12-3	Lucky Mansion	35	55	27	Y	45	24	Y
MTW-12-4	352-354 Ma Tau Wai Road	34	55	27	Y	45	24	Y
MTW-12-5	Seng Cheong Building	39	55	32	Y	45	29	Y
MTW-12-6	Great Wall Building	41	55	33	Y	45	30	Y
MTW-12-7	197-199 Ma Tau Wai Road	45	55	37	Y	45	34	Y
MTW-12-8	Pak Tai Mansion	47	55	39	Y	45	36	Y
MTW-12-9	Residential premises along Hung Kwong Street	43	55	35	Y	45	32	Y
MTW-12-10	Lucky Building	35	55	28	Y	45	25	Y
MTW-12-11	Jing Ming Building	34	55	26	Y	45	23	Y
MTW-12-12	One Elegance	43	55	35	Y	45	32	Y
MTW-13-1	Cheung Chuk Shan Memorial School	43	55	37	Y	-	-	Y
MTW-14-1	PLK Lam Man Chan English Primary School	37	55	32	Y	-	-	Y
MTW-15-1	Hung Hom Lutheran Primary School	40	55	36	Y	-	-	Y
MTW-16-1	SKH Good Shepherd Primary School	38	55	34	Y	-	-	Y
MTW-17-1	Loyal Mansion	38	55	30	Y	45	27	Y
MTW-18-1	Residential premises along Chi Kiang St	32	55	25	Y	45	22	Y
MTW-18-2	No. 2 Kowloon City Road	33	55	26	Y	45	23	Y
MTW-19-1	Holy Trinity Church	38	55	30	Y	45	27	Y
HOM-1-1	Ko Shan Theartre	43	55	35	Y	45	32	Y
HOM-2-1	Faerie Court	41	55	34	Y	45	31	Y
HOM-2-2	Lee Wing Building	43	55	35	Y	45	32	Y
HOM-2-3	Wing Lam Mansion	43	55	36	Y	45	33	Y
HOM-2-4	Tak Lee Court	42	55	34	Y	45	31	Y
HOM-2-5	Chat Ma Mansion	42	55	34	Y	45	31	Y

NSR ID	NSR Description	Lmax	Day and Evening Period (0700 - 2300 hours)			Night-time Period (2300 - 0700 hours)		
		Updated Results, L_{max}, dB(A)	**Criteria, $L_{eq,30min}$, dB(A)**	**Updated Prediction, $L_{eq,30min}$, dB(A)**	**Comply with NCO (Y/N)**	**Criteria, $L_{eq,30min}$, dB(A)**	**Updated Prediction, $L_{eq,30min}$, dB(A)**	**Comply with NCO (Y/N)**
HOM-2-6	Chatham Mansion	45	55	37	Y	45	34	Y
HOM-3-1	Fook Sing Mansion	39	55	31	Y	45	28	Y
HOM-3-2	Marigold Mansion, Block A	39	55	31	Y	45	28	Y
HOM-4-1	Yee Fu Building	36	55	28	Y	45	25	Y
HOM-5-1	271 Chatham Road North	28	55	22	Y	45	<20	Y
HOM-P2	HKPU Student Halls of Residence	35	55	28	Y	45	25	Y
HOM-P3-1	Residential Building, HOM Station Development	37	55	30	Y	45	27	Y
HUH-1-1	Cartas Branchi College of Careers	34	55	30	Y	-	-	Y
HUH-1-2	Lok Ka House	37	55	30	Y	45	27	Y
HUH-1-3	Wing Fung Building	37	55	29	Y	45	26	
SCL (HHS)								
HUH-1-3	Wing Fung Building	16	55	<20	Y	45	<20	Y

Notes:

(1) The operational groundborne noise results are taken from either those presented in SCL(TAW-HUH) EIA Report or SCL(HHS) EIA Report KAT-P1-5 or Supporting Document for Application of VEP (Application No. VEP-370/2012) (June 2012) where applicable.

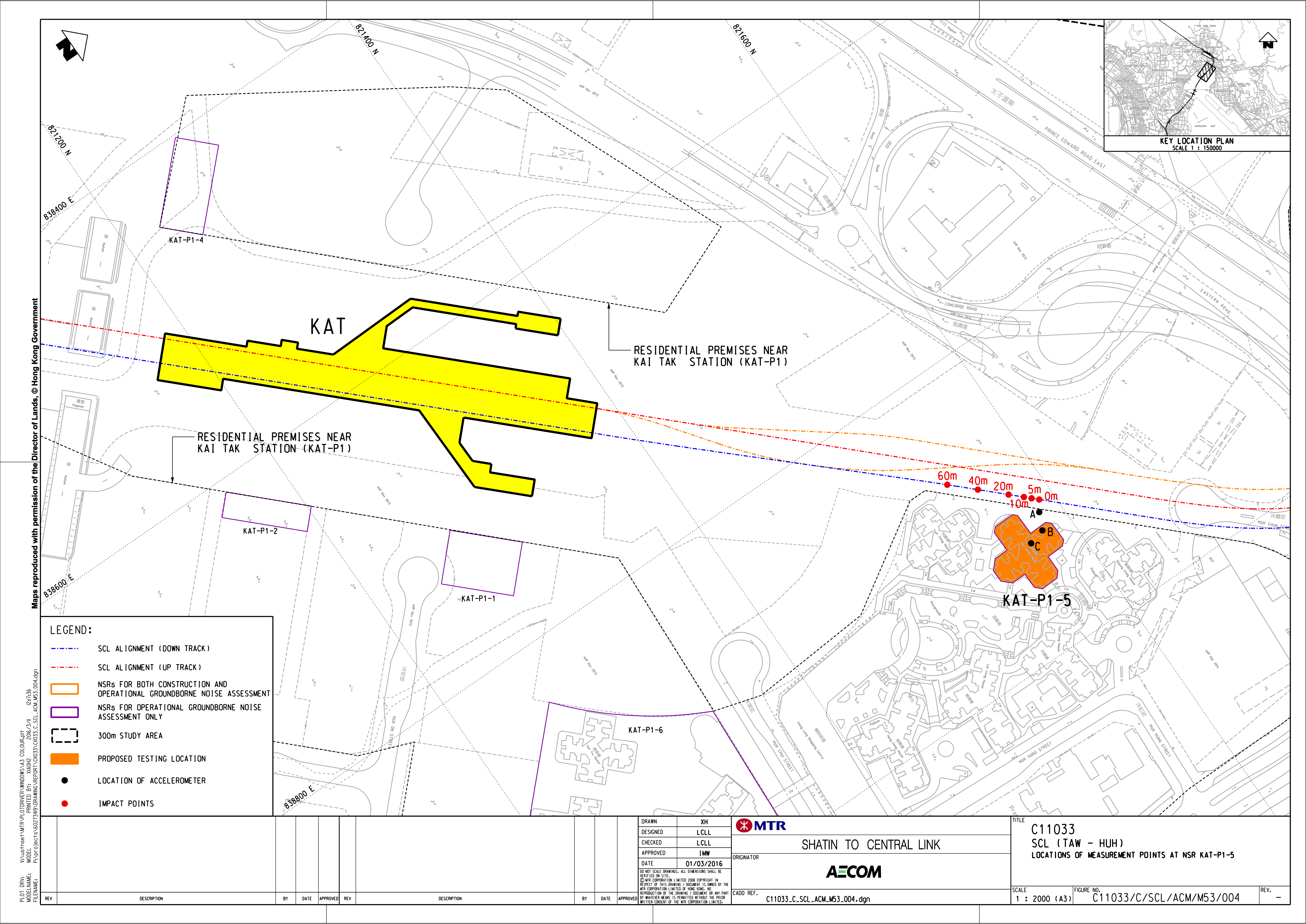
(2) Information based on the Environmental Review Report (ERR) for Update of Fixed Plant Noise Sources at Diamond Hill Station (DIH) and Hin Keng Station (HIK), and Minor Update of HIK Footprint (August 2016) for supporting the Application of Variation of Environmental Permit (Application No.: VEP-506/2016).

(3) There would be no night-time operation at DIH-P3-4 according to the information in ERR.

4 CONCLUSION

4.1.1 The measurement of LSR values were conducted at the recommended testing locations as stated in the agreed T&RMP. The assumptions adopted in the EIA Reports have been further reviewed and the ground-borne noise prediction for SCL(TAW-HUH) and SCL(HHS) have been updated based on all measured LSR results in the Final OGNMMP and the latest available information.

4.1.2 The updated ground-borne noise levels are all below the noise criteria, and thus the conclusion in the EIA Reports remains unchanged, and no mitigation measures are required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KAT-P1-4
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KAT-P1-2
KAT-P1-1
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LEGEND:
SCL ALIGNMENT (DOWN TRACK)
SCL ALIGNMENT (UP TRACK)
NSRs FOR BOTH CONSTRUCTION AND OPERATIONAL GROUNDBORNE NOISE ASSESSMENT
NSRs FOR OPERATIONAL GROUNDBORNE NOISE ASSESSMENT ONLY
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LOCATION OF ACCELEROMETER
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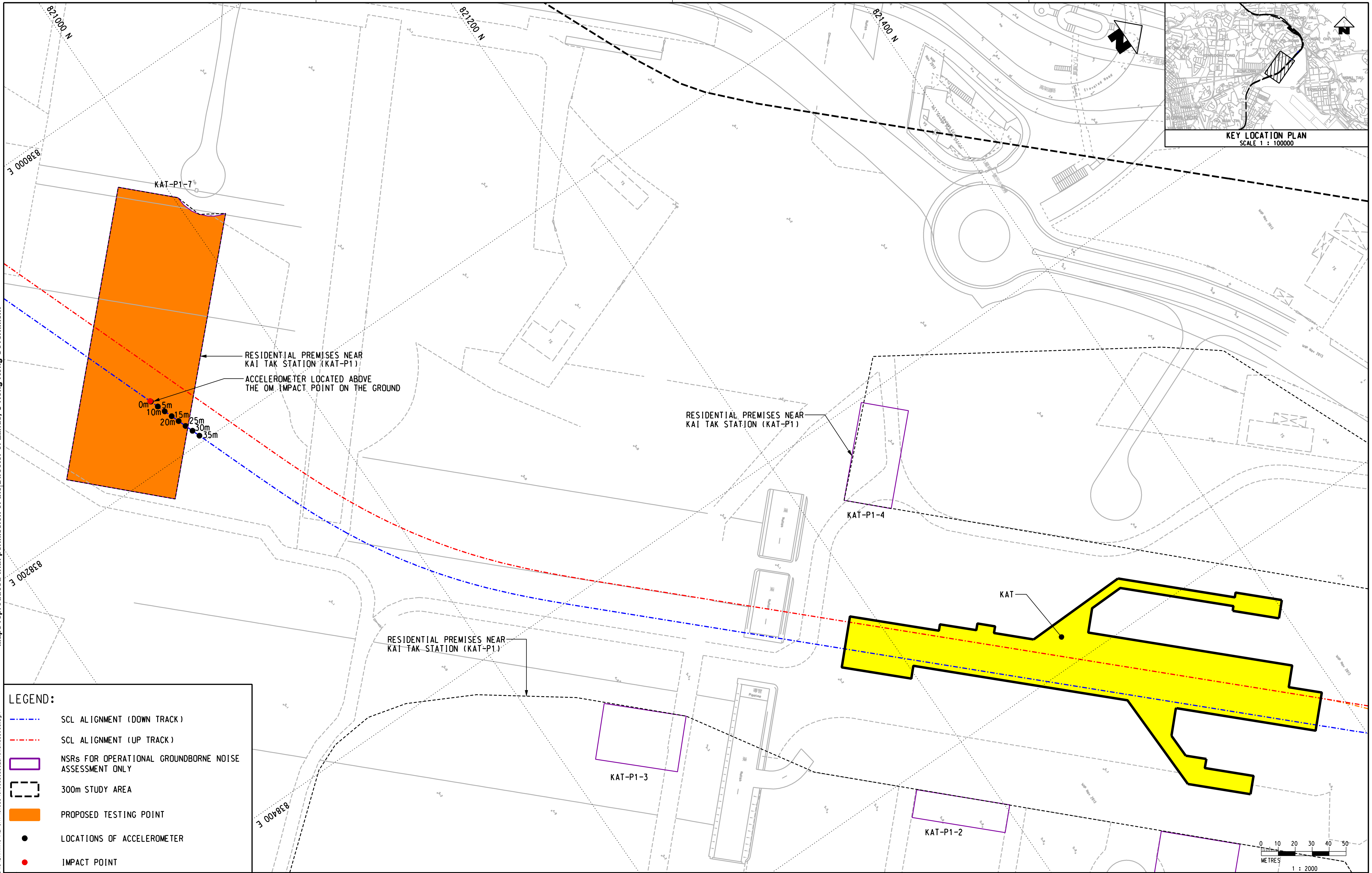

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LOCATIONS OF MEASUREMENT POINTS AT NSR KAT-P1-7

SCALE 1 : 2000 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/005

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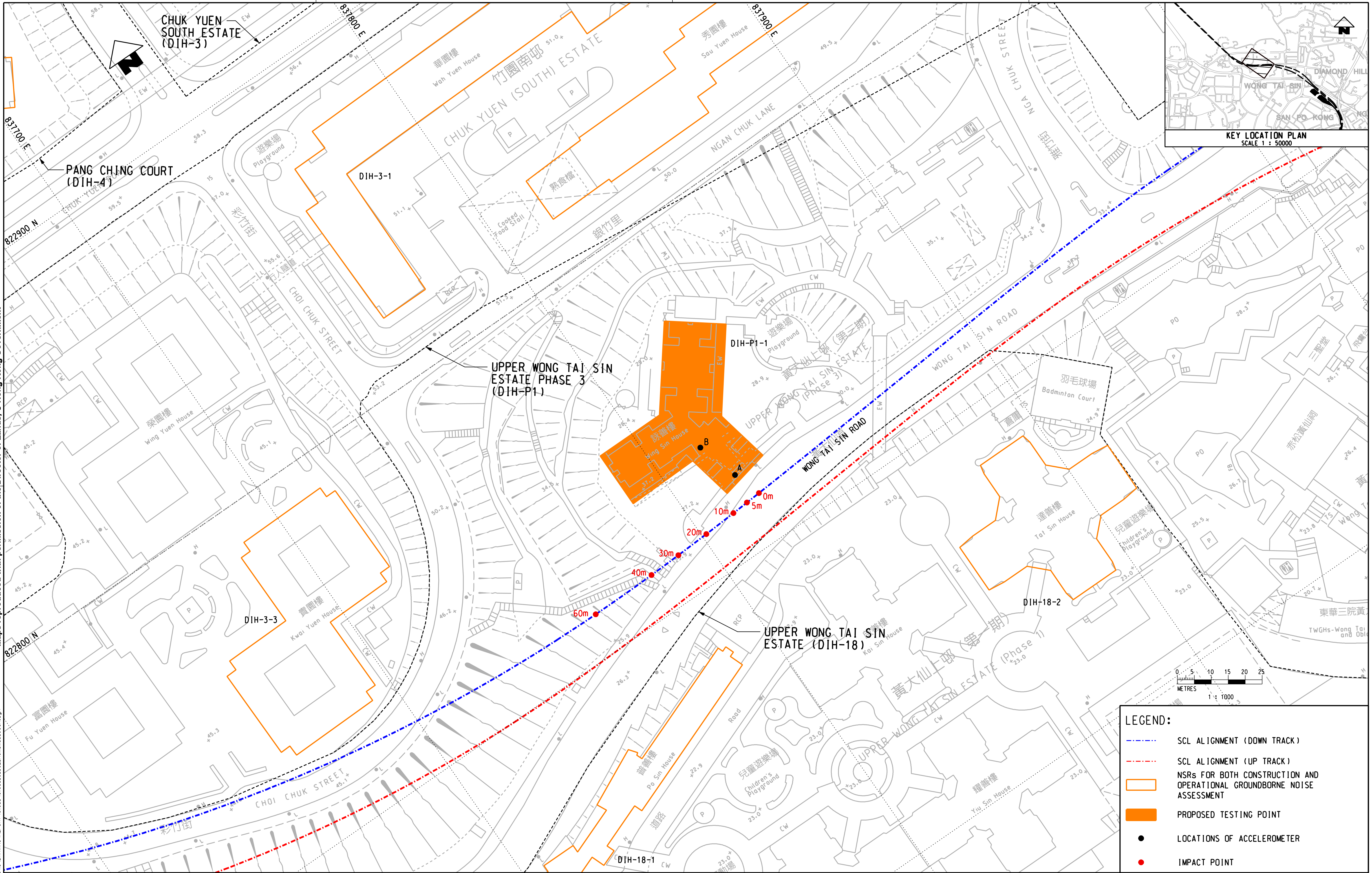

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LOCATIONS OF MEASUREMENT POINTS AT NSR DIH-P1-1

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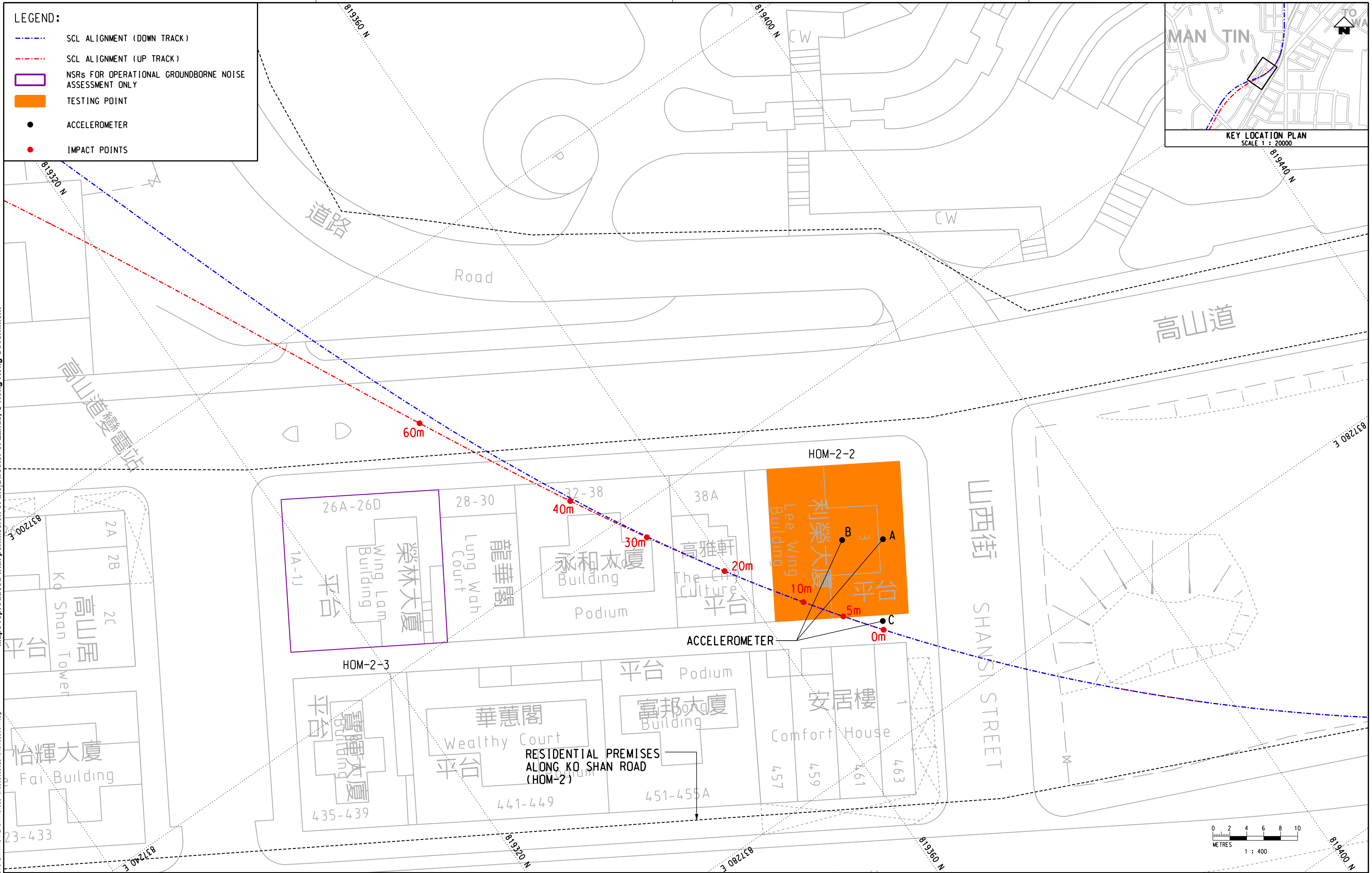

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TITLE
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LOCATIONS OF MEASUREMENT POINTS AT NSR HOM-2-2

SCALE 1 : 400 (A3) | FIGURE NO. C11033/C/SCL/ACM/M53/007 | REV. A

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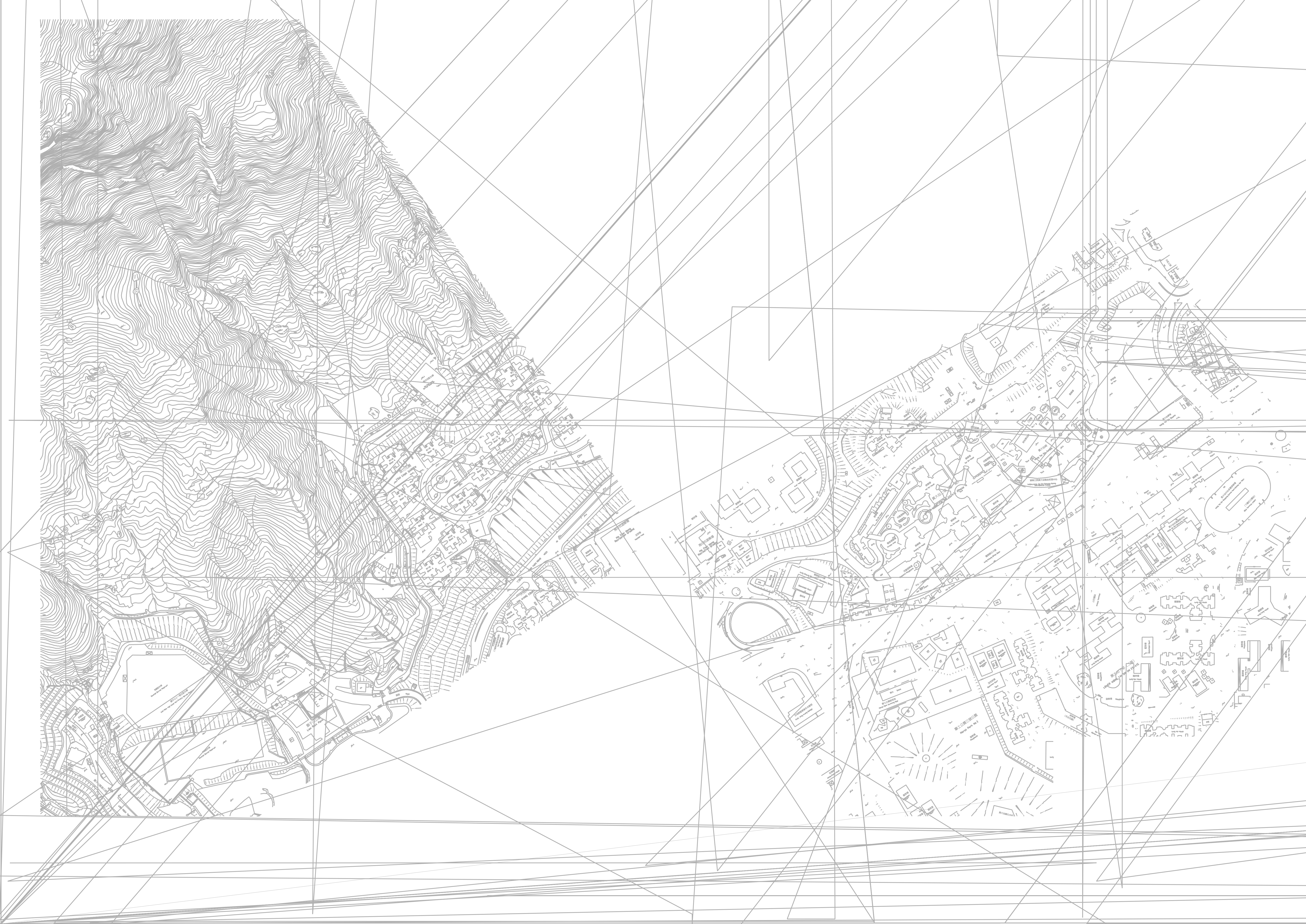

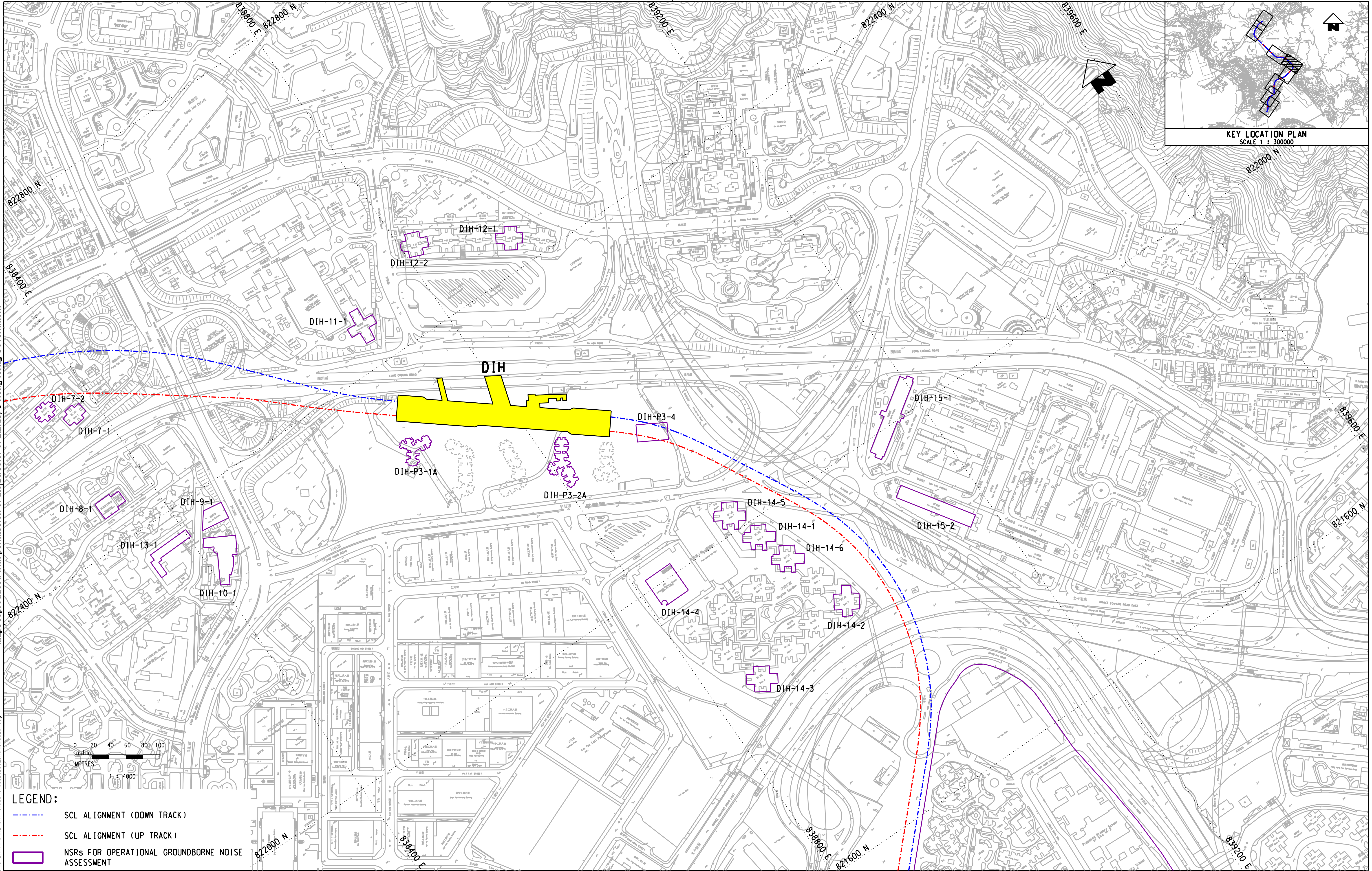

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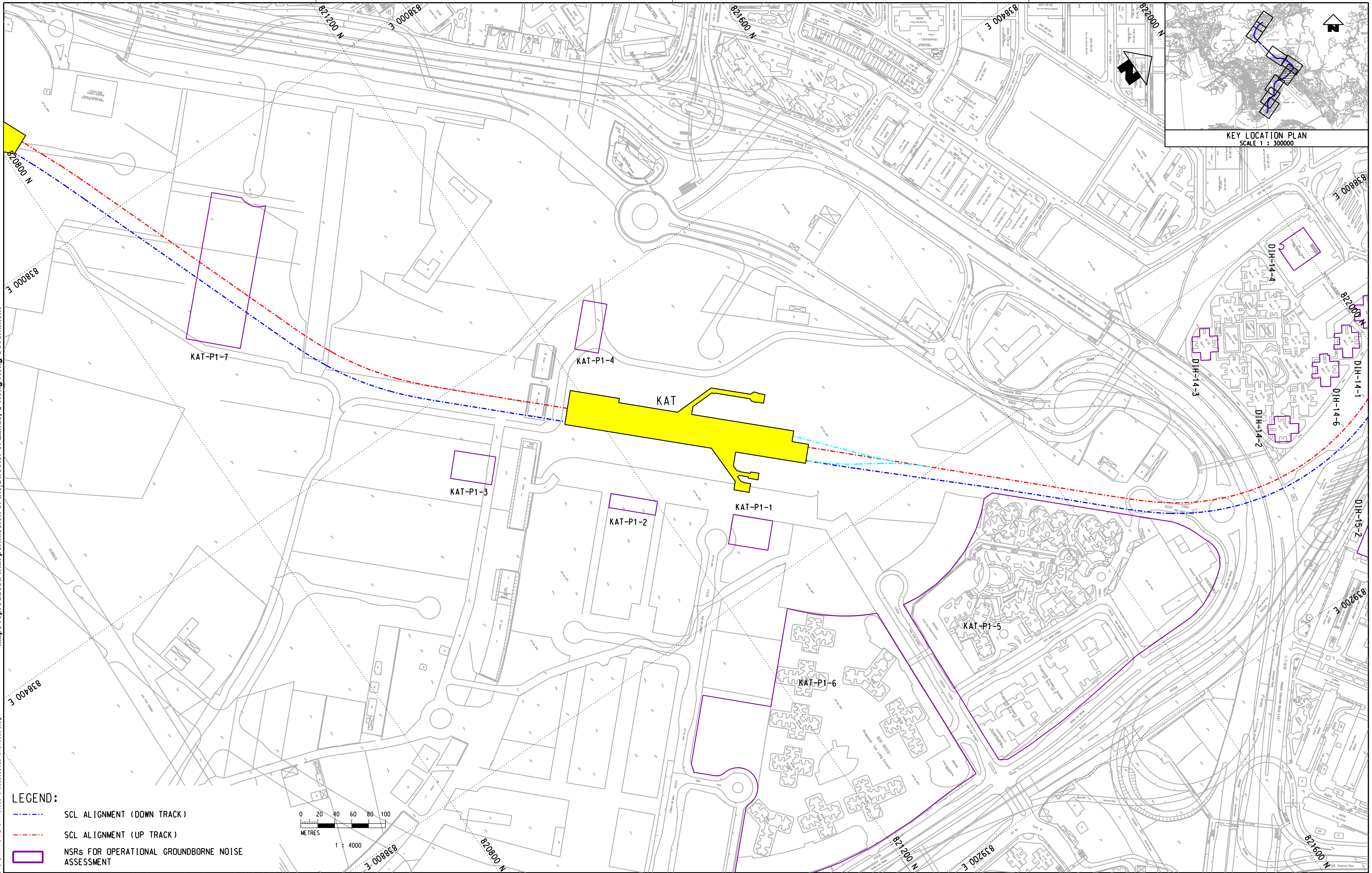
TITLE

C11033
SCL (TAW - HUH)
LOCATIONS OF NOISE SENSITIVE RECEIVERS (GROUNDBORNE)
(SHEET 2 OF 6)

SCALE 1 : 4000 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/014

REV. A



LEGEND:

- SCL ALIGNMENT (DOWN TRACK)
- SCL ALIGNMENT (UP TRACK)
- NSRs FOR OPERATIONAL GROUNDBORNE NOISE ASSESSMENT

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TITLE

C11033
SCL (TAW - HUH)
LOCATIONS OF NOISE SENSITIVE RECEIVERS (GROUNDBORNE)
(SHEET 3 OF 6)

SCALE 1 : 4000 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/015

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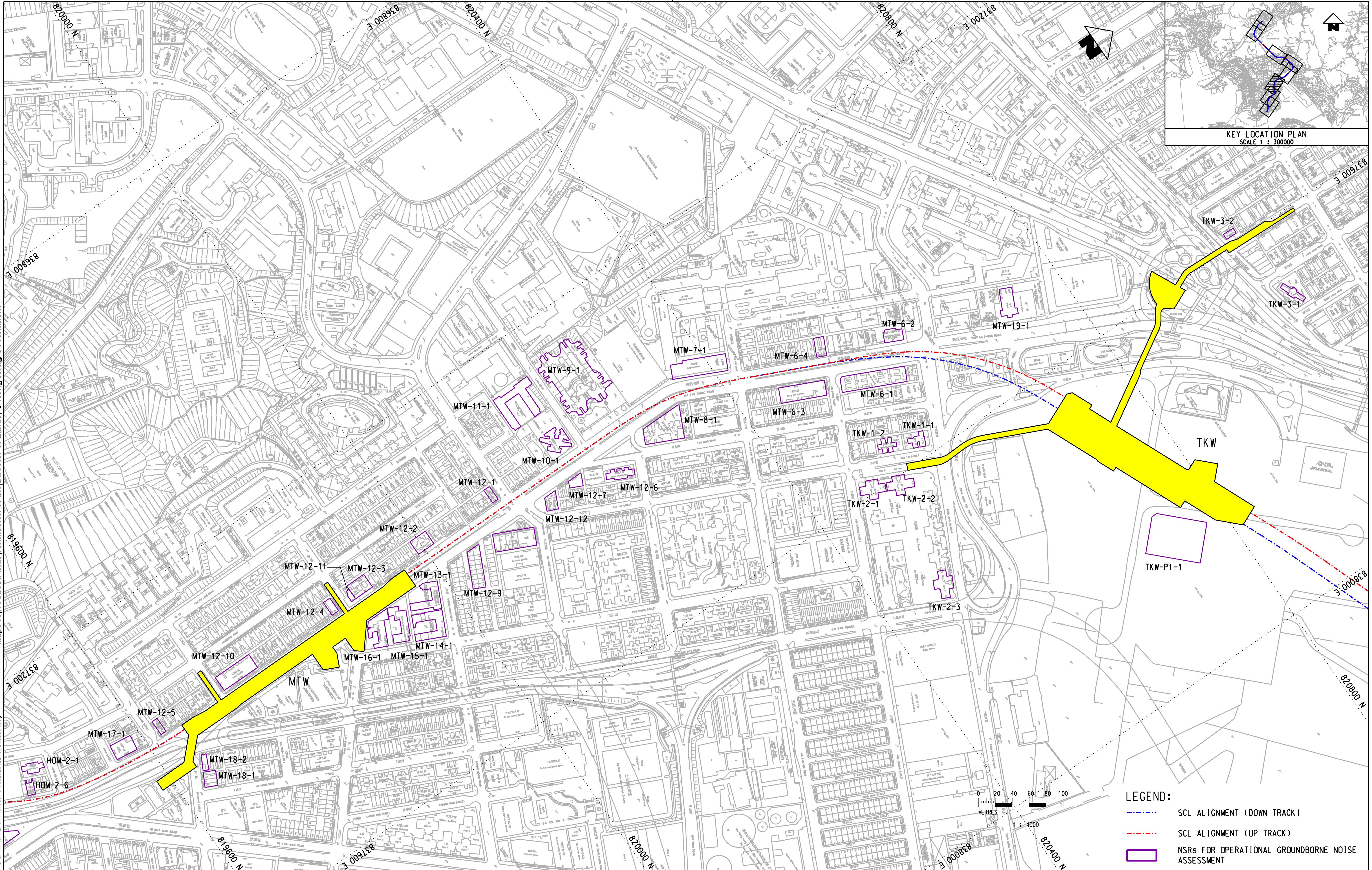

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TITLE

C11033
SCL (TAW - HUH)
LOCATIONS OF NOISE SENSITIVE RECEIVERS (GROUNDBORNE)
(SHEET 4 OF 6)

SCALE 1 : 4000 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/016

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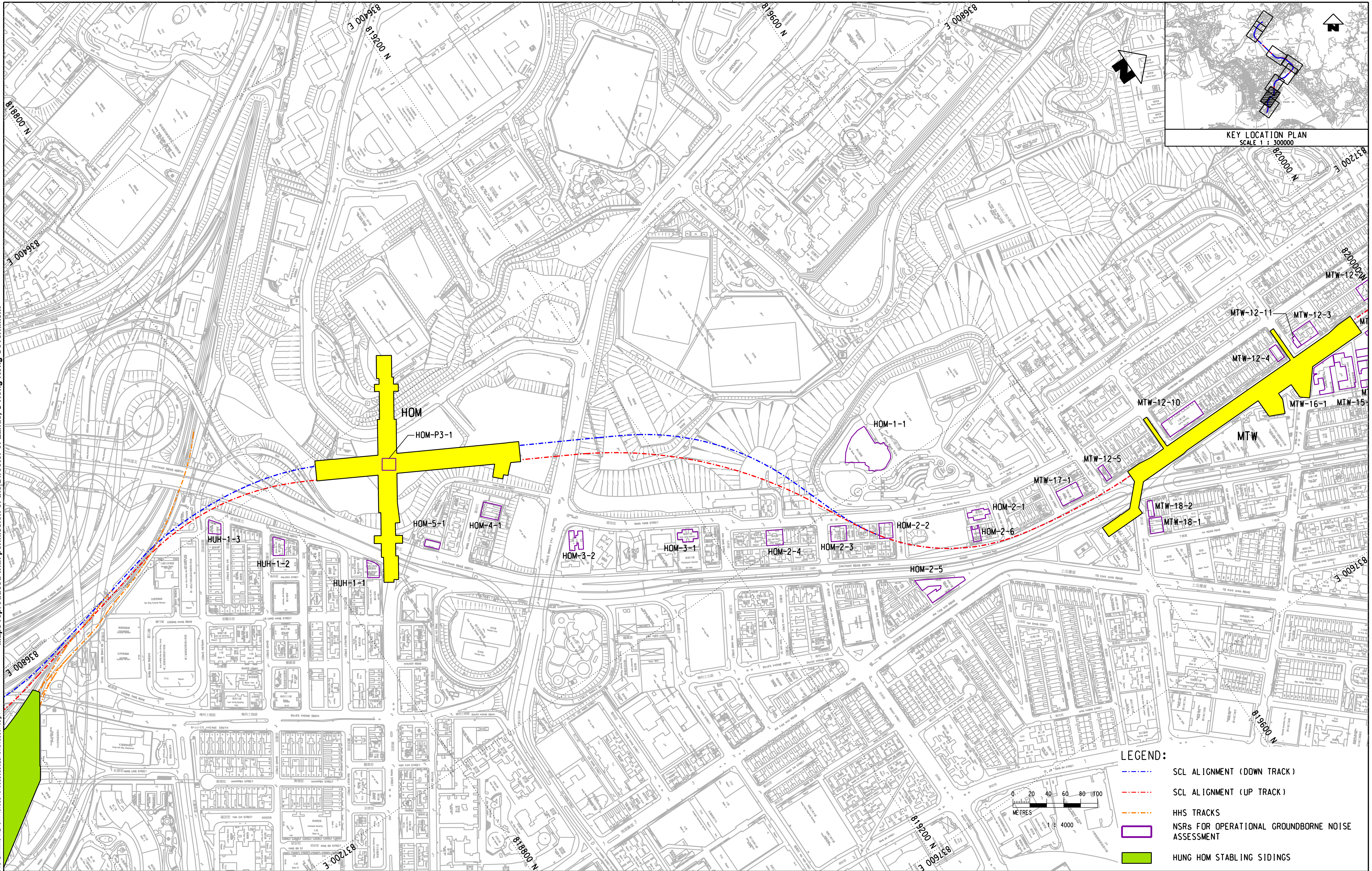

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TITLE

C11033
SCL (TAW - HUH)
LOCATIONS OF NOISE SENSITIVE RECEIVERS (GROUNDBORNE) (SHEET 5 OF 6)

SCALE 1 : 4000 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/017

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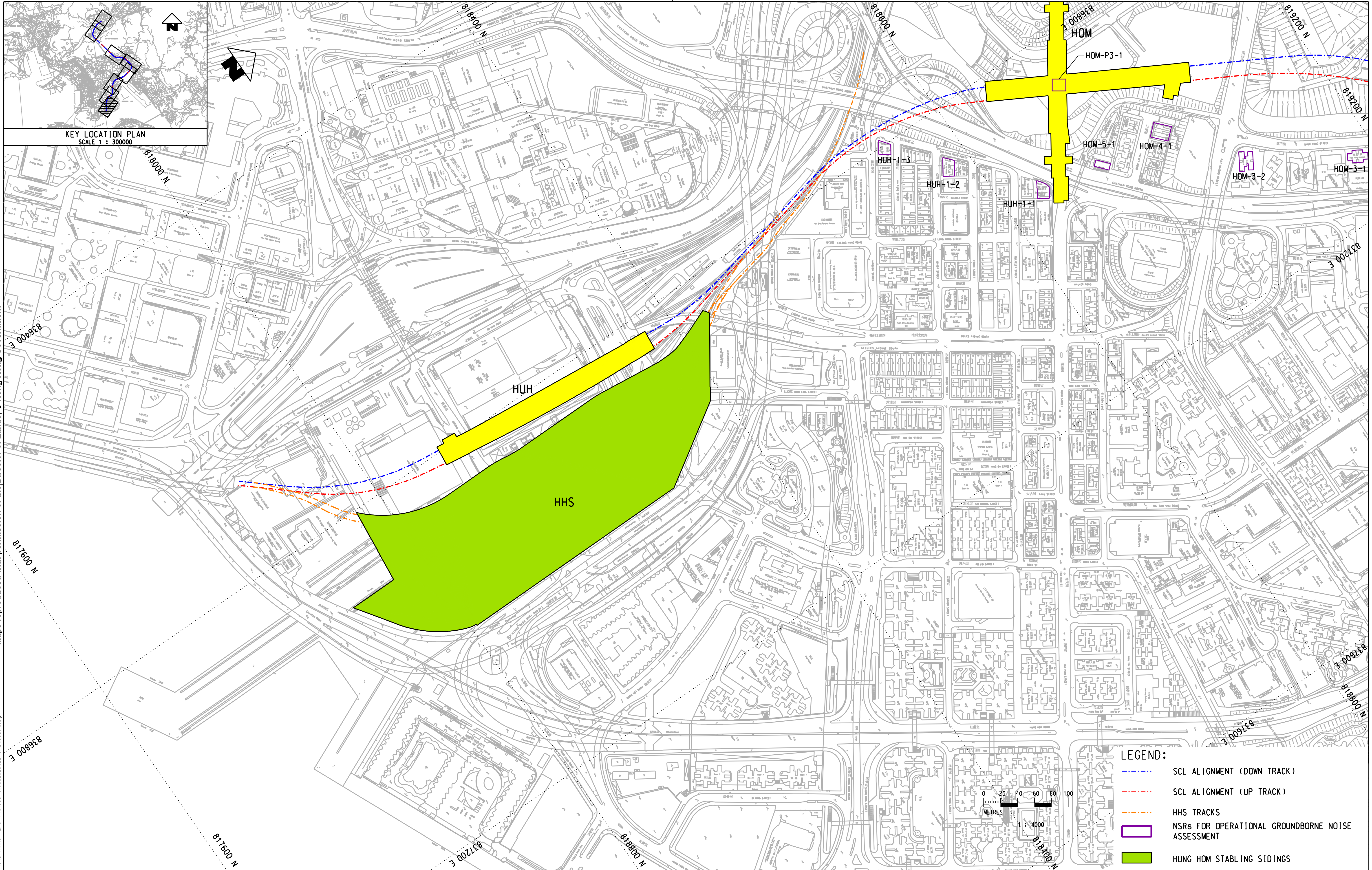

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TITLE

C11033

SCL (TAW - HUH)

LOCATIONS OF NOISE SENSITIVE RECEIVERS (GROUNDBORNE)

(SHEET 6 OF 6)

SCALE 1 : 4000 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/018

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Annex A

Operational Ground-Borne Noise Mitigation Measures Plan – Testing and Review Methodology Plan (Revision D)

AECOM

MTR Corporation Limited

Consultancy Agreement No. C11033

Shatin to Central Link - Tai Wai to Hung Hom Section [SCL(TAW – HUH)] and Stabling Sidings at Hung Hom Freight Yard [SCL(HHS)]

Operational Ground-borne Noise Mitigation Measures Plan – Testing and Review Methodology Plan

January 2016

	Name	Signature
Prepared & Checked:	Jackel Law	[signature]
Reviewed & Approved:	Josh Lam	pp [signature]

Version:	D	Date:	11 January 2016

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Table of Content

Page

List of Tables

List of Figures

Appendices

1 INTRODUCTION

1.1 Background

1.1.1 The Shatin to Central Link (SCL) is a 17km extension of the existing 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 Reports for SCL – Tai Wai to Hung Hom Section [SCL (TAW-HUH)] (Register No. AEIAR-167/2012) and SCL Stabling Sidings at Hung Hom Freight Yard [SCL (HHS)] (Register No. AEIAR-164/2012) were approved on 17 February 2012 under the *Environmental Impact Assessment Ordinance (*EIAO). Following the approval of the EIA Reports, the Environmental Permit (EP) (EP No: EP-438/2012), covering the construction of both SCL (TAW-HUH) and SCL (HHS), was granted on 22 March 2012. Variations of Environmental Permit (VEP) were subsequently applied for EP-438/2012 and the latest Environmental Permit (EP No: EP-438/2012/I) was issued by Director of Environmental Protection (DEP) on 14 October 2015.

1.1.3 Pursuant to EP Condition 2.27, the Permit Holder, MTR Corporation Ltd (MTR), shall deposit with the Director of Environmental Protection (DEP), no later than one month after completion of corresponding parts of the tunnel excavation of the SCL(TAW-HUH) Section (hereinafter referred to as "the Project"), an Operational Ground-borne Noise Mitigation Measures Plan (OGNMMP) to justify the adequacy of the operational ground-borne noise mitigation measures for the Project. The OGNMMP shall include the review and verification of the assumptions adopted in the approved SCL(TAW-HUH) EIA Report (Register No. AEIAR-167/2012) and SCL(HHS) EIA Report (Register No. AEIAR-164/2012), such as line source response (LSR) and ground vibration conditions, and shall also include justifications and recommendations for any contingency noise mitigation measures found necessary, including but not limited to resilient baseplates (type 1) and isolated slab track (type 4). No ground-borne noise will be assessed for at grade section around TAW, HIK and HUH as airborne noise will be the dominant noise source that vibration generated by the tunnel is much larger than the slab track at grade. Ground-borne noise issue for NSRs around HUH will be discussed in relevant submission under EP-437/2012.

1.1.4 Since the tunnel excavation of the Project will be completed in different phases, testing on the LSR and ground vibration conditions will be conducted in phases according to the excavation programme.

1.1.5 The prediction methodology recommended by the FTA Manual[1] was adopted in the EIA studies and most of correction factors are based on the international guideline except LSR of which values are site specific and are subject to the ground materials, depth of the tunnel and the rock head. During the EIA stage, in situ line source response measurement was not conducted. As part of the review and verification of the assumptions adopted in the ground-borne railway noise impact assessment, it is proposed that line source response and ground vibration conditions will be reviewed and verified by the on-site measurement.

1.1.6 AECOM Asia Co. Ltd has been commissioned by the MTR to prepare this Testing and Review Methodology Plan (T&RMP) and to conduct the LSR test according to the approved T&RMP. The testing results and calculation, together with the approved T&RMP, will be included in the OGNMMP which will be submitted under EP Condition 2.27.

[1] Federal Transit Administration of U.S. Department of Transportation "Transit Noise and Vibration Impact Assessment ", 2006

1.2 Purpose of This T&RMP

1.2.1 This T&RMP is prepared to seek the DEP's agreement on the testing locations and methodology prior to the commencement of LSR test.

1.3 Report Structure

1.3.1 This Test Proposal comprises the following sections:

- Section 1 presents the background information.
- Section 2 describes the tunnel excavation programme and proposed testing locations.
- Section 3 presents the testing methodology.
- Section 4 presents the method of LSR prediction.
- Section 5 presents the review methodology of the operational ground-borne noise.

2 TESTING AND MEASUREMENT LOCATIONS

2.1 Selection of Impact Testing Locations

2.1.1 The selection of testing location is based on the following considerations:

- Ground Type – LSR values at different ground types (soil, rock and mixed rock) is proposed to be obtained for review in OGNMMP.
- Accessibility – The testing receiver location should be accessible for conducting the test on building structure or foundation.
- Ambient vibration – The measurement results will be affected by the ambient vibration from existing traffic. As such the measurement location should be located away from roads with heavy traffic.
- Building Pile – Type and depth of building foundation and building pile arrangement are considered. High rise building with pile down to rock head would give high noise level from tunnel and will have higher priority for selection.
- Predicted Ground-borne Noise Levels – LSR test is proposed to be conducted at the more sensitive locations in close proximity to the SCL tunnel, i.e. the ground-borne noise sensitive receivers (NSRs) predicted with relatively higher operational ground borne noise levels. The NSRs identified in the EIA Reports will be reviewed for selection of appropriate testing location(s).
- Tunnel Depth – The measurement signal would be weak if the tunnel is too deep in vertical depth and too far in horizontal distance. The slant distance between ground level of the testing location and the track level of the tunnel is preferable to be within 20m and should not be greater than 40m.

2.1.2 There are three different types of geological characteristics which are soil, mixed rock and rock along the alignment. Representative LSR values of these three geological characteristics will be obtained and applied in the upcoming OGNMMP.

2.1.3 It is important to obtain a measureable vibration impact at the NSR with minimal influences from the existing surrounding environment. Existing ambient vibration environment at the NSRs is considered as an important factor because the vibration impact source for the testing is relatively low and would be easily affected by the vibration induced from surrounding road traffic. The tunnel of this project is running under the urban area with busy roads, and most NSRs are subject to high ambient vibration environment; thus they are considered not suitable for the test. Slant distance to the tunnel is also a key factor for consideration as the larger the separation distance between tunnel and NSR, the weaker the vibration signal to be recorded at the NSR. There are many NSRs being too far away, more than 40m slant distance from the tunnel, which the vibration signal would be insignificant to measure and therefore not suitable for the test. NSRs with predicted $L_{eq\ 30min(dB(A))}$ lower than 30 dB(A) in the EIA ground-borne noise prediction results would not be considered as a representative location for testing and measurement as the vibration signal is predicted to be insignificant to measure.

2.1.4 All NSRs in the EIA Reports were considered according to the criteria in **Section 2.1.1** and reviewed in **Appendix A**. Based on the considerations discussed in **Section 2.1.2** and **2.1.3**, four out of ten NSRs were selected to be the most suitable and most representative for each geological type for the LSR measurement (**Table 2.1** refers). The corresponding measurement locations at the selected NSRs are summarised in **Table 2.2** and the testing locations are shown in **Figure C11033/C/SCL/ACM/M53/001 – 003**. MTR will notify the relevant representative such as management office of selected NSRs prior to the testing and measurement, and a contact would be made available for them during the test in case there is nuisance lodged by residents.

2.1.5

Table 2.1 Justifications for NSR selection for LSR measurement

Ground Type	NSRs	Justification(s)	Selected LSR Measurement Location (Y/N)
Mixed Rock	DIH-18-1	Farther distance to the tunnel compared with DIH-P1-1.	N
	DIH-18-2	Farther distance to the tunnel compared with DIH-P1-1.	N
	DIH-P1-1[1]	An existing structure close to the tunnel.	Y
	DIH-P3-1	Farther distance to the tunnel and lower predicted level compared with KAT-P1-7.	N
	DIH-P3-2	Farther distance to the tunnel and lower predicted level compared with KAT-P1-7.	N
	HOM-2-1	Situated at the margin of mixed rock and rock that actual effect of hammer impact test is unknown and hence not suitable to apply to all NSRs of mixed rock type.	N
	KAT-P1-7[1]	Short slant distance among relevant NSRs together with high predicted level.	Y
Soil	KAT-P1-5	The only NSR fulfils all criterions after screening.	Y
Rock	HOM-2-2	Located directly above the tunnel.	Y
	HOM-2-3	Farther distance to the tunnel compared with HOM-2-2.	N

Note:
(1) The more conservative result measured from DIH-P1-1 and KAT-P1-7 will be applied for updating LSR value of NSRs at mixed rock type.

Table 2.2 Proposed Measurement and Testing Locations

NSR		Predicted Night-time Ground-borne Noise Levels in the EIA Report, dB(A)	Latest Approx. Hori. Distance from the Tunnel, m	Slant Distance (From Ground Level to Track Level), m	Ground Type	Location of Hammer Impact Test (Approx. Tunnel Depth)	Anticipated Testing Schedule
ID	Description						
DIH-P1-1(1)	Upper Wong Tai Sin Estate - Wing Sin House	32	20 (up track) 10 (down track)	32	Mixed Rock	Down Track Tunnel (-2.2mPD)	Mid 2016
KAT-P1-5(2)	Kai Ching Estate – Mun Ching House	40	25 (up track) 13 (down track)	19	Soil	Down Track Tunnel (-8.1mPD)	Early 2016
KAT-P1-7	Residential Premises near KAT	45	0 (up track) 0 (down track)	20	Mixed Rock	Down Track Tunnel (-14mPD)	Early 2016
HOM-2-2	Lee Wing Bldg	41	0 (up track) 0 (down track)	24	Rock	Up track Tunnel (-11mPD)	End 2016

Note:
(1) DIH-P1-1 is a planned NSR during EIA stage. Assumptions were made on the horizontal building setback distance from tunnels (i.e. 0m from up track and 5m from down track) and noise levels were predicted based on this assumption.
(2) KAT-P1-5 is a planned NSR during EIA stage. Assumptions were made on the horizontal building setback distance from tunnels (i.e. 10m from up track and 20m from down track) and noise levels were predicted based on this assumption.

3 TESTING METHODOLOGY

3.1 Instrumentations

3.1.1 The impact force levels applied within the tunnel would be measured using a SINUS Harmonie connected to a laptop computer and vibration levels would be measured using a Bruel & Kjaer PULSE also connected to a laptop computer. Bruel & Kjaer and Wilcoxon accelerometers would be used on the surface. Details of the instruments are provided in **Table 3.1**.

Table 3.1 Instruments to be Used in the Hammer Impact Test

Instrument	Manufacturer / Model No.	Purpose
Pneumatic Hammer and Air Compressor	WM model S	Connection to 4-hp air compressor to induce force (impact) at about 400kN
Impact Controller	WM type 1	Connection to pneumatic hammer to control impact on/ off
Analyzer Platform	Bruel & Kjaer PULSE; Sinus Harmonie	Spectrum analyzers for data acquisition
Accelerometer	Bruel & Kjaer type 4370V; Wilcoxon Research 731-207	Vibration transducers to measure vibration
Force transducer	PCB 207C	Fitted to pneumatic hammer to measure impact force

3.2 Testing and Measurement Procedures

3.2.1 The testing would be carried out after the completion of tunnel excavation. The testing and measurement procedures are summarised below:

- The test will be carried out during night time when background vibration levels are at their lowest. All construction works inside tunnel and the adjacent tunnel shall be suspended during the testing.
- The impact hammer will hit on the centreline of tunnel invert. The hammer will apply measured impact forces within the tunnel at 7 impact points in each testing location to represent the length of at least half a train (i.e. about 100m). The measured impact forces will be logged by the spectrum analyzer. Each impact points will have 10 hits at 400kN on the tunnel invert. The locations of impact points for selected NSRs are illustrated in **Figure C11033/C/SCL/ACM/M53/001 – 003.**
- Accelerometers adhere on the ground and on the building foundation of the selected NSRs. Site photos showing the position of accelerometer are shown in **Appendix B**.
- By communication of staff between ground and tunnel, the pneumatic hammer will be activated to apply an impact on the tunnel invert.
- The impact force in tunnel and the vibration levels on the ground will be recorded by the two separated spectrum analyzers. Measurement will be conducted in narrow frequency bands from 6.3Hz to 500Hz.
- Impact force and vibration measurements will be repeated for all impact location points along the tunnel at minimum distance of half train length (i.e. about 100m). Due to symmetry of the train, the point source response of transfer mobility for the another half train length can be obtained by calculation by multiplying two to the measured results. At each impact point, 10 hits will be sufficient for prediction of LSR.

4 METHOD OF LINE SOURCE RESPONSE PREDICTION

4.1 Introduction

4.1.1 The vibration response caused by a unit point source impact can be obtained from the hammer impact test and the best fit curves can be calculated to determine the LSR at the selected NSRs along the SCL alignment. The prediction of LSR is presented in this section.

4.2 Prediction Method of Line Source Response

4.2.1 The measurement data will be processed so that the specific geological conditions at selected receivers along the alignment, namely, the setback of the receiver from the alignment, the depth of the tunnel, and the depth of the receiver-building basement can be input. For the given input conditions, the best fit curves of PSR are determined from the impact database with respect to the setback, and source and receiver depth. The LSR (TM_{line} , dB re $1e^{-9}$ $(m/s)/(N/m^{0.5})$)) will then be determined by numerical integration with the formula[2] as shown below, of the Point Source Response (PSR, TM_{pi}) along the length of the train centred on the receiver, while PSR will be determined from impacting within the tunnel.

$$TM_{\mathrm{line}} = 10 \times \log 10 \left[h \times \left(\frac{10^{\frac{TMpi}{10}}}{2} + 10^{\frac{TMp2}{10}} + \cdots + 10^{\frac{TMpn-1}{10}} + \frac{10^{\frac{TMpn}{10}}}{2} \right) \right]$$

Where

h	=	Impact interval (m) (interval varying from 5m to 40m)
TMpi	=	Point source transfer mobility for ith impact location (dB re 1e-9 (m/s)/N)
n	=	Last impact location

4.2.2 The calculation of LSR will follow the calculation outlined in paragraph 11.3.2 Analysis of Transfer Mobility Data in FTA Manual[3].

4.2.3 The measured LSR will be compared with those adopted in the EIA Reports for equivalent ground types to allow verification of the ground-borne noise calculation in the EIA Report.

[2] Federal Railroad Administration of U.S. Department of Transportation “High-Speed Ground Transportation Noise and Vibration Impact Assessment”, 2012
[3] Federal Transit Administration of U.S. Department of Transportation “Transit Noise and Vibration Impact Assessment ”, 2006

5 REVIEW OF OPERATIONAL GROUND-BORNE NOISE METHODOLOGY

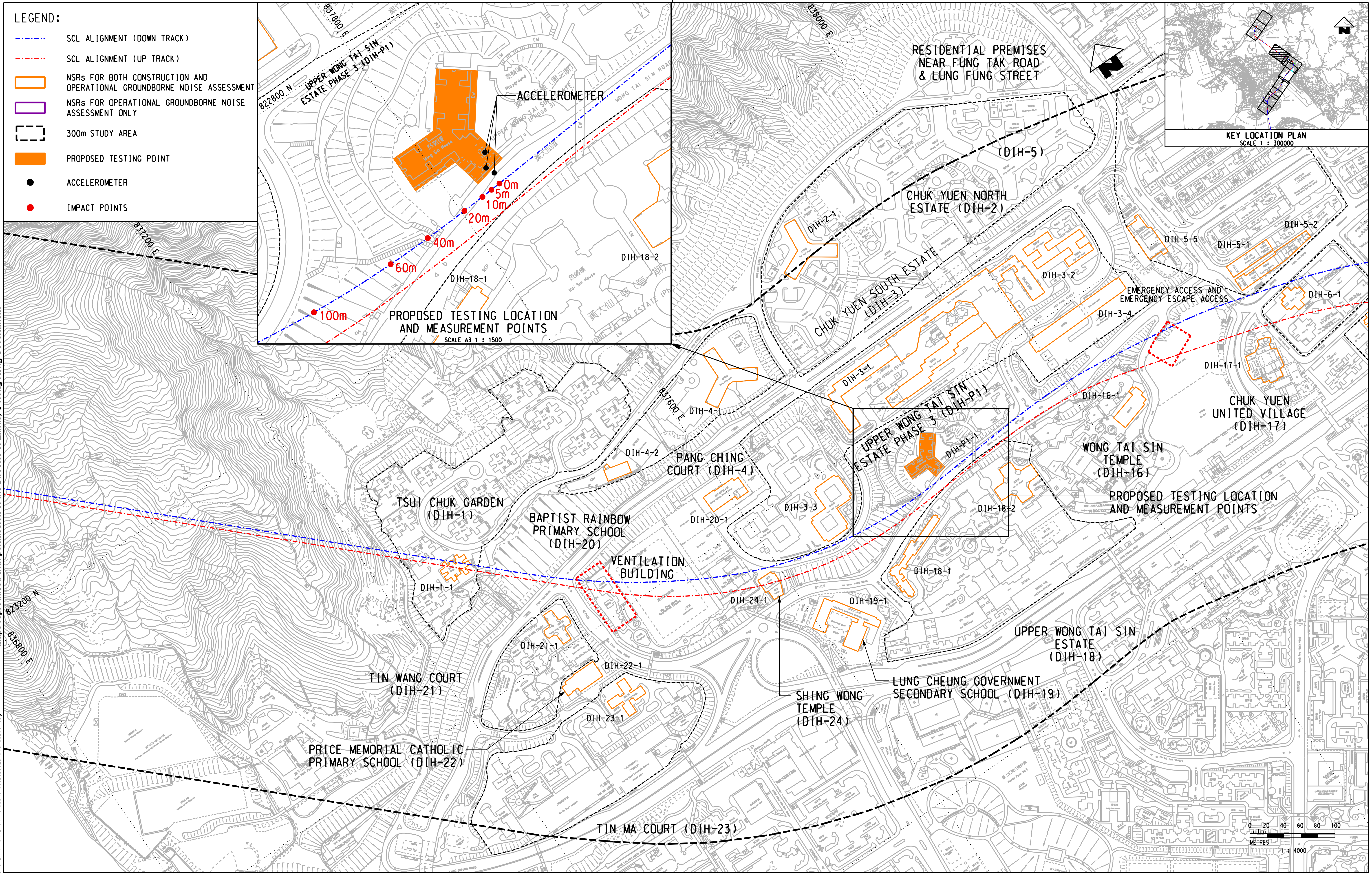
5.1 Review of Other Assumptions

5.1.1 Other assumptions adopted in the EIA Reports will be reviewed and updated based on the latest available information, where necessary, in the upcoming Operational Ground-borne Noise Mitigation Measures Plan.

- Tunnel Coupling Loss (TCL) and Building Coupling Loss (BCL) – these factors depend on whether the tunnel and building (or building piles) are in rock or soft ground. Updated building information, if any, will be reviewed.
- Geological Profile – updated geological profile along the alignment, if any, will be reviewed.
- Speed – updated speed profile along the alignment, if any, will be reviewed.
- Turnout Adjustment – updated information, if any, on the type of turnouts to be used and the adjustment corresponding to corresponding type of turnouts will be reviewed.

5.2 Update of Ground-borne Noise Assessment

5.2.1 Ground-borne noise assessment at the selected NSRs will be updated according to the review findings of the assumptions as discussed in **Section 5.1** and the measurement results of LSR. Assessment methodology will follow the prediction methodology recommended by the FTA Manual, which was adopted in the EIA Reports.



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SHATIN TO CENTRAL LINK

ORIGINATOR

AECOM

CADD REF. C11033_C_SCL_ACM_M53_001A.dgn

TITLE

C11033

SCL (TAW - HUH)

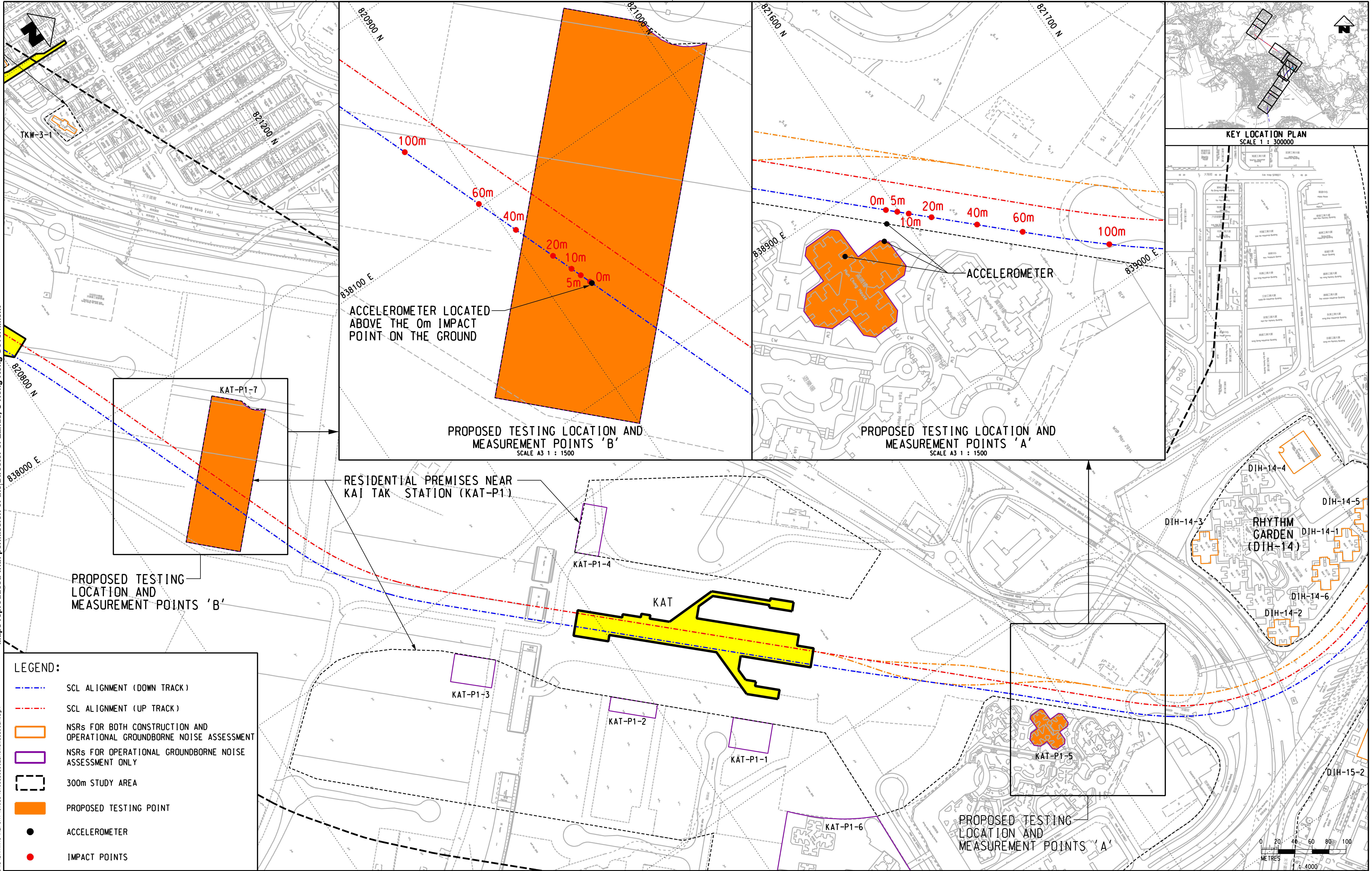
LOCATIONS OF NOISE SENSITIVE RECEIVERS (GROUNDBORNE)

(SHEET 1 OF 3)

SCALE 1 : 4000 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/001

REV. A



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C11033
SCL (TAW - HUH)
LOCATIONS OF NOISE SENSITIVE RECEIVERS (GROUNDBORNE)
(SHEET 2 OF 3)

SCALE 1 : 4000 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/002

REV. A

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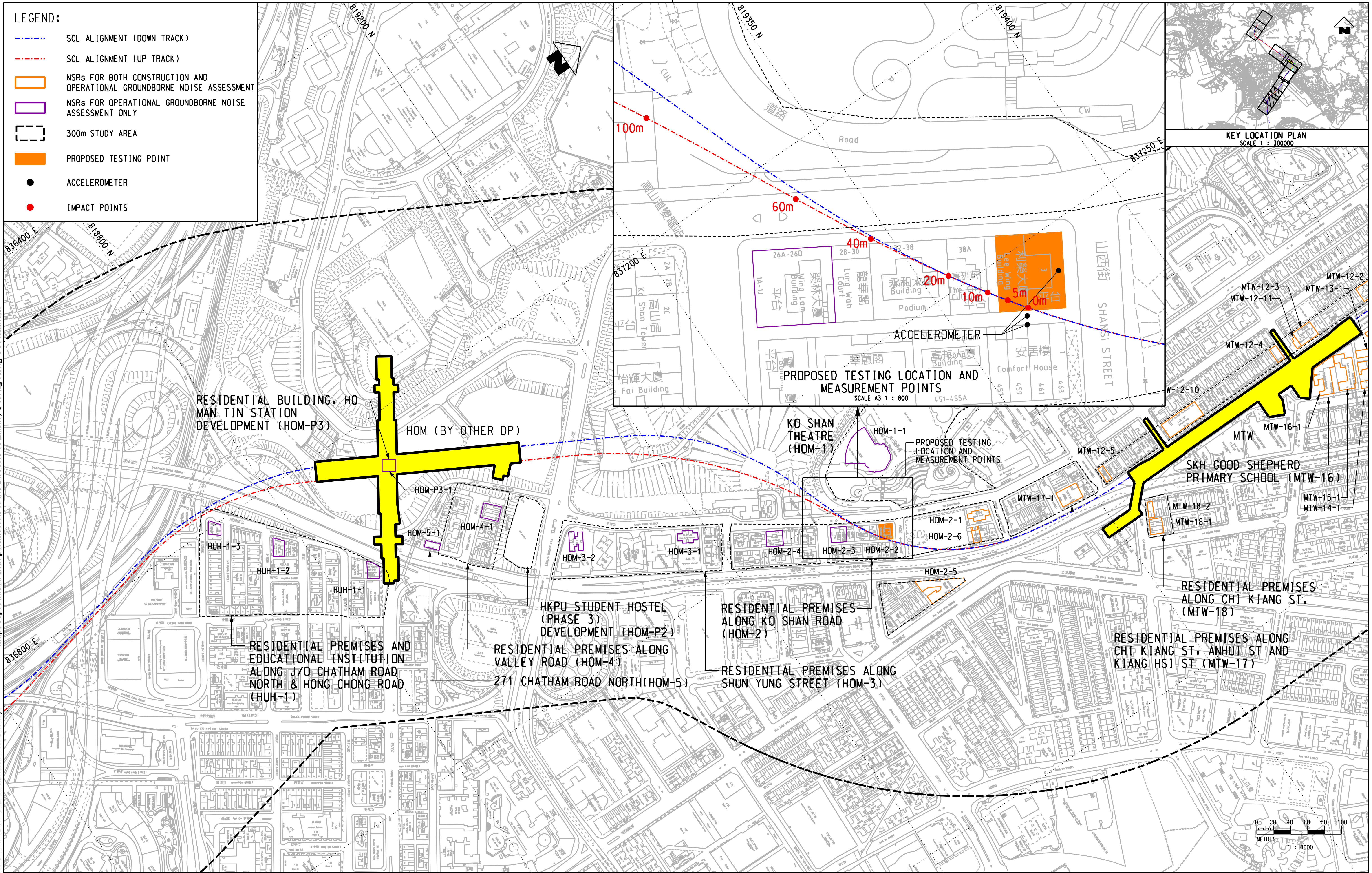

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ORIGINATOR: AECOM

TITLE

C11033

SCL (TAW - HUH)

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

CADD REF. C11033_C_SCL_ACM_M53_003A.dgn

SCALE 1 : 4000 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/003

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Appendix A

Selection of Measurement Locations from NSRs in the SCL EIA Reports

Appendix A Selection of Measurement Locations from the NSRs in the SCL EIA Reports

NSR ID	NSR Description	Ground Type [8]	A [7]		B [10]	C [11]	D [12]	E [13]	Justification of not selected for LSR measurement
			Worst case Scenario[6]		Building Piles (Y/N/NA) [4]	The Nearest Slant Distance to Tunnel (m) [5]	Ambient Vibration (High /Low) [9]	Accessibility (Y/N)	
			Predicted $L_{eq,30min}$ (dB(A))	Criterion $L_{eq,30min}$ (dB(A))					
DIH-1-1	Tsui Chuk Garden Block 5	Rock	40	45	Y	80	Low	Y	(C)
DIH 2-1	Pak Yuen House	Mixed rock	39	45	Y	297	Low	Y	(C)
DIH-3-1	Wah Yuen House	Mixed rock	39	45	Y	112	Low	Y	(C)
DIH-3-2	Nga Yuen House	Mixed rock	39	45	Y	128	Low	Y	(C)
DIH-3-3	Kwai Yuen House	Mixed rock	42	45	Y	44	Low	Y	(C)
DIH-3-4	Chui Yuen House	Mixed rock	39	45	Y	67	Low	Y	(C)
DIH-4-1	Pang Ching Court	Mixed rock	39	45	Y	207	Low	Y	(C)
DIH-4-2	Carbo Anglo-Chinese Kindergarten[2]	Mixed rock	44	55	N	137	Low	Y	(B), (C)
DIH-5-1	Rainbow Home	Rock	34	45	N	48	Low	Y	(B), (C)
DIH-5-2	Residential premises	Rock	35	45	N	41	Low	Y	(B), (C)
DIH-5-5	Our Lady's Kindergarten[2]	Mixed rock	34	55	N	94	Low	Y	(B), (C)
DIH 6-1	WTS Fire Station and Quarters Block A	Rock	39	45	N	35	Low	Y	(B)
DIH-7-1	Tropicana Gardens Block 2	Rock	35	45	Y	49	High	Y	(C), (D)
DIH-7-2	Tropicana Gardens Block 3	Rock	37	45	Y	45	Low	Y	(C)
DIH-8-1	Redemption Lutheran Church	Rock	25	45	N	118	Low	Y	(A), (B), (C)
DIH-9-1	Shek On Building[2]	Rock	27	55	N	121	High	Y	(A), (B), (C), (D)
DIH-10-1	Hong Kong Sheung Keung Hui Nursing Home	Rock	22	45	N	170	High	Confirm upon request	(A), (B), (C), (D)
DIH-11-1	Lung Wan House	Mixed rock	<20	45	Y	65	High	Y	(A), (C), (D)
DIH-12-1	Galaxia Tower B	Mixed rock	<20	45	Y	182	Low	Y	(A), (C)
DIH-12-2	Galaxia Tower E	Mixed rock	<20	45	Y	163	Low	Y	(A), (C)
DIH-13-1	Canossa Primary School[2]	Rock	28	55	N	162	Low	Confirm upon request	(A), (B), (C)
DIH-14-1	Rhythm Garden Block 2	Mixed rock	28	45	N	43	Low	Y	(A), (B), (C)
DIH-14-2	Rhythm Garden Block 5	Soil	30	45	N	35	High	Y	(A), (B), (D)
DIH-14-3	Rhythm Garden Block 8	Soil	24	45	N	176	High	Y	(A), (B), (C), (D)
DIH-14-4	Canossa Primary School[2] (San PoKong)	Mixed rock	<20	55	N	146	Low	Confirm upon request	(A), (B), (C)
DIH-14-5	Rhythm Garden Block 1	Mixed rock	29	45	N	36	Low	Y	(A), (B)
DIH-14-6	Rhythm Garden Block 3	Mixed rock	28	45	N	49	Low	Y	(A), (B), (C)
DIH-15-1	Kam Wan House	Mixed rock	26	45	Y	89	High	Y	(A), (C), (D)
DIH-15-2	Kam Pik House	Mixed rock	26	45	Y	70	High	Y	(A), (C), (D)
DIH-16-1	Wong Tai Sin Temple	Mixed rock	36	45	N	42	Low	Confirm upon request	(B), (C)
DIH-17-1	Chuk Yuen United Village	Mixed rock	36	45	N	37	High	Y	(B), (D)
DIH-18-1	Upper Wong Tai Sin Estate Po Sin House	Mixed rock	38	45	Y	34	Low	Y	- [14]
DIH-18-2	Upper Wong Tai Sin Estate Tat Sin House	Mixed rock	41	45	Y	40	Low	Y	- [14]
DIH-19-1	Lung Cheung Gov.Secondary School[2]	Mixed rock	45	55	N	45	Low	Confirm upon request	(B), (C)
DIH-20-1	Baptist Rainbow Primary School[2]	Mixed rock	44	55	N	92	Low	Confirm upon request	(B), (C)

Appendix A Selection of Measurement Locations from the NSRs in the SCL EIA Reports

NSR ID	NSR Description	Ground Type [8]	A [7]		B [10]	C [11]	D [12]	E [13]	Justification of not selected for LSR measurement
			Worst case Scenario[6]		Building Piles (Y/N/NA) [4]	The Nearest Slant Distance to Tunnel (m) [5]	Ambient Vibration (High /Low) [9]	Accessibility (Y/N)	
			Predicted $L_{eq,30min}$ (dB(A))	Criterion $L_{eq,30min}$ (dB(A))					
DIH-21-1	Tin Wang Court Wang King House	Rock	33	45	Y	51	Low	Y	(C)
DIH-22-1	Price Memorial Catholic Primary School[2]	Mixed rock	34	55	N	89	Low	Confirm upon request	(B), (C)
DIH-23-1	Tin Ma Court Chun On House	Mixed rock	29	45	Y	108	Low	Y	(A), (C)
DIH-24-1	Shing Wong Temple	Mixed rock	44	45	N	28	Low	Y	(B)
DIH-P1-1	Upper Wong Tai Sin Estate Phase 3[3]	Mixed rock	32	45	Y	32	Low	Y	- [14]
DIH-P2-1	TBA[1]	Mixed rock	<20	45	NA	78	High	Confirm upon request	(A), (C), (D)
DIH-P2-2	TBA[1]	Mixed rock	43	45	NA	20	High	Confirm upon request	(D)
DIH-P2-3	TBA[1]	Mixed rock	45	45	NA	20	High	Confirm upon request	(D)
DIH-P2-4	TBA[1]	Mixed rock	25	45	NA	36	Low	Confirm upon request	(A)
DIH-P3-1	TBA [1]	Mixed rock	36	45	NA	28	Low	Confirm upon request	-[14]
DIH-P3-2	TBA [1]	Mixed rock	36	45	NA	30	Low	Confirm upon request	-[14]
KAT-P1-1	Residential premises near Kai Tak Station[1]	Soil	23	45	NA	76	Low	Y	(A), (C)
KAT-P1-2	Residential premises near Kai Tak Station[1]	Soil	25	45	NA	76	Low	Y	(A), (C)
KAT-P1-3	Residential premises near Kai Tak Station[1]	Soil	31	45	NA	57	Low	Y	(C)
KAT-P1-4	Residential premises near Kai Tak Station[1]	Soil	<20	45	NA	67	Low	Y	(A), (C)
KAT-P1-5	Residential premises near Kai Tak Station Site 1A[3]	Soil	40	45	Y	19	Low	Y	- [14]
KAT-P1-6	Residential premises near Kai Tak Station Site 1B	Soil	25	45	NA	166	Low	Y	(A), (C)
KAT-P1-7	Residential premises near Kai Tak Station[1]	Mixed rock	45	45	NA	20	Low	Y	-[14]
TKW-1-1	Parc 22	Soil	25	45	N	86	Low	Y	(A), (B), (C)
TKW-1-2	Sanford Mansion	Mixed rock	25	45	N	96	Low	Y	(A), (B), (C)
TKW-2-1	Skytower Tower 1	Soil	<20	45	Y	141	Low	Y	(A), (C)
TKW-2-2	Skytower Tower 2	Soil	<20	45	Y	141	Low	Y	(A), (C)
TKW-2-3	Skytower Tower 7	Mixed rock	<20	45	Y	235	Low	Y	(A), (C)
TKW-3-1	Prince Ritz	Mixed rock	<20	45	Y	236	High	Y	(A), (C), (D)
TKW-3-2	Prosperity House	Mixed rock	<20	45	N	251	High	Y	(A), (B), (C), (D)
TKW-P1-1	Residential premises near To Kwa Wan Station[1]	Mixed rock	30	45	NA	27	Low	Confirm upon request	(A)
MTW-6-1	Fok On Building	Mixed rock	37	45	N	23	High	Y	(B), (D)
MTW-6-2	HK Society for the Protection of Children[2]	Mixed rock	50	55	N	18	High	Y	(B), (D)

Appendix A Selection of Measurement Locations from the NSRs in the SCL EIA Reports

NSR ID	NSR Description	Ground Type [8]	A [7]		B [10]	C [11]	D [12]	E [13]	Justification of not selected for LSR measurement
			Worst case Scenario[6]		Building Piles (Y/N/NA) [4]	The Nearest Slant Distance to Tunnel (m) [5]	Ambient Vibration (High /Low) [9]	Accessibility (Y/N)	
			Predicted $L_{eq,30min}$ (dB(A))	Criterion $L_{eq,30min}$ (dB(A))					
MTW-6-3	Chung Nam Mansion	Mixed rock	35	45	N	25	High	Y	(B), (D)
MTW-6-4	Pok Oi Lau	Mixed rock	45	45	N	19	High	Y	(B), (D)
MTW-7-1	Geranium House	Rock	40	45	N	21	High	Y	(B), (D)
MTW-8-1	Horae Palace	Rock	35	45	Y	23	High	Y	(D)
MTW-9-1	Majestic Park	Rock	28	45	Y	39	High	Confirm upon request	(A), (D)
MTW-10-1	18 Farm Road	Rock	35	45	Y	23	High	Y	(D)
MTW-11-1	Farm Road Government Primary School[2]	Rock	32	55	N	67	High	Confirm upon request	(B), (C), (D)
MTW-12-1	Yuet Fai Mansion	Rock	38	45	N	25	High	Y	(B), (D)
MTW-12-2	Delight Court	Mixed rock	33	45	Y	27	High	Y	(D)
MTW-12-3	Lucky Mansion	Mixed rock	29	45	N	25	High	Y	(A), (B), (D)
MTW-12-4	352-354 Ma Tau Wai Rd	Mixed rock	29	45	N	25	High	Y	(A), (B), (D)
MTW-12-5	Seng Cheong Building	Mixed rock	32	45	N	25	High	Y	(B), (D)
MTW-12-6	Great Wall Building	Rock	30	45	N	35	High	Y	(A), (B), (D)
MTW-12-7	197-199 Ma Tau Wai Rd	Rock	37	45	N	23	High	Y	(B), (D)
MTW-12-8	Pak Tai Mansion	Rock	40	45	N	22	High	Y	(B), (D)
MTW-12-9	Residential premises along Hung Kwong Street	Mixed rock	38	45	N	22	High	Y	(B), (D)
MTW-12-10	Lucky Building	Mixed rock	31	45	N	23	High	Y	(B), (D)
MTW-12-11	Jing Ming Building	Mixed rock	29	45	N	28	High	Y	(A), (B), (D)
MTW-12-12	One Elegance	Rock	36	45	Y	22	High	Y	(D)
MTW-13-1	Cheung Chuk Shan Memorial School[2]	Mixed rock	44	55	N	22	High	Y	(B), (D)
MTW-14-1	PLK Lam Man Chan English Primary School[2]	Mixed rock	29	55	N	40	High	Y	(A), (B), (D)
MTW-15-1	Hung Hom Lutheran Primary School[2]	Mixed rock	43	55	N	22	High	Confirm upon request	(B), (D)
MTW-16-1	SKH Good Shepherd Primary School[2]	Mixed rock	42	55	N	22	High	Confirm upon request	(B), (D)
MTW-17-1	Loyal Mansion	Mixed rock	32	45	N	26	High	Y	(B), (D)
MTW-18-1	Residential premises along Chi Kiang St	Mixed rock	21	45	N	48	Low	N (Dismantled)	(A), (B), (C), (E)
MTW-18-2	No. 2 Kowloon City Road	Mixed rock	24	45	N	33	Low	N (Dismantled)	(A), (B), (E)
MTW-19-1	Holy Trinity Church	Soil	29	45	N	58	High	Confirm upon request	(A), (B), (C), (D)
HOM-1-1	Ko Shan Theatre[2]	Rock	30	45	Y	61	Low	Y	(A), (C)
HOM-2-1	Faerie Court	Mixed rock	35	45	Y	27	Low	Y	- [14]
HOM-2-2	Lee Wing Bldg	Rock	41	45	Y	24	Low	Y	- [14]
HOM-2-3	Wing Lam Mansion	Rock	36	45	Y	25	Low	Y	- [14]
HOM-2-4	Tak Lee Court	Rock	35	45	Y	61	Low	Y	(C)
HOM-2-5	Chat Ma Mansion	Rock	28	45	N	49	High	Y	(A), (B), (C), (D)
HOM-2-6	Chatham Mansion	Mixed rock	43	45	N	19	High	Y	(B), (D)

Appendix A Selection of Measurement Locations from the NSRs in the SCL EIA Reports

NSR ID	NSR Description	Ground Type [8]	A [7]		B [10]	C [11]	D [12]	E [13]	Justification of not selected for LSR measurement
			Worst case Scenario[6]		Building Piles (Y/N/NA) [4]	The Nearest Slant Distance to Tunnel (m) [5]	Ambient Vibration (High /Low) [9]	Accessibility (Y/N)	
			Predicted $L_{eq,30min}$ (dB(A))	Criterion $L_{eq,30min}$ (dB(A))					
HOM-3-1	Fook Sing Mansion	Rock	25	45	Y	92	Low	Confirm upon request	(A), (C)
HOM-3-2	Marigold Mansion, Blk A	Rock	37	45	Y	96	Low	Confirm upon request	(C)
HOM-4-1	Yee Fu Building	Rock	33	45	Y	60	Low	Y	(C)
HOM-5-1	271 Chatham Road North	Rock	28	45	N	87	High	Y	(A), (B), (C), (D)
HOM-P2	HKPU Phase 3[2]	Rock	36	55	Y	57	High	Confirm upon request	(C), (D)
HOM-P3-1	Residential Building, HOM Development[1]	Rock	41	45	NA	45	Low	Confirm upon request	(C)
HUH-1-1	Cartas Branchi College of Careers[2]	Rock	<20	55	N	100	High	Y	(A), (B), (C), (D)
HUH-1-2	Lok Ka House	Rock	24	45	N	58	High	Y	(A), (B), (C), (D)
HUH-1-3	Wing Fung Bldg	Soil	38	45	N	21	High	Y	(D)

Notes:

[1] The information of unconstructed NSRs is to be confirmed. For DIH area, compared with DIH-P3-1 and DIH-P3-2, DIH-P2-1 and DIH-P2-4 are farther away from the tunnel; DIH-P2-2 and DIH-P2-3 are situated with higher ambient noise. In addition, the DIH scheme should refer to the approved SCL(HHS) EIA such that DHS will not be built. Therefore, DIH-P2-1 to DIH-P2-4 are not selected for testing locations. Nevertheless, ground-borne noise assessment will be updated according to the review findings and the measurement results.

[2] Daytime noise criteria and operation conditions are used for the assessment of school.

[3] The up-to-date names for DIH-P1-1 and KAT-P1-5 are Upper Wong Tai Sin Estate – Wing Sin House and Kai Ching Estate – Mun Ching House respectively.

[4] Y: Building pile of the NSR founded on rock head; N: Building pile of the NSR not founded on rock head; NA: No existing piles and information of future piles is not available yet.

[5] The nearest distance to tunnel is determined between the boundary of respective NSR and tunnel (i.e. the slant distance from ground level to track level.)

[6] Worst case Scenario represents either Nighttime noise criteria or Daytime noise criteria adopted in EIA reports for NSRs depending on its land use.

[7] NSRs which predicted Leq,30min(dB(A)) is lower than 30 are not considered as a representative location for testing and measurement.

[8] The Ground Type is categorized into 3 groups which are Rock, Mixed rock and Soil. Tunnel on or under rockhead is defined as Rock; Tunnel above rockhead and below soil is defined as Mixed rock, and Tunnel in the soil is defined as Soil. For the SCL (TAW-HUH) tunnel, the condition of tunnel below rockhead and above soil does not exist.

[9] Low: For the nearest road(s) with traffic flow AADT less than 30,000, relative low ambient vibration anticipated at NSRs; High: For the nearest road(s) with traffic flow AADT equal or higher than 30,000, relative high ambient vibration anticipated at NSRs.

[10] NSRs with no building piles founded on rock head or no available information of building piles are less preferrable to be selected as a representative location for testing and measurement.

[11] NSRs which have slant distance greater than 40m to the tunnel are not considered as a representative location for testing and measurement.

[12] NSRs which have high ambient vibration are not considered as a representative location for testing and measurement.

[13] NSRs which are inaccessible are not considered as a representative location for testing and measurement.

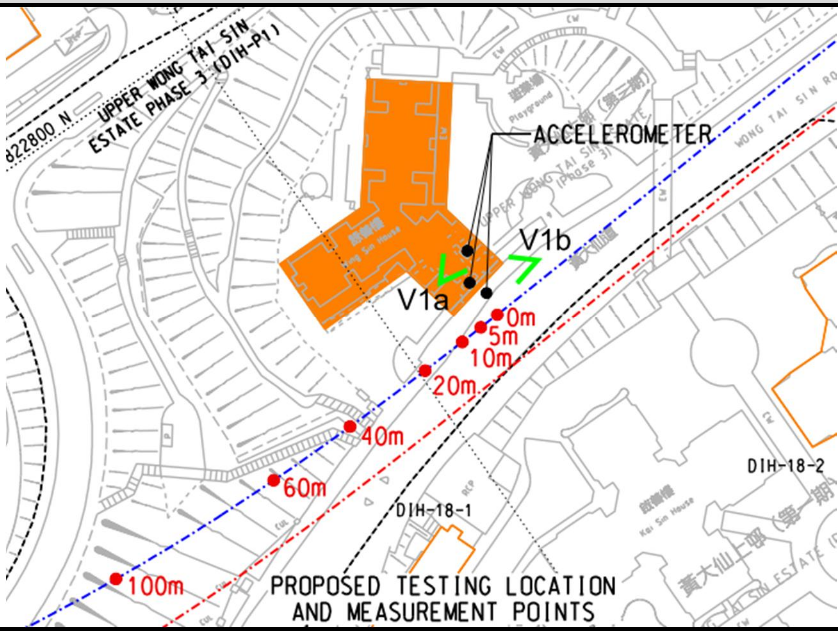
[14] 4 out of 10 NSRs are selected as measurement locations and each geological characteristic is represented by at least one selected NSR. Compared with the selected NSR DIH-P1-1, DIH-18-1 and DIH-18-2 are farther away from the tunnel, and HOM-2-1 is situated at the margin of mixed rock and rock that LSR value is not suitable to apply to all NSRs at mixed rock type. Comparing 3 planned NSRs at mixed rock, KAT-P1-7 is considered more respresentative than DIH-P3-1 and DIH-P3-2 due to its shorter slant distance together with higher predicted level and hence is selected as another NSR at mixed rock. KAT-P1-5 is selected as it is the only NSR at soil type. HOM-2-2 is selected as NSR at rock type since it is located directly above tunnel and is closer to it compared with HOM-2-3.

Appendix B

Photo records of Proposed Measurement Points at selected NSRs

Appendix B - Photo records of Proposed Measurement Points at selected NSRs

1) Upper Wong Tai Sin Estate – Wing Sin House (DIH-P1-1)

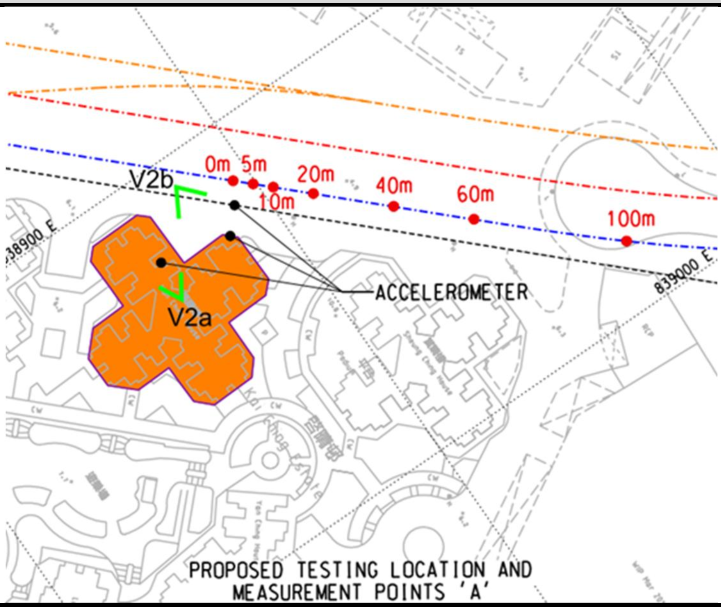


Key Plan of proposed measurement points in DIH-P1-1

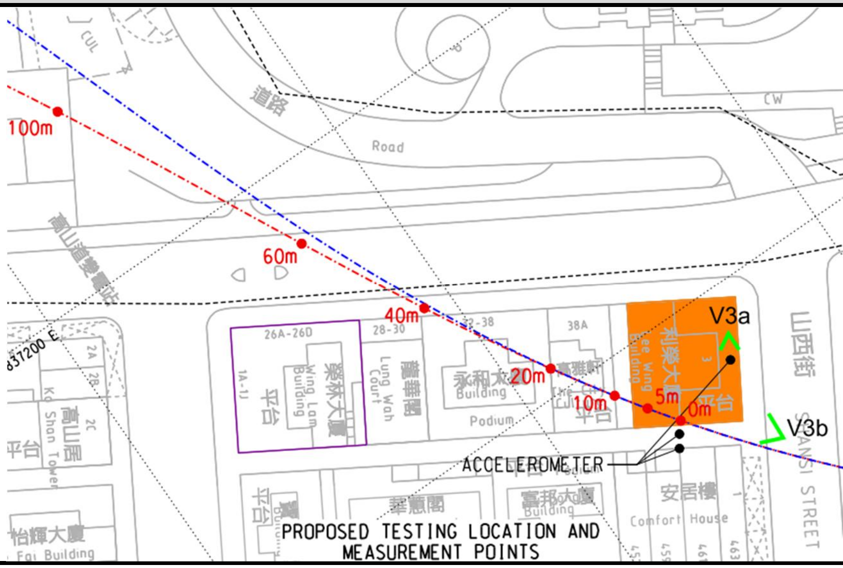
V1a: Indoor measurement point

V1b: Outdoor measurement points

Appendix B - Photo records of Proposed Measurement Points at selected NSRs

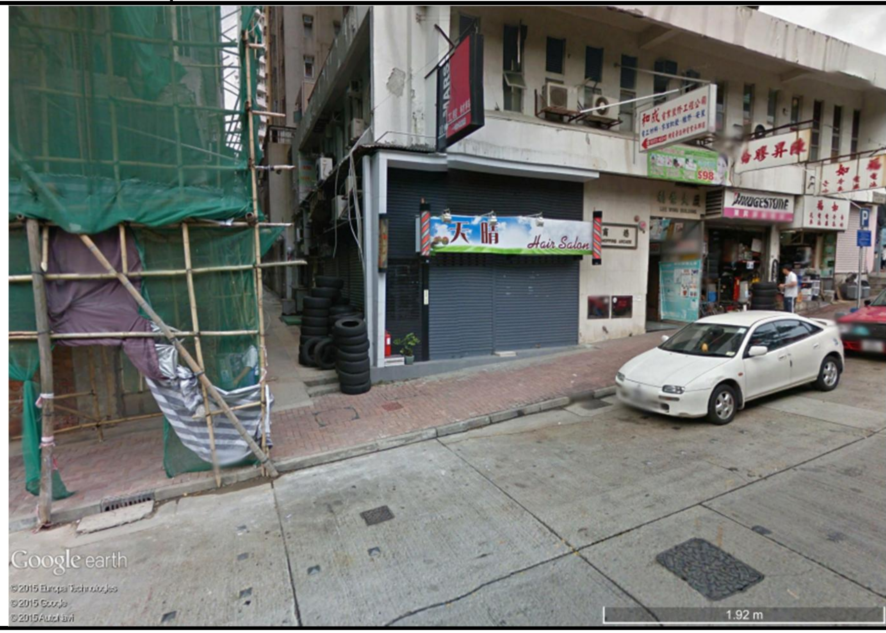
2) Kai Ching Estate – Mun Ching House (KAT-P1-5)	
	
Key Plan of proposed measurement points in KAT-P1-5	
	
V2a: Indoor measurement point	V2b: Outdoor measurement points

3) Lee Wing Bldg (HOM-2-2)



Key Plan of proposed measurement points in HOM-2-2

V3a: Indoor measurement point



V3b: Outdoor measurement points

Note:
The proposed indoor measurement points are subject to minor change depending on the condition on testing day. In the case where indoor measurement points are under disturbance or considered unsuitable for obtaining vibration signal, outdoor measurement points would be adopted as an alternative.

Annex B1

Excerpt of Operational Ground-borne Noise Mitigation Measures Plan (Batch 1 – Kai Ching Estate, Mun Ching House) (June 2016)

MTR Corporation Limited

Shatin to Central Link –
Tai Wai to Hung Hom Section

Operational Ground-borne Noise Mitigation Measures Plan – Batch 1 (Version D)

(June 2016)

Verified by: Fredrick Leong

Position: Independent Environmental Checker

Date: 23 Jun. 2016

MTR Corporation Limited

Shatin to Central Link – Tai Wai to Hung Hom Section

Operational Ground-borne Noise Mitigation Measures Plan – Batch 1 (Version D)

(June 2016)

Certified by: Richard Kwan

Position: Environmental Team Leader

Date: 23 Jun 2016

AECOM

MTR Corporation Limited

Consultancy Agreement No. C11033

Shatin to Central Link - Tai Wai to Hung Hom Section [SCL(TAW – HUH)] and Stabling Sidings at Hung Hom Freight Yard [SCL(HHS)]

Operational Ground-borne Noise Mitigation Measures Plan (Batch 1 – Kai Ching Estate, Mun Ching House)

June 2016

	Name	Signature
Prepared & Checked:	Angela Tong	
Reviewed & Approved:	Josh Lam	

Version:	D	Date:	22 Jun 2016

AECOM Asia Co. Ltd.
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Table of Content

List of Tables

List of Figures

Appendices

1 INTRODUCTION

1.1 Background

1.1.1 The Shatin to Central Link (SCL) is a 17km extension of the existing 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 Reports for SCL – Tai Wai to Hung Hom Section [SCL (TAW-HUH)] (Register No. AEIAR-167/2012) and SCL Stabling Sidings at Hung Hom Freight Yard [SCL (HHS)] (Register No. AEIAR-164/2012) were approved on 17 February 2012 under the *Environmental Impact Assessment Ordinance (*EIAO). Following the approval of the EIA Reports, the Environmental Permit (EP) (EP No: EP-438/2012), covering the construction of both SCL (TAW-HUH) and SCL (HHS), was granted on 22 March 2012. Variations of Environmental Permit (VEP) were subsequently applied for EP-438/2012 and the latest Environmental Permit (EP No: EP-438/2012/J) was issued by Director of Environmental Protection (DEP) on 29 February 2016.

1.1.3 Pursuant to EP Condition 2.27, the Permit Holder, MTR Corporation Ltd (MTR), shall deposit with the Director of Environmental Protection (DEP), no later than one month after completion of corresponding parts of the tunnel excavation of the SCL(TAW-HUH) Section (hereinafter referred to as “the Project”), an Operational Ground-borne Noise Mitigation Measures Plan (OGNMMP) to justify the adequacy of the operational ground-borne noise mitigation measures for the Project. The OGNMMP shall include the review and verification of the assumptions adopted in the approved SCL(TAW-HUH) EIA Report (Register No. AEIAR-167/2012) and SCL(HHS) EIA Report (Register No. AEIAR-164/2012), such as line source response (LSR) and ground vibration conditions, and shall also include justifications and recommendations for any contingency noise mitigation measures found necessary, including but not limited to resilient baseplates (type 1) and isolated slab track (type 4).

1.1.4 Since the tunnel excavation of the Project will be completed in different phases, testing on the LSR and ground vibration conditions will be conducted in phases according to the excavation programme.

1.1.5 The prediction methodology recommended by the FTA Manual[1] was adopted in the EIA studies and most of correction factors are based on the international guideline except LSR of which values are site specific and are subject to the ground materials, depth of the tunnel and the rock head. During the EIA stage, in situ line source response measurement was not conducted. As part of the review and verification of the assumptions adopted in the ground-borne railway noise impact assessment, it is proposed that line source response and ground vibration conditions will be reviewed and verified by the on-site measurement.

1.1.6 AECOM Asia Co. Ltd has been commissioned by the MTR to conduct the LSR test according to the Testing and Review Methodology Plan (T&RMP) (**Appendix A**). According to the T&RMP, the LSR test will be conducted at Upper Wong Tai Sin Estate - Wing Sin House (DIH-P1-1), Kai Ching Estate – Mun Ching House (KAT-P1-5), Residential Premises near KAT (KAT-P1-7) and Lee Wing Bldg (HOM-2-2). With respect to the construction programme, the first impact test was conducted at Mun Ching House on 1 and 2 February 2016.

(1) Federal Transit Administration of U.S. Department of Transportation “Transit Noise and Vibration Impact Assessment ”, 2006

1.2 Purpose of This OGNMMP

1.2.1 This OGNMMP (Batch 1) presents the LSR analysis based on the results of the impact test conducted at Mun Ching House (KAT-P1-5) and the operational ground-borne noise prediction at KAT-P1-5 based on measurement results.

1.3 Report Structure

1.3.1 This Test Proposal comprises the following sections:

- Section 1 presents the background information.
- Section 2 describes the details of impact test and the prediction of LSR based on the measurement results.
- Section 3 presents the LSR analysis and operational ground-borne noise prediction results.
- Section 4 presents the conclusion.

2 IMPACT TESTING AND PREDICTION OF LSR

2.1 Testing Location

2.1.1 The first impact test was conducted at Kai Ching Estate – Mun Ching House (KAT-P1-5) on 1 and 2 Feb 2016. The information of the measurement location at the selected NSR are summarised in **Table 2.1** and the testing locations are shown in **Figure C11033/C/SCL/ACM/M53/004**.

Table 2.1 Measurement and Testing Location

NSR		Predicted Night-time Ground-borne Noise Levels in the EIA Report, dB(A)	Measurement Location[2]		Ground Type	Location of Hammer Impact Test (Approx. Tunnel Depth)	Testing Date
ID	Description		Approx. Hori. Distance from the Tunnel, m	Approx. Slant Distance (From Ground Level to Track Level), m			
KAT-P1-5[1]	Kai Ching Estate – Mun Ching House	40	13 (down track)	19 (down track)	Soil	Down Track Tunnel (-8.1mPD)	1 & 2 Feb 2016

Note:
(1) KAT-P1-5 is a planned NSR during EIA stage. Assumptions were made on the horizontal building setback distance from tunnels (i.e. 10m from up track and 20m from down track) and noise levels were predicted based on this assumption.
(2) Measurement location at the selected NSR is shown in **Figure C11033/C/SCL/ACM/M53/004**.

2.2 Testing Instrumentations

2.2.1 The impact force levels applied within the tunnel were measured using a SINUS Harmonie connected to a laptop computer and vibration velocity levels were measured using a Bruel & Kjaer PULSE connected to a laptop computer. Wilcoxon seismic accelerometers were used on the surface. Details of the instruments used are provided in **Table 2.2** and the calibration records of the instruments are provided in **Appendix B**.

Table 2.2 Instrumentation of the Hammer Impact Test

Instrument	Manufacturer / Model No.	Purpose
Pneumatic Hammer and Air Compressor	WM model S	Connection to 3-hp air compressor to induce force (impact) at about 300kN
Impact Controller	WM type 1	Connection to pneumatic hammer to control impact on/ off
Analyzer Platform	Bruel & Kjaer PULSE; Sinus Harmonie	Spectrum analyzers for data acquisition
Accelerometer	Wilcoxon Research 731-207 and 731A-P31	Vibration transducers to measure vibration
Force transducer	PCB 207C	Fitted to pneumatic hammer to measure impact force

2.3 Testing and Measurement Procedures

2.3.1 The testing and measurement procedures are summarised below:

- The test was carried out during night time when background vibration levels are low. All construction works inside tunnel and the adjacent tunnel were suspended during the testing.

- The impact hammer hit on the centreline of tunnel invert and it applied measured impact forces within the tunnel at six impact points. The measured impact forces were logged by the FFT spectrum analyzer. Each impact points were applied minimum 10 hits at around 300kN[(2)] on the concrete invert along the tunnel.
- Meanwhile, accelerometers adhered on the ground and on the building structure of Mun Ching House. Site photos showing the positions of accelerometers are shown in **Appendix C**.
- The impact force in tunnel and the vibration levels on the ground were recorded by the two separated spectrum analyzers. Measurement signals were recorded in narrow band frequencies from 6.3Hz to 500Hz.
- The test was repeated at each hitting points in turn. The furthest hitting point done was up to 60m from the first hitting point in the tunnel. Testing on the proposed hitting point at 100m was not executed due to limitation of on-site condition. Results indicate that the response signals beyond 40m hitting point are weak and cannot be identified. Thus the response signals at 100m hitting point would be much weaker and would not affect the overall result.

2.4 Prediction of Line Source Response

2.4.1 The vibration response induced by a unit point source impact was obtained from the hammer impact test and the best fit curves were calculated to determine the LSR at Mun Ching House (soil type ground property referring to the geological profile) along the SCL alignment.

2.4.2 The post-processing of measurement data was taken to determine the best fit curves of PSR with respect to the setback distances, and the depth between the impact sources and the receiver. The LSR [TM_{line}, dB re 1e^{-9} (m/s)/(N/m$^{0.5}$)] is then determined by numerical integration with the formula[(3)] as shown below, of the Point Source Response (PSR, TM_{pi}) along the length of the train centred on the receiver, while PSR is determined from impacting within the tunnel.

$$TM_{\text{line}} = 10 \times \log_{10}\left[h \times \left(\frac{10^{\frac{TMp1}{10}}}{2} + 10^{\frac{TMp2}{10}} + \cdots + 10^{\frac{TMpn-1}{10}} + \frac{10^{\frac{TMpn}{10}}}{2} \right) \right]$$

Where

h	=	Impact interval (m) (interval varying from 5m to 40m)
TMpi	=	Point source transfer mobility for ith impact location (dB re 1e-9 (m/s)/N)
n	=	Last impact location

2.4.3 The calculation of LSR follows the calculation outlined in paragraph 11.3.2 Analysis of Transfer Mobility Data in FTA Manual[(4)]. The measured PSR and the determined LSR are presented in **Appendices D** and **E** respectively.

2.4.4 A total of three measurement points including Point A (outdoor ground), Point B (outdoor building structure) and Point C (indoor building structure) were set up. However, only Point A is adopted to determine the LSR as the vibration response of Point B and Point C were weak and cannot be identified. The spectra of the PSR at Point B and Point C as shown in **Appendix D** indicate no significant difference between distances at all frequencies. Thus it is

(2) As mentioned in T&RMP, 400kN is only the design force of the impact machine and the actual output force in fact depends on the machine status and on-site condition.

(3) Federal Railroad Administration of U.S. Department of Transportation "High-Speed Ground Transportation Noise and Vibration Impact Assessment", 2012

(4) Federal Transit Administration of U.S. Department of Transportation "Transit Noise and Vibration Impact Assessment ", 2006

considered that the estimated LSRs at Point B and Point C as shown in **Appendix E** are not appropriate to be used in the ground-borne noise calculation.

3 REVIEW OF OPERATIONAL GROUND-BORNE NOISE PREDICTION

3.1 LSR Adopted in the Approved EIA Report

3.1.1 The LSR determines the vibration levels or attenuation in the ground as a function of distance caused by an incoherent line source of unit force point impacts.

3.1.2 The LSR values adopted in ground-borne noise assessment of SCL (TAW-HUH) and SCL (HHS) EIA Report were referenced from the data of the West Island Line (WIL) EIA Study (EIA Register No. AEIAR-126/2008). The LSR for WIL EIA Study were determined based on the results of borehole impact tests performed in rock, soil and close to the rock head both on the soil side and the rock side, with receiver vibration data taken on surface at various setback distances.

3.2 Review of LSR Values

3.2.1 The test carried out at Mun Ching House (KAT-P1-5) was specifically aimed at determining the LSR values for vibration propagating through soft ground.

3.2.2 The LSR values determined at Mun Ching House (KAT-P1-5) are compared with those used in the SCL EIA study for the same area and the same ground conditions (i.e. WIL D018 Rockhead Depth=28m Hole Depth=15m Slant Distance=18m & 26m). The EIA LSR values are now shown in **Appendix F**. To allow a better comparison, **Appendix G** shows the LSR value determined at measurement locations at a distance similar to EIA study. A summary of observation is presented in **Table 3.1**.

Table 3.1 Comparison between Measurement Data and WIL Data

ID	Location	LSR data adopted in EIA Study	Observation
KAT-P1-5	Kai Ching Estate – Mun Ching House	WIL D018 Rockhead Depth=28m Hole Depth=15m Slant Distance=18m & 26m	Measured LSR values(1) at 18m are about at least 10dB lower than the EIA LSR values in all frequency bands. Measured LSR values at 26m are also lower than the EIA LSR values in all frequency bands.

Note:
(1) The LSR results obtained from the proposed method in the Plan and the actual testing method would have been the same, even given the different number of impact points and impact force. As presented in the Point A graph of **Appendix D**, the maximum difference of the measured PSR value at the nearest point (i.e. 15m slant distance) and the furthest point (i.e. 62m slant distance) is about 30dB. Since the LSR results are obtained based on integration of all the measured PSR values at different distances, the PSR values at nearest distance, which are at least 10dB higher, would dominates the LSR results while the lower PSR values at the further distance would be insignificant to the LSR results. Thus the PSR values further away than 60m horizontal distance do not affect the overall LSR results.

3.2.3 It should be noted that the WIL EIA LSR was measured in the borehole while the current test was measured inside the tunnel. The decoupling effect of vibration propagation between the media of tunnel structure and the ground soil, i.e. the tunnel coupling loss (TCL), would be different to that between the media of borehole casing and the ground soil. Thus the LSR result measured in the impact test should comprise the loss due to decoupling of the actual tunnel structure. The factor of tunnel coupling loss applied in the EIA prediction in NSR KAT-P1-5 was 3dB. Therefore, apart from different testing method and geological profile at WIL D018 and KAT-P1-5, such 3dB tunnel coupling loss also accounts for difference between the EIA LSR and measured LSR.

3.3 Operational Ground-borne Noise Prediction

3.3.1 Ground-borne noise assessment at KAT-P1-5 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 Reports. The prediction results are summarised in **Table 3.2**. Sample calculation is given in **Appendix H**.

Table 3.2 Ground-borne Noise Prediction Results

Location	GBNSR	Description	EIA Prediction (unmitigated scenario), dB(A)		New Prediction (unmitigated scenario, based on measured LSR data), dB(A)		Criterion, dB(A)		Difference Between EIA and New Prediction
Mun Ching House	KAT-P1-5	Kai Ching Estate – Mun Ching House	Lmax	51	Lmax	40	Lmax	-	-11
			Daytime $L_{eq,30min}$	43	Daytime $L_{eq,30min}$	31	Daytime $L_{eq,30min}$	55	-12
			Night-time $L_{eq,30min}$	40	Night-time $L_{eq,30min}$	28	Night-time $L_{eq,30min}$	45	-12

3.3.2 As mentioned in **Section 3.2.3**, the measured LSR comprises of tunnel couple loss which is about 3dB as adopted in the EIA prediction. The updated calculation therefore excluded the tunnel coupling loss in the calculation to avoid double count of the effect.

3.3.3 Results indicate that the measured LSR values at actual soil would give lower ground-borne noise levels than EIA prediction which also below the noise criteria.

3.3.4 The preliminary update of prediction calculation shows no further mitigation measures such as trackform upgrade is required around the NSR KAT-P1-5.

3.4 Review of Other Assumptions

3.4.1 The following assumptions adopted in the EIA Reports will be reviewed and the ground-borne noise prediction for SCL(TAW-HUH) will be updated based on all measured LSR results where applicable in the Final OGNMMP and the latest available information:

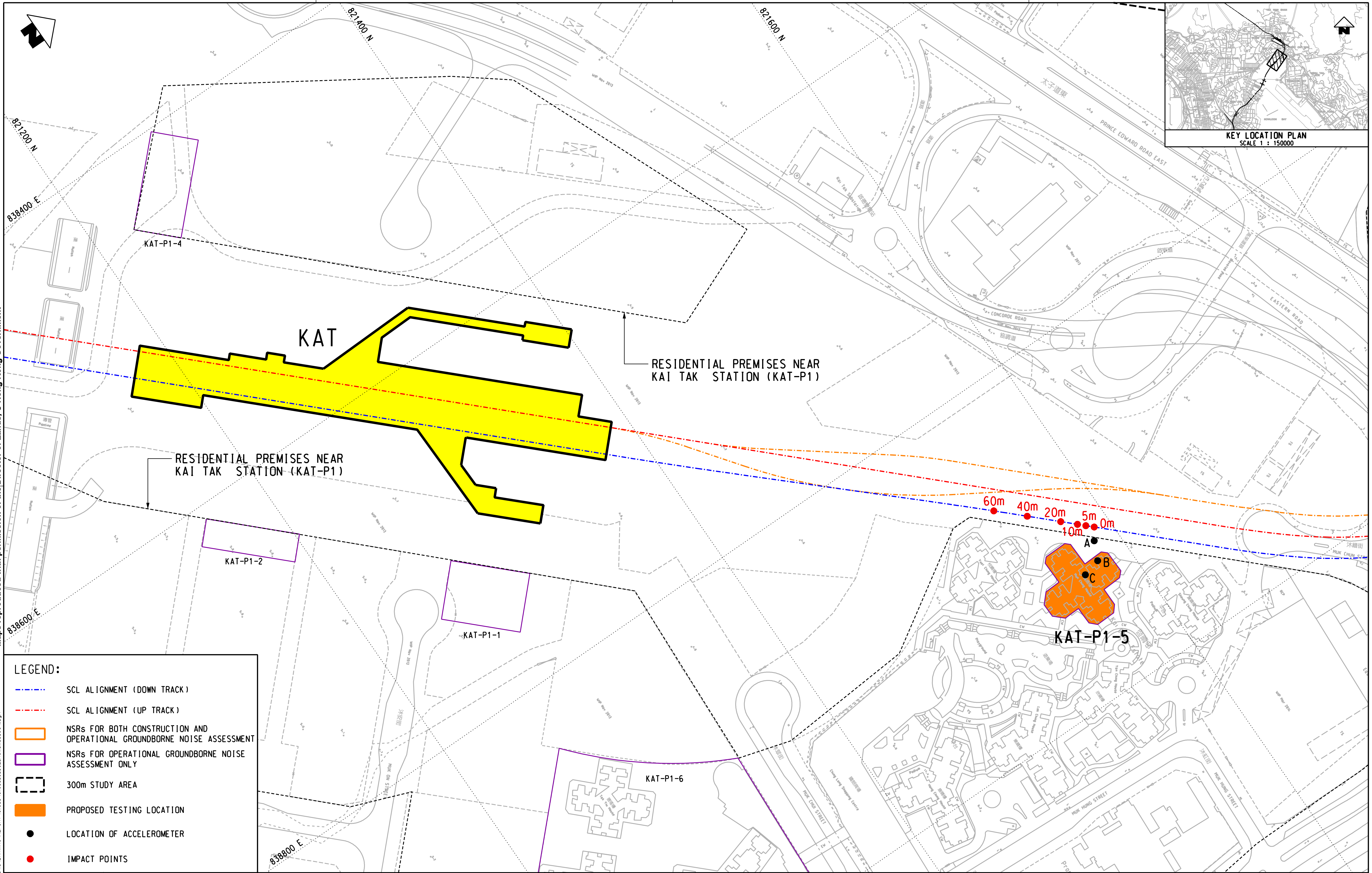
- Tunnel Coupling Loss (TCL) and Building Coupling Loss (BCL) – these factors depend on whether the tunnel and building (or building piles) are in rock or soft ground. Updated building information, if any, will be reviewed.
- Geological Profile – updated geological profile along the alignment, if any, will be reviewed.
- Speed – updated speed profile along the alignment, if any, will be reviewed.
- Turnout Adjustment – updated information, if any, on the type of turnouts to be used and the adjustment corresponding to corresponding type of turnouts will be reviewed.

4 CONCLUSION

4.1.1 The measurement of ground LSR values has been conducted at Kai Ching Estate, Mun Ching House (KAT-P1-5) to check the suitability of the LSR assumptions adopted in the EIA stage for soil ground type.

4.1.2 The measured LSR values result in ground-borne noise levels which are lower than the EIA values in soil at KAT-P1-5.

4.1.3 The assumptions adopted in the EIA Reports will be further reviewed and the ground-borne noise prediction for SCL(TAW-HUH) will be updated based on all measured LSR results where applicable in the Final OGNMMP and the latest available information.



DRAWN	XH
DESIGNED	LCLL
CHECKED	LCLL
APPROVED	IMW
DATE	01/03/2016

DO NOT SCALE DRAWINGS. ALL DIMENSIONS SHALL BE VERIFIED ON SITE.

MTR

SHATIN TO CENTRAL LINK

ORIGINATOR

AECOM

TITLE

C11033

SCL (TAW - HUH)

LOCATIONS OF MEASUREMENT POINTS AT NSR KAT-P1-5

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

CADD REF. C11033_C_SCL_ACM_M53_004.dgn

SCALE 1 : 2000 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/004

REV. -

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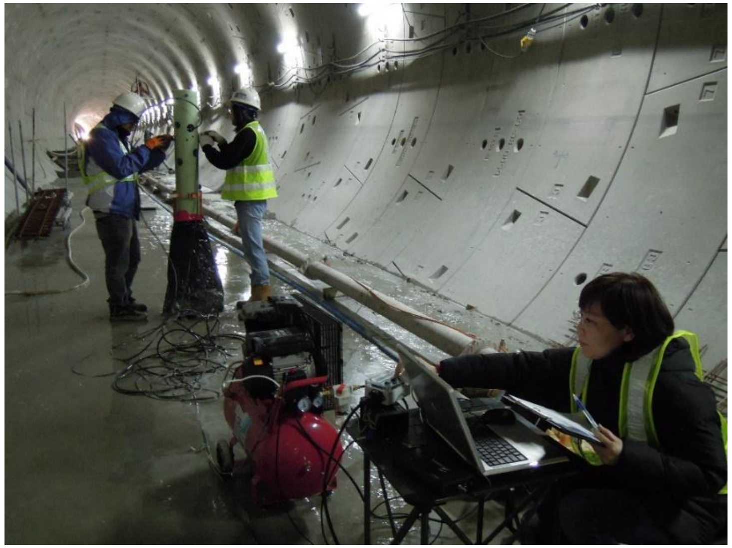
Appendix C

Photo records of Measurement at KAT-P1-5

Appendix C - Photo records of Tunnel Impact test at KAT-P1-5

Kai Ching Estate – Mun Ching House (KAT-P1-5)

Measurement Date: 1-2 Feb 2016
Measurement Time: 23:00-06:00 (Overnight)



Hammer Impact Test in the Tunnel

Point A
(Accelerometer on ground)

Point B
(Accelerometer on Outdoor Building Structure)

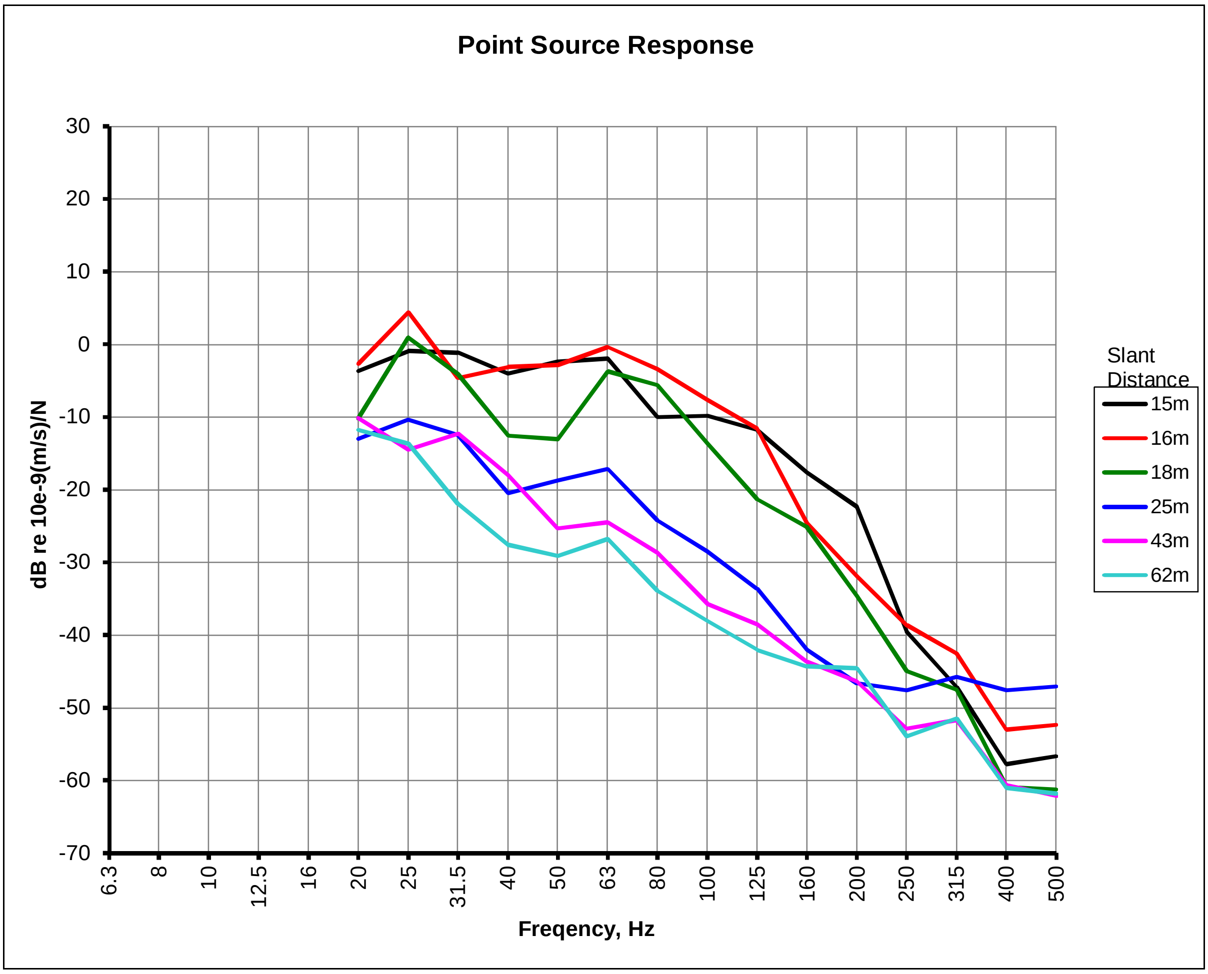
Appendix C - Photo records of Tunnel Impact test at KAT-P1-5

Point C
(Accelermeter on Indoor Building Ground Floor)

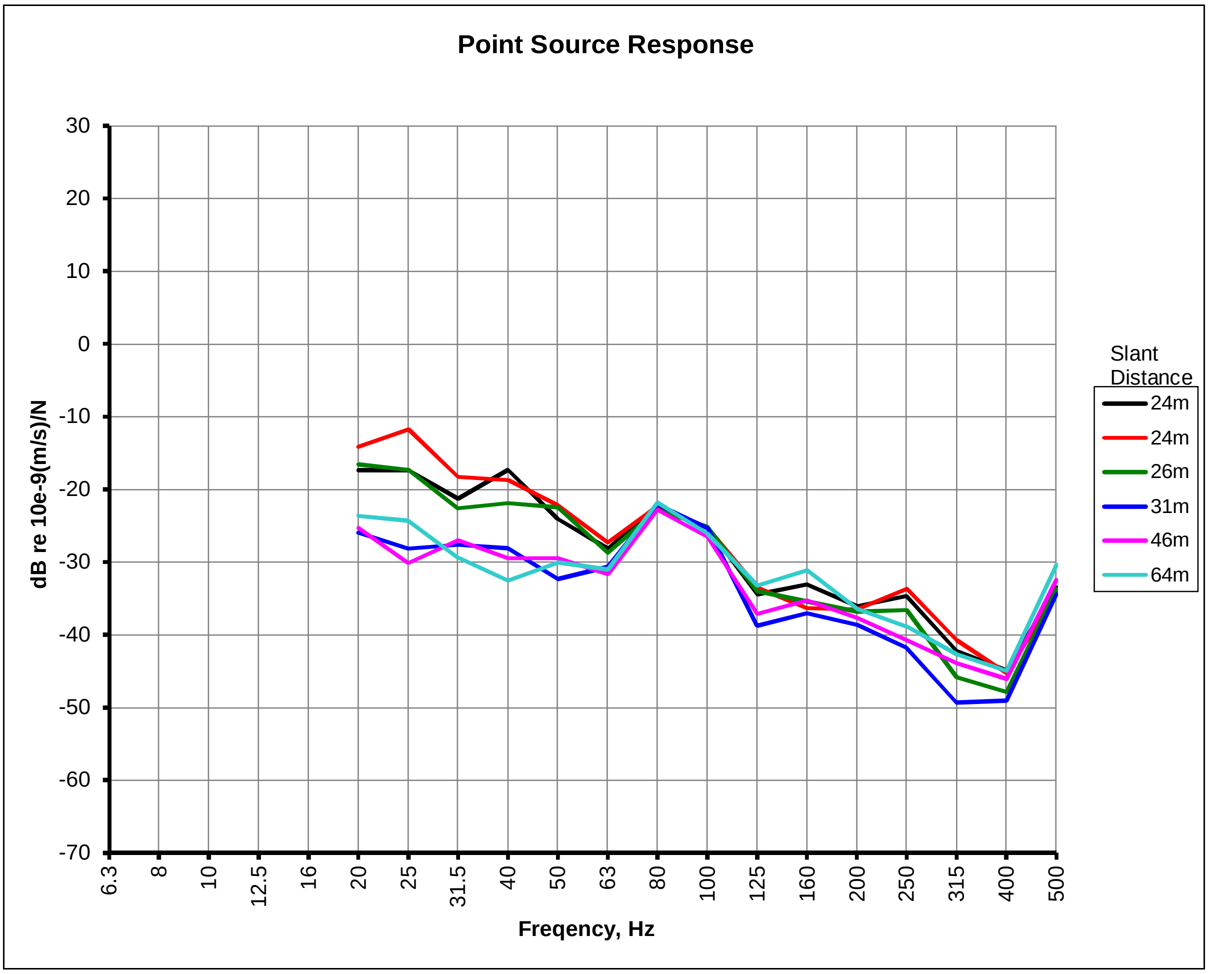
Appendix D

Measured Point Source Responses at KAT-P1-5

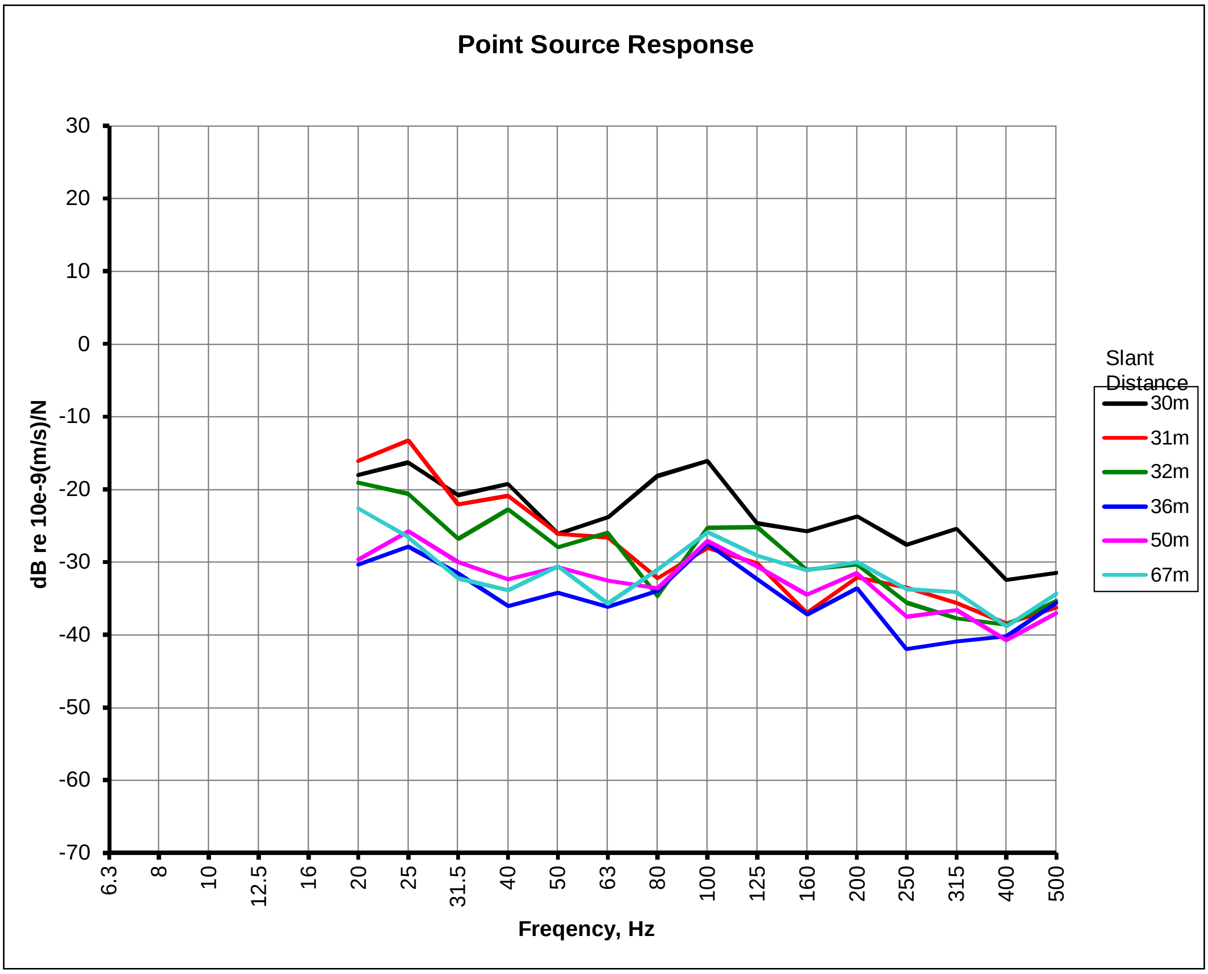
KAT-P1-5 Point A



KAT-P1-5 Point B



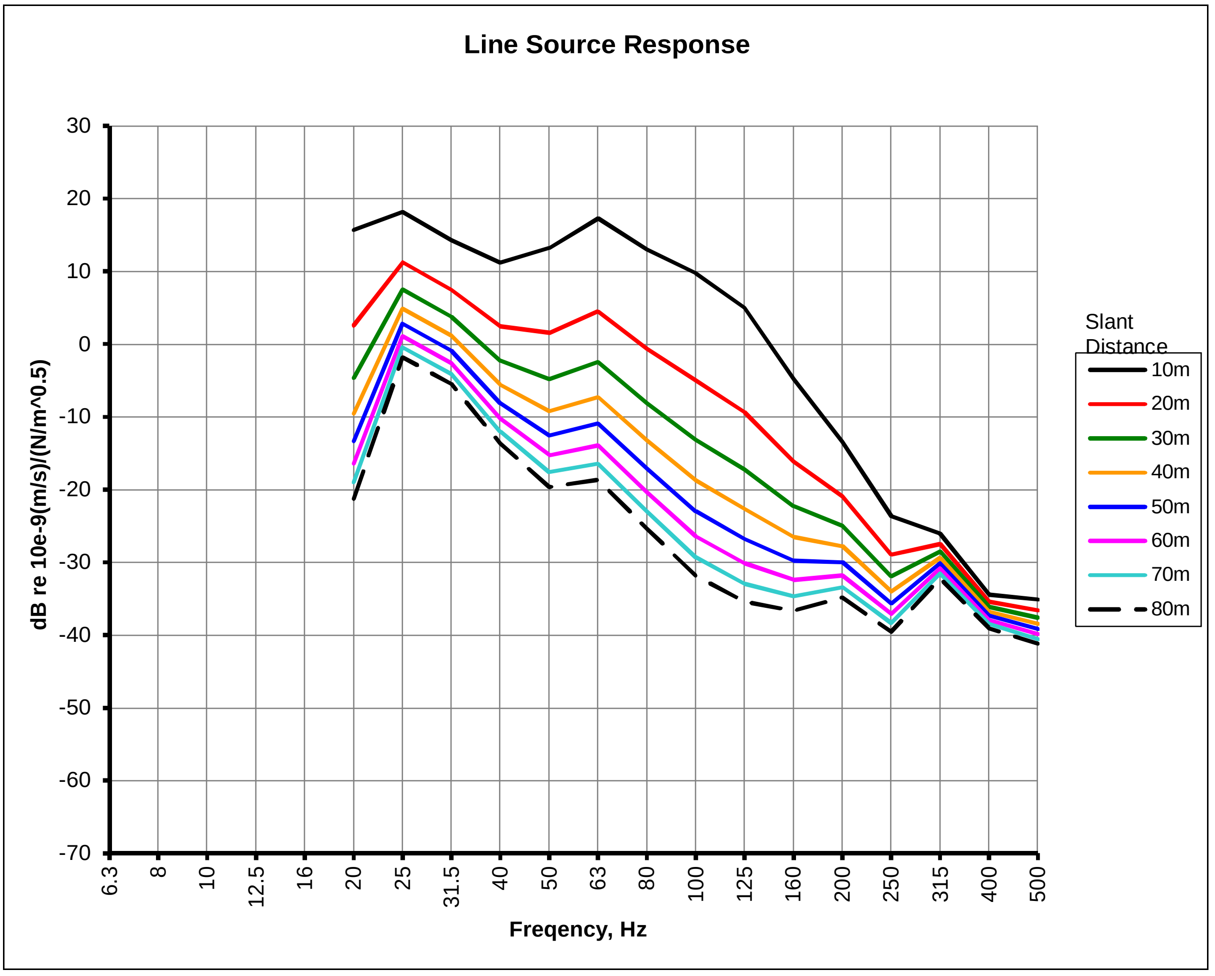
KAT-P1-5   Point C



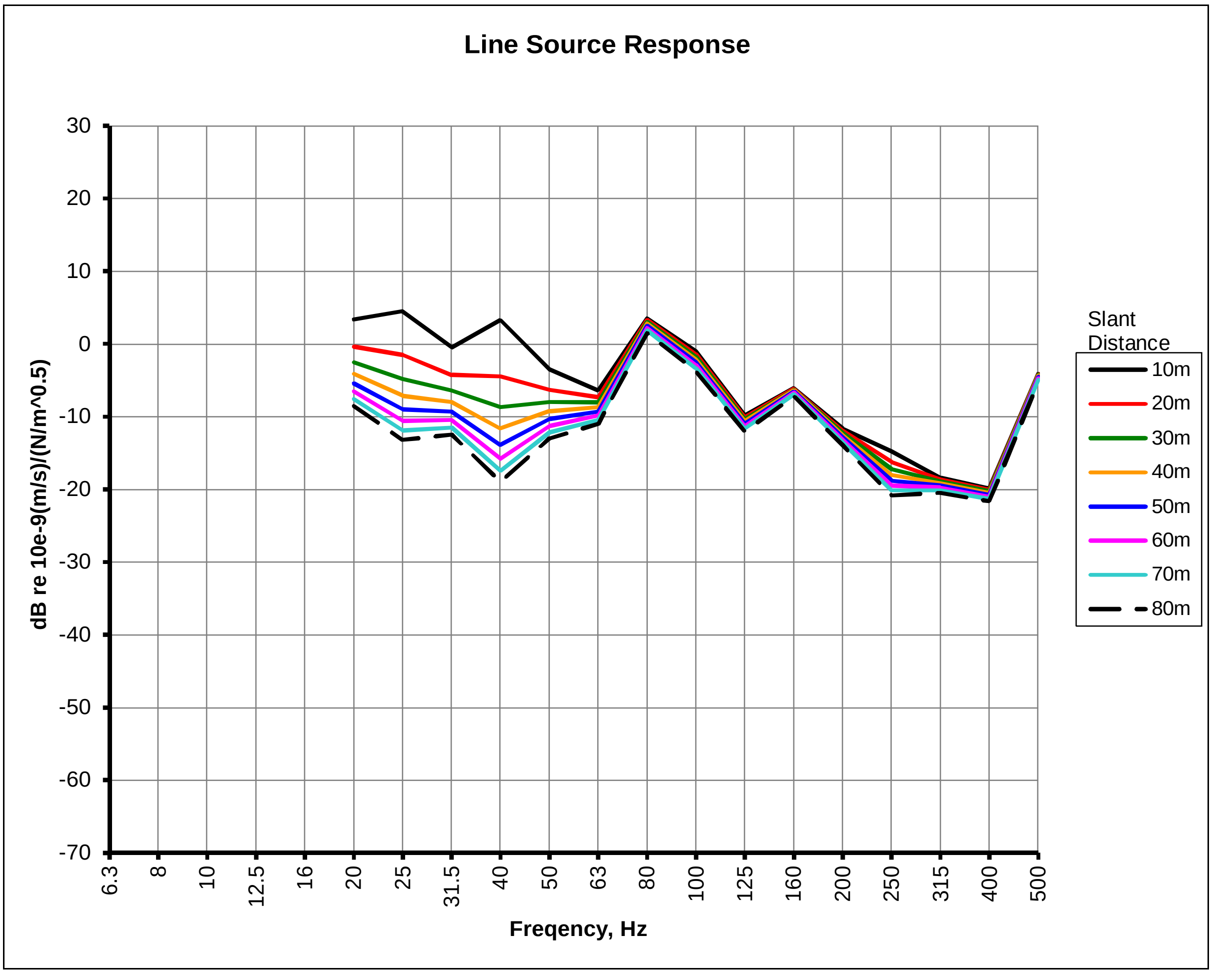
Appendix E

Determined Line Source Responses at KAT-P1-5

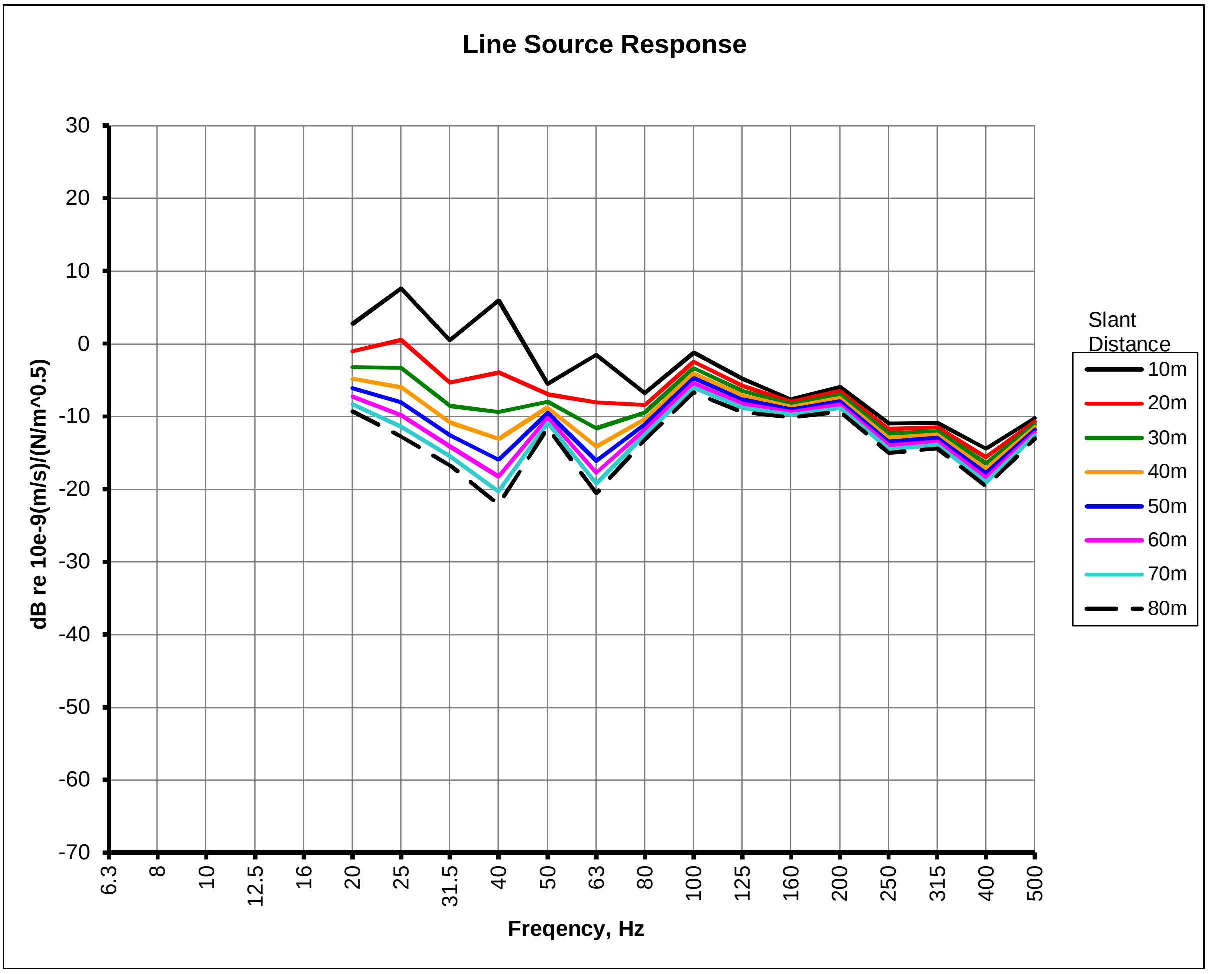
KAT-P1-5   Point A



KAT-P1-5 Point B



KAT-P1-5 Point C



Appendix F

Line Source Responses Adopted in SCL EIA (Appendix 9.5 of SCL(TAW-HUH) EIA Report

Appendix 9.5: Line Source Response Values Obtained from West Island Line EIA Study

Figure A LSR from WIL Borehole D002 (Rock Head Depth 24m, Hole Depth 20m)

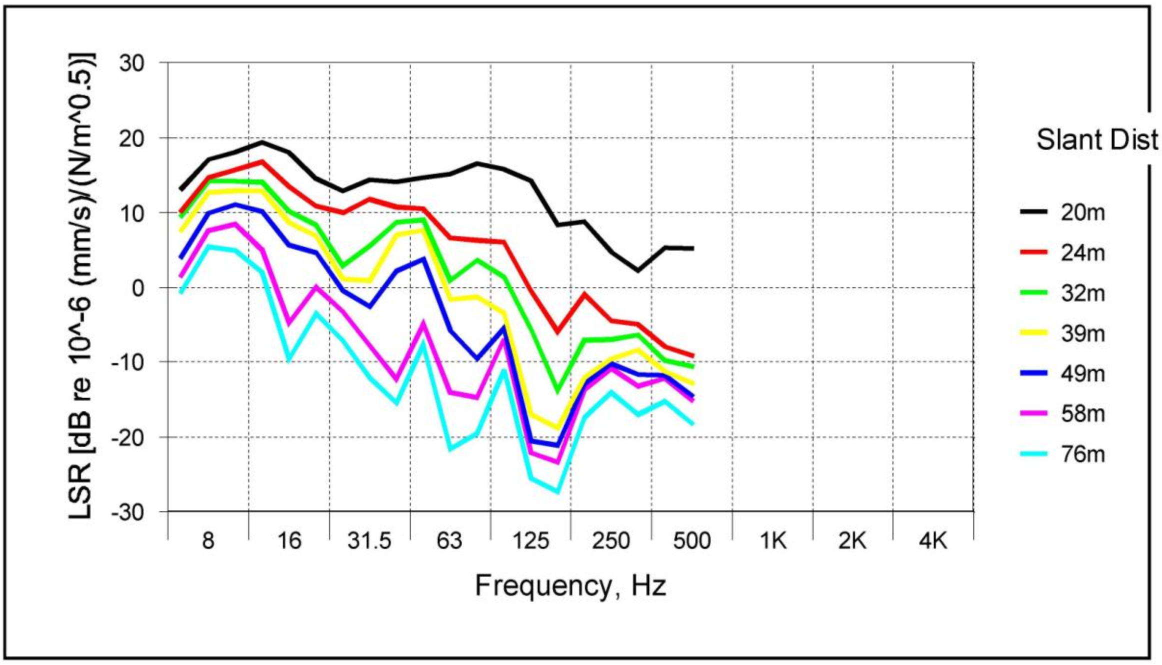


Figure B LSR from WIL Borehole D002 (Rock Head Depth 24m, Hole Depth 34m)

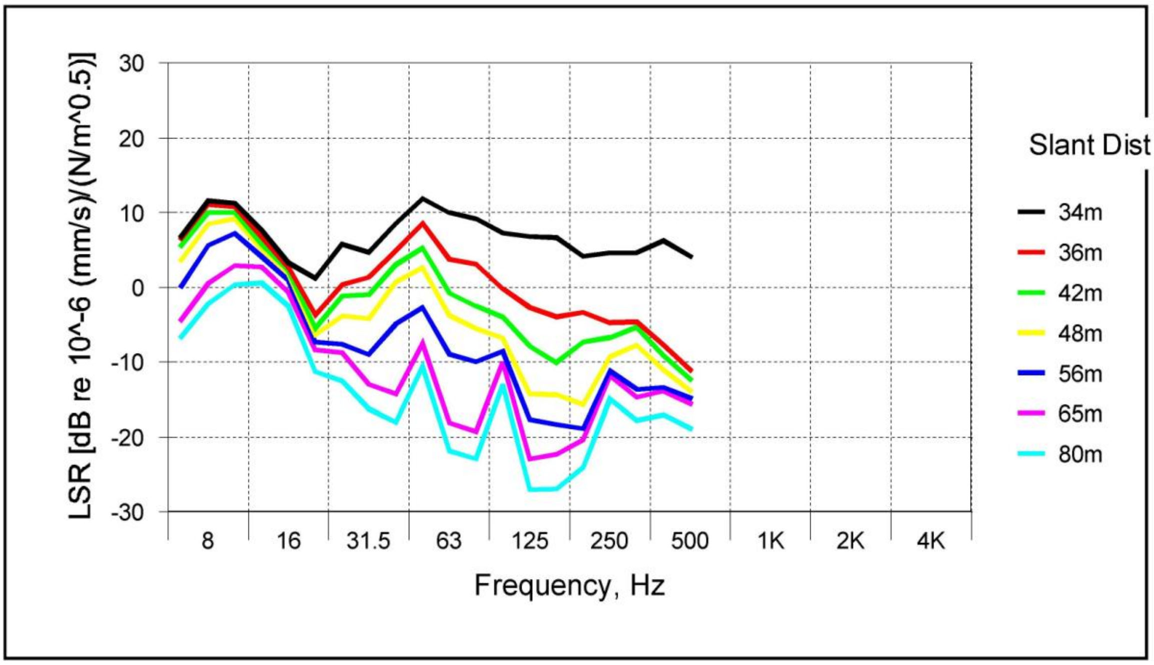


Figure C LSR from WIL Borehole D012 (Rock Head Depth 34m, Hole Depth 18m)

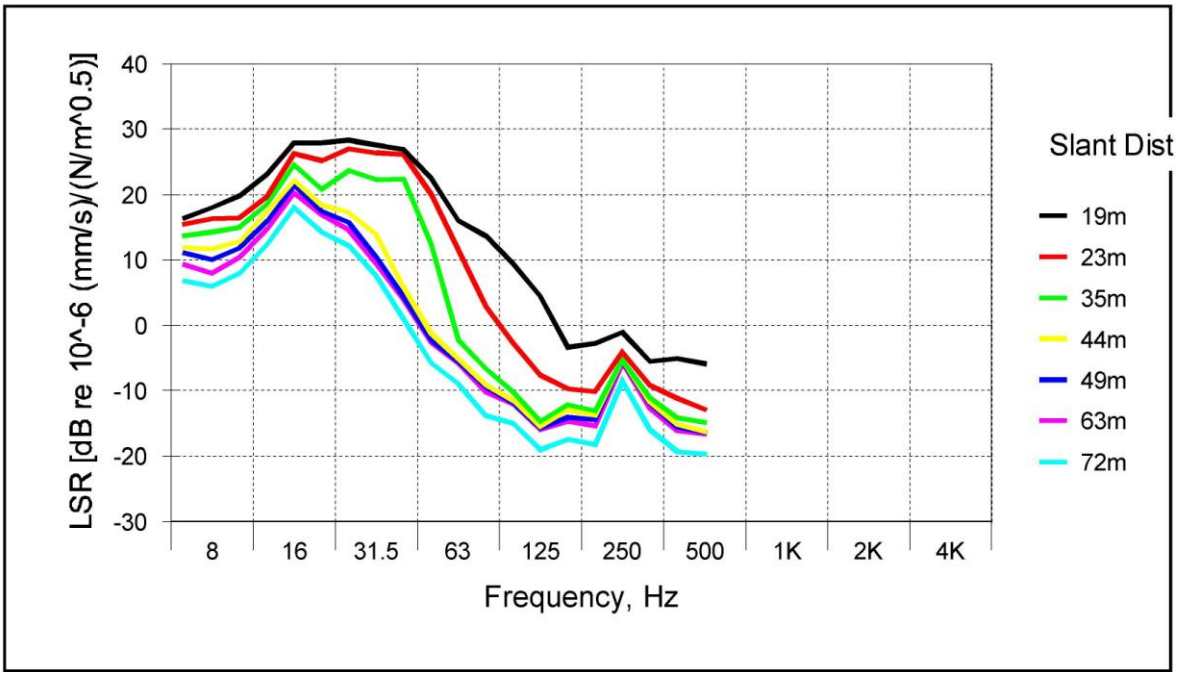


Figure D LSR from WIL Borehole D012 (Rock Head Depth 34m, Hole Depth 41m)

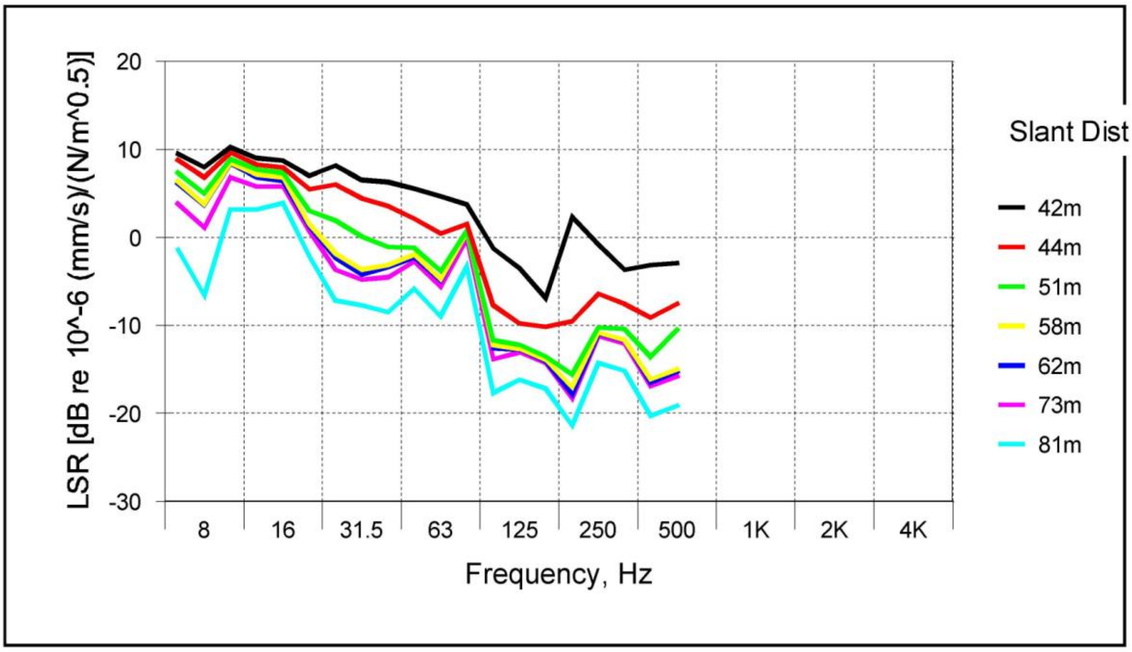


Figure E LSR from WIL Borehole D018 (Rock Head Depth 28m, Hole Depth 15m)

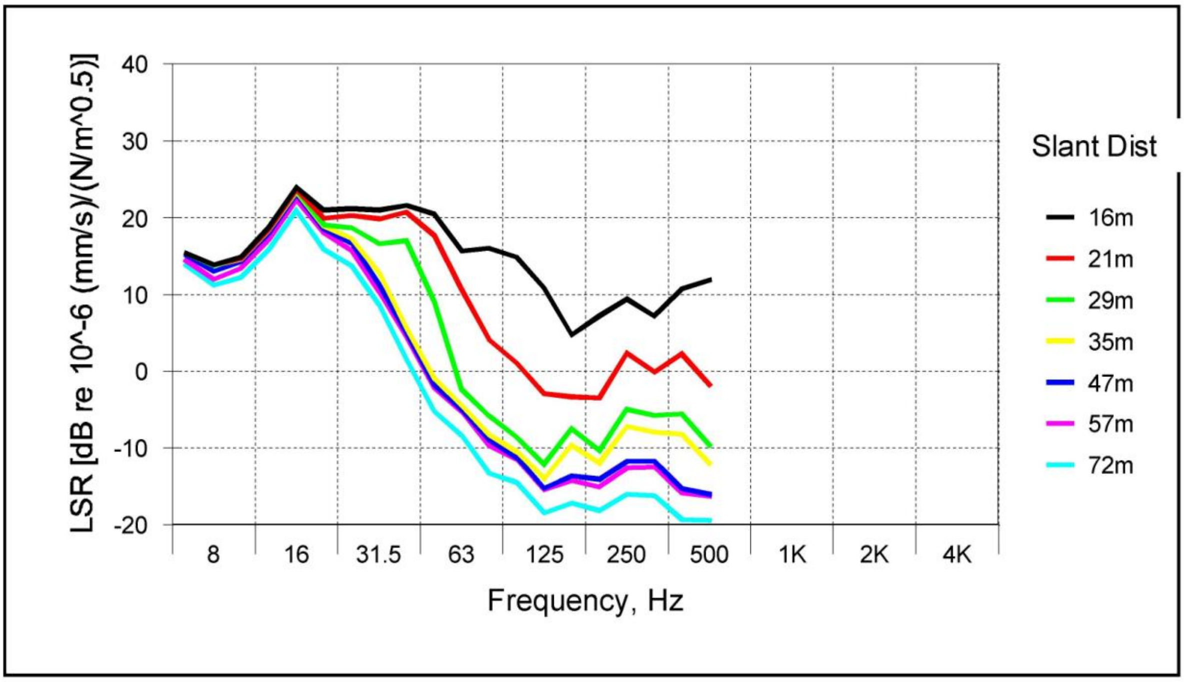


Figure F LSR from WIL Borehole D018 (Rock Head Depth 28m, Hole Depth 40m)

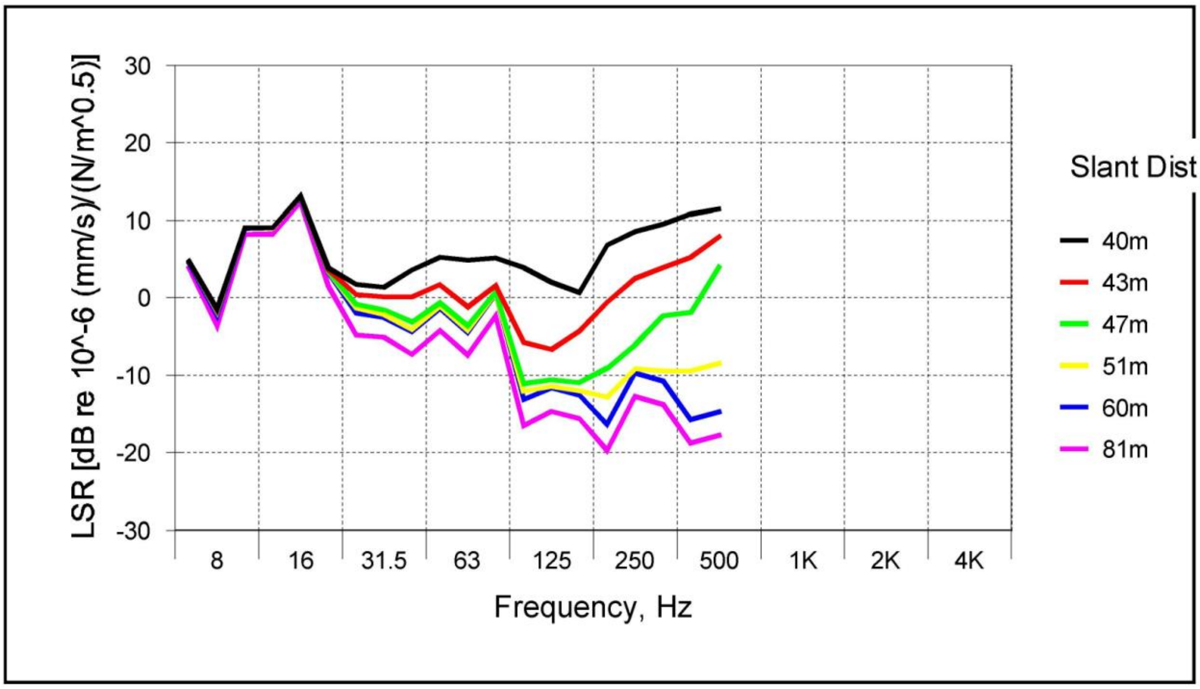
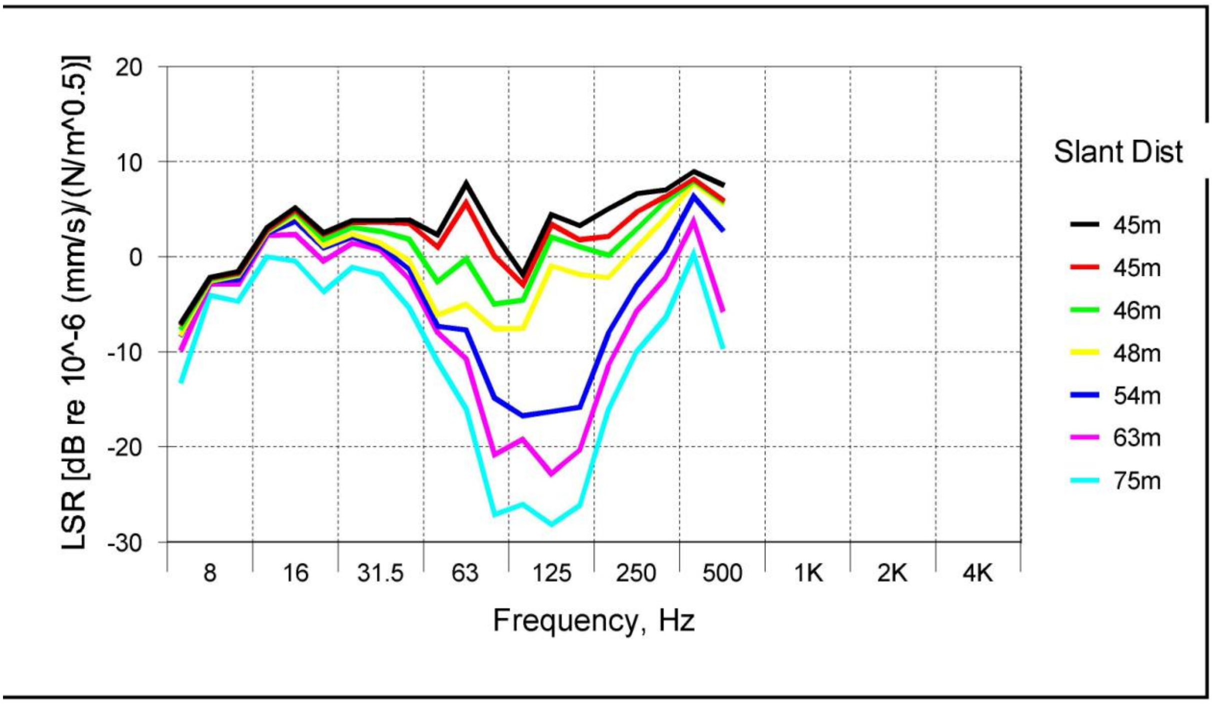


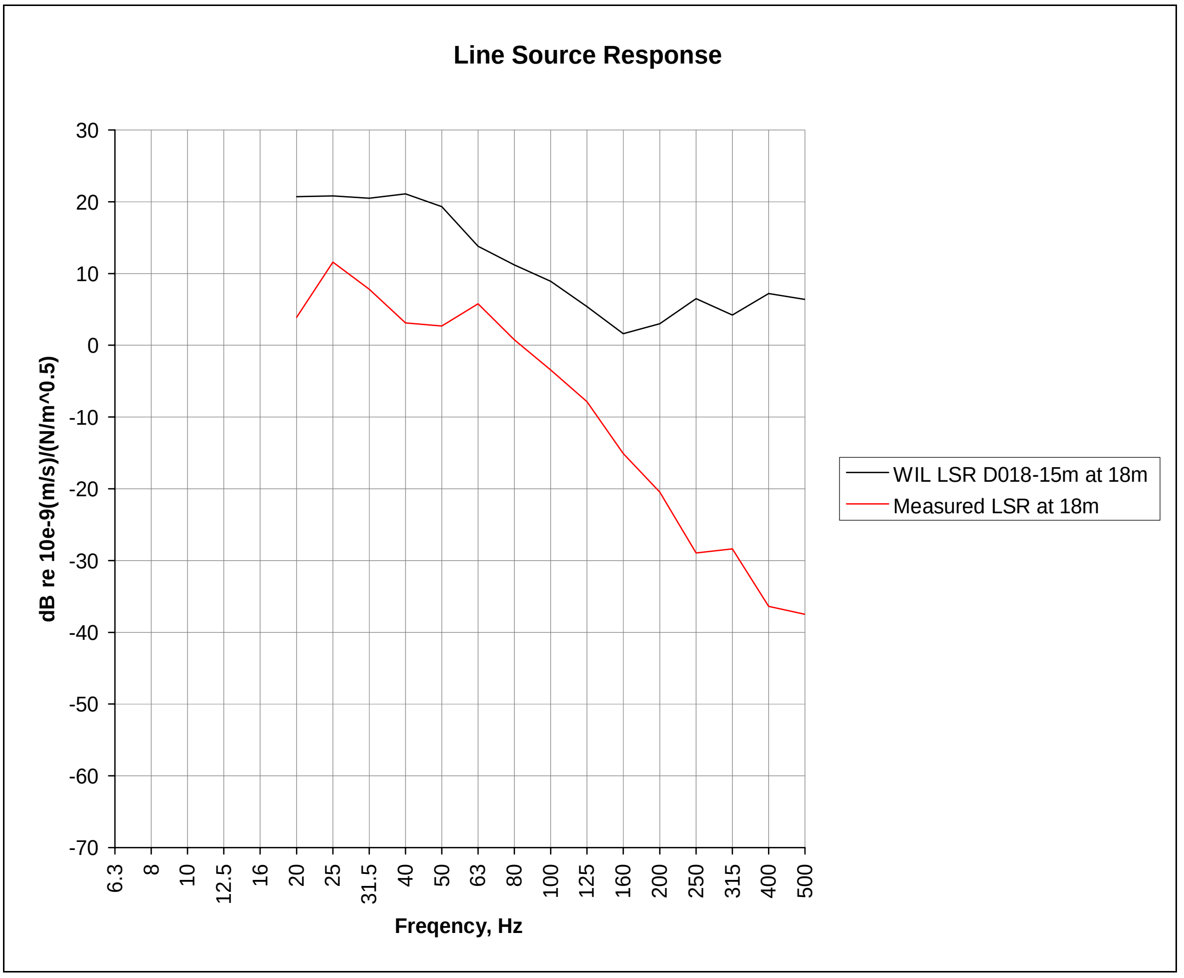
Figure G LSR from WIL Borehole D028 (Rock Head Depth 22m, Hole Depth 44m)

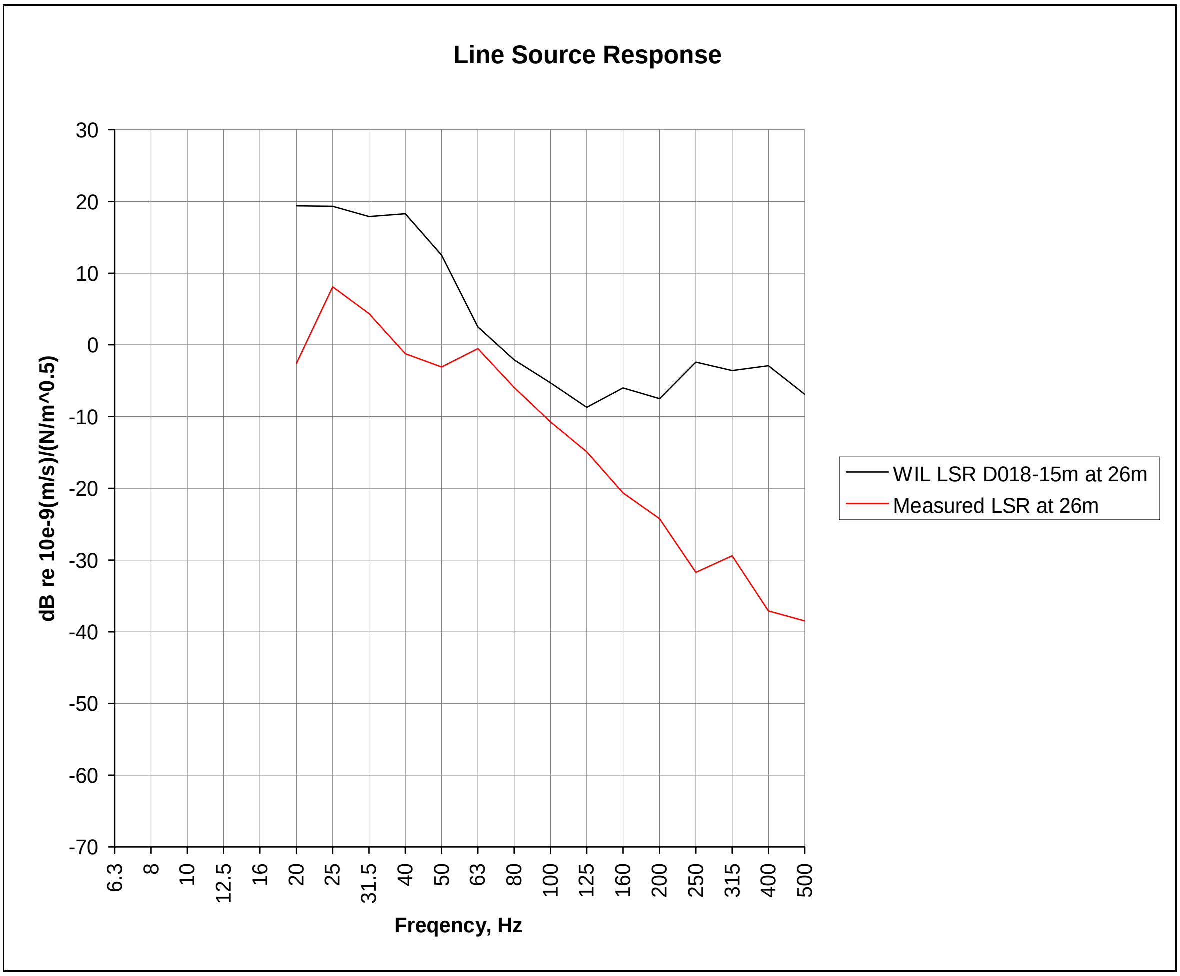


Appendix G

Comparison of Measured and EIA Line Source Responses

Comparison between the LSR adopted in the EIA and Measured LSR at KAT-P1-5




Line Source Response
dB re 10e-9(m/s)/(N/m^0.5)
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
6.3
8
10
12.5
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
Freqency, Hz
WIL LSR D018-15m at 26m
Measured LSR at 26m

Appendix H

Updated Calculations of Ground-borne Noise Prediction

KAT-P1-5 Updated EIA Calculation by Measured LSR

Project:	Shatin Central Link Rail Operational GBN Assessment		**Train Speed:**		60 kph
NSR Ref.:	KAT-P1-5		Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Location:	Residential premises near Kai Tak Station Site 1	Up Track	10	15	18
Assessed Floor	2	Down Track	20	17	26
Item:	49				

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			3.9	11.6	7.8	3.1	2.7	5.8	0.8	-3.5	-7.8	-15.1	-20.5	-28.9	-28.4	-36.4	-37.5
Up Track Vib. Level	dB re 10^{-6}in/sec			37.9	49.6	44.8	38.1	36.7	43.8	41.8	38.5	34.2	22.9	16.5	7.1	4.6	-2.4	-6.5
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-2.6	8.1	4.3	-1.2	-3.1	-0.5	-5.9	-10.7	-14.9	-20.6	-24.2	-31.7	-29.4	-37.1	-38.5
Down Track Vib. Level	dB re 10^{-6}in/sec			31.4	46.1	41.3	33.8	30.9	37.5	35.1	31.3	27.1	17.4	12.8	4.3	3.6	-3.1	-7.5
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				38.8	51.2	46.4	39.5	37.7	44.7	42.6	39.3	34.9	24.0	18.1	8.9	7.2	0.3	-4.0
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	1/3 Oct, dB	52.8	65.2	60.4	53.5	51.5	58.1	55.8	52.3	47.7	36.0	29.1	18.9	16.2	9.0	4.7
Predicted Noise Level	Oct, dB			66.7			60.7			53.7			29.7			10.7
L_{max}	dB(A)	39.5														
$L_{eq,30mins}$	dB(A)	28.3														
Noise Criteria	dB(A)	45														
Compliance		Yes														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the same or the next available smaller borehole depth. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

The following abbreviations are used in the above calculation:

L : Ground borne noise level within the structure
FDL : Force density level for the KCR SP1900 EMU
LSR : Unit force incoherent line source response for the ground
TIL : Trackform attenuation or insertion loss, relative level
TCF : Vibration coupling between the tunnel and the ground for soil based tunnels, relative level
BCF : Vibration coupling loss factor between the soil and the foundation, relative level
BVR : Building vibration reduction or amplification within a structure from the foundation to the occupied areas, relative level
CTN : Conversion from floor and wall vibration to noise
TOC : Turnout and Crossover Factor
SAF : Safety margin to account for wheel/rail condition and projection uncertainties

Remark:
(1) The slant distance in Table 2.1 of this Plan is the measured distance in the testing, while the horizontal and slant distances in this calculation are adopted from the previous EIA calculation for a like-to-like comparison in order to facilitate the comparison of the results between adoption of WIL LSR and the measured LSR. The distance values presented here are independent in Table 2.1.

Annex B2

Excerpt of Operational Ground-borne Noise Mitigation Measures Plan (Batch 2 – Kai Tak Planned Development) (June 2016)

MTR Corporation Limited

Shatin to Central Link –
Tai Wai to Hung Hom Section

Operational Ground-borne Noise Mitigation Measures Plan – Batch 2 (Version C)

(June 2016)

Verified by: Fredrick Leong

Position: Independent Environmental Checker

Date: 23 Jun. 2016

MTR Corporation Limited

Shatin to Central Link –
Tai Wai to Hung Hom Section

Operational Ground-borne Noise Mitigation Measures Plan – Batch 2 (Version C)

(June 2016)

Certified by: Richard Kwan [signature]

Position: Environmental Team Leader

Date: 23 Jun 2016

MTR Corporation Limited

Consultancy Agreement No. C11033

Shatin to Central Link - Tai Wai to Hung Hom Section [SCL(TAW – HUH)] and Stabling Sidings at Hung Hom Freight Yard [SCL(HHS)]

Operational Ground-borne Noise Mitigation Measures Plan (Batch 2 – Kai Tak Planned Development)

June 2016

	Name	Signature
Prepared & Checked:	Angela Tong	Angela
Reviewed & Approved:	pp. Josh Lam	Angela

Version:	C	Date:	22 Jun 2016

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Table of Content

List of Tables

List of Figures

Appendices

1 INTRODUCTION

1.1 Background

1.1.1 The Shatin to Central Link (SCL) is a 17km extension of the existing 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 Reports for SCL – Tai Wai to Hung Hom Section [SCL (TAW-HUH)] (Register No. AEIAR-167/2012) and SCL Stabling Sidings at Hung Hom Freight Yard [SCL (HHS)] (Register No. AEIAR-164/2012) were approved on 17 February 2012 under the *Environmental Impact Assessment Ordinance (*EIAO). Following the approval of the EIA Reports, the Environmental Permit (EP) (EP No: EP-438/2012), covering the construction of both SCL (TAW-HUH) and SCL (HHS), was granted on 22 March 2012. Variations of Environmental Permit (VEP) were subsequently applied for EP-438/2012 and the latest Environmental Permit (EP No: EP-438/2012/J) was issued by Director of Environmental Protection (DEP) on 29 February 2016.

1.1.3 Pursuant to EP Condition 2.27, the Permit Holder, MTR Corporation Ltd (MTR), shall deposit with the Director of Environmental Protection (DEP), no later than one month after completion of corresponding parts of the tunnel excavation of the SCL(TAW-HUH) Section (hereinafter referred to as “the Project”), an Operational Ground-borne Noise Mitigation Measures Plan (OGNMMP) to justify the adequacy of the operational ground-borne noise mitigation measures for the Project. The OGNMMP shall include the review and verification of the assumptions adopted in the approved SCL(TAW-HUH) EIA Report (Register No. AEIAR-167/2012) and SCL(HHS) EIA Report (Register No. AEIAR-164/2012), such as line source response (LSR) and ground vibration conditions, and shall also include justifications and recommendations for any contingency noise mitigation measures found necessary, including but not limited to resilient baseplates (type 1) and isolated slab track (type 4).

1.1.4 Since the tunnel excavation of the Project will be completed in different phases, testing on the LSR and ground vibration conditions will be conducted in phases according to the excavation programme.

1.1.5 The prediction methodology recommended by the FTA Manual[1] was adopted in the EIA studies and most of correction factors are based on the international guideline except LSR of which values are site specific and are subject to the ground materials, depth of the tunnel and the rock head. During the EIA stage, in situ line source response measurement was not conducted. As part of the review and verification of the assumptions adopted in the ground-borne railway noise impact assessment, it is proposed that line source response and ground vibration conditions will be reviewed and verified by the on-site measurement.

1.1.6 AECOM Asia Co. Ltd has been commissioned by the MTR to conduct the LSR test according to the Testing and Review Methodology Plan (T&RMP) (**Appendix A**). According to the T&RMP, the LSR test will be conducted at Upper Wong Tai Sin Estate - Wing Sin House (DIH-P1-1), Kai Ching Estate – Mun Ching House (KAT-P1-5), Residential Premises near KAT (KAT-P1-7) and Lee Wing Bldg (HOM-2-2). The first impact test was conducted at Mun Ching House on 1 and 2 February 2016, and the second impact test was conducted at the planned residential development near KAT on 15 April 2016.

(1) Federal Transit Administration of U.S. Department of Transportation “Transit Noise and Vibration Impact Assessment ”, 2006

1.2 Purpose of This OGNMMP

1.2.1 This OGNMMP (Batch 2) presents the LSR analysis based on the results of the impact test conducted at Residential Premises near KAT (KAT-P1-7) and the operational ground-borne noise prediction at KAT-P1-7 based on measurement results.

1.3 Report Structure

1.3.1 This Test Proposal comprises the following sections:

- Section 1 presents the background information.
- Section 2 describes the details of impact test and the prediction of LSR based on the measurement results.
- Section 3 presents the LSR analysis and operational ground-borne noise prediction results.
- Section 4 presents the conclusion.

2 IMPACT TESTING AND PREDICTION OF LSR

2.1 Testing Location

2.1.1 The second impact test was conducted at Residential Premises near KAT (KAT-P1-7) on 15 April 2016. The information of the measurement location at the selected NSR are summarised in **Table 2.1** and the testing locations are shown in **Figure C11033/C/SCL/ACM/M53/005**.

Table 2.1 Measurement and Testing Location

NSR		Predicted Night-time Ground-borne Noise Levels in the EIA Report, dB(A)	Measurement Location[(2)]		Ground Type	Location of Hammer Impact Test (Approx. Tunnel Depth)	Testing Date
ID	Description		Approx. Hori. Distance from the Tunnel, m	Approx. Slant Distance (From Ground Level to Track Level), m			
KAT-P1-7[(1)]	Residential premises near Kai Tak Station	45	0 (up track) 0 (down track)	18	Mixed rock	Down Track Tunnel (-13mPD)	15 April 2016

Note:
(1) KAT-P1-7 is a planned NSR during EIA stage. Assumptions were made on the vertical distance from tunnels (i.e. 15m from up track and 17m from down track) and noise levels were predicted based on this assumption.
(2) Measurement location at the selected NSR is shown in **Figure C11033/C/SCL/ACM/M53/005**.

2.2 Testing Instrumentations

2.2.1 The impact force levels applied within the tunnel were measured using a SINUS Harmonie connected to a laptop computer and vibration velocity levels on the ground were measured using a Brüel & Kjær PULSE connected to a laptop computer. Wilcoxon seismic accelerometers were used on the ground surface. Details of the instruments used are provided in **Table 2.2** and the calibration records of the instruments are provided in **Appendix B**.

Table 2.2 Instrumentation of the Hammer Impact Test

Instrument	Manufacturer / Model No.	Purpose
Pneumatic Hammer and Air Compressor	WM model 3.5	Connection to 2-hp air compressor to induce force (impact) at about 100kN
Impact Controller	WM type 1	Connection to pneumatic hammer to control impact on/ off
Analyzer Platform	Brüel & Kjær PULSE; Sinus Harmonie	Spectrum analyzers for data acquisition
Accelerometer	Wilcoxon Research 731-207 and 731A-P31	Vibration transducers to measure vibration
Force transducer	PCB 200M200	Fitted to pneumatic hammer to measure impact force

2.3 Testing and Measurement Procedures

2.3.1 The testing and measurement procedures are summarised below:

- The test was carried out during night time when background vibration levels are low. All construction works inside tunnel and the adjacent tunnel were suspended during the testing.

- The impact hammer hit on the tunnel invert and it applied measured impact forces within the tunnel. The measured impact forces were logged by the FFT spectrum analyzer. For each location of accelerometer, impact point was applied minimum 10 hits at around 100kN(2) on the concrete invert.
- Meanwhile, accelerometers fixed on the spikes inserted onto the soil of the ground at different horizontal distances (0m, 5m, 10m, 15m, 20m, 25m, 30m and 35m) from the impact point. Site photos taken during the measurement are shown in **Appendix C**.
- The impact force in tunnel and the vibration levels on the ground were recorded by the two separated spectrum analyzers. Measurement signals were recorded in narrow band frequencies from 6.3Hz to 500Hz.
- The furthest measurement point on the ground was made up to 35m horizontal distance from the impact point. Reading also indicated that the responses of impact signals at 30m horizontal distance were weak and cannot be identified. Hence the impact signals at further distances over 30m would be much lower which are insignificant to the overall result, and testing on the measurement point over 35m from the impact point were not executed.

2.4 Prediction of Line Source Response

2.4.1 The vibration response induced by a unit point source impact was obtained from the hammer impact test and the best fit curves were calculated to determine the LSR at NSR KAT-P1-7 Residential Premises near KAT (mixed rock type ground property referring to the geological profile) along the SCL alignment.

2.4.2 The post-processing of measurement data was taken to determine the best fit curves of PSR with respect to the setback distances, and the depth between the impact source and the receivers. The LSR [TM_{line}, dB re $1e^{-9}$ (m/s)/(N/m$^{0.5}$)] is then determined by numerical integration with the formula(3) as shown below, of the Point Source Response (PSR, TM_{pi}) along the length of the train centred on the receiver, while PSR is determined from impacting within the tunnel.

$$TM_{\text{line}} = 10 \times \log 10 \left[h \times \left(\frac{10^{\frac{TMpi}{10}}}{2} + 10^{\frac{TMp2}{10}} + \cdots + 10^{\frac{TMpn-1}{10}} + \frac{10^{\frac{TMpn}{10}}}{2} \right) \right]$$

Where

H	=	Reciver interval (m) (interval varying from 5m to 40m)
TMpi	=	Point source transfer mobility for ith receiver location (dB re 1e-9 (m/s)/N)
n	=	Last receiver location

2.4.3 The calculation of LSR follows the calculation outlined in paragraph 11.3.2 Analysis of Transfer Mobility Data in FTA Manual(4). The measured PSR and the determined LSR are presented in **Appendices D** and **E** respectively.

(2) As mentioned in T&RMP, 400kN is only the design force of the impact machine and the actual output force in fact depends on the machine status and on-site condition.
(3) Federal Railroad Administration of U.S. Department of Transportation "High-Speed Ground Transportation Noise and Vibration Impact Assessment", 2012
(4) Federal Transit Administration of U.S. Department of Transportation "Transit Noise and Vibration Impact Assessment ", 2006

3 REVIEW OF OPERATIONAL GROUND-BORNE NOISE PREDICTION

3.1 LSR Adopted in the Approved EIA Report

3.1.1 The LSR determines the vibration levels or attenuation in the ground as a function of distance caused by an incoherent line source of unit force point impacts.

3.1.2 The LSR values adopted in ground-borne noise assessment of SCL (TAW-HUH) and SCL (HHS) EIA Report were referenced from the data of the West Island Line (WIL) EIA Study (EIA Register No. AEIAR-126/2008). The LSR for WIL EIA Study were determined based on the results of borehole impact tests performed in rock, soil and close to the rock head both on the soil side and the rock side, with receiver vibration data taken on surface at various setback distances.

3.2 Review of LSR Values

3.2.1 The test carried out at the planned Residential Premises near KAT (KAT-P1-7) was specifically aimed at determining the LSR values for vibration propagating through the ground of mixed rock type.

3.2.2 The LSR values determined at planned Residential Premises near KAT (KAT-P1-7) are compared with those used in the SCL EIA study for the same area and the same ground conditions (i.e. WIL D018 Rockhead Depth=28m Hole Depth=15m Slant Distance=15m & 17m). The EIA LSR values are now shown in **Appendix F**. To allow a better comparison, **Appendix G** shows the LSR value determined at measurement locations at a distance similar to EIA study. A summary of observation is presented in **Table 3.1**.

Table 3.1 Comparison between Measurement Data and WIL Data

ID	Location	LSR data adopted in EIA Study	Observation
KAT-P1-7	Planned Residential Premises near KAT	WIL D018 Rockhead Depth=28m Hole Depth=15m Slant Distance=15m & 17m	Measured LSR values(1) at both 15m and 17m are at least 8dB lower than the EIA LSR values in all frequency bands.

Note:
(1) The maximum difference of the measured PSR value at the nearest point (i.e. 18m slant distance) and the furthest point (i.e. 39m slant distance) is about 15dB as presented in **Appendix D**. Since the LSR results are obtained based on integration of all the measured PSR values at different distances, the PSR values at nearest distance, which are at least 10dB higher, would dominates the LSR results while the lower PSR at the further distance would be insignificant to the LSR results. Thus the PSR values further away than 35m horizontal distance do not affect the overall LSR results.

3.2.3 It should be noted that the WIL EIA LSR was measured in the borehole while the current test was measured inside the tunnel. The decoupling effect of vibration propagation between the media of tunnel structure and the ground soil, i.e. the tunnel coupling loss (TCL), would be different to that between the media of borehole casing and the ground soil. Thus the LSR result measured in the impact test should comprise the loss due to decoupling of the actual tunnel structure. The factor of tunnel coupling loss applied in the EIA prediction for station structure in NSR KAT-P1-7 was 5dB. Therefore, apart from different testing method and geological profile at WIL D018 and KAT-P1-7, such 5dB tunnel coupling loss also accounts for difference between the EIA LSR and measured LSR.

3.3 Operational Ground-borne Noise Prediction

3.3.1 Ground-borne noise assessment at KAT-P1-7 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 Reports. The prediction results are summarised in **Table 3.2**. Sample calculation is given in **Appendix H**.

Table 3.2 Ground-borne Noise Prediction Results

Location	GBNSR	Description	EIA Prediction (unmitigated scenario), dB(A)		New Prediction (unmitigated scenario, based on measured LSR data), dB(A)		Criterion, dB(A)		Difference Between EIA and New Prediction, dB(A)
Kai Tak	KAT-P1-7	Residential Premises near KAT	Lmax	57	Lmax	52	Lmax	-	-
			Daytime $L_{eq,30min}$	48	Daytime $L_{eq,30min}$	42	Daytime $L_{eq,30min}$	55	-6
			Night-time $L_{eq,30min}$	45	Night-time $L_{eq,30min}$	39	Night-time $L_{eq,30min}$	45	-6

3.3.2 As mentioned in **Section 3.2.3**, the measured LSR comprises of tunnel couple loss which is about 5dB as adopted in the EIA prediction. The updated calculation therefore excluded the tunnel coupling loss in the calculation to avoid double count of the effect.

3.3.3 Results indicate that the measured LSR values at actual soil would give lower ground-borne noise levels than EIA prediction which also below the noise criteria.

3.3.4 The preliminary update of prediction calculation shows no further mitigation measures such as trackform upgrade is required around the NSR KAT-P1-7.

3.4 Review of Other Assumptions

3.4.1 The following assumptions adopted in the EIA Reports will be reviewed and the ground-borne noise prediction for SCL(TAW-HUH) will be updated based on all measured LSR results where applicable in the Final OGNMMP and the latest available information:

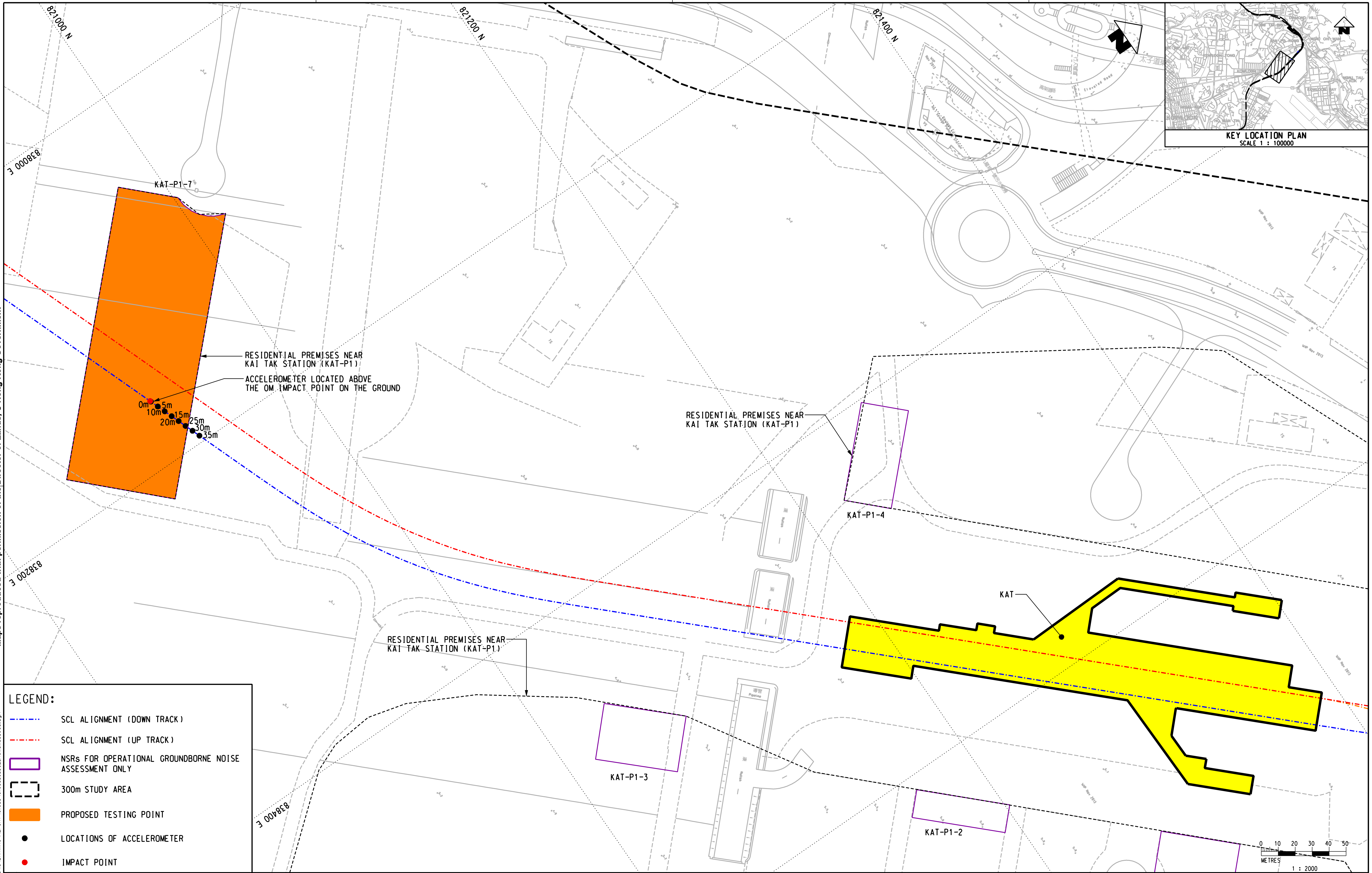
- Tunnel Coupling Loss (TCL) and Building Coupling Loss (BCL) – these factors depend on whether the tunnel and building (or building piles) are in rock or soft ground. Updated building information, if any, will be reviewed.
- Geological Profile – updated geological profile along the alignment, if any, will be reviewed.
- Speed – updated speed profile along the alignment, if any, will be reviewed.
- Turnout Adjustment – updated information, if any, on the type of turnouts to be used and the adjustment corresponding to corresponding type of turnouts will be reviewed.

4 CONCLUSION

4.1.1 The measurement of ground LSR values has been conducted at Residential Premises near KAT (KAT-P1-7) to check the suitability of the LSR assumptions adopted in the EIA stage for mixed rock ground type.

4.1.2 The measured LSR values result in ground-borne noise levels which are lower than the EIA values in soil at KAT-P1-7.

4.1.3 The assumptions adopted in the EIA Reports will be further reviewed and the ground-borne noise prediction for SCL(TAW-HUH) will be updated based on all measured LSR results where applicable in the Final OGNMMP and the latest available information.



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REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

DRAWN	ZFX
DESIGNED	LCLL
CHECKED	LCLL
APPROVED	IMW
DATE	20/APR/2016

MTR

SHATIN TO CENTRAL LINK

ORIGINATOR

AECOM

CADD REF. C11033_C_SCL_ACM_M53_005.dgn

TITLE

C11033

SCL (TAW - HUH)

LOCATIONS OF MEASUREMENT POINTS AT NSR KAT-P1-7

SCALE 1 : 2000 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/005

REV. -

Appendix C

Photo records of Measurement at KAT-P1-7

Appendix C - Photo records of Tunnel Impact test at KAT-P1-7

Residential Premises near KAT (KAT-P1-7)

Measurement Date: 15 April 2016
Measurement Time: 19:00-24:00

Hammer Impact Test in the Tunnel

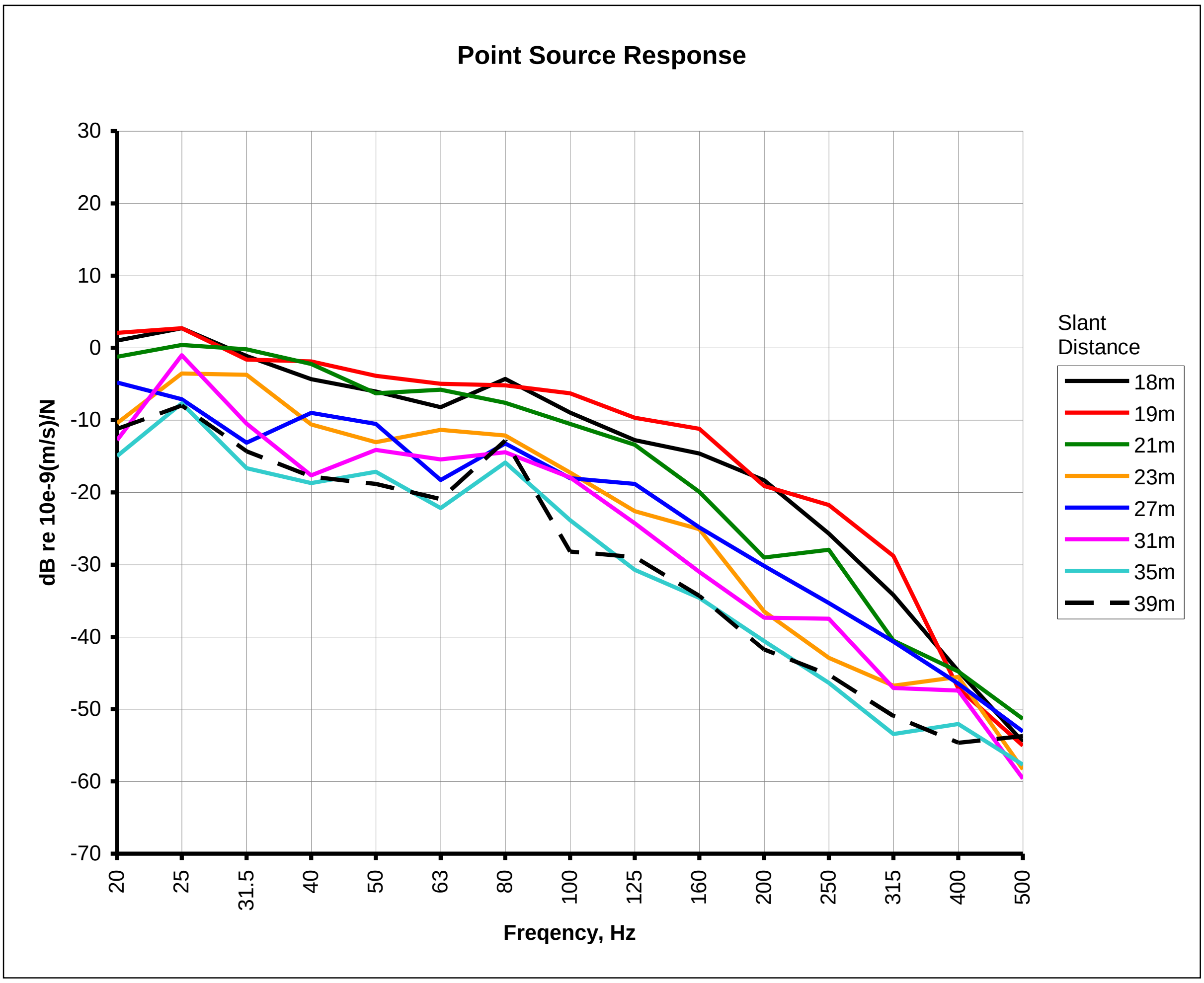
Spike for Setting Accelerometer on ground

Accelerometer on ground

Appendix D

Measured Point Source Responses at KAT-P1-7

KAT-P1-7

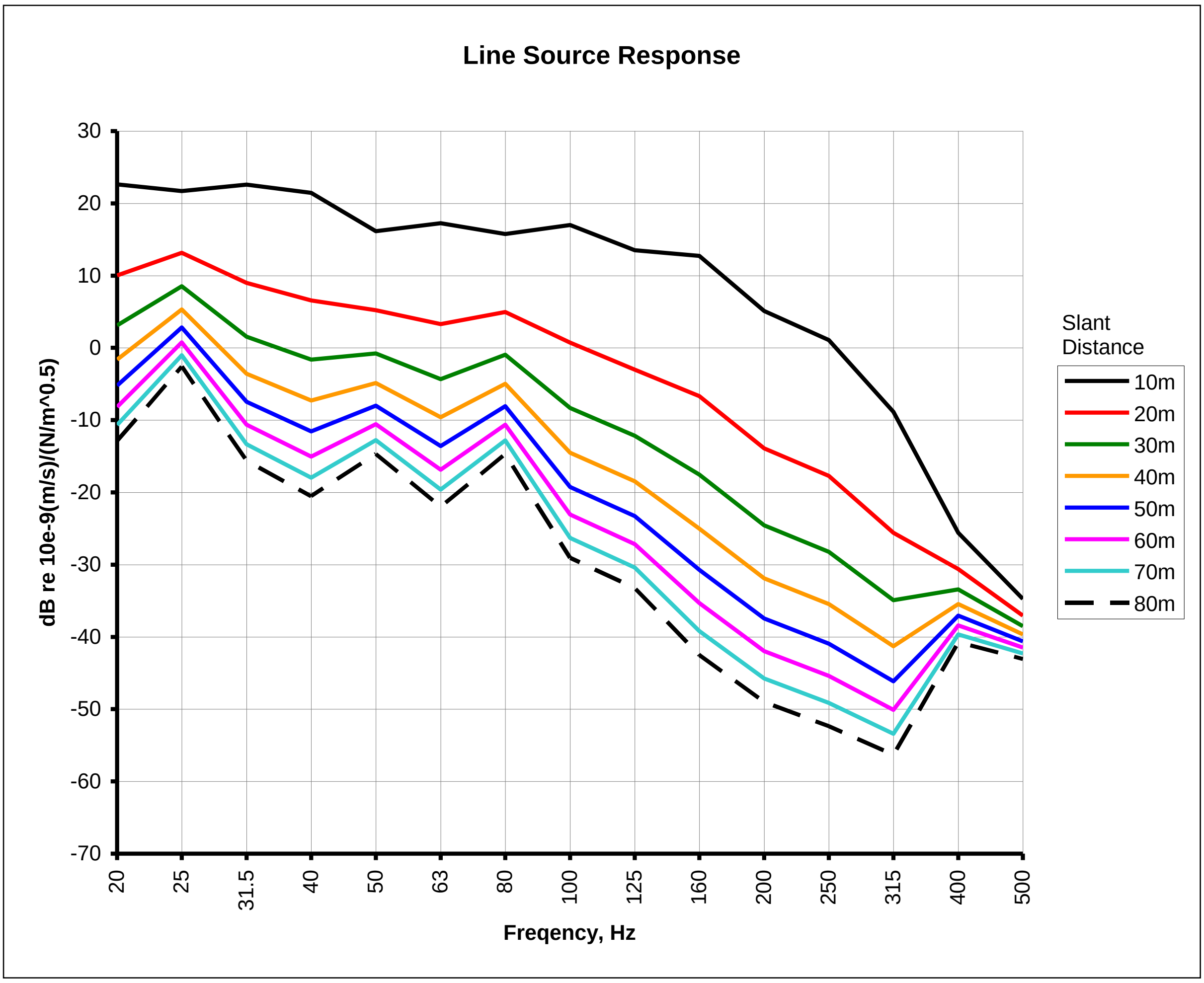


Point Source Response
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
dB re 10e-9(m/s)/N
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
Freqency, Hz
Slant
Distance
18m
19m
21m
23m
27m
31m
35m
39m

Appendix E

Determined Line Source Responses at KAT-P1-7

KAT-P1-7



Line Source Response
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
dB re 10e-9(m/s)/(N/m^0.5)
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
Freqency, Hz
Slant Distance
10m
20m
30m
40m
50m
60m
70m
80m

Appendix F

Line Source Responses Adopted in SCL EIA (Appendix 9.5 of SCL(TAW-HUH) EIA Report

Appendix 9.5: Line Source Response Values Obtained from West Island Line EIA Study

Figure A LSR from WIL Borehole D002 (Rock Head Depth 24m, Hole Depth 20m)

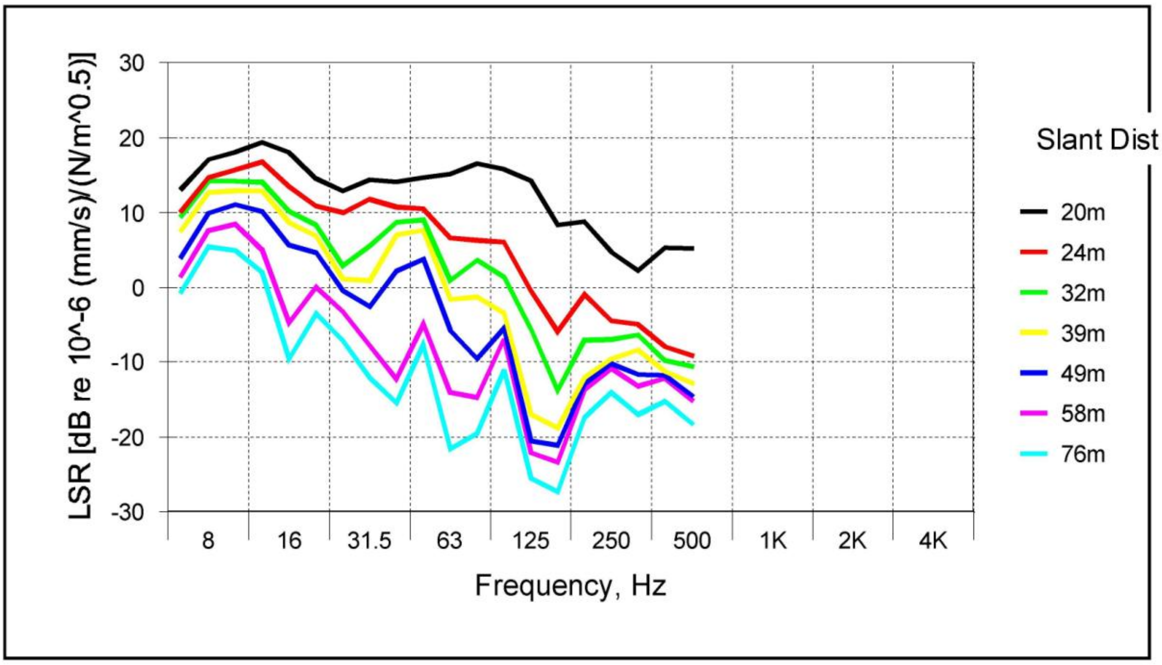


Figure B LSR from WIL Borehole D002 (Rock Head Depth 24m, Hole Depth 34m)

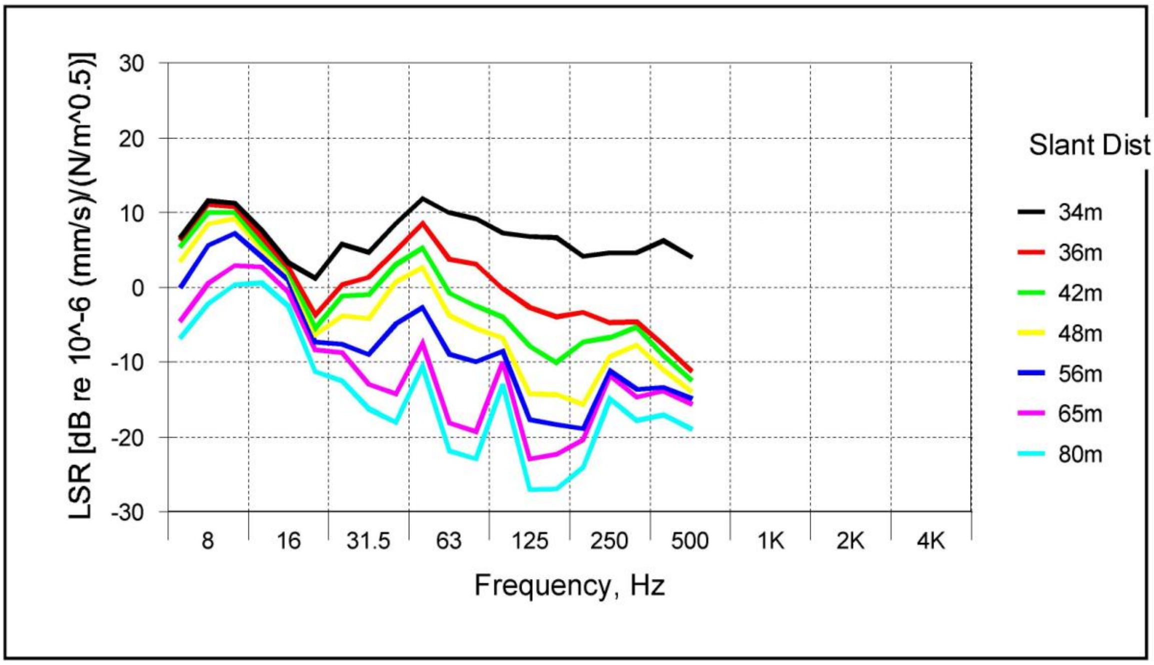


Figure C LSR from WIL Borehole D012 (Rock Head Depth 34m, Hole Depth 18m)

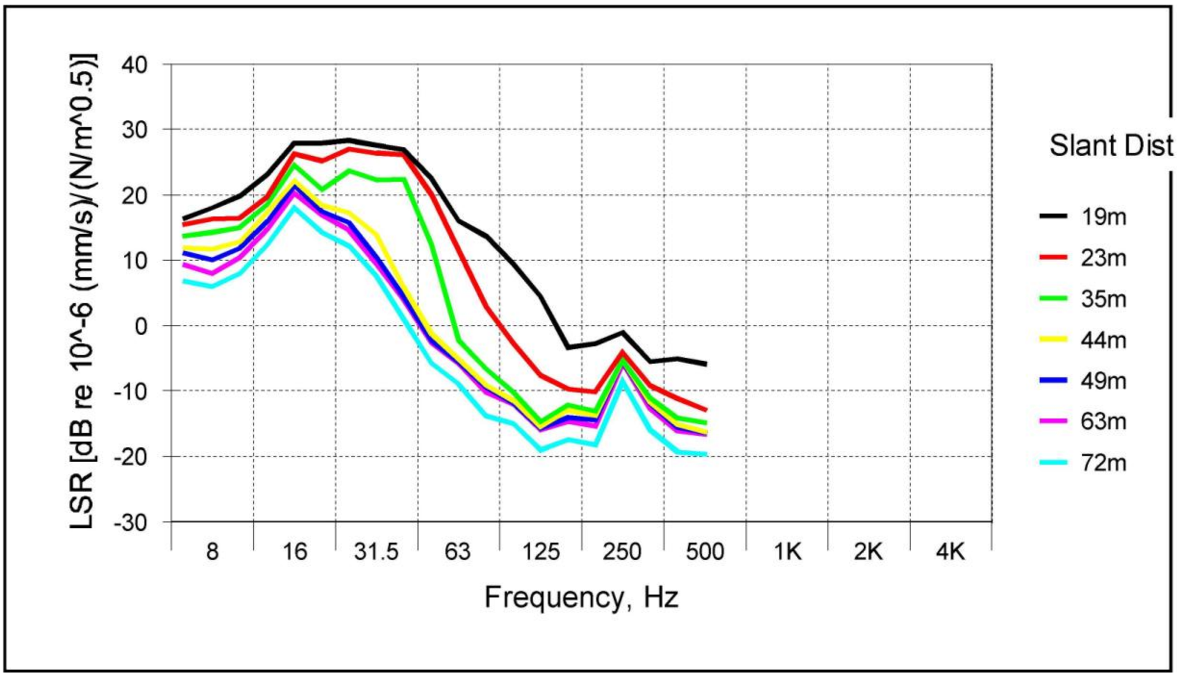


Figure D LSR from WIL Borehole D012 (Rock Head Depth 34m, Hole Depth 41m)

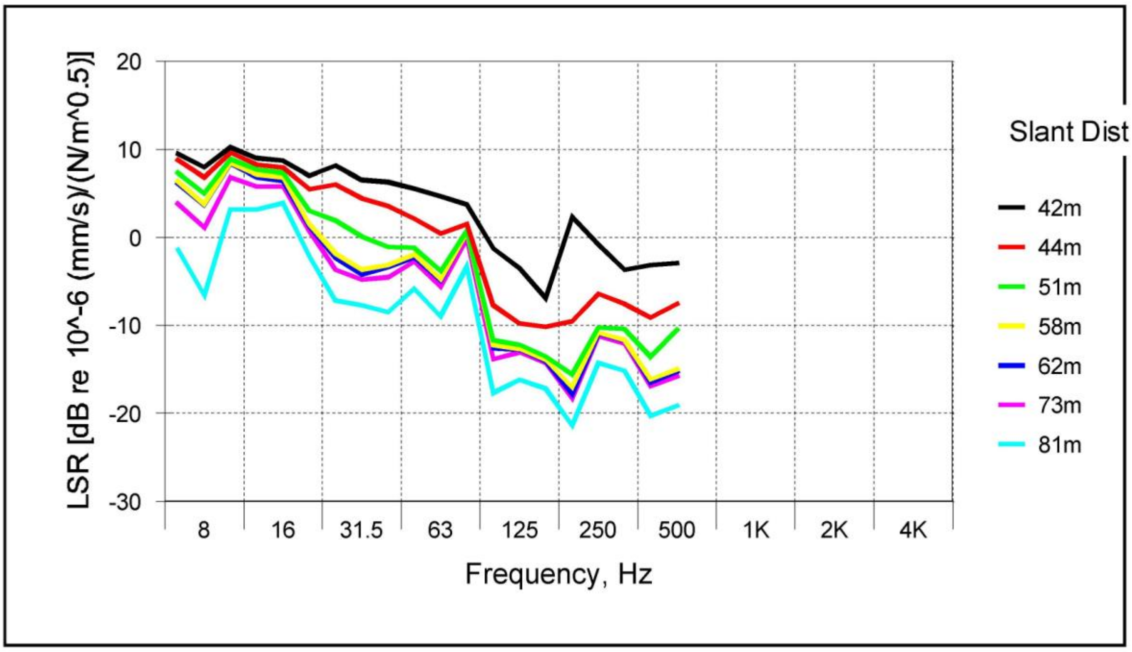


Figure E LSR from WIL Borehole D018 (Rock Head Depth 28m, Hole Depth 15m)

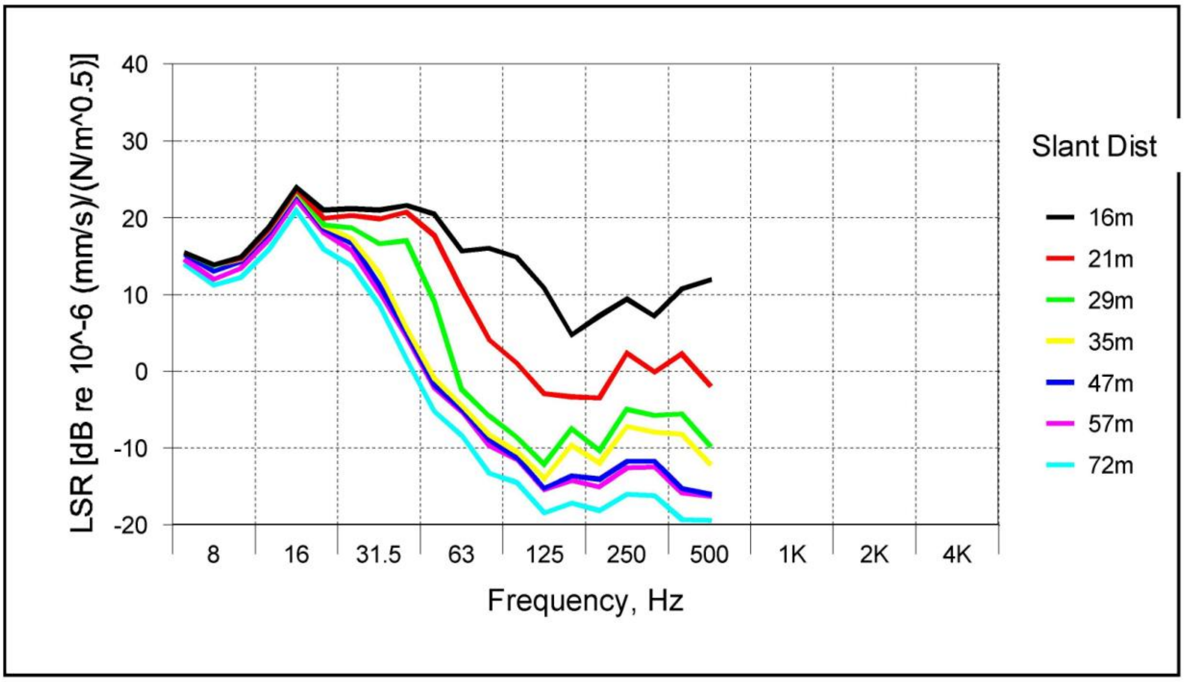


Figure F LSR from WIL Borehole D018 (Rock Head Depth 28m, Hole Depth 40m)

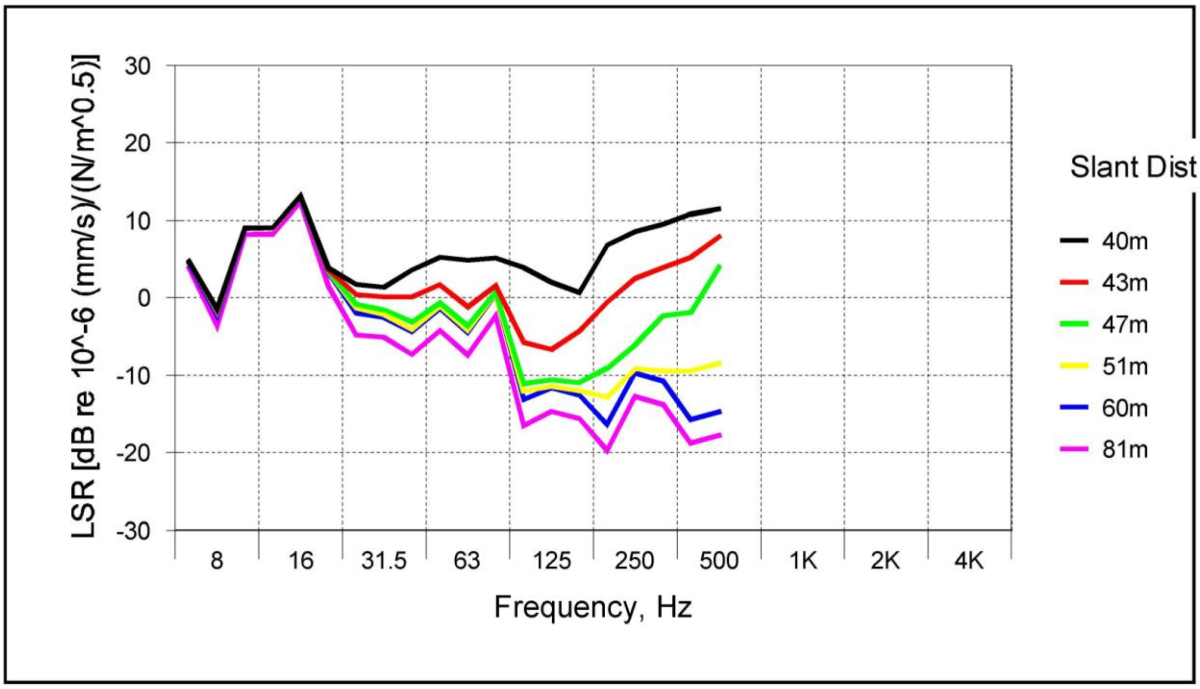
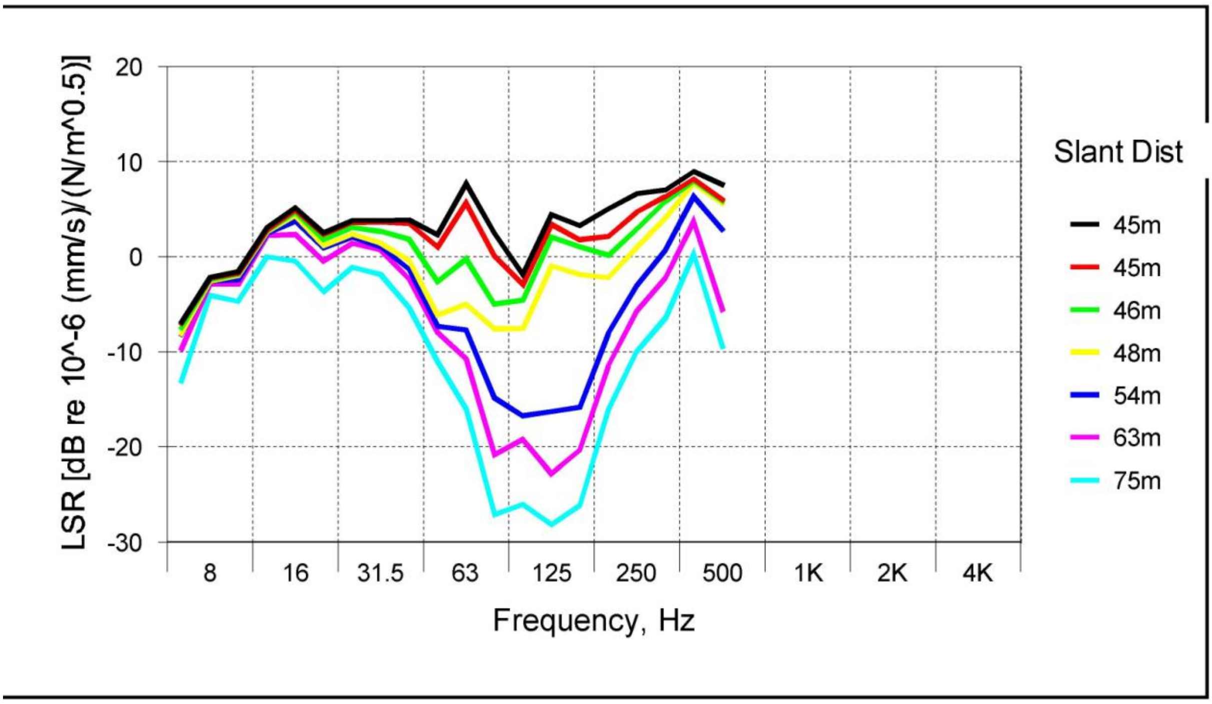


Figure G LSR from WIL Borehole D028 (Rock Head Depth 22m, Hole Depth 44m)

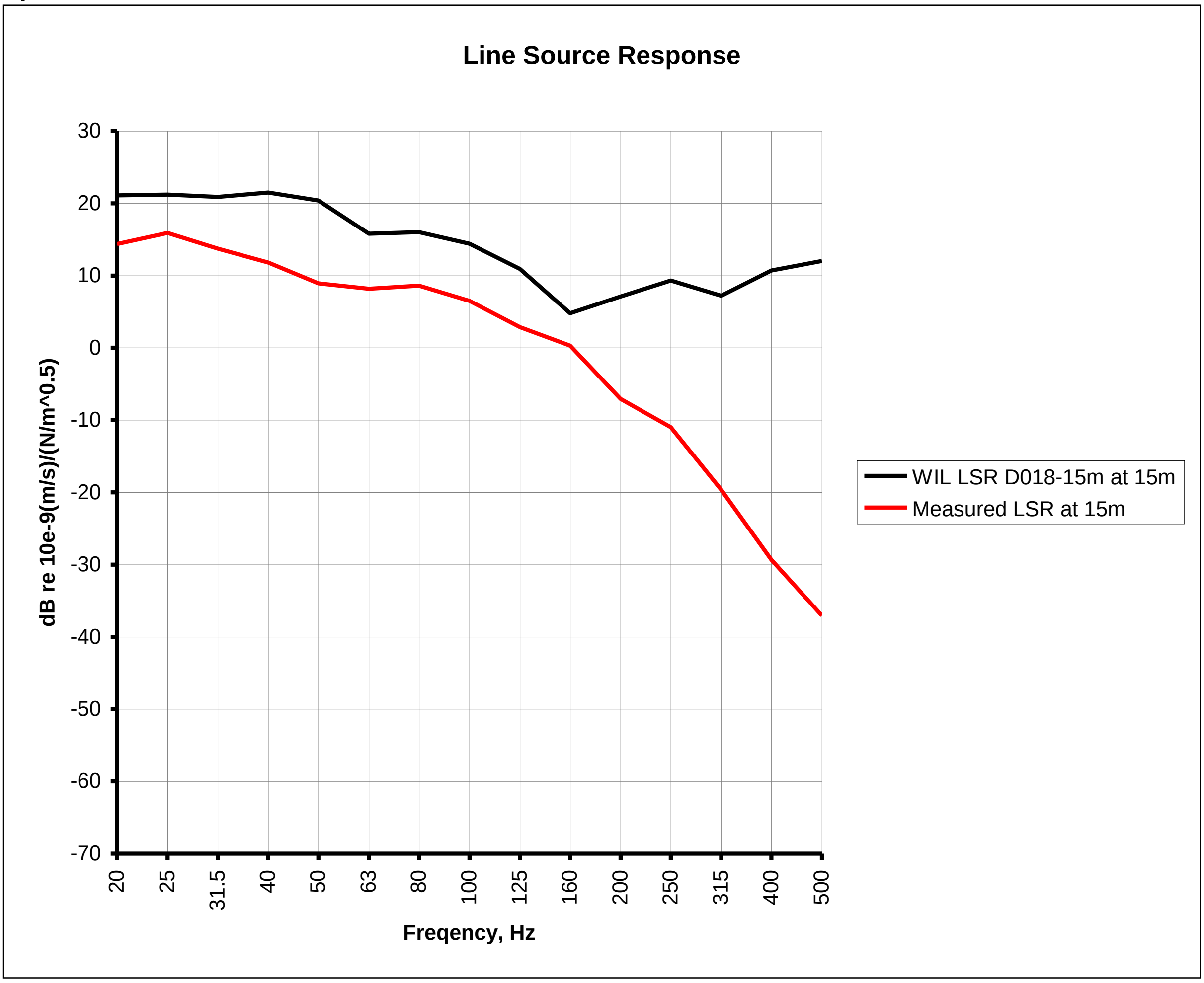


Appendix G

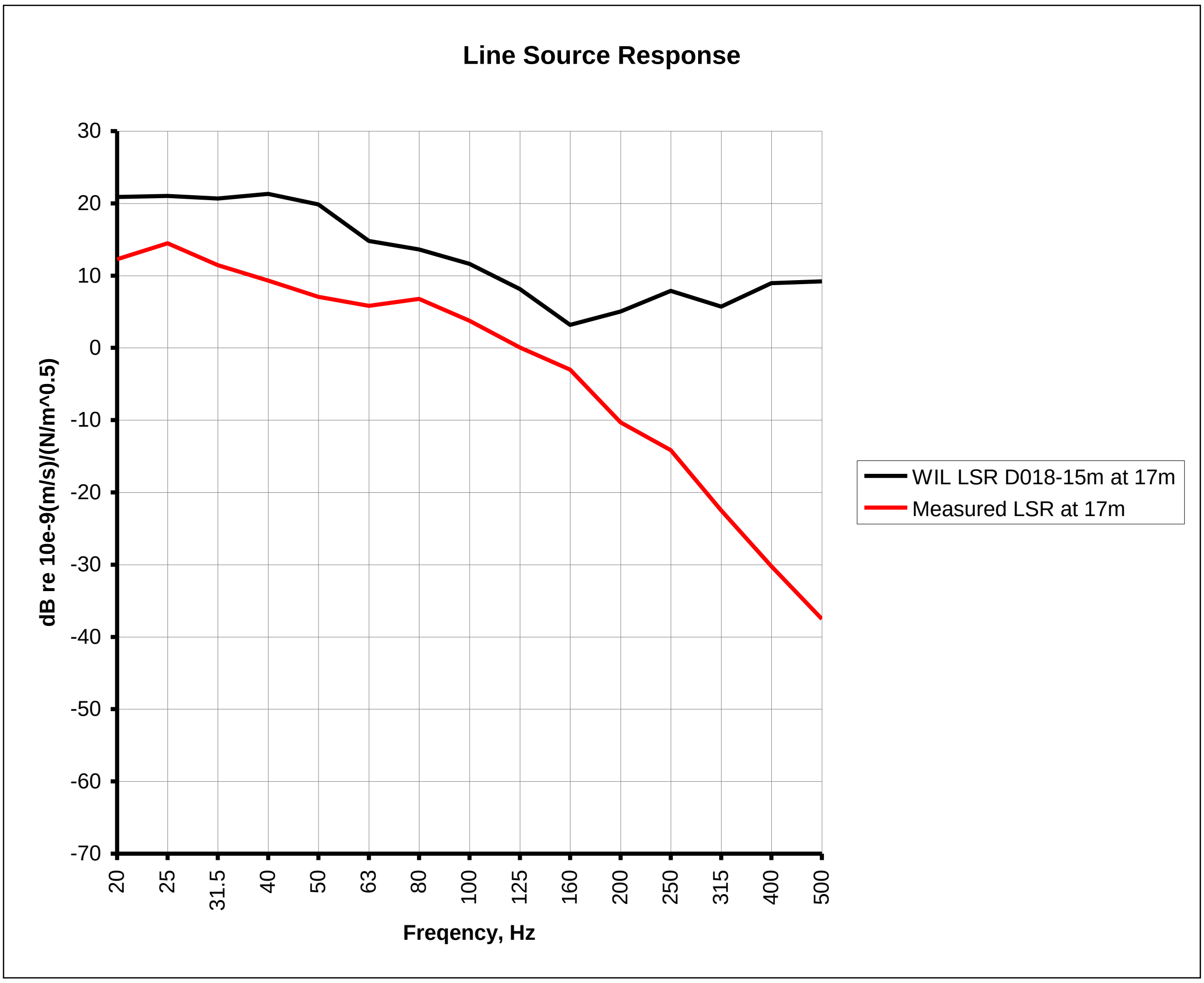
Comparison of Measured and EIA Line Source Responses

Comparison between the LSR adopted in the EIA and Measured LSR at KAT-P1-7

Up Track Calculation



Down Track Calculation



Appendix H

Updated Calculations of Ground-borne Noise Prediction

KAT-P1-7 Updated EIA Calculation by Measured LSR

Project: Shatin Central Link Rail Operational GBN Assessment
NSR Ref.: KAT-P1-7
Location: Residential premises near Kai Tak Station
Assessed Floor 2
Item: 51

Train Speed: 75 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	0	15	15
Down Track	0	17	17

Description	Unit		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
			Frequency (Hz)														
Up Track Calculation																	
FDL	dB re 1 lb/in$^{0.5}$		35.9	39.9	38.9	36.9	35.9	39.9	42.9	43.9	43.9	39.9	38.9	37.9	34.9	35.9	32.9
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb		14.4	15.9	13.7	11.8	8.9	8.2	8.6	6.5	2.9	0.3	-7.1	-11.0	-19.7	-29.3	-37.1
Up Track Vib. Level	dB re 10^{-6}in/sec		50.3	55.8	52.7	48.7	44.8	48.1	51.5	50.4	46.8	40.2	31.9	27.0	15.3	6.6	-4.1
Down Track Calculation																	
FDL	dB re 1 lb/in$^{0.5}$		35.9	39.9	38.9	36.9	35.9	39.9	42.9	43.9	43.9	39.9	38.9	37.9	34.9	35.9	32.9
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb		12.2	14.5	11.4	9.3	7.1	5.8	6.8	3.7	0.1	-3.0	-10.3	-14.2	-22.5	-30.2	-37.5
Down Track Vib. Level	dB re 10^{-6}in/sec		48.2	54.4	50.4	46.2	43.0	45.8	49.7	47.7	44.0	36.9	28.6	23.8	12.5	5.7	-4.6
Total of Up and Down Tracks Calculation																	
Total Vibration Level Outside Building			52.4	58.2	54.7	50.7	47.0	50.1	53.7	52.3	48.6	41.9	33.5	28.7	17.1	9.2	-1.3
BCF	dB	Y/N 0															
BVR-up	dB	Floor 2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB		6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	1/3 Oct, dB	**66.4**	**72.2**	**68.7**	**64.7**	**60.8**	**63.5**	**66.9**	**65.3**	**61.4**	**53.9**	**44.5**	**38.7**	**26.1**	**17.9**	**7.4**
Predicted Noise Level	Oct, dB			**74.3**			**69.2**			**67.0**			**45.6**			**18.3**
L_{max}	dB(A)	**51.5**														
$L_{eq,30mins}$	dB(A)	**39.4**														
Noise Criteria	dB(A)	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the same or the next available smaller borehole depth. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

The following abbreviations are used in the above calculation:
L : Ground borne noise level within the structure
FDL : Force density level for the KCR SP1900 EMU
LSR : Unit force incoherent line source response for the ground
TIL : Trackform attenuation or insertion loss, relative level
TCF : Vibration coupling between the tunnel and the ground for soil based tunnels, relative level
BCF : Vibration coupling loss factor between the soil and the foundation, relative level
BVR : Building vibration reduction or amplification within a structure from the foundation to the occupied areas, relative level
CTN : Conversion from floor and wall vibration to noise
TOC : Turnout and Crossover Factor
SAF : Safety margin to account for wheel/rail condition and projection uncertainties

Remark:
(1) The slant distance in Table 2.1 of this Plan is the measured distance in the testing, while the horizontal and slant distances in this calculation are adopted from the previous EIA calculation for a like-to-like comparison in order to facilitate the comparison of the results between adoption of WIL LSR and the measured LSR. The distance values presented here are independent in Table 2.1.

Annex B3

Excerpt of Operational Ground-borne Noise Mitigation Measures Plan (Batch 3 – Upper Wong Tai Sin Estate) (September 2016)

MTR Corporation Limited

Shatin to Central Link – Tai Wai to Hung Hom Section

Operational Ground-borne Noise Mitigation Measures Plan – Batch 3

(September 2016)

Verified by: Fredrick Leong

Position: Independent Environmental Checker

Date: 14 September 2016

MTR Corporation Limited

Shatin to Central Link –
Tai Wai to Hung Hom Section

Operational Ground-borne Noise Mitigation Measures Plan – Batch 3

(September 2016)

Certified by: PP Richard Kwan

Position: Environmental Team Leader

Date: 14/9/2016

AECOM

MTR Corporation Limited

Consultancy Agreement No. C11033

Shatin to Central Link - Tai Wai to Hung Hom Section [SCL(TAW – HUH)] and Stabling Sidings at Hung Hom Freight Yard [SCL(HHS)]

Operational Ground-borne Noise Mitigation Measures Plan (Batch 3 – Upper Wong Tai Sin Estate)

September 2016

	Name	Signature
Prepared & Checked:	Angela Tong	[signature]
Reviewed & Approved:	Josh Lam	[signature]

Version:	A	Date:	14 September 2016

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Table of Content

Page

List of Tables

List of Figures

Appendices

1 INTRODUCTION

1.1 Background

1.1.1 The Shatin to Central Link (SCL) is a 17km extension of the existing 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 Reports for SCL – Tai Wai to Hung Hom Section [SCL (TAW-HUH)] (Register No. AEIAR-167/2012) and SCL Stabling Sidings at Hung Hom Freight Yard [SCL (HHS)] (Register No. AEIAR-164/2012) were approved on 17 February 2012 under the *Environmental Impact Assessment Ordinance (*EIAO). Following the approval of the EIA Reports, the Environmental Permit (EP) (EP No: EP-438/2012), covering the construction of both SCL (TAW-HUH) and SCL (HHS), was granted on 22 March 2012. Variations of Environmental Permit (VEP) were subsequently applied for EP-438/2012 and the latest Environmental Permit (EP No: EP-438/2012/J) was issued by Director of Environmental Protection (DEP) on 29 February 2016.

1.1.3 Pursuant to EP Condition 2.27, the Permit Holder, MTR Corporation Ltd (MTR), shall deposit with the Director of Environmental Protection (DEP), no later than one month after completion of corresponding parts of the tunnel excavation of the SCL(TAW-HUH) Section (hereinafter referred to as “the Project”), an Operational Ground-borne Noise Mitigation Measures Plan (OGNMMP) to justify the adequacy of the operational ground-borne noise mitigation measures for the Project. The OGNMMP shall include the review and verification of the assumptions adopted in the approved SCL(TAW-HUH) EIA Report (Register No. AEIAR-167/2012) and SCL(HHS) EIA Report (Register No. AEIAR-164/2012), such as line source response (LSR) and ground vibration conditions, and shall also include justifications and recommendations for any contingency noise mitigation measures found necessary, including but not limited to resilient baseplates (type 1) and isolated slab track (type 4).

1.1.4 Since the tunnel excavation of the Project will be completed in different phases, testing on the LSR and ground vibration conditions will be conducted in phases according to the excavation programme.

1.1.5 The prediction methodology recommended by the FTA Manual[1] was adopted in the EIA studies and most of correction factors are based on the international guideline except LSR of which values are site specific and are subject to the ground materials, depth of the tunnel and the rock head. During the EIA stage, in situ line source response measurement was not conducted. As part of the review and verification of the assumptions adopted in the ground-borne railway noise impact assessment, it is proposed that line source response and ground vibration conditions will be reviewed and verified by the on-site measurement.

1.1.6 AECOM Asia Co. Ltd has been commissioned by the MTR to conduct the LSR test according to the Testing and Review Methodology Plan (T&RMP) (**Appendix A**). According to the T&RMP, the LSR test will be conducted at Upper Wong Tai Sin Estate - Wing Sin House (DIH-P1-1), Kai Ching Estate – Mun Ching House (KAT-P1-5), Residential Premises near KAT (KAT-P1-7) and Lee Wing Bldg (HOM-2-2). The first impact test was conducted at Mun Ching House on 1 and 2 February 2016, and the second impact test was conducted at the planned residential development near KAT on 15 April 2016. The third impact test was conducted at Upper Wong Tai Sin Estate - Wing Sin House (DIH-P1-1) on 11 and 12 August 2016.

[1] Federal Transit Administration of U.S. Department of Transportation “Transit Noise and Vibration Impact Assessment ”, 2006

1.2 Purpose of This OGNMMP

1.2.1 This OGNMMP (Batch 3) presents the LSR analysis based on the results of the third impact test conducted at Upper Wong Tai Sin Estate – Wing Sin House (DIH-P1-1) and the operational ground-borne noise prediction at DIH-P1-1 based on measurement results.

1.3 Report Structure

1.3.1 This Test Proposal comprises the following sections:

- Section 1 presents the background information.
- Section 2 describes the details of impact test and the prediction of LSR based on the measurement results.
- Section 3 presents the LSR analysis and operational ground-borne noise prediction results.
- Section 4 presents the conclusion.

2 IMPACT TESTING AND PREDICTION OF LSR

2.1 Testing Location

2.1.1 The third impact test was conducted at Upper Wong Tai Sin Estate – Wing Sin House (DIH-P1-1) on 11 and 12 August 2016. The information of the measurement location at the selected NSR are summarised in **Table 2.1** and the testing locations are shown in **Figure C11033/C/SCL/ACM/M53/006**.

Table 2.1 Measurement and Testing Location

NSR		Predicted Night-time Ground-borne Noise Levels in the EIA Report, dB(A)	Measurement Location(2)		Ground Type	Location of Hammer Impact Test (Approx. Tunnel Depth)	Testing Date
ID	Description		Approx. Hori. Distance from the Tunnel, m	Approx. Slant Distance (From Ground Level to Track Level), m			
DIH-P1-1(1)	Upper Wong Tai Sin Estate – Wing Sin House	32	7 (down track)	31 (down track)	Mixed rock	Down Track Tunnel (-2.2mPD)	11 & 12 Aug 2016

Notes:
(1) DIH-P1-1 is a planned NSR during EIA stage. Assumptions were made on the horizontal distance from tunnels (i.e. 0m from up track and 5m from down track) and noise levels were predicted based on this assumption.
(2) Measurement location at the selected NSR is shown in **Figure C11033/C/SCL/ACM/M53/006**.

2.2 Testing Instrumentations

2.2.1 The impact force levels applied within the tunnel were measured using a SINUS Harmonie connected to a laptop computer and vibration velocity levels on the ground were measured using a Brüel & Kjær PULSE connected to a laptop computer. Wilcoxon seismic accelerometers were used on the ground surface. Details of the instruments used are provided in **Table 2.2** and the calibration records of the instruments are provided in **Appendix B**.

Table 2.2 Instrumentation of the Hammer Impact Test

Instrument	Manufacturer / Model No.	Purpose
Pneumatic Hammer and Air Compressor	WM model 3.5	Connection to 2-hp air compressor to induce force (impact) at about 130kN
Impact Controller	WM type 1	Connection to pneumatic hammer to control impact on/ off
Analyzer Platform	Brüel & Kjær PULSE; Sinus Harmonie	Spectrum analyzers for data acquisition
Accelerometer	Wilcoxon Research 731-207 and 731A-P31	Vibration transducers to measure vibration
Force transducer	PCB 200M200	Fitted to pneumatic hammer to measure impact force

2.3 Testing and Measurement Procedures

2.3.1 The testing and measurement procedures are summarised below:

- The test was carried out during night time when background vibration levels are medium due to the nearby traffic. All construction works inside tunnel and the adjacent tunnel were suspended during the testing.

- The impact hammer hit on the tunnel invert and it applied measured impact forces within the tunnel. The measured impact forces were logged by the FFT spectrum analyzer. For each location of accelerometer, impact point was applied minimum 10 hits at around 130kN[(2)] on the concrete invert.
- Meanwhile, accelerometers were mounted on the ground and inside the building of Wing Sin House. The impact hammer in the tunnel hit on the tunnel invert at different horizontal distances (5m, 10m, 20m, 30m, 40m and 60m) from the first impact point (i.e. 0m). Site photos taken during the measurement are shown in **Appendix C**.
- The impact force in tunnel and the vibration levels on the ground were recorded by the two separated spectrum analyzers. Measurement signals were recorded in narrow band frequencies from 6.3Hz to 500Hz.
- The furthest impact point in the tunnel was made up to 60m horizontal distance from the zero meter impact point. Reading also indicated that the responses of impact signals at 10m horizontal distance were weak and cannot be identified. Hence the impact signals at further distances over 10m would be much lower which are insignificant to the overall result, and testing on the measurement point over 60m from the impact point were not executed.

2.4 Prediction of Line Source Response

2.4.1 The vibration response induced by a unit point source impact was obtained from the hammer impact test and the best fit curves were calculated to determine the LSR at NSR DIH-P1-1 Upper Wong Tai Sin Estate – Wing Sin House (mixed rock type ground property referring to the geological profile) along the SCL alignment.

2.4.2 The post-processing of measurement data was taken to determine the best fit curves of PSR with respect to the setback distances, and the depth between the impact source and the receivers. The LSR [TM_{line}, dB re $1e^{-9}$ (m/s)/(N/$m^{0.5}$)] is then determined by numerical integration with the formula[(3)] as shown below, of the Point Source Response (PSR, TM_{pi}) along the length of the train centred on the receiver, while PSR is determined from impacting within the tunnel.

$$TM_{\text{line}} = 10 \times \log_{10}\left[h \times \left(\frac{10^{\frac{TMp1}{10}}}{2} + 10^{\frac{TMp2}{10}} + \cdots + 10^{\frac{TMpn-1}{10}} + \frac{10^{\frac{TMpn}{10}}}{2} \right) \right]$$

Where

H	=	Receiver interval (m) (interval varying from 5m to 40m)
TMpi	=	Point source transfer mobility for ith receiver location (dB re 1e-9 (m/s)/N)
n	=	Last receiver location

2.4.3 The calculation of LSR follows the calculation outlined in paragraph 11.3.2 Analysis of Transfer Mobility Data in FTA Manual[(4)]. The measured PSR and the determined LSR are presented in **Appendices D** and **E** respectively.

2.4.4 A total of two measurement points including Point A (outdoor) and Point B (indoor building structure) were set up. However, only Point A is adopted to determine the LSR as the vibration response of Point B was weak and cannot be identified. It is considered that the measurement results at Point B are not appropriate to be used in the ground-borne noise calculation.

(2) As mentioned in T&RMP, 400kN is only the design force of the impact machine and the actual output force in fact depends on the machine status and on-site condition.
(3) Federal Railroad Administration of U.S. Department of Transportation "High-Speed Ground Transportation Noise and Vibration Impact Assessment", 2012
(4) Federal Transit Administration of U.S. Department of Transportation "Transit Noise and Vibration Impact Assessment ", 2006

3 REVIEW OF OPERATIONAL GROUND-BORNE NOISE PREDICTION

3.1 LSR Adopted in the Approved EIA Report

3.1.1 The LSR determines the vibration levels or attenuation in the ground as a function of distance caused by an incoherent line source of unit force point impacts.

3.1.2 The LSR values adopted in ground-borne noise assessment of SCL (TAW-HUH) and SCL (HHS) EIA Report were referenced from the data of the West Island Line (WIL) EIA Study (EIA Register No. AEIAR-126/2008). The LSR for WIL EIA Study were determined based on the results of borehole impact tests performed in rock, soil and close to the rock head both on the soil side and the rock side, with receiver vibration data taken on surface at various setback distances.

3.2 Review of LSR Values

3.2.1 The test carried out at the Upper Wong Tai Sin Estate – Wing Sin House (DIH-P1-1) was specifically aimed at determining the LSR values for vibration propagating through the ground of mixed rock type.

3.2.2 The LSR values determined at Upper Wong Tai Sin Estate – Wing Sin House (DIH-P1-1) are compared with those used in the SCL EIA study for the same area and the same ground conditions (i.e. WIL D002 Rockhead Depth = 24m, Hole Depth = 34m & 20m, Slant Distance = 37m & 28m). The EIA LSR values are shown in **Appendix F**. To allow a better comparison, **Appendix G** shows the LSR value determined at measurement locations at a distance similar to EIA study. A summary of observation is presented in **Table 3.1**.

Table 3.1 Comparison between Measurement Data and WIL Data

ID	Location	LSR data adopted in EIA Study	Observation
DIH-P1-1	Upper Wong Tai Sin Estate – Wing Sin House	WIL D002 Rockhead Depth=24m Hole Depth=34m & 20m Slant Distance=37m & 28m	Measured LSR values at both 37m & 28m are in general lower than the EIA LSR values at most frequency bands and are of similar magnitude at 63Hz and 160Hz.

3.2.3 It should be noted that the WIL EIA LSR was measured in the borehole while the current test was measured inside the tunnel. The decoupling effect of vibration propagation between the media of tunnel structure and the ground soil, i.e. the tunnel coupling loss (TCL), would be different to that between the media of borehole casing and the ground soil. Thus the LSR result measured in the impact test should comprise the loss due to decoupling of the actual tunnel structure. The factor of tunnel coupling loss applied in the EIA prediction for the structure at NSR DIH-P1-1 was 5dB. Therefore, apart from different testing method and geological profile at WIL D002 and DIH-P1-1, such 5dB tunnel coupling loss also accounts for difference between the EIA LSR and measured LSR.

3.3 Operational Ground-borne Noise Prediction

3.3.1 Ground-borne noise assessment at DIH-P1-1 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 Reports. The prediction results are summarised in **Table 3.2**. Sample calculation is given in **Appendix H**.

Table 3.2 Ground-borne Noise Prediction Results

Location	GBNSR	Description	EIA Prediction (unmitigated scenario), dB(A)		New Prediction (unmitigated scenario, based on measured LSR data), dB(A)		Criterion, dB(A)		Difference Between EIA and New Prediction, dB(A)
Wong Tai Sin	DIH-P1-1	Upper Wong Tai Sin Estate – Wing Sin House	Lmax	45	Lmax	42	Lmax	-	-
			Daytime $L_{eq,30min}$	35	Daytime $L_{eq,30min}$	32	Daytime $L_{eq,30min}$	55	-3
			Night-time $L_{eq,30min}$	32	Night-time $L_{eq,30min}$	29	Night-time $L_{eq,30min}$	45	-3

3.3.2 As mentioned in **Section 3.2.3**, the measured LSR comprises of tunnel couple loss which is about 5dB as adopted in the EIA prediction. The updated calculation therefore excluded the tunnel coupling loss in the calculation to avoid double count of the effect.

3.3.3 Results indicate that the measured LSR values at actual ground condition would give lower ground-borne noise levels than EIA predictions which are also below the noise criteria.

3.3.4 The preliminary update of prediction calculation shows no further mitigation measures such as trackform upgrade is required around the NSR DIH-P1-1.

3.4 Review of Other Assumptions

3.4.1 The following assumptions adopted in the EIA Reports will be reviewed and the ground-borne noise prediction for SCL(TAW-HUH) will be updated based on all measured LSR results where applicable in the Final OGNMMP and the latest available information:

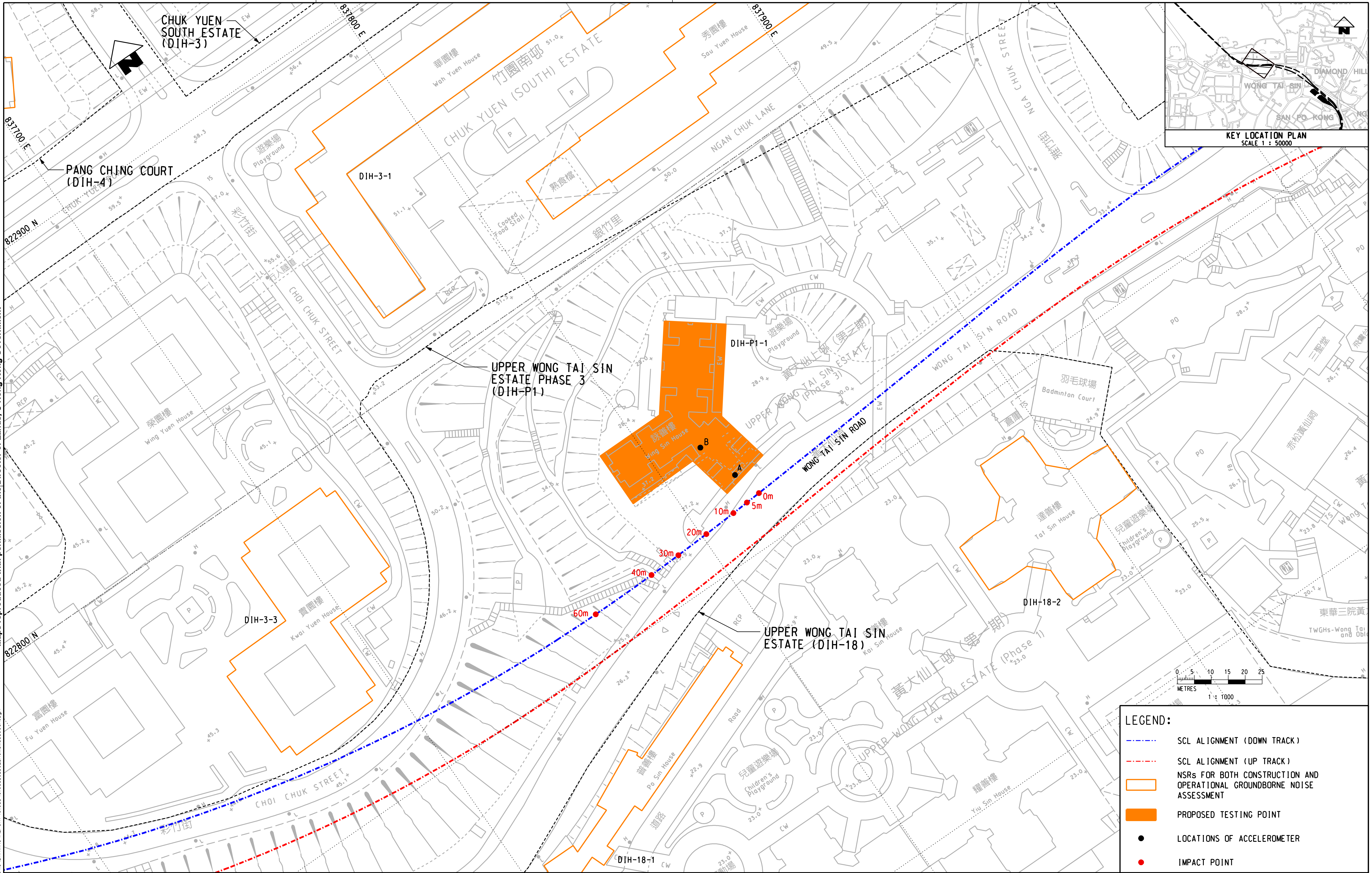
- Tunnel Coupling Loss (TCL) and Building Coupling Loss (BCL) – these factors depend on whether the tunnel and building (or building piles) are in rock or soft ground. Updated building information, if any, will be reviewed.
- Geological Profile – updated geological profile along the alignment, if any, will be reviewed.
- Speed – updated speed profile along the alignment, if any, will be reviewed.
- Turnout Adjustment – updated information, if any, on the type of turnouts to be used and the adjustment corresponding to corresponding type of turnouts will be reviewed.

4 CONCLUSION

4.1.1 The measurement of ground LSR values has been conducted at Upper Wong Tai Sin Estate – Wing Sin House (DIH-P1-1) to check the suitability of the LSR assumptions adopted in the EIA stage for mixed rock ground type.

4.1.2 The measured LSR values result in ground-borne noise levels which are lower than the EIA predictions at DIH-P1-1.

4.1.3 The assumptions adopted in the EIA Reports will be further reviewed and the ground-borne noise prediction for SCL(TAW-HUH) will be updated based on all measured LSR results where applicable in the Final OGNMMP and the latest available information.



LEGEND:

- SCL ALIGNMENT (DOWN TRACK)
- SCL ALIGNMENT (UP TRACK)
- NSRs FOR BOTH CONSTRUCTION AND OPERATIONAL GROUNDBORNE NOISE ASSESSMENT
- PROPOSED TESTING POINT
- LOCATIONS OF ACCELEROMETER
- IMPACT POINT

REV	DESCRIPTION	BY	DATE	APPROVED
A	-	---	07SEP16	---

DRAWN	XH
DESIGNED	LCLL
CHECKED	LCLL
APPROVED	IMW
DATE	07/SEP/2016

MTR

SHATIN TO CENTRAL LINK

ORIGINATOR: AECOM

CADD REF. C11033_C_SCL_ACM_M53_006A.dgn

TITLE
C11033
SCL (TAW - HUH)
LOCATIONS OF MEASUREMENT POINTS AT NSR DIH-P1-1

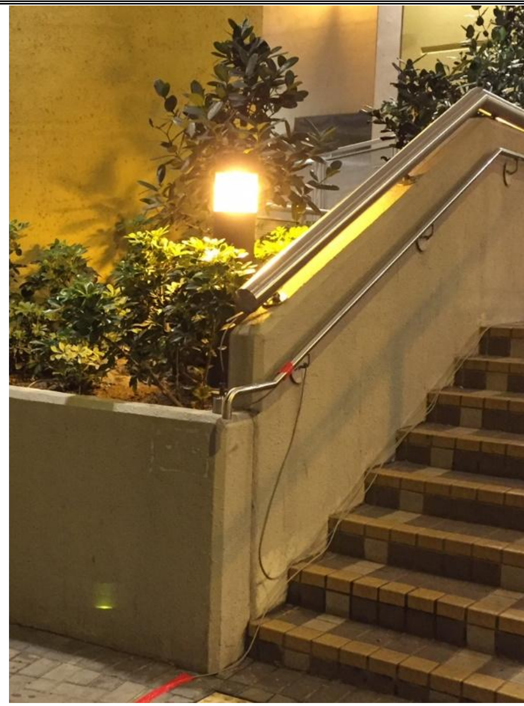
SCALE 1 : 1000 (A3)
FIGURE NO. C11033/C/SCL/ACM/M53/006
REV. A

PLOT DRV: V:\ustnset\MTR\PLOTDRIVER\WINDOWS\A3 COLOUR.plt 10:23:40
MODELNAME: MODEL PRINTED BY: ZENGFX 2016/9/9
FILENAME: P:\PROJECTS\60273499\DRAWING\REPORT\C11033\C11033_C_SCL_ACM_M53_006A.dgn

Appendix C

Photo records of Measurement at DIH-P1-1

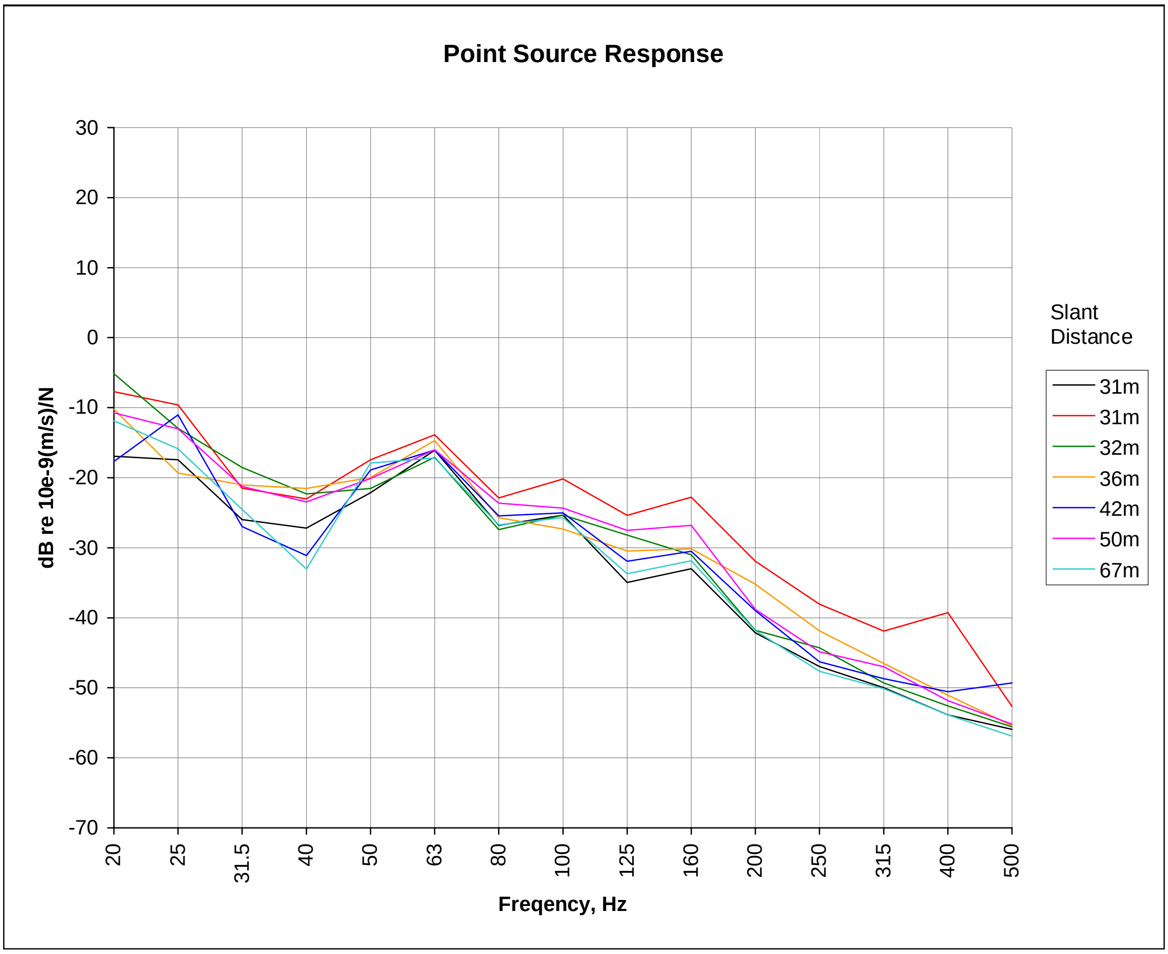
Appendix C - Photo records of Tunnel Impact test at DIH-P1-1

Upper Wong Tai Sin Estate - Wing Sin House (DIH-P1-1)	
Measurement Date: 11 Aug 2016 & 12 Aug 2016 Measurement Time: 11:00pm 11 Aug to 5:00am 12 Aug 2016	
	**Point A (Outdoor)**  **Point B (Indoor Building Structure)** 
Hammer Impact Test in the Tunnel	**Accelerometer on ground level**

Appendix D

Measured Point Source Responses at DIH-P1-1

DIH-P1-1

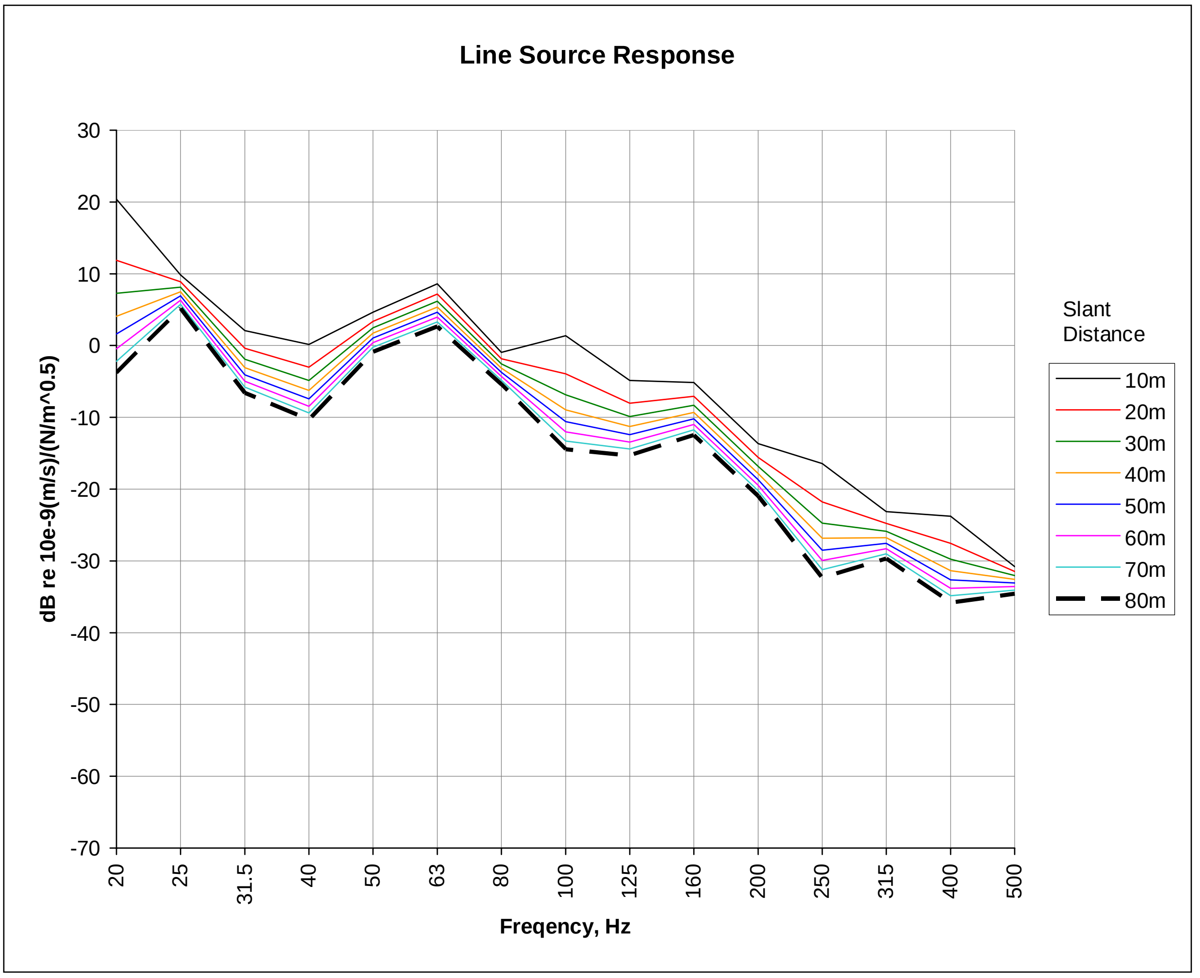


Point Source Response
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
dB re 10e-9(m/s)/N
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
Freqency, Hz
Slant Distance
31m
31m
32m
36m
42m
50m
67m

Appendix E

Determined Line Source Responses at DIH-P1-1

DIH-P1-1



Line Source Response
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
dB re 10e-9(m/s)/(N/m^0.5)
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
Freqency, Hz
Slant Distance
10m
20m
30m
40m
50m
60m
70m
80m

Appendix F

Line Source Responses Adopted in SCL EIA (Appendix 9.5 of SCL(TAW-HUH) EIA Report

Appendix 9.5: Line Source Response Values Obtained from West Island Line EIA Study

Figure A LSR from WIL Borehole D002 (Rock Head Depth 24m, Hole Depth 20m)

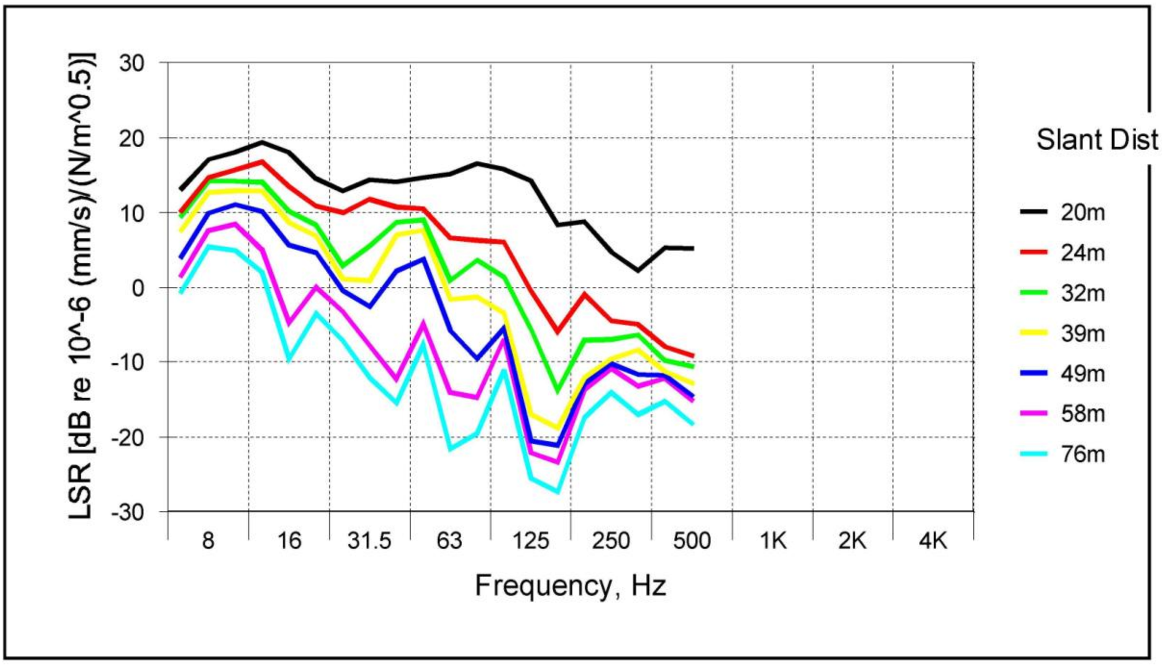


Figure B LSR from WIL Borehole D002 (Rock Head Depth 24m, Hole Depth 34m)

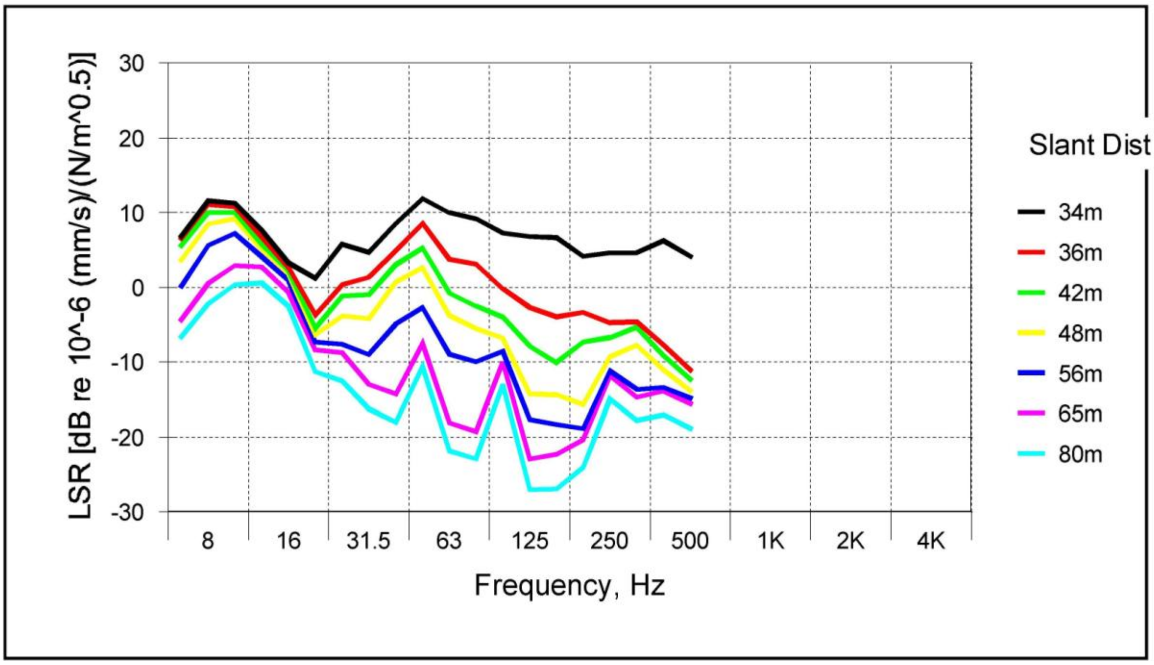


Figure C LSR from WIL Borehole D012 (Rock Head Depth 34m, Hole Depth 18m)

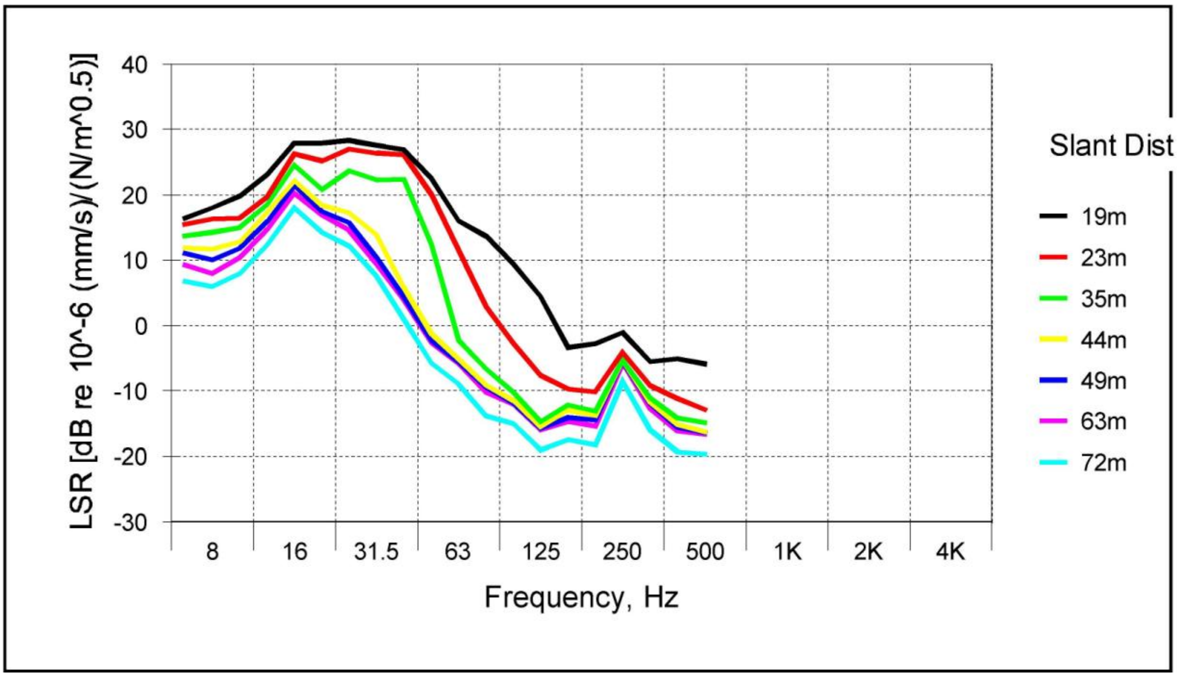


Figure D LSR from WIL Borehole D012 (Rock Head Depth 34m, Hole Depth 41m)

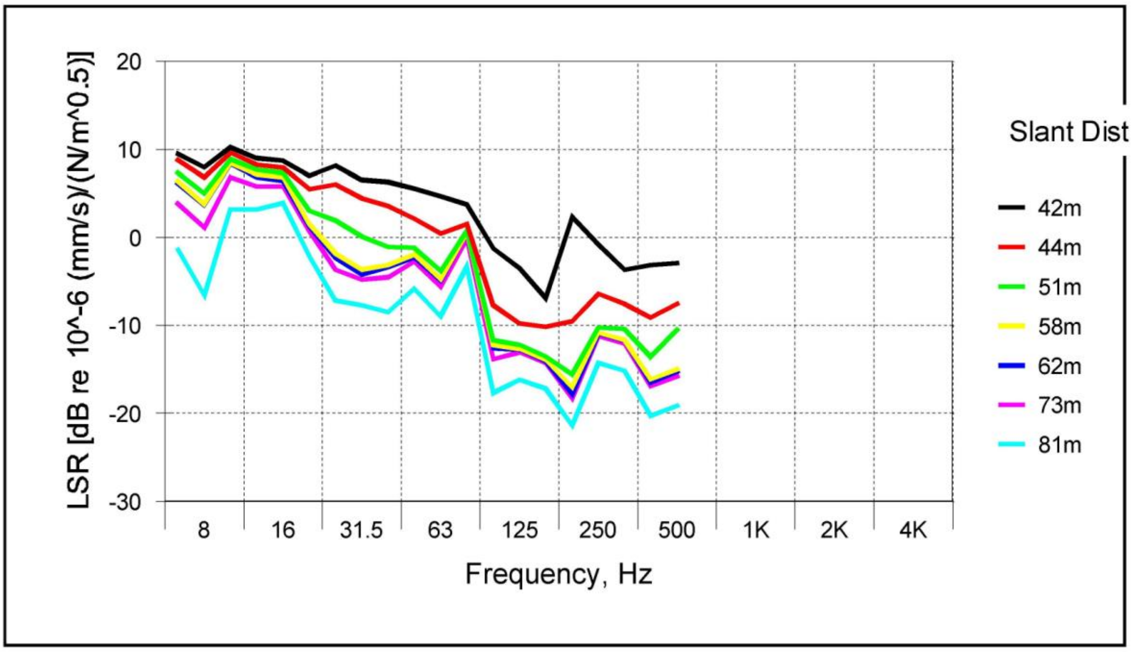


Figure E LSR from WIL Borehole D018 (Rock Head Depth 28m, Hole Depth 15m)

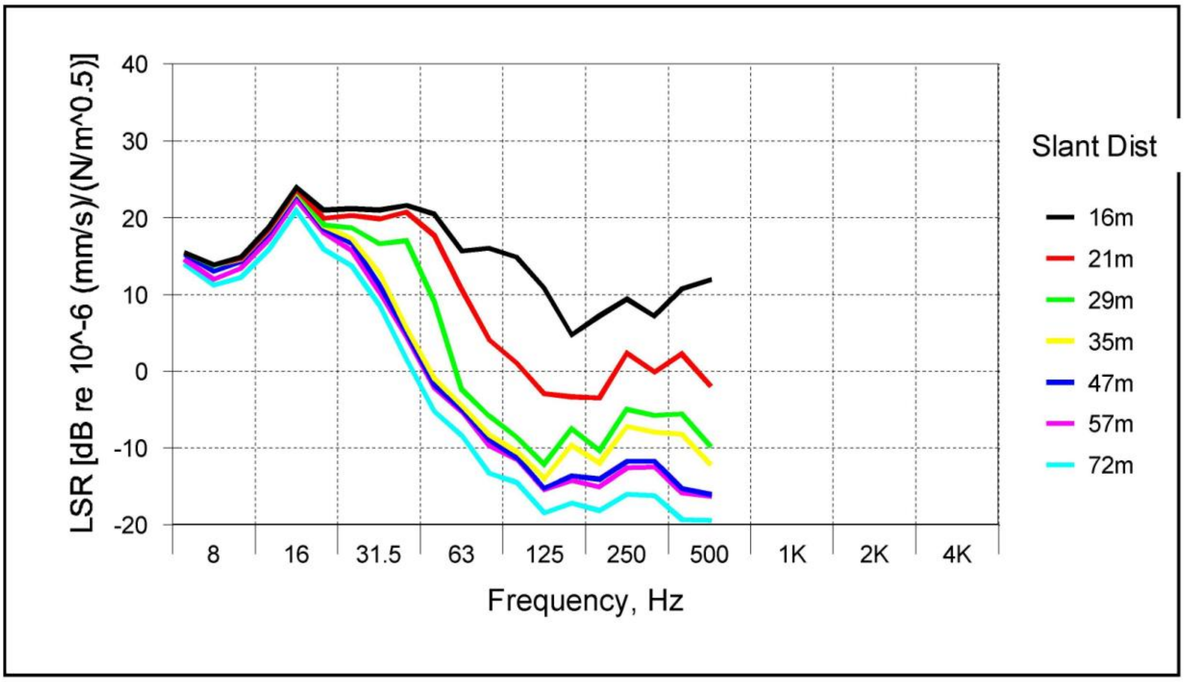


Figure F LSR from WIL Borehole D018 (Rock Head Depth 28m, Hole Depth 40m)

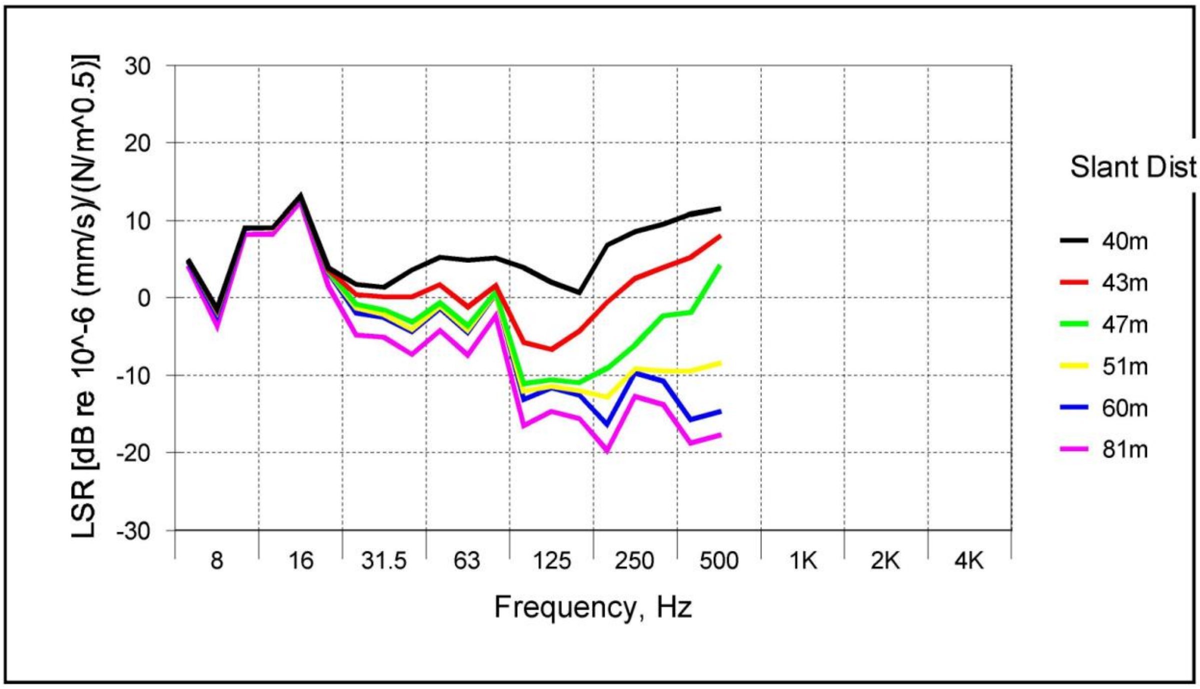
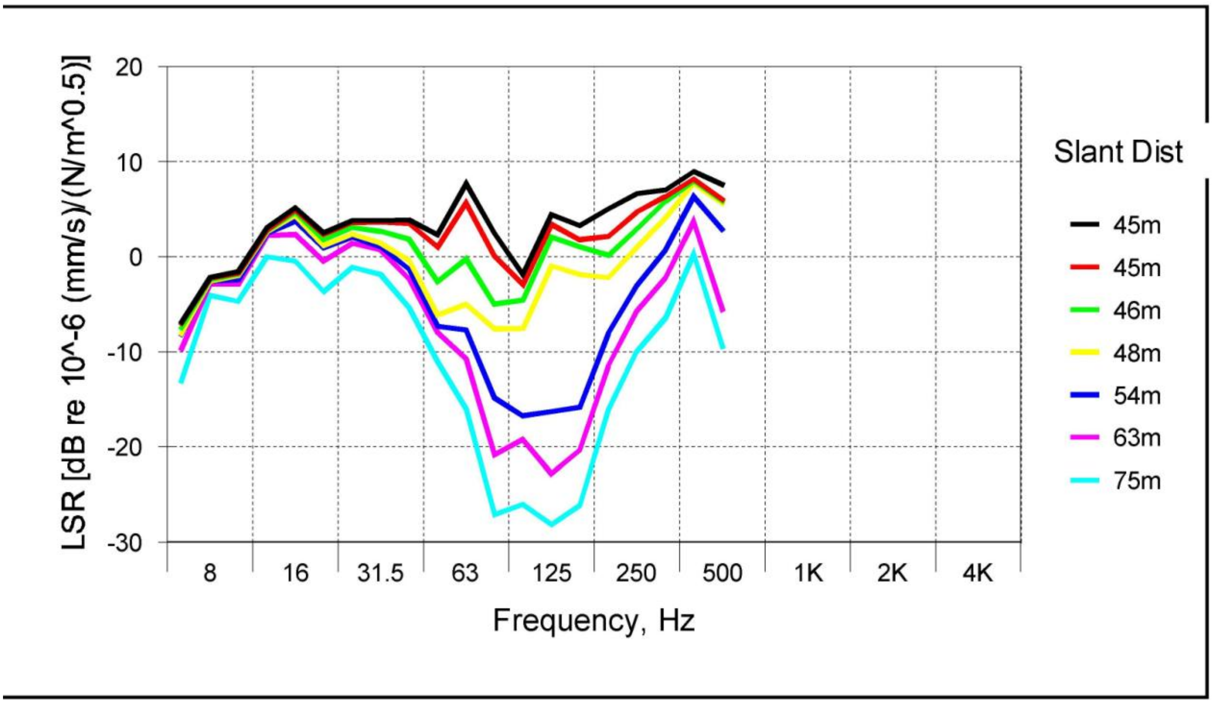


Figure G LSR from WIL Borehole D028 (Rock Head Depth 22m, Hole Depth 44m)

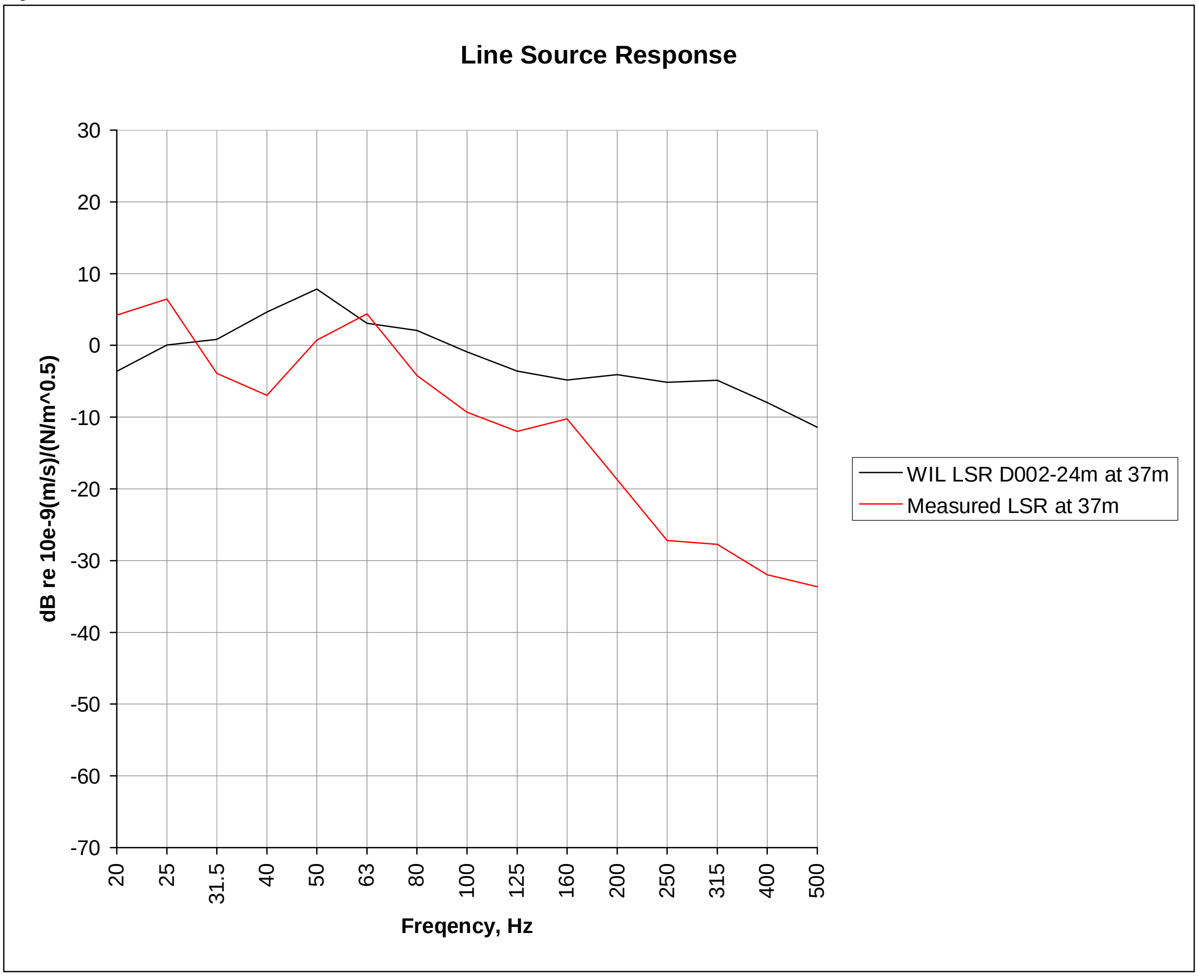


Appendix G

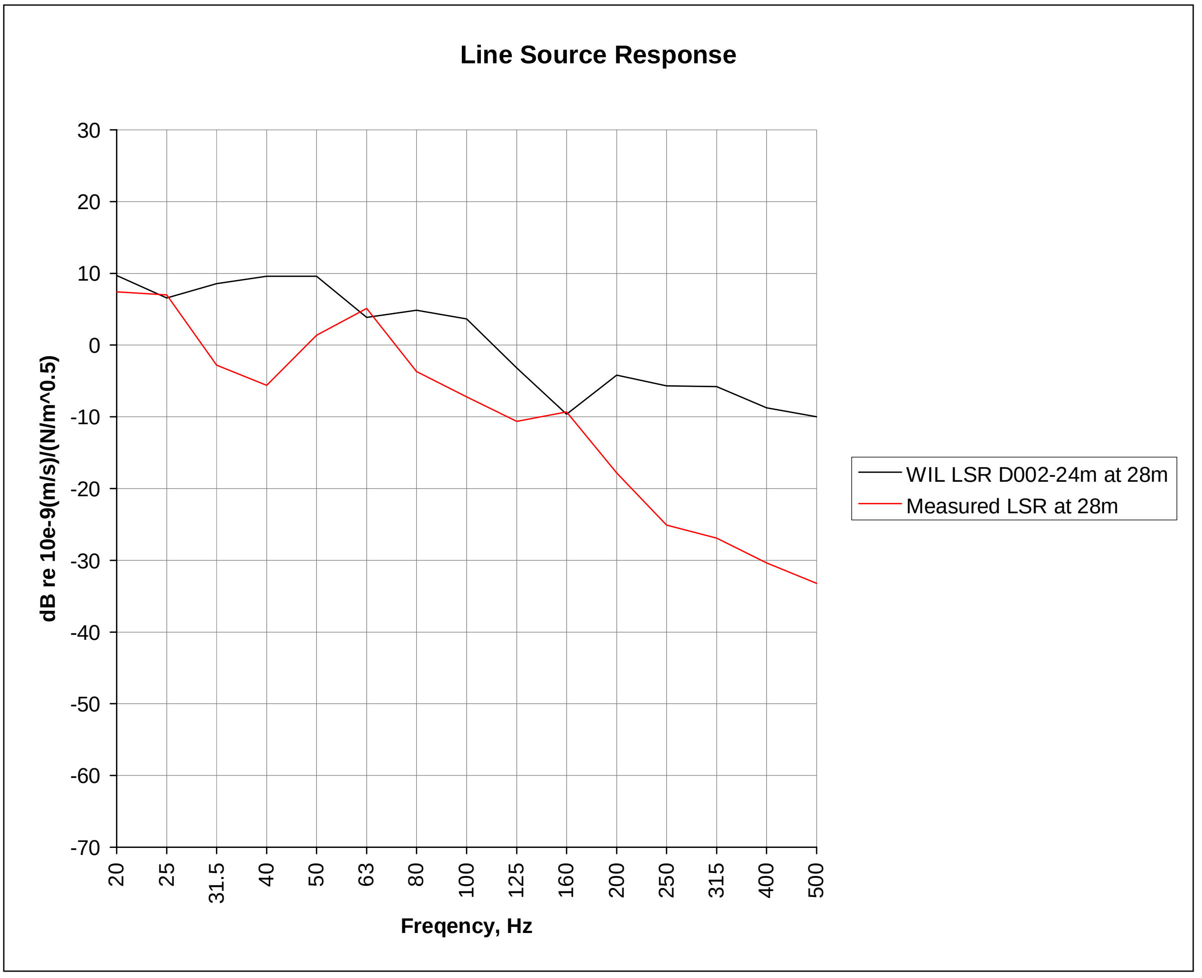
Comparison of Measured and EIA Line Source Responses

Comparison between the LSR adopted in the EIA and Measured LSR at DIH-P1-1

Up Track Calculation



Down Track Calculation



Appendix H

Updated Calculations of Ground-borne Noise Prediction

DIH-P1-1 Updated EIA Calculation by Measured LSR

Appendix 9.3: Detailed Operational Groundborne Noise Calculations

Project: Shatin Central Link Rail Operational GBN Assessment
NSR Ref.: DIH-P1-1
Location: Upper Wong Tai Sin Estate Phase 3
Assessed Floor 2
Item: 40

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	0	37	37
Down Track	5	28	28

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			4.2	6.5	-3.9	-7.0	0.7	4.4	-4.2	-9.3	-12.0	-10.2	-18.7	-27.2	-27.7	-31.9	-33.6
Up Track Vib. Level	dB re 10^{-6}in/sec			41.7	48.0	36.6	31.5	38.2	45.9	40.3	36.2	33.5	31.3	21.8	12.3	8.8	5.6	0.9
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.4	7.0	-2.8	-5.6	1.4	5.1	-3.7	-7.2	-10.6	-9.3	-17.8	-25.1	-26.9	-30.4	-33.2
Down Track Vib. Level	dB re 10^{-6}in/sec			45.0	48.5	37.7	32.9	38.9	46.6	40.8	38.3	34.9	32.2	22.7	14.4	9.6	7.2	1.3
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.6	51.3	40.2	35.3	41.6	49.3	43.6	40.4	37.3	34.8	25.3	16.5	12.2	9.4	4.1
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	1/3 Oct, dB	60.6	65.3	54.2	49.3	55.4	62.7	56.8	53.4	50.1	46.8	36.3	26.5	21.2	18.1	12.8
Predicted Noise Level	Oct, dB			65.7			64.3			55.7			36.8			19.3
L_{max}	dB(A)	42.4														
$L_{eq,30mins}$	dB(A)	29.4														
Noise Criteria	dB(A)	45														
Compliance		Yes														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the same or the next available smaller borehole depth. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

The following abbreviations are used in the above calculation:

L : Ground borne noise level within the structure
FDL : Force density level for the KCR SP1900 EMU
LSR : Unit force incoherent line source response for the ground
TIL : Trackform attenuation or insertion loss, relative level
TCF : Vibration coupling between the tunnel and the ground for soil based tunnels, relative level
BCF : Vibration coupling loss factor between the soil and the foundation, relative level
BVR : Building vibration reduction or amplification within a structure from the foundation to the occupied areas, relative level
CTN : Conversion from floor and wall vibration to noise
TOC : Turnout and Crossover Factor
SAF : Safety margin to account for wheel/rail condition and projection uncertainties

Remark:

(1) The slant distance in Table 2.1 of this Plan is the measured distance in the testing, while the horizontal and slant distances in this calculation are adopted from the previous EIA calculation for a like-to-like comparison in order to facilitate the comparison of the results between adoption of WIL LSR and the measured LSR. The distance values presented here are independent in Table 2.1.

Appendix B4

Excerpt of Operational Ground-borne Noise Mitigation Measures Plan (Batch 4 – Lee Wing Building) (March 2017)

MTR Corporation Limited

Shatin to Central Link – Tai Wai to Hung Hom Section

Operational Ground-borne Noise Mitigation Measures Plan – Batch 4

(March 2017)

Verified by: Fredrick Leong

Position: Independent Environmental Checker

Date: 7 Mar. 2017

MTR Corporation Limited

Shatin to Central Link –
Tai Wai to Hung Hom Section

Operational Ground-borne Noise Mitigation Measures Plan – Batch 4

(March 2017)

Certified by: Felice Wong

Position: Environmental Team Leader

Date: 7 March 2017

AECOM

MTR Corporation Limited

Consultancy Agreement No. C11033

Shatin to Central Link - Tai Wai to Hung Hom Section [SCL(TAW – HUH)] and Stabling Sidings at Hung Hom Freight Yard [SCL(HHS)]

Operational Ground-borne Noise Mitigation Measures Plan (Batch 4 – Lee Wing Building)

March 2017

	Name	Signature
Prepared & Checked:	Angela Tong	Angela
Reviewed & Approved:	Josh Lam	Angela

Version:	A	Date:	6 March 2017

AECOM Asia Co. Ltd.
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Table of Content

Page

List of Tables

List of Figures

Appendices

1 INTRODUCTION

1.1 Background

1.1.1 The Shatin to Central Link (SCL) is a 17km extension of the existing 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 Reports for SCL – Tai Wai to Hung Hom Section [SCL (TAW-HUH)] (Register No. AEIAR-167/2012) and SCL Stabling Sidings at Hung Hom Freight Yard [SCL (HHS)] (Register No. AEIAR-164/2012) were approved on 17 February 2012 under the *Environmental Impact Assessment Ordinance (*EIAO). Following the approval of the EIA Reports, the Environmental Permit (EP) (EP No: EP-438/2012), covering the construction of both SCL (TAW-HUH) and SCL (HHS), was granted on 22 March 2012. Variations of Environmental Permit (VEP) were subsequently applied for EP-438/2012 and the latest Environmental Permit (EP No: EP-438/2012/K) was issued by Director of Environmental Protection (DEP) on 4 October 2016.

1.1.3 Pursuant to EP Condition 2.27, the Permit Holder, MTR Corporation Ltd (MTR), shall deposit with the Director of Environmental Protection (DEP), no later than one month after completion of corresponding parts of the tunnel excavation of the SCL(TAW-HUH) Section (hereinafter referred to as “the Project”), an Operational Ground-borne Noise Mitigation Measures Plan (OGNMMP) to justify the adequacy of the operational ground-borne noise mitigation measures for the Project. The OGNMMP shall include the review and verification of the assumptions adopted in the approved SCL(TAW-HUH) EIA Report (Register No. AEIAR-167/2012) and SCL(HHS) EIA Report (Register No. AEIAR-164/2012), such as line source response (LSR) and ground vibration conditions, and shall also include justifications and recommendations for any contingency noise mitigation measures found necessary, including but not limited to resilient baseplates (type 1) and isolated slab track (type 4).

1.1.4 Since the tunnel excavation of the Project will be completed in different phases, testing on the LSR and ground vibration conditions will be conducted in phases according to the excavation programme.

1.1.5 The prediction methodology recommended by the FTA Manual[1] was adopted in the EIA studies and most of correction factors are based on the international guideline except LSR of which values are site specific and are subject to the ground materials, depth of the tunnel and the rock head. During the EIA stage, in situ line source response measurement was not conducted. As part of the review and verification of the assumptions adopted in the ground-borne railway noise impact assessment, it is proposed that line source response and ground vibration conditions will be reviewed and verified by the on-site measurement.

1.1.6 AECOM Asia Co. Ltd has been commissioned by the MTR to conduct the LSR test according to the Testing and Review Methodology Plan (T&RMP) (**Appendix A**). According to the T&RMP, the LSR test will be conducted at Upper Wong Tai Sin Estate - Wing Sin House (DIH-P1-1), Kai Ching Estate – Mun Ching House (KAT-P1-5), Residential Premises near KAT (KAT-P1-7) and Lee Wing Bldg (HOM-2-2). The impact test at Mun Ching House (KAT-P1-5), planned residential development near KAT (KAT-P1-7), Upper Wong Tai Sin Estate - Wing Sin House (DIH-P1-1) in February, April and August 2016 respectively. The last impact test was conducted at Lee Wing Building (HOM-2-2) on 10 February 2017.

(1) Federal Transit Administration of U.S. Department of Transportation “Transit Noise and Vibration Impact Assessment ”, 2006

1.2 Purpose of This OGNMMP

1.2.1 This OGNMMP (Batch 4) presents the LSR analysis based on the results of the impact test conducted at Lee Wing Building (HOM-2-2) and the operational ground-borne noise prediction at HOM-2-2 based on measurement results.

1.3 Report Structure

1.3.1 This Test Proposal comprises the following sections:

- Section 1 presents the background information.
- Section 2 describes the details of impact test and the prediction of LSR based on the measurement results.
- Section 3 presents the LSR analysis and operational ground-borne noise prediction results.
- Section 4 presents the conclusion.

2 IMPACT TESTING AND PREDICTION OF LSR

2.1 Testing Location

2.1.1 The forth impact test was conducted at Lee Wing Building (HOM-2-2) on 10 February 2017. The information of the measurement location at the selected NSR are summarised in **Table 2.1** and the testing locations are shown in **Figure C11033/C/SCL/ACM/M53/007**.

Table 2.1 Measurement and Testing Location

NSR		Predicted Night-time Ground-borne Noise Levels in the EIA Report, dB(A)	Measurement Location(1)		Ground Type	Location of Hammer Impact Test (Approx. Tunnel Depth)	Testing Date
ID	Description		Approx. Hori. Distance from the Tunnel, m	Approx. Slant Distance (From Ground Level to Track Level), m			
HOM-2-2	Lee Wing Building	41	8 (up track)	24 (up track)	Rock	Up Track Tunnel (-11mPD)	10 Feb 2017

Notes:
(1) Measurement location at the selected NSR is shown in **Figure C11033/C/SCL/ACM/M53/007**.

2.2 Testing Instrumentations

2.2.1 The impact force levels applied within the tunnel were measured using a SINUS Harmonie connected to a laptop computer and vibration velocity levels on the ground were measured using a Brüel & Kjær PULSE connected to a laptop computer. Wilcoxon seismic accelerometers were used on the ground surface. Details of the instruments used are provided in **Table 2.2** and the calibration records of the instruments are provided in **Appendix B**.

Table 2.2 Instrumentation of the Hammer Impact Test

Instrument	Manufacturer / Model No.	Purpose
Pneumatic Hammer and Air Compressor	WM model S	Connection to compressed air to induce force (impact) at about 250kN
Impact Controller	WM type 1	Connection to pneumatic hammer to control impact on/ off
Analyzer Platform	Brüel & Kjær PULSE; Sinus Harmonie	Spectrum analyzers for data acquisition
Accelerometer	Wilcoxon Research 731-207 and 731A-P31	Vibration transducers to measure vibration
Force transducer	Lorenz K-18	Fitted to pneumatic hammer to measure impact force

2.3 Testing and Measurement Procedures

2.3.1 The testing and measurement procedures are summarised below:

- The test was carried out during night time when background vibration levels are medium due to the nearby traffic. All construction works inside tunnel and the adjacent tunnel were suspended during the testing.
- The impact hammer hit on the tunnel invert and it applied measured impact forces within the tunnel. The measured impact forces were logged by the FFT spectrum analyzer. For each

location of accelerometer, impact point was applied minimum 10 hits at around 250kN(2) on the concrete invert.

- Meanwhile, accelerometers were mounted on the ground and inside the building of Lee Wing Building. The impact hammer in the tunnel hit on the tunnel invert at different horizontal distances (5m, 10m, 20m, 30m, 40m and 60m) from the first impact point (i.e. 0m). Site photos taken during the measurement are shown in **Appendix C**.
- The impact force in tunnel and the vibration levels on the ground were recorded by the two separated spectrum analyzers. Measurement signals were recorded in narrow band frequencies from 6.3Hz to 500Hz.
- The furthest impact point in the tunnel was made up to 60m horizontal distance from the zero meter impact point. Reading also indicated that the responses of impact signals at 60m horizontal distance were weak and cannot be identified. Hence the impact signals at further distances over 60m would be much lower which are insignificant to the overall result, and testing on the measurement point over 60m from the impact point were not executed.

2.4 Prediction of Line Source Response

2.4.1 The vibration response induced by a unit point source impact was obtained from the hammer impact test and the best fit curves were calculated to determine the LSR at NSR HOM-2-2 Lee Wing Building (rock type ground property referring to the geological profile) along the SCL alignment.

2.4.2 The post-processing of measurement data was taken to determine the best fit curves of PSR with respect to the setback distances, and the depth between the impact source and the receivers. The LSR [TM_{line}, dB] is then determined by numerical integration with the formula(3) as shown below, of the Point Source Response (PSR, TM_{pi}) along the length of the train centred on the receiver, while PSR is determined from impacting within the tunnel.

$$TM_{\text{line}} = 10 \times \log_{10}\left[h \times \left(\frac{10^{\frac{TMp1}{10}}}{2} + 10^{\frac{TMp2}{10}} + \cdots + 10^{\frac{TMpn-1}{10}} + \frac{10^{\frac{TMpn}{10}}}{2} \right) \right]$$

Where

H	=	Impact interval (m) (interval varying from 5m to 20m)
TMpi	=	Point source transfer mobility for ith impact location (dB)
n	=	Last impact location

2.4.3 The calculation of LSR follows the calculation outlined in paragraph 11.3.2 Analysis of Transfer Mobility Data in FTA Manual(4). The measured PSR and the determined LSR are presented in **Appendices D** and **E** respectively.

2.4.4 A total of three measurement points including Point A (indoor), Point B (indoor) and Point C (outdoor) were set up. However, only Point A is adopted to determine the LSR as Point B was influenced by electro-magnetic wave induced by elevator at the lobby while the vibration response of Point C was weak and cannot be identified. It is considered that the measurement results at Point B and C are not appropriate to be used in the ground-borne noise calculation.

(2) As mentioned in T&RMP, 400kN is only the design force of the impact machine and the actual output force in fact depends on the machine status and on-site condition.
(3) Federal Railroad Administration of U.S. Department of Transportation "High-Speed Ground Transportation Noise and Vibration Impact Assessment", 2012
(4) Federal Transit Administration of U.S. Department of Transportation "Transit Noise and Vibration Impact Assessment ", 2006

3 REVIEW OF OPERATIONAL GROUND-BORNE NOISE PREDICTION

3.1 LSR Adopted in the Approved EIA Report

3.1.1 The LSR determines the vibration levels or attenuation in the ground as a function of distance caused by an incoherent line source of unit force point impacts.

3.1.2 The LSR values adopted in ground-borne noise assessment of SCL (TAW-HUH) and SCL (HHS) EIA Report were referenced from the data of the West Island Line (WIL) EIA Study (EIA Register No. AEIAR-126/2008). The LSR for WIL EIA Study were determined based on the results of borehole impact tests performed in rock, soil and close to the rock head both on the soil side and the rock side, with receiver vibration data taken on surface at various setback distances.

3.2 Review of LSR Values

3.2.1 The test carried out at the Lee Wing Building (HOM-2-2) was specifically aimed at determining the LSR values for vibration propagating through the ground of rock type.

3.2.2 The LSR values determined at Lee Wing Building (HOM-2-2) are compared with those used in the SCL EIA study for the same area and the same ground conditions (**Table 3.1** refers). The EIA LSR values are shown in **Appendix F**. To allow a better comparison, **Appendix G** shows the LSR value determined at measurement locations at a distance similar to EIA study. A summary of observation is presented in **Table 3.1**.

Table 3.1 Comparison between Measurement Data and WIL Data

ID	Location	LSR data adopted in EIA Study	Observation
HOM-2-2	Lee Wing Building	Up track: WIL D012 Rockhead Depth=34m Hole Depth=18m Slant Distance=19m Down track: WIL D002 Rockhead Depth=24m Hole Depth=20m Slant Distance=30m	Measured LSR values at both 19m & 30m are lower than the EIA LSR values at low frequency bands below 63Hz and are of similar magnitude at 100Hz to 200Hz. At high frequency band 315Hz, the measured LSR are slightly higher than the EIA LSR.

3.3 Operational Ground-borne Noise Prediction

3.3.1 Ground-borne noise assessment at HOM-2-2 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 Reports. The prediction results are summarised in **Table 3.2**. Sample calculation is given in **Appendix H**.

Table 3.2 Ground-borne Noise Prediction Results

Location	GBNSR	Description	EIA Prediction (unmitigated scenario), dB(A)		New Prediction (unmitigated scenario, based on measured LSR data), dB(A)		Criterion, dB(A)		Difference Between EIA and New Prediction, dB(A)
Ho Man Tin	HOM-2-2	Lee Wing Building	Lmax	52	Lmax	45	Lmax	-	-
			Daytime $L_{eq,30min}$	44	Daytime $L_{eq,30min}$	37	Daytime $L_{eq,30min}$	55	-7
			Night-time $L_{eq,30min}$	41	Night-time $L_{eq,30min}$	34	Night-time $L_{eq,30min}$	45	-7

3.3.2 Results indicate that the measured LSR values at actual ground condition would give lower ground-borne noise levels than EIA predictions which are also below the noise criteria.

3.3.3 The preliminary update of prediction calculation shows no further mitigation measures such as trackform upgrade is required around the NSR HOM-2-2.

3.4 Review of Other Assumptions

3.4.1 The following assumptions adopted in the EIA Reports will be reviewed and the ground-borne noise prediction for SCL(TAW-HUH) will be updated based on all measured LSR results where applicable in the Final OGNMMP and the latest available information:

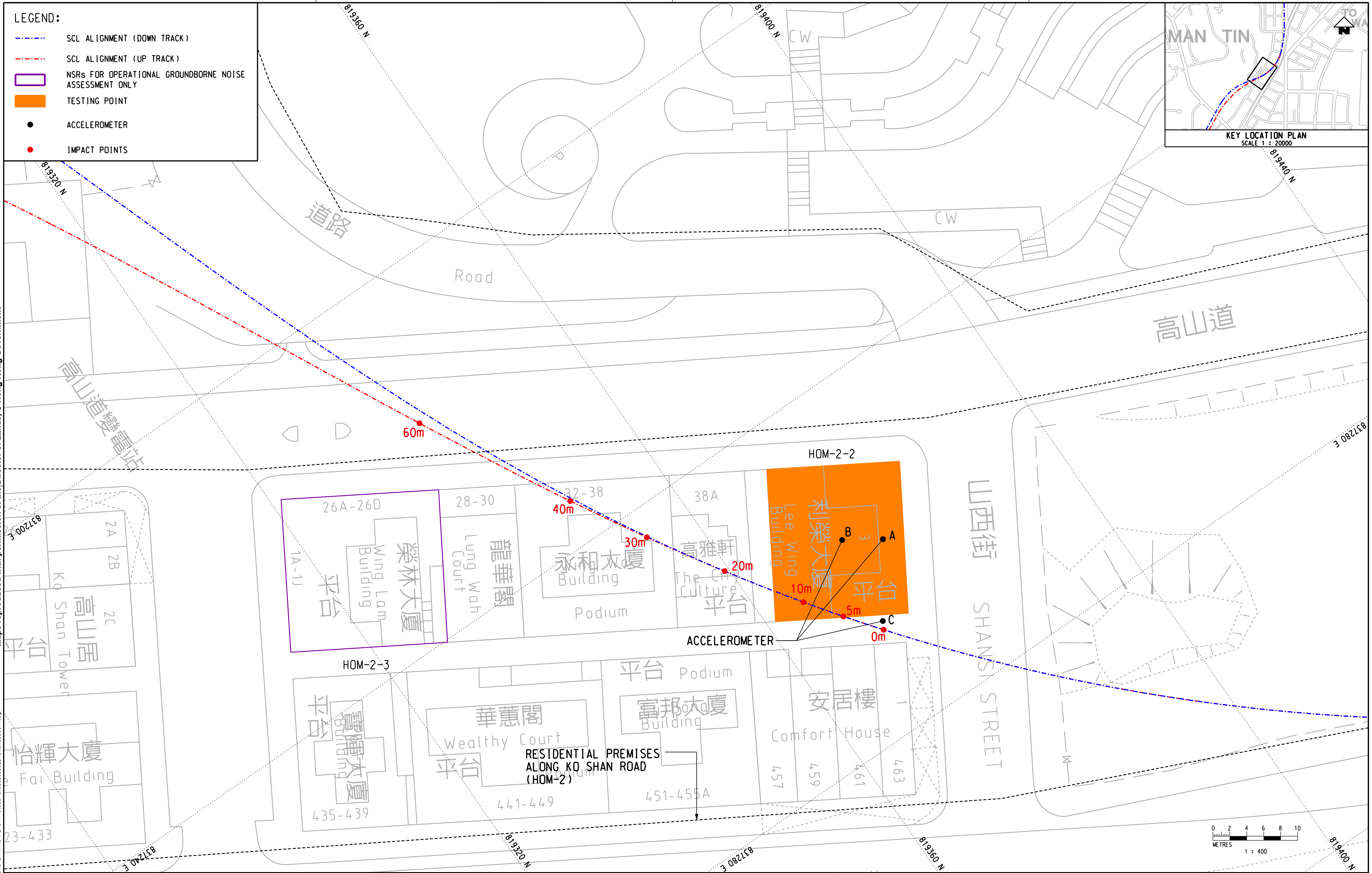
- Tunnel Coupling Loss (TCL) and Building Coupling Loss (BCL) – these factors depend on whether the tunnel and building (or building piles) are in rock or soft ground. Updated building information, if any, will be reviewed.
- Geological Profile – updated geological profile along the alignment, if any, will be reviewed.
- Speed – updated speed profile along the alignment, if any, will be reviewed.
- Turnout Adjustment – updated information, if any, on the type of turnouts to be used and the adjustment corresponding to corresponding type of turnouts will be reviewed.

4 CONCLUSION

4.1.1 The measurement of ground LSR values has been conducted at Lee Wing Building (HOM-2-2) to check the suitability of the LSR assumptions adopted in the EIA stage for rock ground type.

4.1.2 The measured LSR values result in ground-borne noise levels which are lower than the EIA predictions at HOM-2-2.

4.1.3 The assumptions adopted in the EIA Reports will be further reviewed and the ground-borne noise prediction for SCL(TAW-HUH) will be updated based on all measured LSR results where applicable in the Final OGNMMP and the latest available information.



DRAWN	XH
DESIGNED	LCLL
CHECKED	LCLL
APPROVED	IMW
DATE	22/FEB/2017

DO NOT SCALE DRAWINGS. ALL DIMENSIONS SHALL BE VERIFIED ON SITE.

MTR

SHATIN TO CENTRAL LINK

ORIGINATOR

AECOM

CADD REF. C11033_C_SCL_ACM_M53_007A.dgn

TITLE

C11033

SCL (TAW - HUH)

LOCATIONS OF MEASUREMENT POINTS AT NSR HOM-2-2

SCALE 1 : 400 (A3)

FIGURE NO. C11033/C/SCL/ACM/M53/007

REV. A

REV	DESCRIPTION	BY	DATE	APPROVED	REV	DESCRIPTION	BY	DATE	APPROVED

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MODELNAME: MODEL PRINTED BY: ZENGFX 2017/2/28 16:14:13
FILENAME: P:\projects\60273419\DRAWING\REPORT\C11033_C_SCL_ACM_M53_007A.dgn

Appendix C

Photo records of Measurement at HOM-2-2

Appendix C - Photo records of Tunnel Impact test at HOM-2-2

To Kwa Wan - Lee Wing Building (HOM-2-2)

Measurement Date: 10 Feb 2017
Measurement Time: 01:00am to 6:00am 10 Feb 2017

Hammer Impact Test in the Tunnel

Point A (Indoor)

Point B (Indoor)

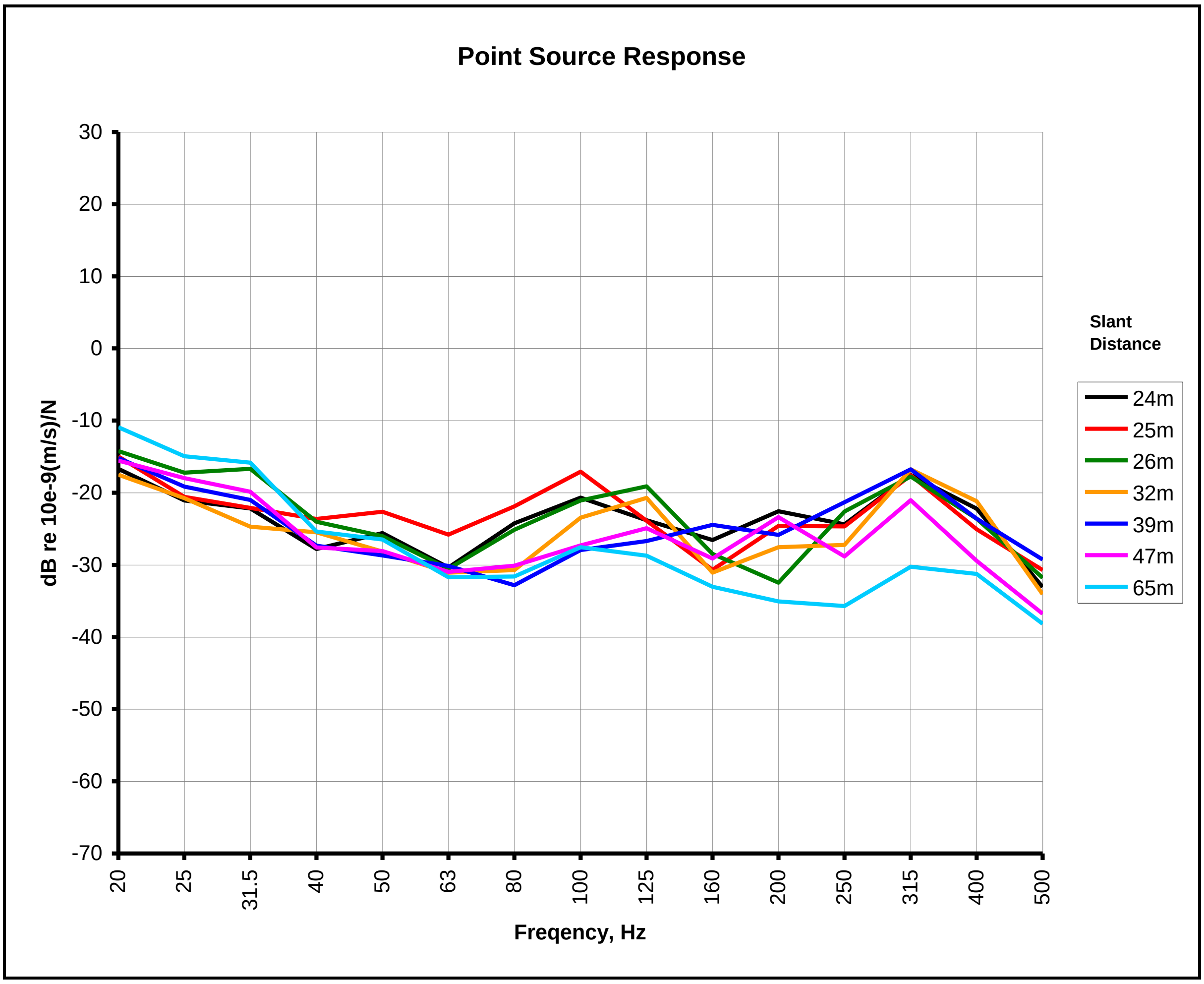
Point C (Outdoor)

Accelerometer on ground level

Appendix D

Measured Point Source Responses at HOM-2-2

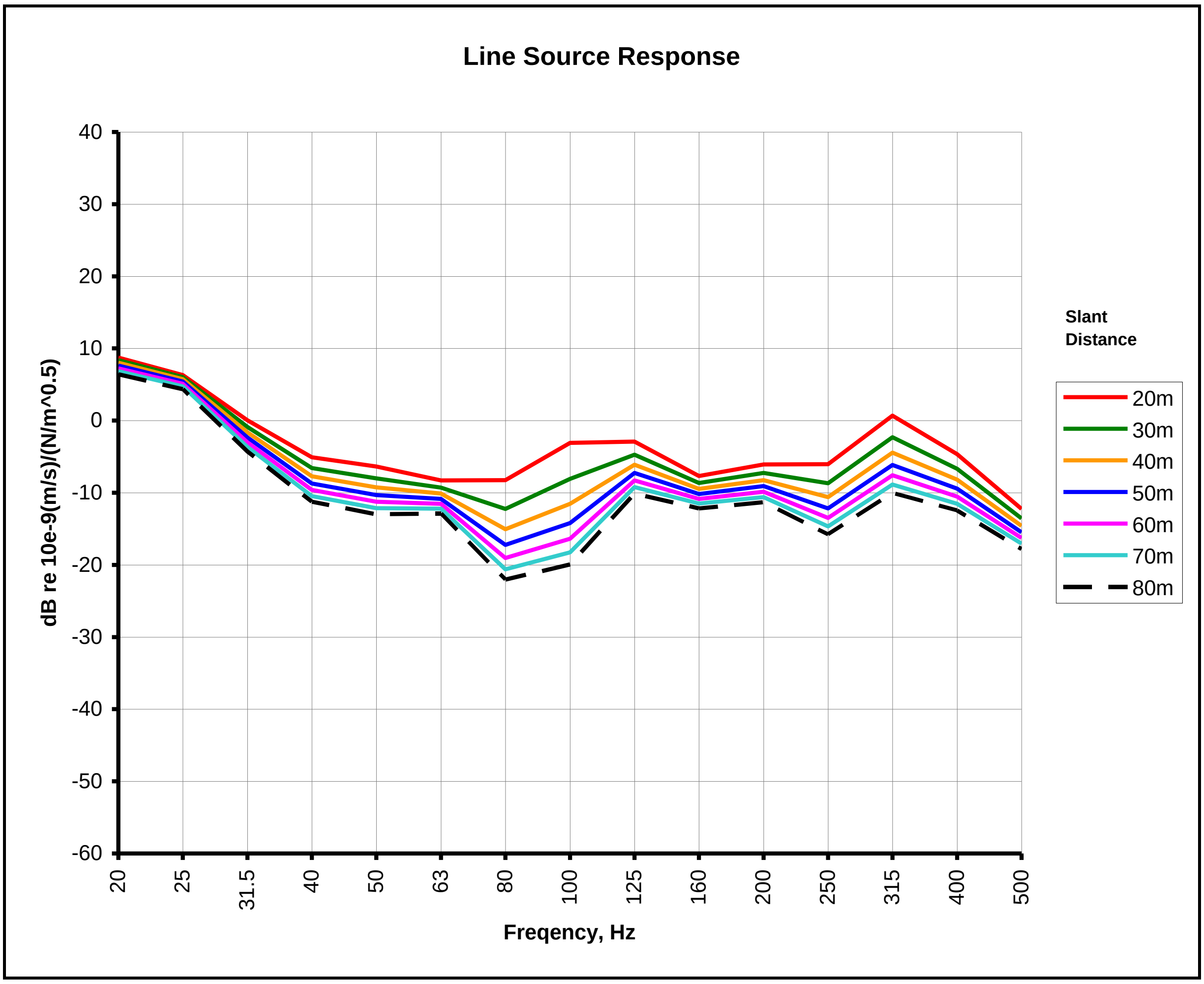
HOM-2-2


Point Source Response
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
dB re 10e-9(m/s)/N
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
Freqency, Hz
Slant Distance
24m
25m
26m
32m
39m
47m
65m

Appendix E

Determined Line Source Responses at HOM-2-2

HOM-2-2



Line Source Response
40
30
20
10
0
-10
-20
-30
-40
-50
-60
dB re 10e-9(m/s)/(N/m^0.5)
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
Freqency, Hz
Slant
Distance
20m
30m
40m
50m
60m
70m
80m

Appendix F

Line Source Responses Adopted in SCL EIA (Appendix 9.5 of SCL(TAW-HUH) EIA Report

Appendix 9.5: Line Source Response Values Obtained from West Island Line EIA Study

Figure A LSR from WIL Borehole D002 (Rock Head Depth 24m, Hole Depth 20m)

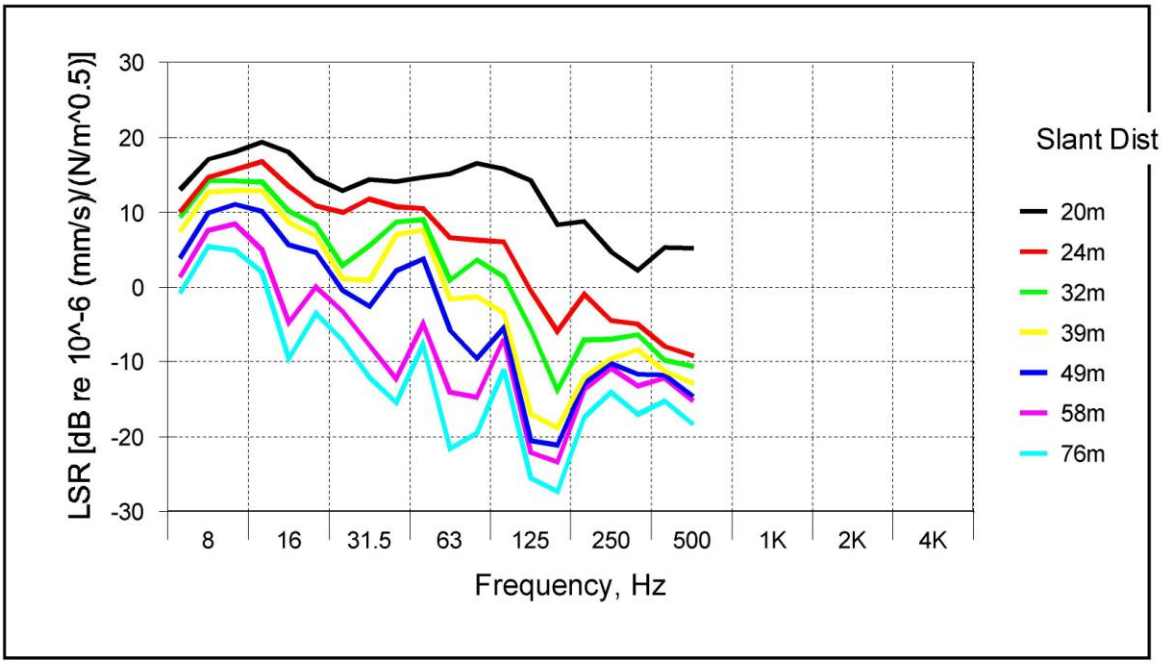


Figure B LSR from WIL Borehole D002 (Rock Head Depth 24m, Hole Depth 34m)

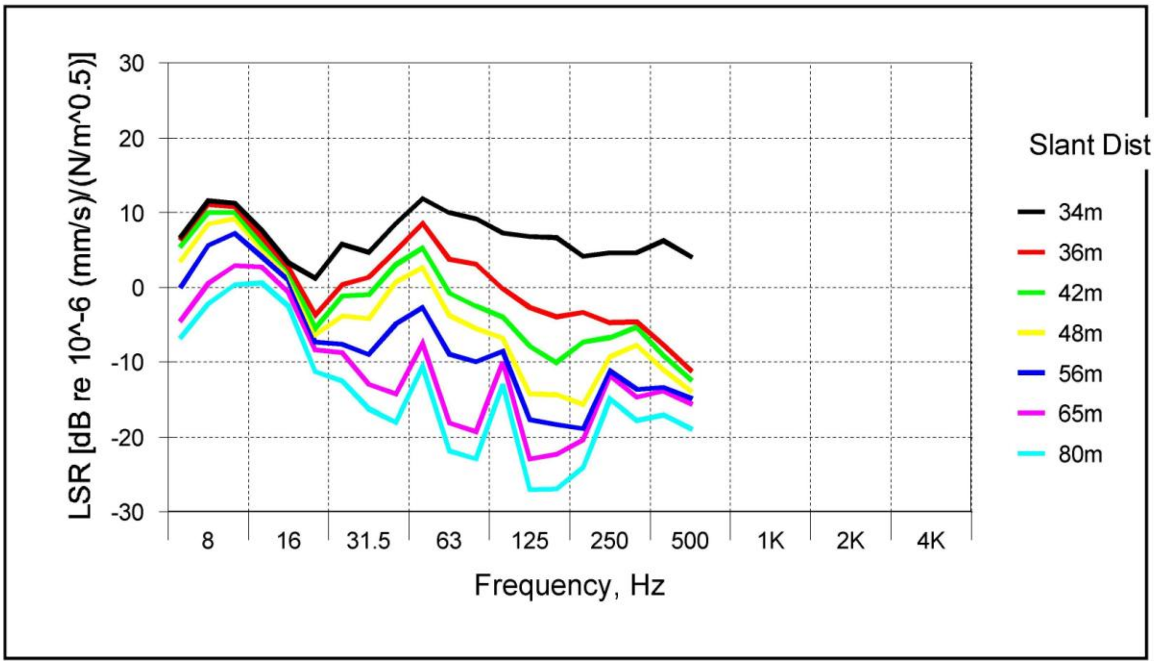


Figure C LSR from WIL Borehole D012 (Rock Head Depth 34m, Hole Depth 18m)

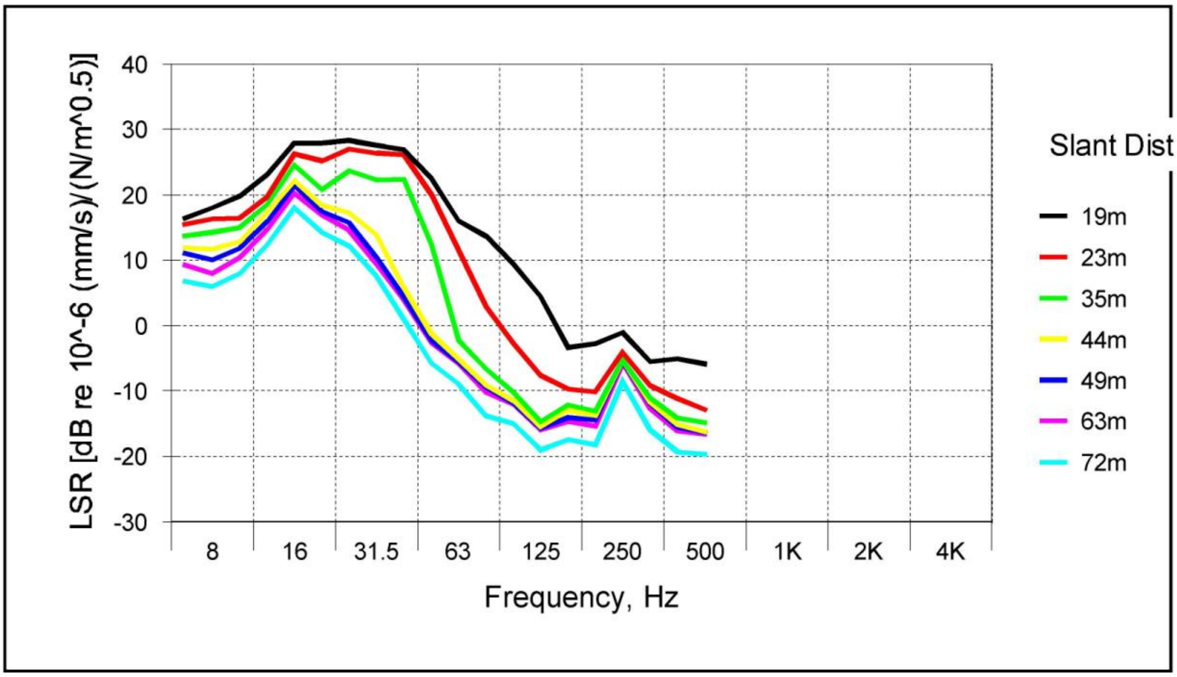


Figure D LSR from WIL Borehole D012 (Rock Head Depth 34m, Hole Depth 41m)

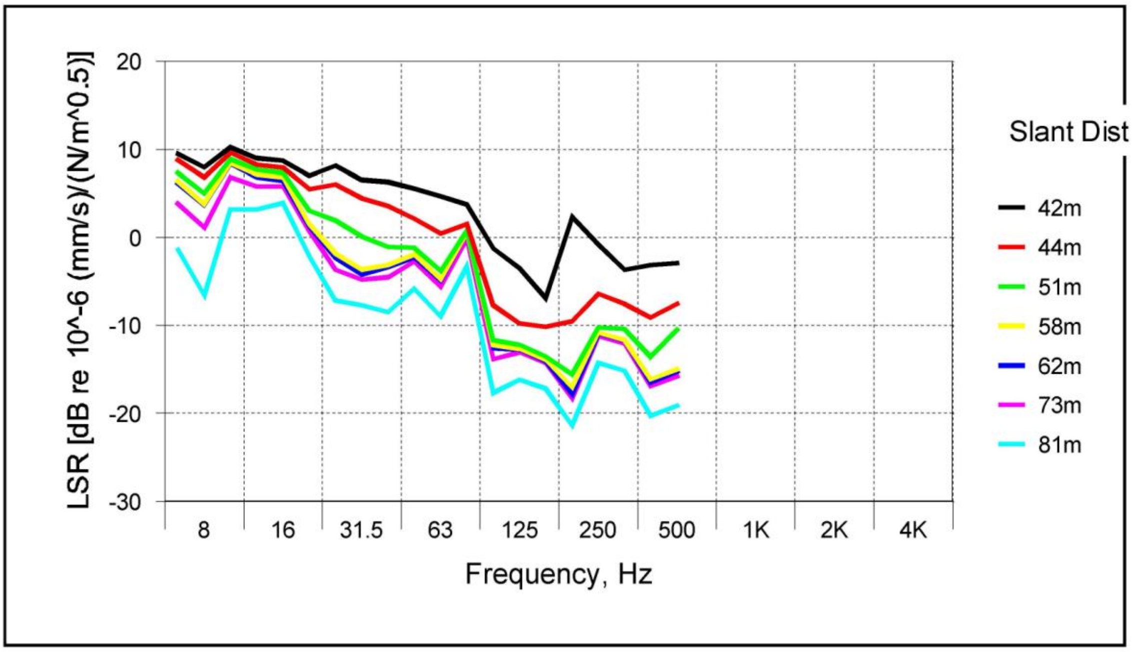


Figure E LSR from WIL Borehole D018 (Rock Head Depth 28m, Hole Depth 15m)

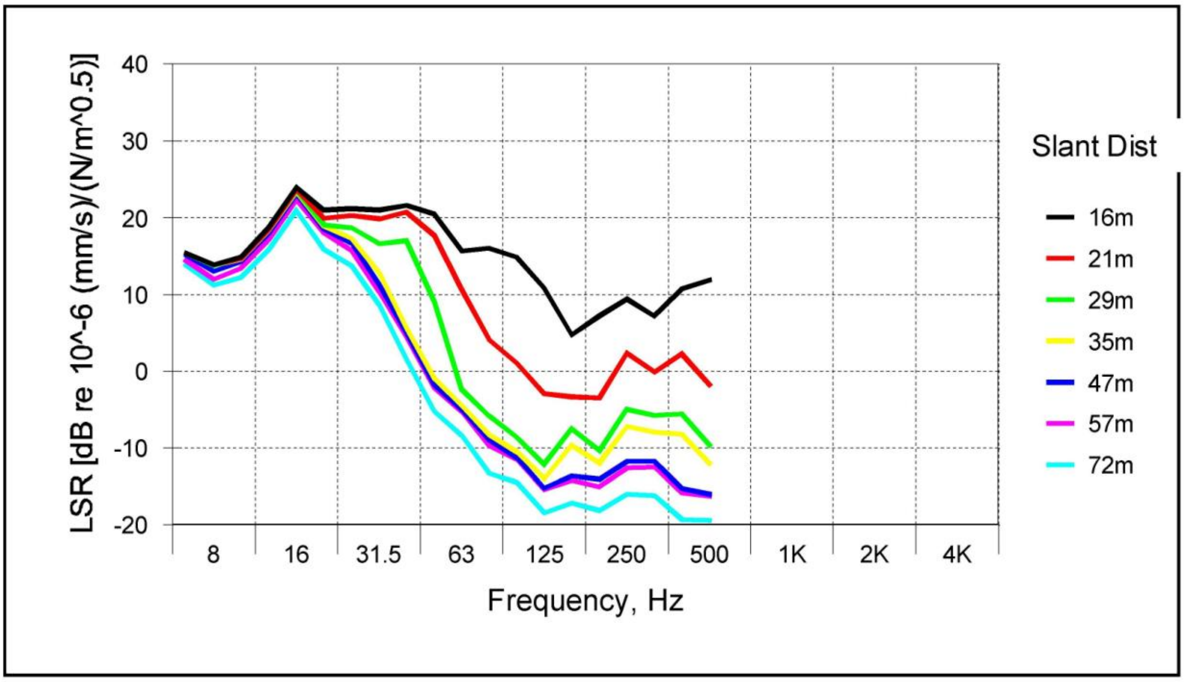


Figure F LSR from WIL Borehole D018 (Rock Head Depth 28m, Hole Depth 40m)

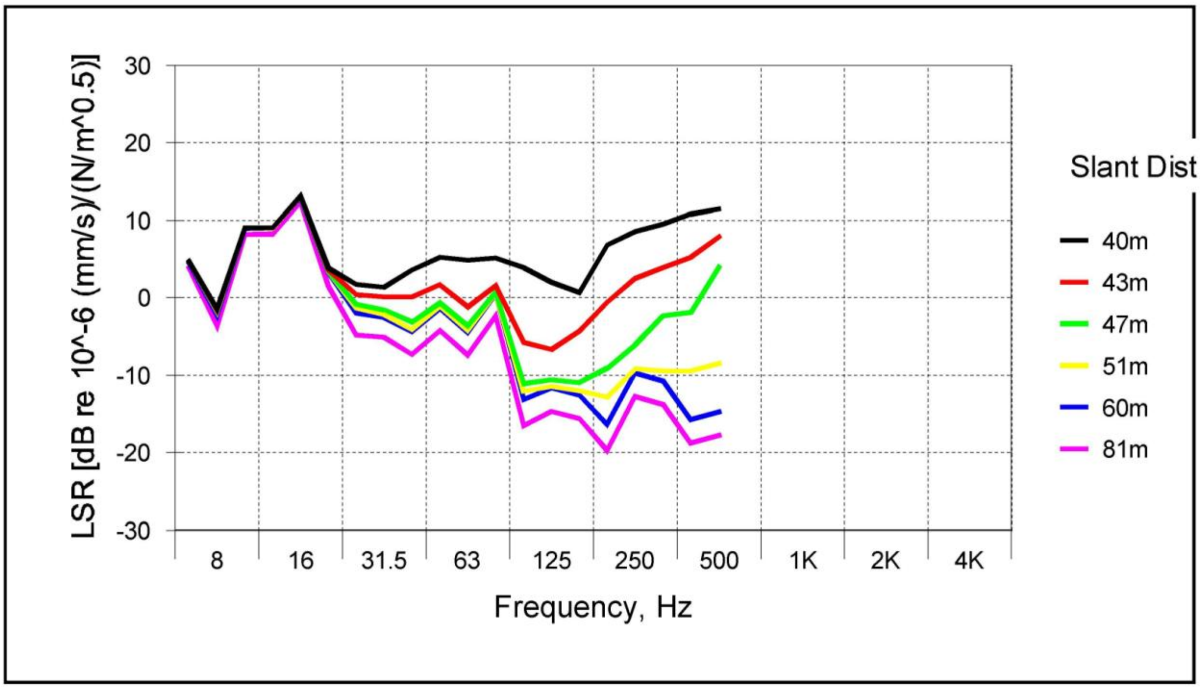
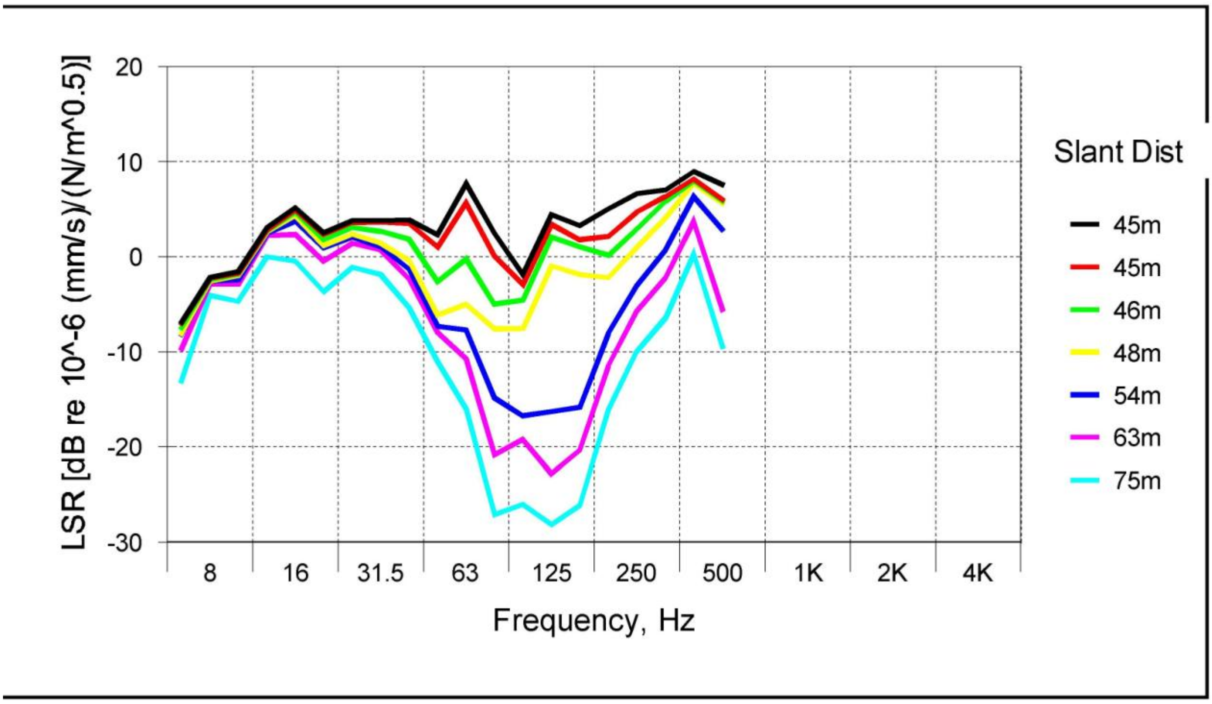


Figure G LSR from WIL Borehole D028 (Rock Head Depth 22m, Hole Depth 44m)

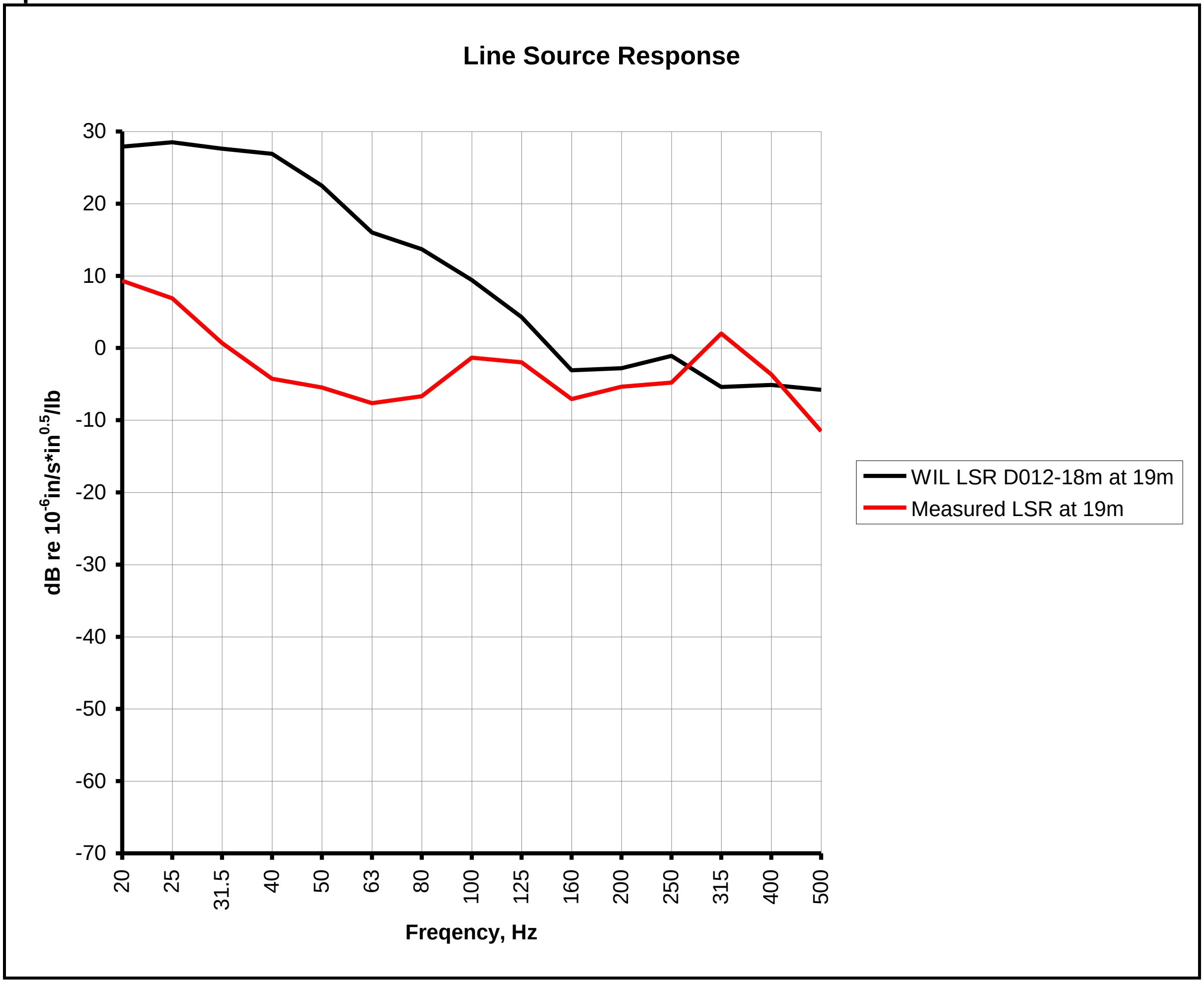


Appendix G

Comparison of Measured and EIA Line Source Responses

Comparison between the LSR adopted in the EIA and Measured LSR at HOM-2-2

Up Track Calculation



Down Track Calculation

Appendix H

Updated Calculations of Ground-borne Noise Prediction

HOM-2-2 Updated EIA Calculation by Measured LSR

Project:	Shatin Central Link Rail Operational GBN Assessment		**Train Speed:**	55 kph
NSR Ref.:	HOM-2-2			
Location:	Lee Wing Building			
Assessed Floor	2			
Item:	91			

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	0	19	19
Down Track	0	30	30

Selected Borehole Details:

	Borehole Ref.	Rockhead Depth, m	Hole Depth, m	Slant Dist, m
Up Track	D012	34	18	19[1]
Down Track	D002	24	20	30[1]

Description	Unit		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
			Frequency (Hz)														
Up Track Calculation																	
FDL	dB re 1 lb/in$^{0.5}$		33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB Y/N	N															
TIL	dB Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb		9.3	6.9	0.7	-4.3	-5.5	-7.7	-6.7	-1.3	-2.0	-7.1	-5.4	-4.8	2.0	-3.7	-11.5
Up Track Vib. Level	dB re 10^{-6}in/sec		42.5	44.1	36.9	30.0	27.8	29.6	33.6	39.9	39.3	30.2	30.9	30.4	34.3	29.6	18.7
Down Track Calculation																	
FDL	dB re 1 lb/in$^{0.5}$		33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB Y/N	N															
TIL	dB Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb		8.8	6.5	-0.4	-6.1	-7.5	-8.9	-11.3	-7.0	-4.2	-8.2	-6.8	-7.9	-1.5	-6.1	-13.1
Down Track Vib. Level	dB re 10^{-6}in/sec		42.1	43.8	35.8	28.2	25.8	28.4	29.0	34.2	37.1	29.0	29.4	27.3	30.8	27.2	17.2
Total of Up and Down Tracks Calculation																	
Total Vibration Level Outside Building			45.3	47.0	39.4	32.2	29.9	32.0	34.8	40.9	41.3	32.6	33.2	32.2	35.9	31.6	21.0
BCF	dB Y/N	0															
BVR-up	dB Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB		6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Predicted Noise Level	1/3 Oct, dB		**59.3**	**61.0**	**53.4**	**46.2**	**43.7**	**45.4**	**48.0**	**53.9**	**54.1**	**44.6**	**44.2**	**42.2**	**44.9**	**40.3**	**29.7**
Predicted Noise Level	Oct, dB				**61.8**			**50.9**			**57.3**			**48.7**			**40.6**
L_{max}	dB(A)		**44.8**														
$L_{eq,30mins}$	dB(A)		**34.0**														
Noise Criteria	dB(A)		**45**														
Compliance			**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the same or the next available smaller borehole depth. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

The following abbreviations are used in the above calculation:

- L : Ground borne noise level within the structure
- FDL : Force density level for the KCR SP1900 EMU
- LSR : Unit force incoherent line source response for the ground
- TIL : Trackform attenuation or insertion loss, relative level
- TCF : Vibration coupling between the tunnel and the ground for soil based tunnels, relative level
- BCF : Vibration coupling loss factor between the soil and the foundation, relative level
- BVR : Building vibration reduction or amplification within a structure from the foundation to the occupied areas, relative level
- CTN : Conversion from floor and wall vibration to noise
- TOC : Turnout and Crossover Factor
- SAF : Safety margin to account for wheel/rail condition and projection uncertainties

Remark:
(1) The slant distance in Table 2.1 of this Plan is the measured distance in the testing, while the horizontal and slant distances in this calculation are adopted from the previous EIA calculation for a like-to-like comparison in order to facilitate the comparison of the results between adoption of WIL LSR and the measured LSR. The distance values presented here are independent in Table 2.1.

Annex C

Summary of Updated Operational Ground-borne Noise Assessment Results

Annex C - Operational Groundborne Noise Assessment Results

Project: SCL (TAW-HUH) SCL (HHS)

Item	NSR	Location	Floor	Horizontal Distance		Vertical Distance		Reference LSR[2]		TCF[4]	TOC[5]		Track Type[6]		CCF	BCF	L_{max}[7]	Speed[8]	Passby Duration	SEL[9] 1UP&DN	Train Freqency	Predicted $L_{eq\ 30min}$ (dB(A))				Cumulative Noise Level (dB(A))	NCO Criteria (Nighttime)	Criteria Achieved?
				Up Track (m)	Down Track (m)	Up Track (m)	Down Track (m)	Up	Down		Up	Down	Up	Down				kph	(sec)	(dB(A))	no./30m/dir	SCL (TAW-HUH)	SCL (HHS)	SCL (MKK-HUH)	KTE			
1	DIH-1-1	Tsui Chuk Garden Block 5	1	0	0	80	80	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	45	95	7	56	6	31	---	---	---	31	45	Yes
2	DIH-2-1	Pak Yuen House	1	295	290	65	65	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	39	90	8	51	6	26	---	---	---	26	45	Yes
3	DIH-3-1	Wah Yuen House	1	102	100	50	50	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	42	90	8	53	6	29	---	---	---	29	45	Yes
4	DIH-3-2	Nga Yuen House	1	135	120	45	45	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	40	80	9	52	6	28	---	---	---	28	45	Yes
5	DIH-3-3	Kwai Yuen House	1	24	5	44	44	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	44	90	8	56	6	32	---	---	---	32	45	Yes
6	DIH-3-4	Chui Yuen House	1	55	50	45	45	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	42	80	9	54	6	30	---	---	---	30	45	Yes
7	DIH-4-1	Pang Ching Court	1	210	195	70	70	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	40	90	8	52	6	27	---	---	---	27	45	Yes
8	DIH-4-2	Carbo Anglo-Chinese Kindergarden	0	130	115	75	75	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	43	90	8	55	6	36[1]	---	---	---	36	55[3]	Yes
9	DIH-5-1	Rainbow Home	0	68	25	42	41	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	47	80	9	59	6	34	---	---	---	34	45	Yes
10	DIH-5-2	Residential premises	1	50	8	41	40	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	45	80	9	58	6	33	---	---	---	33	45	Yes
11	DIH-5-5	Our Lady's Kindergarden	0	121	85	40	40	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	43	80	9	55	6	36[1]	---	---	---	36	55[3]	Yes
12	DIH 6-1	WTS Fire Station and Quarters Block A	1	4	5	35	35	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	48	85	8	60	6	35	---	---	---	35	45	Yes
13	DIH-7-1	Tropicana Gardens Block 2	4	29	63	40	40	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	39	85	8	51	6	26	---	---	---	26	45	Yes
14	DIH-7-2	Tropicana Gardens Block 3	4	21	54	40	40	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	40	85	8	52	6	27	---	---	---	27	45	Yes
15	DIH-8-1	Redemption Lutheran Church	0	116	163	20	20	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	43	85	8	55	6	30	---	---	---	30	45	Yes
16	DIH-9-1	Shek On Building	0	118	156	25	25	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	43	80	9	55	6	36[1]	---	---	---	36	55[3]	Yes
17	DIH-10-1	Hong Kong Sheung Keung Hui Nursing Home	1	168	188	25	25	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	39	80	9	52	6	27	---	---	---	27	45	Yes
18	DIH-11-1	Lung Wan House	1	75	60	25	25	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	35	35	20	51	6	26	---	---	---	26	45	Yes
19	DIH-12-1	Galaxia Tower B	5	195	180	30	30	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	23	55	12	37	6	<20	---	---	---	<20	45	Yes
20	DIH-12-2	Galaxia Tower E	5	180	160	30	30	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	21	45	15	36	6	<20	---	---	---	<20	45	Yes
21	DIH-13-1	Canossa Primary School	0	160	200	25	25	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	42	85	8	54	6	35[1]	---	---	---	35	55[3]	Yes
22	DIH-14-1	Rhythm Garden Block 2	1	38	50	20	20	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	41	60	11	55	6	30	---	---	---	30	45	Yes
23	DIH-14-2	Rhythm Garden Block 5	1	30	43	18	18	KAT-P1-5	KAT-P1-5	B	0	0	0	0	N	N	32	60	11	45	6	21	---	---	---	21	45	Yes
24	DIH-14-3	Rhythm Garden Block 8	1	175	185	17	17	KAT-P1-5	KAT-P1-5	B	0	0	0	0	N	N	13	60	11	27	6	<20	---	---	---	<20	45	Yes
25	DIH-14-4	Canossa Primary School (San Po Kong)	1	145	160	20	20	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	37	60	11	51	6	32[1]	---	---	---	32	55[3]	Yes
26	DIH-14-5	Rhythm Garden Block 1	1	30	43	20	20	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	41	55	12	55	6	30	---	---	---	30	45	Yes
27	DIH-14-6	Rhythm Garden Block 3	1	45	56	19	19	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	41	60	11	54	6	29	---	---	---	29	45	Yes
28	DIH-15-1	Kam Wan House	0	100	85	25	25	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	41	60	11	54	6	29	---	---	---	29	45	Yes
29	DIH-15-2	Pik Hoi House	0	75	65	25	25	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	41	55	12	55	6	30	---	---	---	30	45	Yes
30	DIH-16-1	Wong Tai Sin Temple	0	22	35	36	36	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	46	85	8	58	6	33	---	---	---	33	45	Yes
31	DIH-17-1	Chuk Yuen United Village	0	21	63	30	30	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	46	85	8	58	6	33	---	---	---	33	45	Yes
32	DIH-18-1	Upper Wong Tai Sin Estate Po Sin House	1	15	30	30	30	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	45	85	8	57	6	33	---	---	---	33	45	Yes
33	DIH-18-2	Upper Wong Tai Sin Estate Tat Sin House	1	26	37	31	31	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	45	90	8	57	6	32	---	---	---	32	45	Yes
34	DIH-19-1	Lung Cheung Gov. Secondary School	0	38	55	24	24	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	46	90	8	58	6	39[1]	---	---	---	39	55[3]	Yes
35	DIH-20-1	Baptist Rainbow Primary School	0	95	80	45	45	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	45	90	8	57	6	38[1]	---	---	---	38	55[3]	Yes
36	DIH-21-1	Tin Wang Court Wang King House	1	25	45	45	45	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	46	90	8	58	6	33	---	---	---	33	45	Yes
37	DIH-22-1	Price Memorial Catholic Primary School	0	80	95	40	40	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	45	90	8	57	6	38[1]	---	---	---	38	55[3]	Yes
38	DIH-23-1	Tin Ma Court Chun On House	1	100	115	40	40	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	42	90	8	53	6	29	---	---	---	29	45	Yes
39	DIH-24-1	Shing Wong Temple	1	0	5	28	28	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	46	90	8	58	6	34	---	---	---	34	45	Yes
40	DIH-P1-1	Upper Wong Tai Sin Estate Phase 3	2	19	10	34	30	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	44	90	8	55	6	31	---	---	---	31	45	Yes
41	DIH-P3-1A	Planned receivers in the CDA site	2	30	10	26	26	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	35	60	11	49	6	24	---	---	---	24	45	Yes
42	DIH-P3-2A	Planned receivers in the CDA site	2	30	10	28	28	HOM-2-2	HOM-2-2	S	0	0	0	0	N	N	38	60	11	52	6	27	---	---	---	27	45	Yes
-	DIH-P3-4	Planned receivers in the CDA site	1	0	0	18	18	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	45	60	11	58	6	34	---	---	---	34	-	-
43	KAT-P1-1	Residential premises near Kai Tak Station	2	75	90	15	15	KAT-P1-5	KAT-P1-5	S	0	1	0	0	N	N	15	35	20	31	6	<20	---	---	---	<20	45	Yes

Annex C - Operational Groundborne Noise Assessment Results

Project: SCL (TAW-HUH) SCL (HHS)

Item	NSR	Location	Floor	Horizontal Distance		Vertical Distance		Reference LSR[2]		TCF[4]	TOC[5]		Track Type[6]		CCF	BCF	L_{max}[7]	Speed[8]	Passby Duration	SEL[9] 1UP&DN	Train Freqency	Predicted $L_{eq\ 30min}$ (dB(A))				Cumulative Noise Level (dB(A))	NCO Criteria (Nighttime)	Criteria Achieved?
				Up Track (m)	Down Track (m)	Up Track (m)	Down Track (m)	Up	Down		Up	Down	Up	Down				kph	(sec)	(dB(A))	no./30m/dir	SCL (TAW-HUH)	SCL (HHS)	SCL (MKK-HUH)	KTE			
44	KAT-P1-2	One Kai Tak	4	75	90	15	15	KAT-P1-5	KAT-P1-5	S	0	0	0	0	N	N	8	50	14	22	6	<20	---	---	---	<20	45	Yes
45	KAT-P1-3	Residential premises near Kai Tak Station	2	55	70	15	15	KAT-P1-5	KAT-P1-5	C	0	0	0	0	N	N	21	70	10	34	6	<20	---	---	---	<20	45	Yes
46	KAT-P1-4	Residential premises near Kai Tak Station	2	80	65	15	15	KAT-P1-5	KAT-P1-5	S	0	0	0	0	N	N	16	65	11	29	6	<20	---	---	---	<20	45	Yes
47	KAT-P1-5	Mun Ching House, Kai Ching Estate	1	13	25	14	14	KAT-P1-5	KAT-P1-5	B	0	0	0	0	N	N	42	60	11	56	6	31	---	---	---	31	45	Yes
48	KAT-P1-6	Tower H3, De Novo	1	93	80	15	15	KAT-P1-5	KAT-P1-5	C	1	1	0	0	N	N	26	55	12	40	6	<20	---	---	---	<20	45	Yes
49	KAT-P1-7	Residential premises near Kai Tak Station	2	0	0	20	20	KAT-P1-7	KAT-P1-7	C	0	0	0	0	N	N	48	75	9	61	6	36	---	---	---	36	45	Yes
50	TKW-1-1	Parc 22	1	85	90	13	20	KAT-P1-5	DIH-P1-1	B	0	0	0	0	N	N	37	70	10	50	6	25	---	---	---	25	45	Yes
51	TKW-1-2	Sanford Mansion	1	95	95	12	23	KAT-P1-5	DIH-P1-1	B	0	0	0	0	N	N	37	70	10	50	6	25	---	---	---	25	45	Yes
52	TKW-2-1	Skytower Tower 1	5	140	140	13	20	KAT-P1-5	DIH-P1-1	B	0	0	0	0	N	N	28	70	10	41	6	<20	---	---	---	<20	45	Yes
53	TKW-2-2	Skytower Tower 2	5	140	140	12	23	KAT-P1-5	DIH-P1-1	B	0	0	0	0	N	N	28	70	10	41	6	<20	---	---	---	<20	45	Yes
54	TKW-2-3	Skytower Tower 7	5	235	260	15	27	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	24	70	10	37	6	<20	---	---	---	<20	45	Yes
55	TKW-3-1	Prince Ritz	5	235	255	23	23	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	13	20	34	32	6	<20	---	---	---	<20	45	Yes
56	TKW-3-2	Prosperity House	2	250	270	23	23	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	26	45	15	41	6	<20	---	---	---	<20	45	Yes
57	TKW-P1-1	Residential premises near To Kwa Wan Station	1	35	15	22	22	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	35	45	15	50	6	25	---	---	---	25	45	Yes
58	MTW-6-1	Fok On Building	2	17.5	12	15	24	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	42	65	11	55	6	31	---	---	---	31	45	Yes
59	MTW-6-2	HK Society for the Protection of Children	0	10	17	15	24	KAT-P1-5	DIH-P1-1	B	0	0	0	0	N	N	47	65	11	60	6	41[1]	---	---	---	41	55[3]	Yes
60	MTW-6-3	Chung Nam Mansion	2	20	20	15	27	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	42	65	11	55	6	30	---	---	---	30	45	Yes
61	MTW-6-4	Pok Oi Lau	0	12	12	15	27	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	46	65	11	60	6	35	---	---	---	35	45	Yes
62	MTW-7-1	Geranium House	1	12.5	12.5	17	28	DIH-P1-1	HOM-2-2	B	0	0	0	0	N	N	46	65	11	59	6	34	---	---	---	34	45	Yes
63	MTW-8-1	Horae Palace	3	15	15	17	28	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	43	65	11	57	6	32	---	---	---	32	45	Yes
64	MTW-9-1	Majestic Park	3	35	35	18	30	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	40	65	11	53	6	29	---	---	---	29	45	Yes
65	MTW-10-1	18 Farm Road	3	15	15	18	30	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	43	65	11	56	6	32	---	---	---	32	45	Yes
66	MTW-11-1	Farm Road Government Primary School	0	65	65	18	30	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	44	65	11	57	6	38[1]	---	---	---	38	55[3]	Yes
67	MTW-12-1	Yuet Fai Mansion	1	11	11	22	33	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	47	65	11	60	6	35	---	---	---	35	45	Yes
68	MTW-12-2	Delight Court	3	17.5	17.5	20	30	DIH-P1-1	HOM-2-2	B	0	0	0	0	N	N	41	65	11	54	6	29	---	---	---	29	45	Yes
69	MTW-12-3	Lucky Mansion	3	15	15	20	30	DIH-P1-1	HOM-2-2	S	0	0	0	0	N	N	35	55	12	49	6	24	---	---	---	24	45	Yes
70	MTW-12-4	352-354 Ma Tau Wai Road	2	15	15	20	30	DIH-P1-1	HOM-2-2	S	0	0	0	0	N	N	34	40	17	49	6	24	---	---	---	24	45	Yes
71	MTW-12-5	Seng Cheong Building	1	17.5	17.5	18	29	KAT-P1-5	DIH-P1-1	B	0	0	0	0	N	N	39	50	14	54	6	29	---	---	---	29	45	Yes
72	MTW-12-6	Great Wall Building	3	30	30	18	30	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	41	65	11	54	6	30	---	---	---	30	45	Yes
73	MTW-12-7	197-199 Ma Tau Wai Road	2	15	15	18	30	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	45	65	11	58	6	34	---	---	---	34	45	Yes
74	MTW-12-8	Pak Tai Mansion	1	12	12	18	30	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	47	65	11	61	6	36	---	---	---	36	45	Yes
75	MTW-12-9	Residential premises along Hung Kwong Street	2	12	12	19	32	DIH-P1-1	HOM-2-2	B	0	0	0	0	N	N	43	65	11	57	6	32	---	---	---	32	45	Yes
76	MTW-12-10	Lucky Building	2	15	15	18	28	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	35	55	12	49	6	25	---	---	---	25	45	Yes
77	MTW-12-11	Jing Ming Building	2	19	19	20	30	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	34	50	14	48	6	23	---	---	---	23	45	Yes
78	MTW-12-12	One Elegance	3	12	12	18	30	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	43	65	11	57	6	32	---	---	---	32	45	Yes
79	MTW-13-1	Cheung Chuk Shan Memorial School	0	10	10	20	30	DIH-P1-1	HOM-2-2	S	0	0	0	0	N	N	43	65	11	56	6	37[1]	---	---	---	37	55[3]	Yes
80	MTW-14-1	PLK Lam Man Chan English Primary School	1	35	35	20	30	DIH-P1-1	HOM-2-2	S	0	0	0	0	N	N	37	55	12	51	6	32[1]	---	---	---	32	55[3]	Yes
81	MTW-15-1	Hung Hom Lutheran Primary School	0	10	10	20	30	DIH-P1-1	HOM-2-2	S	0	0	0	0	N	N	40	50	14	55	6	36[1]	---	---	---	36	55[3]	Yes
82	MTW-16-1	SKH Good Shepherd Primary School	0	10	10	20	30	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	38	45	15	53	6	34[1]	---	---	---	34	55[3]	Yes
83	MTW-17-1	Loyal Mansion	3	20	20	17	28	DIH-P1-1	DIH-P1-1	B	0	0	0	0	N	N	38	55	12	52	6	27	---	---	---	27	45	Yes
84	MTW-18-1	Residential premises along Chi Kiang St	2	45	45	17	27	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	32	50	14	47	6	22	---	---	---	22	45	Yes
85	MTW-18-2	No. 2 Kowloon City Road	2	28	28	17	27	DIH-P1-1	DIH-P1-1	S	0	0	0	0	N	N	33	50	14	48	6	23	---	---	---	23	45	Yes
86	MTW-19-1	Holy Trinity Church	0	55	65	18	25	KAT-P1-5	DIH-P1-1	B	0	0	0	0	N	N	38	55	12	52	6	27	---	---	---	27	45	Yes
87	HOM-1-1	Ko Shan Theartre	0	50	50	35	40	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	43	55	12	57	6	32	---	---	---	32	45	Yes
88	HOM-2-1	Faerie Court	2	20	20	18	29	DIH-P1-1	HOM-2-2	B	0	0	0	0	N	N	41	55	12	55	6	31	---	---	---	31	45	Yes
89	HOM-2-2	Lee Wing Building	2	0	0	24	34	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	43	55	12	57	6	32	---	---	---	32	45	Yes
90	HOM-2-3	Wing Lam Mansion	2	15	15	20	30	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	43	55	12	57	6	33	---	---	---	33	45	Yes
91	HOM-2-4	Tak Lee Court	1	50	55	35	45	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	42	60	11	56	6	31	---	---	---	31	45	Yes

Annex C - Operational Groundborne Noise Assessment Results

Project: SCL (TAW-HUH) SCL (HHS)

Item	NSR	Location	Floor	Horizontal Distance		Vertical Distance		Reference LSR[2]		TCF[4]	TOC[5]		Track Type[6]		CCF	BCF	L_{max}[7]	Speed[8]	Passby Duration	SEL[9] 1UP&DN	Train Freqency	Predicted $L_{eq\ 30min}$ (dB(A))				Cumulative Noise Level (dB(A))	NCO Criteria (Nighttime)	Criteria Achieved?
				Up Track (m)	Down Track (m)	Up Track (m)	Down Track (m)	Up	Down		Up	Down	Up	Down				kph	(sec)	(dB(A))	no./30m/dir	SCL (TAW-HUH)	SCL (HHS)	SCL (MKK-HUH)	KTE			
92	HOM-2-5	Chat Ma Mansion	1	45	45	20	30	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	42	55	12	56	6	31	---	---	---	31	45	Yes
93	HOM-2-6	Chatham Mansion	1	3	3	19	30	DIH-P1-1	HOM-2-2	B	0	0	0	0	N	N	45	55	12	58	6	34	---	---	---	34	45	Yes
94	HOM-3-1	Fook Sing Mansion	1	85	100	35	40	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	39	55	12	53	6	28	---	---	---	28	45	Yes
95	HOM-3-2	Marigold Mansion, Block A	1	85	110	45	45	HOM-2-2	HOM-2-2	B	0	0	0	0	N	N	39	55	12	53	6	28	---	---	---	28	45	Yes
96	HOM-4-1	Yee Fu Building	1	40	70	45	45	HOM-2-2	HOM-2-2	S	0	0	0	0	N	N	36	55	12	50	6	25	---	20[10]	<20	27	45	Yes
97	HOM-5-1	271 Chatham Road North	2	75	75	45	45	HOM-2-2	HOM-2-2	S	0	0	0	0	N	N	28	35	20	44	6	<20	---	20[10]	23	26	45	Yes
98	HOM-P2	HKPU Student Halls of Residence	1	35	65	45	45	HOM-2-2	HOM-2-2	S	0	0	0	0	N	N	35	50	14	50	6	25	---	<20	<20	27	45	Yes
99	HOM-P3-1	Residential Building, HOM Station Development	1	0	0	45	45	HOM-2-2	HOM-2-2	S	0	0	0	0	N	N	37	50	14	51	6	27	---	20[10]	36	37	45	Yes
100	HUH-1-1	Cartas Branchi College of Careers	0	95	125	30	30	HOM-2-2	HOM-2-2	S	0	0	0	0	N	N	34	45	15	49	6	30[1]	---	20[10]	26	32	55[3]	Yes
101	HUH-1-2	Lok Ka House	1	55	80	18	18	HOM-2-2	HOM-2-2	C	0	0	0	0	N	N	37	50	14	52	6	27	---	20[10]	<20	28	45	Yes
102	HUH-1-3	Wing Fung Building	1	10	25	18	18	KAT-P1-5	KAT-P1-5	C	0	0	0	0	N	N	37	60	11	51	6	26	<20	<20[11]	<20	29	45	Yes

Notes:

[1] A 3dB(A) upward adjustment is made to account for the daytime headway of 12 EMU trains within a 30 minutes period per direction.

[2] Reference LSR are measurement result taken at representative NSR.

[3] Daytime criteria are used for educational buildings, church and temple.

[4] TCF types : B - Bored tunnel, C - Cut and cover tunnel, S - Station

[5] TOC types : 0 - No turnouts, 1 - turnout, 2 - inclined turnout

[5] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate, Type 2 = Egg Type Baseplate, Type 3 = 12.5Hz FST.

[6] L_{max} has incorporated a +0.5dB(A) correction to passby L_{eq} based on previous study.

[7] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/V_{ref}), in line with FTA manual.

[8] Calculation based on 8-car train with 23.75m legth for each car.

[9] SEL calculations have incorporated a 3 dB correction factor for the leading and trailling effect.

[10] Noise levels are estimated from predicted noise level of adjacent NSR.

[11] Noise levels predicted in OGNMMP for SCL(MKK-HUH) under EP Condition 2.16 of EP-437/2012.

Annex C - Operational Groundborne Noise Assessment Results

Project: SCL (TAW-HUH) SCL (HHS)

Item	NSR	Location	Floor	Horizontal Distance		Vertical Distance		Reference LSR[1]		TCF[2]	TOC[3]		Track Type[4]		CCF	BCF	L_{max}[5]	Speed[6]	Passby Duration	SEL[7] 1UP&DN	Train Freqency	Predicted $L_{eq\ 30min}$ (dB(A))	NCO Criteria (Nighttime)	Criteria Achieved?
				Up Track (m)	Down Track (m)	Up Track (m)	Down Track (m)	Up	Down		Up	Down	Up	Down				kph	(sec)	(dB(A))	no./30m/dir	SCL (HHS)		
102	HUH-1-3	Wing Fung Building	1	45	-	0	-	KAT-P1-5	-	C	0	0	0	0	N	N	16	25	27	33	6	<20	45	Yes

Notes:

[1] Reference LSR are measurement result taken at representative NSR.

[2] TCF types : B - Bored tunnel, C - Cut and cover tunnel, S - Station

[3] TOC types : 0 - No turnouts, 1 - turnout, 2 - inclined turnout

[4] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate, Type 2 = Egg Type Baseplate, Type 3 = 12.5Hz FST.

[5] L_{max} has incorporated a +0.5dB(A) correction to passby L_{eq} based on previous study.

[5] FDL based on 60kph data and adjusted by the correction factor of $20x\log(V/V_{ref})$, in line with FTA manual.

[6] Calculation based on 8-car train with 23.75m legth for each car.

[7] Nighttime train frequency is presented. For HHS, 6 trains per 30 minutes is assumed at the tunnel section under Chatham Road North for tuning around.

Annex D

Detailed Operational Ground-borne Noise Calculations

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-1-1
Location:	Tsui Chuk Garden Block 5
Assessed Floor	1
Item:	1

Train Speed: 95 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	0	80	80
Down Track	0	80	80

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			38.0	42.0	41.0	39.0	38.0	42.0	45.0	46.0	46.0	42.0	41.0	40.0	37.0	38.0	35.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.8	5.7	-2.9	-9.9	-11.7	-11.5	-21.2	-19.2	-8.8	-10.7	-9.9	-14.7	-9.0	-11.2	-16.4
Up Track Vib. Level	dB re 10^{-6}in/sec			45.8	47.7	38.1	29.1	26.3	30.5	23.8	26.8	37.2	31.3	31.1	25.3	28.0	26.7	18.6
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			38.0	42.0	41.0	39.0	38.0	42.0	45.0	46.0	46.0	42.0	41.0	40.0	37.0	38.0	35.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.8	5.7	-2.9	-9.9	-11.7	-11.5	-21.2	-19.2	-8.8	-10.7	-9.9	-14.7	-9.0	-11.2	-16.4
Down Track Vib. Level	dB re 10^{-6}in/sec			45.8	47.7	38.1	29.1	26.3	30.5	23.8	26.8	37.2	31.3	31.1	25.3	28.0	26.7	18.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				48.8	50.7	41.1	32.1	29.3	33.5	26.8	29.8	40.2	34.3	34.1	28.3	31.0	29.8	21.6
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**64.8**	**66.7**	**57.1**	**48.1**	**45.1**	**48.9**	**42.0**	**44.8**	**55.0**	**48.3**	**47.1**	**40.3**	**42.0**	**40.5**	**32.3**
Predicted Noise Level	**Oct, dB**			**67.2**			**51.0**			**56.1**			**48.9**			**41.1**
L_{max}	**dB(A)**	**44.6**														
$L_{eq,30mins}$	**dB(A)**	**31.4**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-2-1
Location:	Pak Yuen House
Assessed Floor	1
Item:	2

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	295	65	302
Down Track	290	65	297

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-18.3	4.0	-10.6	-15.5	-2.6	1.8	-7.7	-23.4	-23.3	-17.2	-27.3	-41.4	-32.2	-46.2	-35.2
Up Track Vib. Level	dB re 10^{-6}in/sec			19.2	45.5	29.9	23.0	34.9	43.4	36.8	22.1	22.2	24.3	13.2	-1.9	4.4	-8.7	-0.6
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-18.1	4.1	-10.5	-15.4	-2.6	1.9	-7.7	-23.3	-23.2	-17.1	-27.2	-41.3	-32.1	-46.1	-35.1
Down Track Vib. Level	dB re 10^{-6}in/sec			19.4	45.6	30.0	23.1	35.0	43.4	36.8	22.3	22.3	24.4	13.3	-1.8	4.4	-8.6	-0.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				22.3	48.6	33.0	26.1	38.0	46.4	39.8	25.2	25.3	27.4	16.3	1.2	7.4	-5.6	2.4
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**38.3**	**64.6**	**49.0**	**42.1**	**53.8**	**61.8**	**55.0**	**40.2**	**40.1**	**41.4**	**29.3**	**13.2**	**18.4**	**5.1**	**13.1**
Predicted Noise Level	**Oct, dB**			**64.7**			**63.1**			**45.4**			**29.7**			**13.9**
L_{max}	**dB(A)**	**38.9**														
$L_{eq,30mins}$	**dB(A)**	**25.9**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-3-1
Location:	Wah Yuen House
Assessed Floor	1
Item:	3

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	102	50	114
Down Track	100	50	112

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

			Frequency (Hz)														
Description	Unit		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																	
FDL	dB re 1 lb/in$^{0.5}$		37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb		-7.1	5.9	-6.7	-10.8	-0.3	4.0	-5.6	-16.1	-17.6	-13.4	-23.0	-34.0	-29.3	-39.2	-33.7
Up Track Vib. Level	dB re 10^{-6}in/sec		30.4	47.5	33.8	27.8	37.2	45.5	38.9	29.4	27.9	28.1	17.5	5.5	7.2	-1.7	0.8
Down Track Calculation																	
FDL	dB re 1 lb/in$^{0.5}$		37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb		-6.9	6.0	-6.6	-10.7	-0.2	4.1	-5.6	-15.9	-17.5	-13.4	-23.0	-33.9	-29.3	-39.1	-33.6
Down Track Vib. Level	dB re 10^{-6}in/sec		30.6	47.5	33.9	27.8	37.3	45.6	39.0	29.6	28.0	28.1	17.6	5.6	7.2	-1.6	0.9
Total of Up and Down Tracks Calculation																	
Total Vibration Level Outside Building			33.6	50.5	36.9	30.8	40.3	48.6	42.0	32.5	31.0	31.1	20.5	8.6	10.2	1.4	3.9
BCF	dB	Y/N 0															
BVR-up	dB	Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB		6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**49.6**	**66.5**	**52.9**	**46.8**	**56.1**	**64.0**	**57.2**	**47.5**	**45.8**	**45.1**	**33.5**	**20.6**	**21.2**	**12.1**	**14.6**
Predicted Noise Level	**Oct, dB**			**66.7**			**65.3**			**51.0**			**34.0**			**16.6**
L_{max}	**dB(A)**	**41.6**														
$L_{eq,30mins}$	**dB(A)**	**28.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-3-2
Location:	Nga Yuen House
Assessed Floor	1
Item:	4

Train Speed: 80 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	135	45	142
Down Track	120	45	128

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

		Frequency (Hz)														
Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-9.6	5.5	-7.6	-11.8	-0.8	3.5	-6.1	-17.7	-18.9	-14.3	-24.0	-35.7	-30.0	-40.8	-34.0
Up Track Vib. Level	dB re 10^{-6}in/sec	26.9	46.0	31.9	25.7	35.7	44.0	37.4	26.8	25.6	26.2	15.5	2.8	5.5	-4.3	-0.5
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-8.4	5.7	-7.2	-11.3	-0.6	3.8	-5.8	-16.9	-18.3	-13.9	-23.5	-34.9	-29.7	-40.0	-33.9
Down Track Vib. Level	dB re 10^{-6}in/sec	28.1	46.2	32.3	26.2	35.9	44.3	37.7	27.6	26.2	26.6	16.0	3.6	5.8	-3.5	-0.4
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		30.5	49.1	35.2	28.9	38.8	47.2	40.6	30.2	28.9	29.4	18.7	6.2	8.7	-0.9	2.6
BCF	dB Y/N 0															
BVR-up	dB Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**46.5**	**65.1**	**51.2**	**44.9**	**54.6**	**62.6**	**55.8**	**45.2**	**43.7**	**43.4**	**31.7**	**18.2**	**19.7**	**9.8**	**13.3**
Predicted Noise Level	**Oct, dB**			**65.3**			**63.9**			**49.0**			**32.2**			**15.0**
L_{max}	**dB(A)**	**40.0**														
$L_{eq,30mins}$	**dB(A)**	**27.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-3-3
Location:	Kwai Yuen House
Assessed Floor	1
Item:	5

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	24	44	50
Down Track	5	44	44

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

		Frequency (Hz)														
Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	2.4	7.5	-3.4	-6.8	1.7	5.9	-3.8	-9.9	-12.8	-10.3	-19.4	-27.8	-26.9	-33.3	-32.4
Up Track Vib. Level	dB re 10^{-6}in/sec	39.9	49.1	37.1	31.8	39.2	47.4	40.7	35.6	32.7	31.2	21.1	11.7	9.6	4.2	2.1
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	3.9	7.8	-2.9	-6.1	2.0	6.2	-3.5	-8.9	-12.0	-9.8	-18.8	-26.8	-26.5	-32.4	-32.2
Down Track Vib. Level	dB re 10^{-6}in/sec	41.4	49.3	37.6	32.4	39.5	47.7	41.0	36.6	33.5	31.7	21.7	12.7	10.0	5.1	2.3
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		43.8	52.2	40.4	35.1	42.4	50.6	43.9	39.1	36.1	34.5	24.4	15.3	12.8	7.7	5.2
BCF	dB Y/N 0															
BVR-up	dB Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**59.8**	**68.2**	**56.4**	**51.1**	**58.2**	**66.0**	**59.1**	**54.1**	**50.9**	**48.5**	**37.4**	**27.3**	**23.8**	**18.4**	**15.9**
Predicted Noise Level	**Oct, dB**			**68.6**			**67.3**			**56.6**			**38.0**			**20.4**
L_{max}	**dB(A)**	**44.5**														
$L_{eq,30mins}$	**dB(A)**	**31.5**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-3-4
Location:	Chui Yuen House
Assessed Floor	1
Item:	6

Train Speed: 80 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	55	45	71
Down Track	50	45	67

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit	Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 $lb/in^{0.5}$	36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$	-1.6	6.9	-4.8	-8.5	0.8	5.1	-4.6	-12.5	-14.8	-11.6	-20.9	-30.4	-27.9	-35.8	-33.0
Up Track Vib. Level	dB re $10^{-6}in/sec$	34.9	47.4	34.7	29.0	37.3	45.6	38.9	32.0	29.7	28.9	18.6	8.1	7.6	0.7	0.5
Down Track Calculation																
FDL	dB re 1 $lb/in^{0.5}$	36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$	-1.0	7.0	-4.6	-8.2	1.0	5.2	-4.4	-12.1	-14.5	-11.4	-20.7	-30.0	-27.8	-35.4	-32.9
Down Track Vib. Level	dB re $10^{-6}in/sec$	35.5	47.5	34.9	29.3	37.5	45.7	39.1	32.4	30.0	29.1	18.8	8.5	7.7	1.1	0.6
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		38.2	50.4	37.8	32.2	40.4	48.7	42.0	35.2	32.8	32.0	21.7	11.3	10.7	3.9	3.6
BCF	dB Y/N 0															
BVR-up	dB Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**54.2**	**66.4**	**53.8**	**48.2**	**56.2**	**64.1**	**57.2**	**50.2**	**47.6**	**46.0**	**34.7**	**23.3**	**21.7**	**14.6**	**14.3**
Predicted Noise Level	**Oct, dB**			**66.7**			**65.4**			**53.1**			**35.2**			**17.5**
L_{max}	**dB(A)**	**42.1**														
$L_{eq,30mins}$	**dB(A)**	**29.7**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-4-1
Location:	Pang Ching Court
Assessed Floor	1
Item:	7

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	210	70	221
Down Track	195	70	207

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz)														
				20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-14.7	4.6	-9.3	-14.0	-1.9	2.5	-7.0	-21.0	-21.5	-16.0	-25.9	-39.0	-31.3	-44.0	-34.7
Up Track Vib. Level	dB re 10^{-6}in/sec			22.8	46.2	31.2	24.5	35.7	44.1	37.5	24.5	24.0	25.5	14.6	0.5	5.3	-6.4	-0.2
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-14.0	4.8	-9.1	-13.7	-1.7	2.7	-6.9	-20.6	-21.1	-15.7	-25.7	-38.5	-31.1	-43.5	-34.6
Down Track Vib. Level	dB re 10^{-6}in/sec			23.6	46.3	31.5	24.9	35.8	44.2	37.6	25.0	24.4	25.8	14.9	1.0	5.5	-6.0	-0.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				26.2	49.2	34.3	27.7	38.8	47.1	40.6	27.7	27.2	28.7	17.7	3.7	8.4	-3.2	2.9
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**42.2**	**65.2**	**50.3**	**43.7**	**54.6**	**62.5**	**55.8**	**42.7**	**42.0**	**42.7**	**30.7**	**15.7**	**19.4**	**7.5**	**13.6**
Predicted Noise Level	**Oct, dB**			**65.4**			**63.9**			**47.3**			**31.2**			**14.7**
L_{max}	**dB(A)**	**39.8**														
$L_{eq,30mins}$	**dB(A)**	**26.8**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)		**Train Speed:**	90 kph
NSR Ref.:	DIH-4-2			
Location:	Carbo Anglo-Chinese Kindergarden			
Assessed Floor	0			
Item:	8			

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	130	75	150
Down Track	115	75	137

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz)														
				20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-10.2	5.4	-7.8	-12.1	-0.9	3.4	-6.2	-18.1	-19.2	-14.5	-24.2	-36.1	-30.1	-41.2	-34.1
Up Track Vib. Level	dB re 10^{-6}in/sec			27.3	46.9	32.7	26.4	36.6	44.9	38.3	27.4	26.3	27.0	16.3	3.4	6.4	-3.7	0.4
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-9.2	5.6	-7.4	-11.7	-0.7	3.6	-6.0	-17.5	-18.7	-14.1	-23.8	-35.4	-29.9	-40.5	-34.0
Down Track Vib. Level	dB re 10^{-6}in/sec			28.3	47.1	33.1	26.9	36.8	45.1	38.5	28.1	26.8	27.4	16.7	4.1	6.7	-3.0	0.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				30.8	50.0	35.9	29.7	39.7	48.0	41.4	30.8	29.6	30.2	19.5	6.8	9.5	-0.3	3.5
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**48.8**	**68.0**	**53.9**	**47.7**	**57.5**	**65.4**	**58.6**	**47.8**	**46.4**	**46.2**	**34.5**	**20.8**	**22.5**	**12.4**	**16.2**
Predicted Noise Level	**Oct, dB**			**68.2**			**66.8**			**51.6**			**34.9**			**17.8**
L_{max}	**dB(A)**	**42.9**														
$L_{eq,30mins}$	**dB(A)**	**33[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.
[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.
[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-5-1
Location:	Rainbow Home
Assessed Floor	0
Item:	9

Train Speed: 80 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	68	42	80
Down Track	25	41	48

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 $lb/in^{0.5}$	36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$	7.8	5.7	-2.9	-9.9	-11.7	-11.5	-21.2	-19.2	-8.8	-10.7	-9.9	-14.7	-9.0	-11.2	-16.4
Up Track Vib. Level	dB re 10^{-6}in/sec	44.3	46.2	36.6	27.6	24.8	29.0	22.3	25.3	35.7	29.8	29.6	23.8	26.5	25.3	17.1
Down Track Calculation																
FDL	dB re 1 $lb/in^{0.5}$	36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$	8.3	6.1	-1.6	-7.9	-9.5	-10.1	-16.0	-12.9	-6.4	-9.4	-8.3	-11.2	-5.1	-8.5	-14.7
Down Track Vib. Level	dB re 10^{-6}in/sec	44.8	46.6	37.9	29.6	27.0	30.4	27.5	31.6	38.1	31.1	31.2	27.3	30.4	28.0	18.8
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		47.6	49.4	40.3	31.7	29.1	32.8	28.6	32.5	40.1	33.5	33.5	28.9	31.9	29.8	21.0
BCF	dB Y/N 0															
BVR-up	dB Floor 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Frequency (Hz) applies to columns 20–500.

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**65.6**	**67.4**	**58.3**	**49.7**	**46.9**	**50.2**	**45.8**	**49.5**	**56.9**	**49.5**	**48.5**	**42.9**	**44.9**	**42.5**	**33.7**
Predicted Noise Level	**Oct, dB**			**68.0**			**52.8**			**58.2**			**50.8**			**43.1**
L_{max}	**dB(A)**	**46.6**														
$L_{eq,30mins}$	**dB(A)**	**34.2**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: DIH-5-2
Location: Residential premises
Assessed Floor 1
Item: 10

Train Speed: 80 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	50	41	65
Down Track	8	40	41

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.0	5.9	-2.4	-9.1	-10.8	-10.9	-19.1	-16.6	-7.9	-10.2	-9.3	-13.2	-7.4	-10.1	-15.7
Up Track Vib. Level	dB re 10^{-6}in/sec			44.5	46.4	37.1	28.4	25.7	29.6	24.4	27.9	36.6	30.3	30.2	25.2	28.1	26.4	17.8
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.5	6.2	-1.3	-7.4	-8.9	-9.8	-14.7	-11.2	-5.8	-9.1	-7.9	-10.3	-4.1	-7.8	-14.2
Down Track Vib. Level	dB re 10^{-6}in/sec			45.0	46.7	38.2	30.1	27.6	30.7	28.8	33.3	38.7	31.4	31.6	28.2	31.4	28.7	19.3
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				47.8	49.6	40.7	32.3	29.8	33.2	30.2	34.4	40.8	33.9	34.0	30.0	33.1	30.7	21.6
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**63.8**	**65.6**	**56.7**	**48.3**	**45.6**	**48.6**	**45.4**	**49.4**	**55.6**	**47.9**	**47.0**	**42.0**	**44.1**	**41.4**	**32.3**
Predicted Noise Level	**Oct, dB**			**66.2**			**51.6**			**57.1**			**49.6**			**41.9**
L_{max}	**dB(A)**	**45.5**														
$L_{eq,30mins}$	**dB(A)**	**33.0**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: DIH-5-5
Location: Our Lady's Kindergarden
Assessed Floor 0
Item: 11

Train Speed: 80 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	121	40	127
Down Track	85	40	94

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
		Frequency (Hz)														
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-8.3	5.7	-7.1	-11.3	-0.5	3.8	-5.8	-16.9	-18.2	-13.9	-23.5	-34.8	-29.6	-40.0	-33.8
Up Track Vib. Level	dB re 10^{-6}in/sec	28.2	46.2	32.4	26.2	36.0	44.3	37.7	27.6	26.3	26.6	16.0	3.7	5.9	-3.5	-0.3
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-4.9	6.3	-5.9	-9.8	0.2	4.5	-5.2	-14.6	-16.5	-12.7	-22.2	-32.6	-28.8	-37.8	-33.4
Down Track Vib. Level	dB re 10^{-6}in/sec	31.6	46.8	33.6	27.7	36.7	45.0	38.3	29.9	28.0	27.8	17.3	5.9	6.7	-1.3	0.1
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		33.3	49.5	36.0	30.0	39.3	47.6	41.0	31.9	30.2	30.3	19.7	8.0	9.3	0.7	2.9
BCF	dB Y/N 0															
BVR-up	dB Floor 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**51.3**	**67.5**	**54.0**	**48.0**	**57.1**	**65.0**	**58.2**	**48.9**	**47.0**	**46.3**	**34.7**	**22.0**	**22.3**	**13.4**	**15.6**
Predicted Noise Level	**Oct, dB**			**67.8**			**66.4**			**52.3**			**35.2**			**17.7**
L_{max}	**dB(A)**	**42.7**														
$L_{eq,30mins}$	**dB(A)**	**33[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.
[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.
[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH 6-1
Location:	WTS Fire Station and Quarters Block A
Assessed Floor	1
Item:	12

Train Speed: 85 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	4	35	35
Down Track	5	35	35

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

		Frequency (Hz)														
Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	8.7	6.4	-0.8	-6.7	-8.1	-9.3	-12.8	-8.9	-4.9	-8.6	-7.3	-9.0	-2.7	-6.9	-13.6
Up Track Vib. Level	dB re 10^{-6}in/sec	45.7	47.4	39.2	31.4	28.9	31.8	31.2	36.1	40.1	32.4	32.7	30.0	33.4	30.1	20.4
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	8.7	6.4	-0.8	-6.7	-8.1	-9.3	-12.8	-8.9	-4.9	-8.6	-7.3	-9.0	-2.7	-6.9	-13.6
Down Track Vib. Level	dB re 10^{-6}in/sec	45.7	47.4	39.2	31.4	28.9	31.8	31.2	36.1	40.1	32.4	32.7	30.0	33.4	30.1	20.4
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		48.7	50.4	42.2	34.4	31.9	34.8	34.2	39.1	43.1	35.4	35.7	33.0	36.4	33.2	23.4
BCF	dB Y/N 0															
BVR-up	dB Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**64.7**	**66.4**	**58.2**	**50.4**	**47.7**	**50.2**	**49.4**	**54.1**	**57.9**	**49.4**	**48.7**	**45.0**	**47.4**	**43.9**	**34.1**
Predicted Noise Level	**Oct, dB**			**67.1**			**54.0**			**59.9**			**52.1**			**44.3**
L_{max}	**dB(A)**	**48.0**														
$L_{eq,30mins}$	**dB(A)**	**35.3**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-7-1
Location:	Tropicana Gardens Block 2
Assessed Floor	4
Item:	13

Train Speed: 85 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	29	40	49
Down Track	63	40	75

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.3	6.1	-1.7	-8.0	-9.6	-10.2	-16.2	-13.1	-6.5	-9.5	-8.4	-11.3	-5.3	-8.7	-14.8
Up Track Vib. Level	dB re 10^{-6}in/sec			45.3	47.1	38.4	30.0	27.5	30.9	27.8	31.9	38.5	31.5	31.7	27.7	30.8	28.4	19.3
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.9	5.8	-2.7	-9.7	-11.4	-11.3	-20.5	-18.4	-8.5	-10.6	-9.7	-14.2	-8.5	-10.9	-16.2
Down Track Vib. Level	dB re 10^{-6}in/sec			44.9	46.8	37.3	28.4	25.6	29.7	23.5	26.6	36.5	30.5	30.3	24.8	27.5	26.1	17.8
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				48.1	50.0	40.9	32.3	29.6	33.3	29.2	33.0	40.6	34.0	34.0	29.5	32.4	30.4	21.6
BCF	dB	Y/N	0															
BVR-up	dB	Floor	4	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**58.1**	**60.0**	**50.9**	**42.3**	**39.4**	**42.7**	**38.4**	**42.0**	**49.4**	**42.0**	**41.0**	**35.5**	**37.4**	**35.1**	**26.3**
Predicted Noise Level	**Oct, dB**			**60.5**			**45.4**			**50.8**			**43.4**			**35.6**
L_{max}	**dB(A)**	**39.2**														
$L_{eq,30mins}$	**dB(A)**	**26.5**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-7-2
Location:	Tropicana Gardens Block 3
Assessed Floor	4
Item:	14

Train Speed: 85 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	21	40	45
Down Track	54	40	67

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
				Frequency (Hz)														
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.4	6.2	-1.4	-7.7	-9.2	-9.9	-15.4	-12.1	-6.1	-9.3	-8.1	-10.7	-4.6	-8.2	-14.5
Up Track Vib. Level	dB re 10^{-6}in/sec			45.4	47.2	38.6	30.4	27.8	31.1	28.6	33.0	38.9	31.8	31.9	28.3	31.4	28.8	19.6
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.0	5.8	-2.4	-9.2	-10.9	-11.0	-19.4	-17.0	-8.0	-10.3	-9.4	-13.5	-7.7	-10.3	-15.8
Down Track Vib. Level	dB re 10^{-6}in/sec			45.0	46.9	37.6	28.8	26.1	30.0	24.6	28.0	37.0	30.7	30.7	25.6	28.4	26.7	18.2
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				48.2	50.1	41.1	32.7	30.1	33.6	30.1	34.2	41.1	34.3	34.3	30.2	33.2	30.9	21.9
BCF	dB	Y/N	0															
BVR-up	dB	Floor	4	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**58.2**	**60.1**	**51.1**	**42.7**	**39.9**	**43.0**	**39.3**	**43.2**	**49.9**	**42.3**	**41.3**	**36.2**	**38.2**	**35.6**	**26.6**
Predicted Noise Level	**Oct, dB**			**60.6**			**45.8**			**51.3**			**43.9**			**36.1**
L_{max}	**dB(A)**	**39.7**														
$L_{eq,30mins}$	**dB(A)**	**27.0**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-8-1
Location:	Redemption Lutheran Church
Assessed Floor	0
Item:	15

Train Speed: 85 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	116	20	118
Down Track	163	20	164

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz)														
				20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.4	5.4	-3.8	-11.4	-13.4	-12.5	-25.1	-24.0	-10.7	-11.7	-11.2	-17.3	-12.0	-13.3	-17.8
Up Track Vib. Level	dB re 10^{-6}in/sec			44.4	46.4	36.2	26.6	23.7	28.5	18.9	21.0	34.3	29.3	28.9	21.7	24.0	23.7	16.3
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.1	5.1	-4.6	-12.7	-14.8	-13.4	-28.4	-28.1	-12.3	-12.6	-12.2	-19.6	-14.5	-15.0	-18.9
Down Track Vib. Level	dB re 10^{-6}in/sec			44.1	46.1	35.4	25.3	22.2	27.7	15.6	16.9	32.8	28.4	27.8	19.4	21.5	22.0	15.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				47.3	49.3	38.8	29.0	26.0	31.1	20.6	22.4	36.6	31.9	31.4	23.7	25.9	26.0	18.7
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**65.3**	**67.3**	**56.8**	**47.0**	**43.8**	**48.5**	**37.8**	**39.4**	**53.4**	**47.9**	**46.4**	**37.7**	**38.9**	**38.7**	**31.4**
Predicted Noise Level	**Oct, dB**			**67.7**			**50.1**			**54.6**			**47.6**			**39.4**
L_{max}	**dB(A)**	**43.1**														
$L_{eq,30mins}$	**dB(A)**	**30.4**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-9-1
Location:	Shek On Building
Assessed Floor	0
Item:	16

Train Speed: 80 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	118	25	121
Down Track	156	25	158

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in^0.5			36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^-6in/s*in^0.5/lb			7.4	5.4	-3.9	-11.5	-13.5	-12.5	-25.3	-24.3	-10.8	-11.8	-11.2	-17.5	-12.2	-13.4	-17.8
Up Track Vib. Level	dB re 10^-6in/sec			43.9	45.9	35.6	26.0	23.0	27.9	18.2	20.2	33.7	28.7	28.3	21.0	23.3	23.1	15.7
Down Track Calculation																		
FDL	dB re 1 lb/in^0.5			36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^-6in/s*in^0.5/lb			7.1	5.1	-4.5	-12.6	-14.6	-13.3	-28.0	-27.7	-12.1	-12.5	-12.1	-19.3	-14.3	-14.8	-18.8
Down Track Vib. Level	dB re 10^-6in/sec			43.6	45.6	35.0	24.9	21.9	27.2	15.5	16.8	32.4	28.0	27.4	19.2	21.2	21.7	14.7
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.7	48.8	38.3	28.5	25.5	30.6	20.0	21.8	36.1	31.4	30.9	23.2	25.4	25.4	18.2
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**64.7**	**66.8**	**56.3**	**46.5**	**43.3**	**48.0**	**37.2**	**38.8**	**52.9**	**47.4**	**45.9**	**37.2**	**38.4**	**38.1**	**30.9**
Predicted Noise Level	**Oct, dB**			**67.2**			**49.5**			**54.1**			**47.0**			**38.9**
L_{max}	**dB(A)**	**42.6**														
$L_{eq,30mins}$	**dB(A)**	**33[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.
[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.
[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-10-1
Location:	Hong Kong Sheung Keung Hui Nursing Home
Assessed Floor	1
Item:	17

Train Speed: 80 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	168	25	170
Down Track	188	25	190

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			7.0	5.1	-4.7	-12.9	-14.9	-13.4	-28.8	-28.6	-12.4	-12.7	-12.3	-19.9	-14.8	-15.2	-19.0
Up Track Vib. Level	dB re $10^{-6}in/sec$			43.5	45.6	34.8	24.6	21.6	27.1	14.7	15.9	32.1	27.8	27.2	18.6	20.7	21.3	14.5
Down Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			36.5	40.5	39.5	37.5	36.5	40.5	43.5	44.5	44.5	40.5	39.5	38.5	35.5	36.5	33.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			6.9	5.0	-5.0	-13.3	-15.4	-13.7	-29.9	-30.0	-13.0	-13.0	-12.7	-20.6	-15.7	-15.8	-19.4
Down Track Vib. Level	dB re $10^{-6}in/sec$			43.4	45.5	34.5	24.2	21.1	26.8	13.6	14.5	31.5	27.5	26.8	17.9	19.8	20.7	14.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.5	48.5	37.7	27.4	24.3	29.9	17.2	18.3	34.8	30.7	30.0	21.3	23.3	24.0	17.3
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**62.5**	**64.5**	**53.7**	**43.4**	**40.1**	**45.3**	**32.4**	**33.3**	**49.6**	**44.7**	**43.0**	**33.3**	**34.3**	**34.7**	**28.0**
Predicted Noise Level	**Oct, dB**			**64.9**			**46.6**			**50.9**			**43.9**			**35.5**
L_{max}	**dB(A)**	**39.4**														
$L_{eq,30mins}$	**dB(A)**	**27.0**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-11-1
Location:	Lung Wan House
Assessed Floor	1
Item:	18

Train Speed: 35 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	75	25	79
Down Track	60	25	65

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			29.3	33.3	32.3	30.3	29.3	33.3	36.3	37.3	37.3	33.3	32.3	31.3	28.3	29.3	26.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-2.9	6.7	-5.2	-9.0	0.6	4.8	-4.8	-13.3	-15.5	-12.0	-21.4	-31.2	-28.3	-36.6	-33.1
Up Track Vib. Level	dB re 10^{-6}in/sec			26.5	40.0	27.1	21.3	29.9	38.2	31.5	24.0	21.9	21.3	10.9	0.1	0.1	-7.3	-6.8
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			29.3	33.3	32.3	30.3	29.3	33.3	36.3	37.3	37.3	33.3	32.3	31.3	28.3	29.3	26.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-0.6	7.0	-4.5	-8.0	1.1	5.3	-4.4	-11.9	-14.3	-11.3	-20.6	-29.8	-27.7	-35.2	-32.8
Down Track Vib. Level	dB re 10^{-6}in/sec			28.7	40.4	27.9	22.3	30.4	38.6	32.0	25.5	23.0	22.0	11.8	1.5	0.6	-5.9	-6.5
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				30.7	43.2	30.5	24.8	33.2	41.4	34.8	27.8	25.5	24.7	14.4	3.9	3.4	-3.5	-3.6
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**46.7**	**59.2**	**46.5**	**40.8**	**49.0**	**56.8**	**50.0**	**42.8**	**40.3**	**38.7**	**27.4**	**15.9**	**14.4**	**7.2**	**7.1**
Predicted Noise Level	**Oct, dB**			**59.5**			**58.2**			**45.7**			**27.9**			**10.5**
L_{max}	**dB(A)**	**34.8**														
$L_{eq,30mins}$	**dB(A)**	**26.0**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-12-1
Location:	Galaxia Tower B
Assessed Floor	5
Item:	19

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	195	30	197
Down Track	180	30	182

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz)														
				20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6} $in/s*in^{0.5}/lb$			-13.4	4.9	-8.9	-13.4	-1.6	2.8	-6.8	-20.2	-20.8	-15.5	-25.4	-38.2	-30.9	-43.1	-34.5
Up Track Vib. Level	dB re 10^{-6} in/sec			14.9	37.1	22.4	15.8	26.7	35.0	28.5	16.1	15.4	16.7	5.8	-7.9	-3.7	-14.9	-9.3
Down Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6} $in/s*in^{0.5}/lb$			-12.5	5.0	-8.6	-13.0	-1.4	3.0	-6.6	-19.6	-20.4	-15.2	-25.1	-37.6	-30.7	-42.6	-34.4
Down Track Vib. Level	dB re 10^{-6} in/sec			15.8	37.3	22.7	16.2	26.9	35.2	28.6	16.7	15.9	17.0	6.2	-7.3	-3.4	-14.3	-9.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				18.3	40.2	25.5	19.0	29.8	38.1	31.6	19.4	18.7	19.9	9.0	-4.6	-0.5	-11.6	-6.2
BCF	dB	Y/N	0															
BVR-up	dB	Floor	5	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**26.3**	**48.2**	**33.5**	**27.0**	**37.6**	**45.5**	**38.8**	**26.4**	**25.5**	**25.9**	**14.0**	**-0.6**	**2.5**	**-8.9**	**-3.5**
Predicted Noise Level	**Oct, dB**			**48.4**			**46.9**			**30.7**			**14.4**			**2.0**
L_{max}	**dB(A)**	**22.8**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-12-2
Location:	Galaxia Tower E
Assessed Floor	5
Item:	20

Train Speed: 45 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	180	30	182
Down Track	160	30	163

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

		Frequency (Hz)														
Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	31.5	35.5	34.5	32.5	31.5	35.5	38.5	39.5	39.5	35.5	34.5	33.5	30.5	31.5	28.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-12.5	5.0	-8.6	-13.0	-1.4	3.0	-6.6	-19.6	-20.4	-15.2	-25.1	-37.6	-30.7	-42.6	-34.4
Up Track Vib. Level	dB re 10^{-6}in/sec	14.0	35.5	20.9	14.5	25.1	33.5	26.9	14.9	14.1	15.3	4.4	-9.1	-5.2	-16.1	-10.9
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	31.5	35.5	34.5	32.5	31.5	35.5	38.5	39.5	39.5	35.5	34.5	33.5	30.5	31.5	28.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-11.2	5.2	-8.1	-12.5	-1.1	3.2	-6.4	-18.8	-19.7	-14.8	-24.6	-36.7	-30.4	-41.8	-34.2
Down Track Vib. Level	dB re 10^{-6}in/sec	15.3	35.7	21.4	15.0	25.4	33.7	27.1	15.7	14.8	15.7	4.9	-8.2	-4.9	-15.3	-10.7
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		17.7	38.6	24.2	17.7	28.3	36.6	30.0	18.4	17.5	18.5	7.7	-5.6	-2.0	-12.7	-7.8
BCF	dB Y/N 0															
BVR-up	dB Floor 5	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**25.7**	**46.6**	**32.2**	**25.7**	**36.1**	**44.0**	**37.2**	**25.4**	**24.3**	**24.5**	**12.7**	**-1.6**	**1.0**	**-10.0**	**-5.1**
Predicted Noise Level	**Oct, dB**			**46.8**			**45.4**			**29.5**			**13.1**			**1.5**
L_{max}	**dB(A)**	**21.3**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: DIH-13-1
Location: Canossa Primary School
Assessed Floor 0
Item: 21

Train Speed: 85 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	160	25	162
Down Track	200	25	202

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.1	5.1	-4.6	-12.7	-14.7	-13.3	-28.3	-28.0	-12.2	-12.5	-12.2	-19.5	-14.4	-15.0	-18.8
Up Track Vib. Level	dB re 10^{-6}in/sec			44.1	46.1	35.4	25.3	22.3	27.7	15.7	17.1	32.8	28.5	27.8	19.5	21.6	22.1	15.2
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			6.8	4.9	-5.1	-13.6	-15.7	-13.9	-30.5	-30.7	-13.3	-13.1	-12.9	-21.0	-16.1	-16.1	-19.6
Down Track Vib. Level	dB re 10^{-6}in/sec			43.9	46.0	34.9	24.5	21.3	27.1	13.5	14.3	31.8	27.9	27.1	18.0	19.9	20.9	14.4
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				47.0	49.1	38.2	27.9	24.9	30.4	17.8	18.9	35.3	31.2	30.5	21.8	23.8	24.5	17.8
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Predicted Noise Level	**1/3 Oct, dB**			**65.0**	**67.1**	**56.2**	**45.9**	**42.7**	**47.8**	**35.0**	**35.9**	**52.1**	**47.2**	**45.5**	**35.8**	**36.8**	**37.2**	**30.5**
Predicted Noise Level	**Oct, dB**					**67.4**			**49.2**			**53.4**			**46.5**			**38.1**
L_{max}	**dB(A)**			**41.9**														
$L_{eq,30mins}$	**dB(A)**			**32[8]**														
Noise Criteria	**dB(A)**			**55[9]**														
Compliance				**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.
[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.
[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-14-1
Location:	Rhythm Garden Block 2
Assessed Floor	1
Item:	22

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	38	20	43
Down Track	50	20	54

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			4.4	7.9	-2.7	-5.9	2.1	6.3	-3.4	-8.6	-11.8	-9.6	-18.6	-26.5	-26.4	-32.0	-32.1
Up Track Vib. Level	dB re 10^{-6}in/sec			38.4	45.9	34.3	29.1	36.1	44.3	37.6	33.4	30.2	28.4	18.4	9.5	6.6	2.0	-1.1
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			1.8	7.4	-3.6	-7.0	1.5	5.7	-3.9	-10.3	-13.1	-10.5	-19.7	-28.2	-27.1	-33.7	-32.5
Down Track Vib. Level	dB re 10^{-6}in/sec			35.8	45.4	33.4	28.0	35.5	43.7	37.1	31.7	28.9	27.5	17.3	7.8	5.9	0.3	-1.5
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				40.3	48.7	36.9	31.6	38.8	47.0	40.4	35.6	32.6	31.0	20.9	11.8	9.3	4.2	1.7
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**56.3**	**64.7**	**52.9**	**47.6**	**54.6**	**62.4**	**55.6**	**50.6**	**47.4**	**45.0**	**33.9**	**23.8**	**20.3**	**14.9**	**12.4**
Predicted Noise Level	**Oct, dB**			**65.0**			**63.8**			**53.1**			**34.5**			**16.9**
L_{max}	**dB(A)**	**41.0**														
$L_{eq,30mins}$	**dB(A)**	**29.8**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-14-2
Location:	Rhythm Garden Block 5
Assessed Floor	1
Item:	23

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	30	18	35
Down Track	43	18	47

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	KAT-P1-5

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-6.1	6.9	3.2	-3.1	-6.1	-3.9	-9.7	-15.0	-19.0	-23.5	-25.6	-32.3	-28.5	-36.0	-37.6
Up Track Vib. Level	dB re 10^{-6}in/sec			27.9	44.9	40.2	31.9	27.9	34.1	31.3	27.0	23.0	14.5	11.4	3.7	4.5	-2.0	-6.6
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-11.3	4.1	0.5	-6.6	-10.7	-9.0	-15.1	-20.8	-24.6	-28.0	-28.6	-34.5	-29.3	-36.6	-38.4
Down Track Vib. Level	dB re 10^{-6}in/sec			22.7	42.1	37.5	28.4	23.3	29.0	25.9	21.2	17.4	10.0	8.4	1.5	3.7	-2.6	-7.4
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				29.0	46.8	42.1	33.5	29.2	35.3	32.4	28.1	24.1	15.8	13.2	5.8	7.1	0.7	-4.0
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**45.0**	**62.8**	**58.1**	**49.5**	**45.0**	**50.7**	**47.6**	**43.1**	**38.9**	**29.8**	**26.2**	**17.8**	**18.1**	**11.4**	**6.7**
Predicted Noise Level	**Oct, dB**			**64.2**			**53.1**			**44.6**			**27.3**			**12.9**
L_{max}	**dB(A)**	**31.8**														
$L_{eq,30mins}$	**dB(A)**	**20.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-14-3
Location:	Rhythm Garden Block 8
Assessed Floor	1
Item:	24

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	175	17	176
Down Track	185	17	186

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	KAT-P1-5

Description	Unit	Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-34.6	-8.4	-12.0	-22.2	-31.4	-31.6	-39.2	-47.0	-50.1	-48.0	-42.0	-44.4	-32.9	-39.1	-41.9
Up Track Vib. Level	dB re 10^{-6}in/sec	-0.6	29.6	25.0	12.8	2.6	6.4	1.8	-5.0	-8.1	-10.0	-5.0	-8.4	0.1	-5.1	-10.9
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-35.6	-8.9	-12.5	-22.8	-32.2	-32.5	-40.2	-48.1	-51.1	-48.8	-42.6	-44.9	-33.1	-39.2	-42.0
Down Track Vib. Level	dB re 10^{-6}in/sec	-1.6	29.1	24.5	12.2	1.8	5.5	0.8	-6.1	-9.1	-10.8	-5.6	-8.9	-0.1	-5.2	-11.0
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		2.0	32.4	27.8	15.5	5.2	9.0	4.3	-2.5	-5.6	-7.4	-2.3	-5.6	3.0	-2.2	-8.0
BCF	dB Y/N 0															
BVR-up	dB Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**18.0**	**48.4**	**43.8**	**31.5**	**21.0**	**24.4**	**19.5**	**12.5**	**9.2**	**6.6**	**10.7**	**6.4**	**14.0**	**8.5**	**2.7**
Predicted Noise Level	**Oct, dB**			**49.7**			**26.9**			**14.9**			**16.2**			**10.0**
L_{max}	**dB(A)**	**13.1**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-14-4
Location:	Canossa Primary School (San Po Kong)
Assessed Floor	1
Item:	25

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	145	20	146
Down Track	160	20	161

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-9.9	5.4	-7.7	-12.0	-0.9	3.5	-6.1	-17.9	-19.1	-14.4	-24.1	-35.9	-30.0	-41.0	-34.1
Up Track Vib. Level	dB re 10^{-6}in/sec			24.1	43.4	29.3	23.0	33.1	41.5	34.9	24.1	22.9	23.6	12.9	0.1	3.0	-7.0	-3.1
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-11.1	5.3	-8.1	-12.4	-1.1	3.2	-6.3	-18.7	-19.6	-14.8	-24.5	-36.6	-30.3	-41.7	-34.2
Down Track Vib. Level	dB re 10^{-6}in/sec			22.9	43.3	28.9	22.6	32.9	41.2	34.7	23.3	22.4	23.2	12.5	-0.6	2.7	-7.7	-3.2
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				26.5	46.4	32.1	25.8	36.0	44.4	37.8	26.7	25.7	26.4	15.7	2.8	5.8	-4.3	-0.1
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**42.5**	**62.4**	**48.1**	**41.8**	**51.8**	**59.8**	**53.0**	**41.7**	**40.5**	**40.4**	**28.7**	**14.8**	**16.8**	**6.4**	**10.6**
Predicted Noise Level	**Oct, dB**			**62.6**			**61.1**			**45.7**			**29.1**			**12.2**
L_{max}	**dB(A)**	**37.2**														
$L_{eq,30mins}$	**dB(A)**	**29[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.
[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.
[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-14-5
Location:	Rhythm Garden Block 1
Assessed Floor	1
Item:	26

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	30	20	36
Down Track	43	20	47

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			5.6	8.1	-2.3	-5.4	2.3	6.5	-3.2	-7.8	-11.2	-9.2	-18.2	-25.7	-26.1	-31.3	-32.0
Up Track Vib. Level	dB re 10^{-6}in/sec			38.8	45.3	33.9	28.8	35.6	43.7	37.1	33.4	30.1	28.0	18.0	9.5	6.1	1.9	-1.7
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			3.1	7.7	-3.2	-6.5	1.8	6.0	-3.7	-9.4	-12.4	-10.0	-19.1	-27.3	-26.7	-32.8	-32.3
Down Track Vib. Level	dB re 10^{-6}in/sec			36.4	44.9	33.1	27.8	35.1	43.3	36.6	31.8	28.8	27.2	17.1	7.9	5.5	0.4	-2.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				40.8	48.1	36.5	31.3	38.3	46.5	39.8	35.7	32.5	30.6	20.6	11.8	8.8	4.2	1.1
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**56.8**	**64.1**	**52.5**	**47.3**	**54.1**	**61.9**	**55.0**	**50.7**	**47.3**	**44.6**	**33.6**	**23.8**	**19.8**	**14.9**	**11.8**
Predicted Noise Level	**Oct, dB**			**64.5**			**63.3**			**53.0**			**34.2**			**16.7**
L_{max}	**dB(A)**	**40.6**														
$L_{eq,30mins}$	**dB(A)**	**29.8**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-14-6
Location:	Rhythm Garden Block 3
Assessed Floor	1
Item:	27

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	45	19	49
Down Track	56	19	59

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			3.1	7.7	-3.2	-6.5	1.8	6.0	-3.7	-9.4	-12.4	-10.0	-19.1	-27.3	-26.7	-32.8	-32.3
Up Track Vib. Level	dB re 10^{-6}in/sec			37.1	45.7	33.8	28.5	35.8	44.0	37.3	32.6	29.6	28.0	17.9	8.7	6.3	1.2	-1.3
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			0.5	7.2	-4.1	-7.6	1.3	5.5	-4.1	-11.1	-13.8	-10.9	-20.1	-29.0	-27.4	-34.5	-32.7
Down Track Vib. Level	dB re 10^{-6}in/sec			34.5	45.2	32.9	27.4	35.3	43.5	36.9	30.9	28.2	27.1	16.9	7.0	5.6	-0.5	-1.7
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				39.0	48.5	36.4	31.0	38.6	46.8	40.1	34.8	32.0	30.6	20.4	10.9	8.9	3.4	1.5
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**55.0**	**64.5**	**52.4**	**47.0**	**54.4**	**62.2**	**55.3**	**49.8**	**46.8**	**44.6**	**33.4**	**22.9**	**19.9**	**14.1**	**12.2**
Predicted Noise Level	**Oct, dB**			**64.8**			**63.6**			**52.4**			**34.0**			**16.4**
L_{max}	**dB(A)**	**40.6**														
$L_{eq,30mins}$	**dB(A)**	**29.4**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-15-1
Location:	Kam Wan House
Assessed Floor	0
Item:	28

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	100	25	103
Down Track	85	25	89

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

		Frequency (Hz)														
Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-5.8	6.2	-6.3	-10.2	0.0	4.3	-5.3	-15.2	-17.0	-13.0	-22.5	-33.2	-29.0	-38.4	-33.5
Up Track Vib. Level	dB re 10^{-6}in/sec	28.2	44.2	30.7	24.8	34.0	42.3	35.7	26.8	25.0	25.0	14.5	2.8	4.0	-4.4	-2.5
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-4.0	6.5	-5.6	-9.5	0.4	4.6	-5.0	-14.0	-16.0	-12.4	-21.8	-32.0	-28.5	-37.3	-33.3
Down Track Vib. Level	dB re 10^{-6}in/sec	30.0	44.5	31.4	25.5	34.4	42.6	36.0	28.0	26.0	25.6	15.2	4.0	4.5	-3.3	-2.3
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		32.2	47.3	34.1	28.2	37.2	45.5	38.8	30.4	28.5	28.3	17.8	6.5	7.2	-0.8	0.6
BCF	dB Y/N 0															
BVR-up	dB Floor 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**50.2**	**65.3**	**52.1**	**46.2**	**55.0**	**62.9**	**56.0**	**47.4**	**45.3**	**44.3**	**32.8**	**20.5**	**20.2**	**11.9**	**13.3**
Predicted Noise Level	**Oct, dB**			**65.6**			**64.2**			**50.7**			**33.3**			**15.8**
L_{max}	**dB(A)**	**40.6**														
$L_{eq,30mins}$	**dB(A)**	**29.4**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-15-2
Location:	Pik Hoi House
Assessed Floor	0
Item:	29

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	75	25	79
Down Track	65	25	70

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

				Frequency (Hz)														
Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*$in^{0.5}$/lb			-2.6	6.7	-5.1	-8.9	0.7	4.9	-4.7	-13.1	-15.3	-11.9	-21.3	-31.1	-28.2	-36.4	-33.1
Up Track Vib. Level	dB re 10^{-6}in/sec			30.7	43.9	31.1	25.4	33.9	42.2	35.5	28.1	25.9	25.3	14.9	4.2	4.1	-3.2	-2.8
Down Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*$in^{0.5}$/lb			-1.0	7.0	-4.6	-8.2	1.0	5.2	-4.4	-12.1	-14.5	-11.4	-20.7	-30.0	-27.8	-35.4	-32.9
Down Track Vib. Level	dB re 10^{-6}in/sec			32.3	44.2	31.7	26.1	34.2	42.5	35.8	29.2	26.7	25.8	15.6	5.2	4.5	-2.2	-2.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				34.6	47.1	34.4	28.7	37.1	45.3	38.7	31.7	29.4	28.6	18.3	7.8	7.3	0.4	0.3
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**52.6**	**65.1**	**52.4**	**46.7**	**54.9**	**62.7**	**55.9**	**48.7**	**46.2**	**44.6**	**33.3**	**21.8**	**20.3**	**13.1**	**13.0**
Predicted Noise Level	**Oct, dB**			**65.4**			**64.1**			**51.6**			**33.8**			**16.2**
L_{max}	**dB(A)**	**40.7**														
$L_{eq,30mins}$	**dB(A)**	**29.9**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-16-1
Location:	Wong Tai Sin Temple
Assessed Floor	0
Item:	30

Train Speed: 85 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	22	36	42
Down Track	35	36	50

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			4.4	7.9	-2.7	-5.9	2.1	6.3	-3.4	-8.6	-11.8	-9.6	-18.6	-26.5	-26.4	-32.0	-32.1
Up Track Vib. Level	dB re 10^{-6}in/sec			41.5	48.9	37.3	32.1	39.1	47.3	40.6	36.4	33.3	31.4	21.4	12.6	9.6	5.0	1.9
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			2.4	7.5	-3.4	-6.8	1.7	5.9	-3.8	-9.9	-12.8	-10.3	-19.4	-27.8	-26.9	-33.3	-32.4
Down Track Vib. Level	dB re 10^{-6}in/sec			39.4	48.6	36.6	31.3	38.7	46.9	40.2	35.1	32.2	30.7	20.6	11.2	9.1	3.7	1.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				43.6	51.8	40.0	34.7	41.9	50.1	43.4	38.8	35.8	34.1	24.0	15.0	12.4	7.4	4.8
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**61.6**	**69.8**	**58.0**	**52.7**	**59.7**	**67.5**	**60.6**	**55.8**	**52.6**	**50.1**	**39.0**	**29.0**	**25.4**	**20.1**	**17.5**
Predicted Noise Level	**Oct, dB**			**70.1**			**68.9**			**58.3**			**39.6**			**22.0**
L_{max}	**dB(A)**	**46.1**														
$L_{eq,30mins}$	**dB(A)**	**33.4**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-17-1
Location:	Chuk Yuen United Village
Assessed Floor	0
Item:	31

Train Speed: 85 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	21	30	37
Down Track	63	30	70

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			5.9	8.1	-2.2	-5.3	2.4	6.6	-3.1	-7.6	-11.0	-9.1	-18.1	-25.5	-26.0	-31.1	-32.0
Up Track Vib. Level	dB re 10^{-6}in/sec			42.9	49.2	37.8	32.7	39.4	47.6	40.9	37.4	34.0	31.9	21.9	13.5	10.0	5.9	2.1
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-1.5	6.9	-4.8	-8.4	0.9	5.1	-4.5	-12.4	-14.8	-11.6	-20.9	-30.3	-27.9	-35.7	-32.9
Down Track Vib. Level	dB re 10^{-6}in/sec			35.6	47.9	35.3	29.6	37.9	46.1	39.5	32.6	30.3	29.5	19.1	8.7	8.1	1.3	1.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				43.7	51.6	39.7	34.5	41.7	49.9	43.3	38.6	35.5	33.9	23.8	14.8	12.2	7.2	4.6
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**61.7**	**69.6**	**57.7**	**52.5**	**59.5**	**67.3**	**60.5**	**55.6**	**52.3**	**49.9**	**38.8**	**28.8**	**25.2**	**19.9**	**17.3**
Predicted Noise Level	**Oct, dB**			**69.9**			**68.7**			**58.0**			**39.4**			**21.8**
L_{max}	**dB(A)**	**45.9**														
$L_{eq,30mins}$	**dB(A)**	**33.2**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-18-1
Location:	Upper Wong Tai Sin Estate Po Sin House
Assessed Floor	1
Item:	32

Train Speed: 85 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	15	30	34
Down Track	30	30	42

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

			Frequency (Hz)														
Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.7	8.6	-1.2	-4.1	3.0	7.1	-2.6	-5.8	-9.6	-8.2	-17.0	-23.7	-25.3	-29.4	-31.6
Up Track Vib. Level	dB re 10^{-6}in/sec			45.7	49.6	38.8	33.9	40.0	48.1	41.4	39.2	35.4	32.8	23.0	15.4	10.7	7.6	2.4
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.0	41.0	40.0	38.0	37.0	41.0	44.0	45.0	45.0	41.0	40.0	39.0	36.0	37.0	34.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			5.6	8.1	-2.3	-5.4	2.3	6.5	-3.2	-7.8	-11.2	-9.2	-18.2	-25.7	-26.1	-31.3	-32.0
Down Track Vib. Level	dB re 10^{-6}in/sec			42.6	49.1	37.7	32.6	39.4	47.5	40.8	37.2	33.9	31.8	21.8	13.3	9.9	5.7	2.0
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				47.5	52.4	41.3	36.3	42.7	50.8	44.2	41.3	37.7	35.4	25.5	17.5	13.3	9.8	5.3
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**63.5**	**68.4**	**57.3**	**52.3**	**58.5**	**66.2**	**59.4**	**56.3**	**52.5**	**49.4**	**38.5**	**29.5**	**24.3**	**20.5**	**16.0**
Predicted Noise Level	**Oct, dB**			**68.8**			**67.6**			**58.4**			**39.1**			**21.8**
L_{max}	**dB(A)**	**45.3**														
$L_{eq,30mins}$	**dB(A)**	**32.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-18-2
Location:	Upper Wong Tai Sin Estate Tat Sin House
Assessed Floor	1
Item:	33

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	26	31	40
Down Track	37	31	48

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit	Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	5.6	8.1	-2.3	-5.4	2.3	6.5	-3.2	-7.8	-11.2	-9.2	-18.2	-25.7	-26.1	-31.3	-32.0
Up Track Vib. Level	dB re 10^{-6}in/sec	43.1	49.6	38.2	33.1	39.9	48.0	41.3	37.7	34.3	32.3	22.3	13.8	10.4	6.2	2.5
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	3.4	7.7	-3.1	-6.4	1.9	6.1	-3.6	-9.3	-12.3	-10.0	-19.0	-27.2	-26.7	-32.7	-32.3
Down Track Vib. Level	dB re 10^{-6}in/sec	40.9	49.2	37.4	32.2	39.4	47.6	40.9	36.3	33.2	31.6	21.5	12.4	9.8	4.8	2.2
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		45.2	52.4	40.8	35.7	42.6	50.8	44.1	40.0	36.8	35.0	24.9	16.2	13.1	8.6	5.4
BCF	dB Y/N 0															
BVR-up	dB Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**61.2**	**68.4**	**56.8**	**51.7**	**58.4**	**66.2**	**59.3**	**55.0**	**51.6**	**49.0**	**37.9**	**28.2**	**24.1**	**19.3**	**16.1**
Predicted Noise Level	**Oct, dB**			**68.8**			**67.6**			**57.4**			**38.5**			**21.0**
		10.66	**23.7**	**17.4**	**17.1**	**28.2**	**40.02**	**36.8**	**35.9**	**35.5**	**35.6**	**27**	**19.6**	**17.5**	**15.078**	**12.9**
		11.63	**236**	**55.6**	**50.9**	**668**	**10044**	**4833**	**3930**	**3578**	**3597**	**505**	**90.4**	**56.8**	**32.195**	**19.5**
L_{max}	**dB(A)**	**44.9**														
$L_{eq,30mins}$	**dB(A)**	**32.0**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-19-1
Location:	Lung Cheung Gov. Secondary School
Assessed Floor	0
Item:	34

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	38	24	45
Down Track	55	24	60

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

				Frequency (Hz)														
Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			4.2	7.8	-2.8	-6.0	2.0	6.2	-3.5	-8.8	-11.9	-9.7	-18.7	-26.6	-26.5	-32.2	-32.2
Up Track Vib. Level	dB re 10^{-6}in/sec			41.7	49.4	37.7	32.5	39.6	47.7	41.1	36.8	33.6	31.8	21.8	12.9	10.0	5.3	2.3
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			0.3	7.2	-4.1	-7.6	1.3	5.5	-4.2	-11.3	-13.8	-11.0	-20.2	-29.2	-27.5	-34.6	-32.7
Down Track Vib. Level	dB re 10^{-6}in/sec			37.8	48.7	36.4	30.9	38.8	47.0	40.3	34.3	31.7	30.5	20.3	10.4	9.1	2.9	1.8
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				43.2	52.1	40.1	34.8	42.2	50.4	43.7	38.7	35.8	34.2	24.1	14.8	12.6	7.3	5.1
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**61.2**	**70.1**	**58.1**	**52.8**	**60.0**	**67.8**	**60.9**	**55.7**	**52.6**	**50.2**	**39.1**	**28.8**	**25.6**	**20.0**	**17.8**
Predicted Noise Level	**Oct, dB**			**70.4**			**69.2**			**58.2**			**39.7**			**22.1**
L_{max}	**dB(A)**	**46.3**														
$L_{eq,30mins}$	**dB(A)**	**36[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.

[9] Daytime criteria are used for educational buildings, church and temple.

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-20-1
Location:	Baptist Rainbow Primary School
Assessed Floor	0
Item:	35

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	95	45	105
Down Track	80	45	92

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.5	5.5	-3.5	-11.0	-12.9	-12.2	-23.9	-22.6	-10.1	-11.4	-10.8	-16.5	-11.1	-12.7	-17.4
Up Track Vib. Level	dB re 10^{-6}in/sec			45.0	47.0	37.0	27.5	24.7	29.3	20.6	22.9	35.4	30.1	29.7	23.0	25.4	24.8	17.2
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.7	5.6	-3.2	-10.5	-12.3	-11.8	-22.6	-20.9	-9.5	-11.1	-10.4	-15.6	-10.1	-12.0	-16.9
Down Track Vib. Level	dB re 10^{-6}in/sec			45.2	47.1	37.3	28.1	25.2	29.7	21.9	24.6	36.0	30.4	30.1	23.9	26.4	25.5	17.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				48.1	50.1	40.2	30.8	28.0	32.5	24.3	26.8	38.7	33.3	33.0	26.5	29.0	28.2	20.4
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**66.1**	**68.1**	**58.2**	**48.8**	**45.8**	**49.9**	**41.5**	**43.8**	**55.5**	**49.3**	**48.0**	**40.5**	**42.0**	**40.9**	**33.1**
Predicted Noise Level	**Oct, dB**			**68.5**			**51.8**			**56.7**			**49.5**			**41.6**
L_{max}	**dB(A)**	**45.2**														
$L_{eq,30mins}$	**dB(A)**	**35[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.
[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.
[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-21-1
Location:	Tin Wang Court Wang King House
Assessed Floor	1
Item:	36

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	25	45	51
Down Track	45	45	64

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

				Frequency (Hz)														
Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.2	6.0	-1.8	-8.3	-9.9	-10.4	-17.0	-14.1	-6.9	-9.7	-8.6	-11.8	-5.9	-9.1	-15.0
Up Track Vib. Level	dB re 10^{-6}in/sec			45.8	47.6	38.7	30.2	27.6	31.2	27.5	31.4	38.6	31.8	31.9	27.7	30.7	28.5	19.5
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.0	5.9	-2.3	-9.0	-10.7	-10.9	-18.9	-16.4	-7.8	-10.2	-9.2	-13.1	-7.3	-10.1	-15.7
Down Track Vib. Level	dB re 10^{-6}in/sec			45.6	47.4	38.2	29.5	26.8	30.7	25.6	29.1	37.7	31.4	31.3	26.4	29.2	27.5	18.9
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				48.7	50.5	41.5	32.9	30.2	33.9	29.7	33.4	41.2	34.6	34.6	30.1	33.0	31.0	22.2
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**64.7**	**66.5**	**57.5**	**48.9**	**46.0**	**49.3**	**44.9**	**48.4**	**56.0**	**48.6**	**47.6**	**42.1**	**44.0**	**41.7**	**32.9**
Predicted Noise Level	**Oct, dB**			**67.1**			**51.9**			**57.3**			**50.0**			**42.2**
L_{max}	**dB(A)**	**45.8**														
$L_{eq,30mins}$	**dB(A)**	**32.8**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: DIH-22-1
Location: Price Memorial Catholic Primary School
Assessed Floor 0
Item: 37

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	80	40	89
Down Track	95	40	103

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.7	5.6	-3.1	-10.3	-12.1	-11.7	-22.3	-20.5	-9.3	-11.0	-10.3	-15.4	-9.8	-11.8	-16.8
Up Track Vib. Level	dB re 10^{-6}in/sec			45.2	47.1	37.4	28.2	25.4	29.8	22.3	25.0	36.2	30.5	30.3	24.1	26.7	25.7	17.7
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.5	5.5	-3.5	-10.9	-12.8	-12.1	-23.7	-22.3	-10.0	-11.4	-10.7	-16.4	-11.0	-12.6	-17.3
Down Track Vib. Level	dB re 10^{-6}in/sec			45.1	47.0	37.0	27.6	24.7	29.4	20.8	23.2	35.5	30.1	29.8	23.1	25.6	24.9	17.2
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				48.1	50.1	40.2	30.9	28.1	32.6	24.6	27.2	38.8	33.3	33.0	26.7	29.2	28.4	20.5
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**66.1**	**68.1**	**58.2**	**48.9**	**45.9**	**50.0**	**41.8**	**44.2**	**55.6**	**49.3**	**48.0**	**40.7**	**42.2**	**41.1**	**33.2**
Predicted Noise Level	**Oct, dB**			**68.6**			**51.9**			**56.8**			**49.6**			**41.7**
L_{max}	**dB(A)**	**45.3**														
$L_{eq,30mins}$	**dB(A)**	**35[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.
[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.
[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-23-1
Location:	Tin Ma Court Chun On House
Assessed Floor	1
Item:	38

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	100	40	108
Down Track	115	40	122

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-6.5	6.0	-6.5	-10.5	-0.1	4.1	-5.5	-15.7	-17.3	-13.2	-22.8	-33.6	-29.2	-38.8	-33.6
Up Track Vib. Level	dB re 10^{-6}in/sec			31.1	47.6	34.0	28.0	37.4	45.7	39.0	29.9	28.2	28.3	17.7	5.9	7.4	-1.3	0.9
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-7.9	5.8	-7.0	-11.1	-0.4	3.9	-5.7	-16.6	-18.0	-13.7	-23.3	-34.5	-29.5	-39.7	-33.8
Down Track Vib. Level	dB re 10^{-6}in/sec			29.7	47.3	33.6	27.4	37.1	45.4	38.8	28.9	27.5	27.8	17.2	5.0	7.0	-2.2	0.7
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				33.4	50.5	36.8	30.7	40.2	48.5	41.9	32.4	30.9	31.1	20.5	8.5	10.2	1.3	3.8
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**49.4**	**66.5**	**52.8**	**46.7**	**56.0**	**63.9**	**57.1**	**47.4**	**45.7**	**45.1**	**33.5**	**20.5**	**21.2**	**12.0**	**14.5**
Predicted Noise Level	**Oct, dB**			**66.7**			**65.3**			**51.0**			**33.9**			**16.6**
L_{max}	**dB(A)**	**41.5**														
$L_{eq,30mins}$	**dB(A)**	**28.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-24-1
Location:	Shing Wong Temple
Assessed Floor	1
Item:	39

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	0	28	28
Down Track	5	28	28

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.1	8.7	-1.1	-3.9	3.1	7.2	-2.5	-5.5	-9.4	-8.0	-16.9	-23.4	-25.2	-29.1	-31.5
Up Track Vib. Level	dB re 10^{-6}in/sec			46.6	50.2	39.4	34.6	40.6	48.7	42.0	40.0	36.1	33.5	23.7	16.1	11.3	8.4	3.0
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.1	8.7	-1.1	-3.9	3.1	7.2	-2.5	-5.5	-9.4	-8.0	-16.9	-23.4	-25.2	-29.1	-31.5
Down Track Vib. Level	dB re 10^{-6}in/sec			46.6	50.2	39.4	34.6	40.6	48.7	42.0	40.0	36.1	33.5	23.7	16.1	11.3	8.4	3.0
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				49.6	53.2	42.4	37.6	43.6	51.7	45.0	43.0	39.2	36.5	26.7	19.1	14.3	11.4	6.0
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**65.6**	**69.2**	**58.4**	**53.6**	**59.4**	**67.1**	**60.2**	**58.0**	**54.0**	**50.5**	**39.7**	**31.1**	**25.3**	**22.1**	**16.7**
Predicted Noise Level	**Oct, dB**			**69.7**			**68.5**			**60.0**			**40.4**			**23.2**
L_{max}	**dB(A)**	**46.5**														
$L_{eq,30mins}$	**dB(A)**	**33.5**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-P1-1
Location:	Upper Wong Tai Sin Estate Phase 3
Assessed Floor	2
Item:	40

Train Speed: 90 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	19	34	39
Down Track	10	30	32

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			5.3	8.0	-2.4	-5.6	2.3	6.4	-3.2	-8.0	-11.3	-9.3	-18.3	-25.9	-26.2	-31.5	-32.0
Up Track Vib. Level	dB re 10^{-6}in/sec			42.8	49.6	38.1	33.0	39.8	48.0	41.3	37.5	34.2	32.2	22.2	13.6	10.3	6.0	2.5
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			37.5	41.5	40.5	38.5	37.5	41.5	44.5	45.5	45.5	41.5	40.5	39.5	36.5	37.5	34.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.6	8.4	-1.6	-4.6	2.7	6.9	-2.8	-6.5	-10.2	-8.6	-17.4	-24.4	-25.6	-30.1	-31.7
Down Track Vib. Level	dB re 10^{-6}in/sec			45.1	49.9	38.9	33.9	40.3	48.4	41.7	39.0	35.4	33.0	23.1	15.1	10.9	7.4	2.8
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				47.1	52.8	41.5	36.5	43.0	51.2	44.5	41.3	37.8	35.6	25.7	17.4	13.6	9.8	5.7
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**61.1**	**66.8**	**55.5**	**50.5**	**56.8**	**64.6**	**57.7**	**54.3**	**50.6**	**47.6**	**36.7**	**27.4**	**22.6**	**18.5**	**14.4**
Predicted Noise Level	**Oct, dB**			**67.2**			**66.0**			**56.5**			**37.3**			**20.0**
L_{max}	**dB(A)**	**43.6**														
$L_{eq,30mins}$	**dB(A)**	**30.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: DIH-P3-1A
Location: Planned receivers in the CDA site
Assessed Floor 2
Item: 41

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	30	26	40
Down Track	10	26	28

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			5.0	8.0	-2.5	-5.7	2.2	6.4	-3.3	-8.2	-11.5	-9.4	-18.4	-26.1	-26.3	-31.7	-32.1
Up Track Vib. Level	dB re 10^{-6}in/sec			34.0	41.0	29.5	24.3	31.2	39.4	32.7	28.8	25.5	23.6	13.6	4.9	1.7	-2.7	-6.1
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.1	8.7	-1.1	-3.9	3.1	7.2	-2.5	-5.5	-9.4	-8.0	-16.9	-23.4	-25.2	-29.1	-31.5
Down Track Vib. Level	dB re 10^{-6}in/sec			38.1	41.7	30.9	26.1	32.1	40.2	33.5	31.5	27.6	25.0	15.1	7.6	2.8	-0.1	-5.5
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				39.5	44.4	33.3	28.3	34.7	42.8	36.1	33.3	29.7	27.3	17.4	9.5	5.3	1.8	-2.8
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**53.5**	**58.4**	**47.3**	**42.3**	**48.5**	**56.2**	**49.3**	**46.3**	**42.5**	**39.3**	**28.4**	**19.5**	**14.3**	**10.5**	**5.9**
Predicted Noise Level	**Oct, dB**			**58.8**			**57.6**			**48.4**			**29.1**			**12.1**
L_{max}	**dB(A)**	**35.3**														
$L_{eq,30mins}$	**dB(A)**	**24.1**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: DIH-P3-2A
Location: Planned receivers in the CDA site
Assessed Floor 2
Item: 42

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	30	28	41
Down Track	10	28	30

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.5	6.3	-1.2	-7.3	-8.8	-9.7	-14.4	-10.9	-5.7	-9.0	-7.8	-10.1	-3.9	-7.7	-14.1
Up Track Vib. Level	dB re 10^{-6}in/sec			37.5	39.3	30.8	22.7	20.2	23.3	21.6	26.1	31.3	24.0	24.2	20.9	24.1	21.3	11.9
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.8	6.5	-0.4	-6.1	-7.5	-8.9	-11.3	-7.0	-4.2	-8.2	-6.8	-7.9	-1.5	-6.1	-13.1
Down Track Vib. Level	dB re 10^{-6}in/sec			37.8	39.5	31.6	23.9	21.5	24.1	24.7	30.0	32.8	24.8	25.2	23.1	26.5	22.9	12.9
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				40.7	42.4	34.2	26.4	23.9	26.8	26.4	31.5	35.2	27.4	27.7	25.1	28.5	25.2	15.4
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**54.7**	**56.4**	**48.2**	**40.4**	**37.7**	**40.2**	**39.6**	**44.5**	**48.0**	**39.4**	**38.7**	**35.1**	**37.5**	**33.9**	**24.1**
Predicted Noise Level	**Oct, dB**			**57.1**			**44.1**			**50.0**			**42.1**			**34.3**
L_{max}	**dB(A)**	**38.1**														
$L_{eq,30mins}$	**dB(A)**	**26.9**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D: Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	DIH-P3-4
Location:	Planned receivers in the CDA site
Assessed Floor	1
Item:	1

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	0	18	18
Down Track	0	18	18

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			14.2	9.5	0.7	-1.8	4.1	8.2	-1.5	-2.2	-6.8	-6.3	-14.9	-20.1	-23.9	-26.0	-30.9
Up Track Vib. Level	dB re 10^{-6}in/sec			48.2	47.5	37.7	33.2	38.1	46.2	39.5	39.8	35.2	31.7	22.1	15.9	9.1	8.0	0.1
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			14.2	9.5	0.7	-1.8	4.1	8.2	-1.5	-2.2	-6.8	-6.3	-14.9	-20.1	-23.9	-26.0	-30.9
Down Track Vib. Level	dB re 10^{-6}in/sec			48.2	47.5	37.7	33.2	38.1	46.2	39.5	39.8	35.2	31.7	22.1	15.9	9.1	8.0	0.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				51.2	50.6	40.7	36.2	41.1	49.2	42.5	42.8	38.2	34.7	25.1	19.0	12.1	11.1	3.2
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**67.2**	**66.6**	**56.7**	**52.2**	**56.9**	**64.6**	**57.7**	**57.8**	**53.0**	**48.7**	**38.1**	**31.0**	**23.1**	**21.8**	**13.9**
Predicted Noise Level	**Oct, dB**			**67.1**			**66.0**			**59.4**			**39.0**			**22.4**
L_{max}	**dB(A)**	**44.9**														
$L_{eq,30mins}$	**dB(A)**	**33.7**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	KAT-P1-1
Location:	Residential premises near Kai Tak Station
Assessed Floor	2
Item:	43

Train Speed: 35 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	75	15	76
Down Track	90	15	91

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	KAT-P1-5

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			29.3	33.3	32.3	30.3	29.3	33.3	36.3	37.3	37.3	33.3	32.3	31.3	28.3	29.3	26.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-19.8	-0.4	-4.1	-12.3	-18.2	-17.2	-23.9	-30.3	-33.9	-35.2	-33.5	-38.1	-30.6	-37.5	-39.7
Up Track Vib. Level	dB re 10^{-6}in/sec			4.5	27.9	23.2	13.1	6.1	11.1	7.5	2.0	-1.6	-6.9	-6.2	-11.8	-7.3	-13.2	-18.3
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			29.3	33.3	32.3	30.3	29.3	33.3	36.3	37.3	37.3	33.3	32.3	31.3	28.3	29.3	26.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	1	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-23.0	-2.1	-5.8	-14.4	-21.0	-20.3	-27.2	-33.9	-37.4	-38.0	-35.3	-39.5	-31.1	-37.8	-40.1
Down Track Vib. Level	dB re 10^{-6}in/sec			11.4	36.2	31.5	20.9	13.3	18.0	14.2	8.4	5.0	0.3	2.0	-3.1	2.2	-3.5	-8.8
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				12.2	36.8	32.1	21.6	14.0	18.8	15.0	9.3	5.8	1.1	2.6	-2.6	2.7	-3.1	-8.4
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**26.2**	**50.8**	**46.1**	**35.6**	**27.8**	**32.2**	**28.2**	**22.3**	**18.6**	**13.1**	**13.6**	**7.4**	**11.7**	**5.6**	**0.3**
Predicted Noise Level	**Oct, dB**			**52.2**			**34.7**			**24.2**			**16.4**			**7.6**
L_{max}	**dB(A)**	**15.4**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	KAT-P1-2
Location:	One Kai Tak
Assessed Floor	4
Item:	44

Train Speed: 50 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	75	15	76
Down Track	90	15	91

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	KAT-P1-5

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			-19.8	-0.4	-4.1	-12.3	-18.2	-17.2	-23.9	-30.3	-33.9	-35.2	-33.5	-38.1	-30.6	-37.5	-39.7
Up Track Vib. Level	dB re $10^{-6}in/sec$			7.6	31.0	26.3	16.2	9.2	14.2	10.6	5.1	1.5	-3.8	-3.1	-8.7	-4.2	-10.1	-15.2
Down Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			-23.0	-2.1	-5.8	-14.4	-21.0	-20.3	-27.2	-33.9	-37.4	-38.0	-35.3	-39.5	-31.1	-37.8	-40.1
Down Track Vib. Level	dB re $10^{-6}in/sec$			4.4	29.3	24.6	14.0	6.4	11.1	7.3	1.5	-2.0	-6.6	-4.9	-10.1	-4.7	-10.4	-15.7
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				9.3	33.2	28.6	18.2	11.0	16.0	12.2	6.7	3.1	-2.0	-0.9	-6.3	-1.4	-7.2	-12.5
BCF	dB	Y/N	0															
BVR-up	dB	Floor	4	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**19.3**	**43.2**	**38.6**	**28.2**	**20.8**	**25.4**	**21.4**	**15.7**	**11.9**	**6.0**	**6.1**	**-0.3**	**3.6**	**-2.5**	**-7.8**
Predicted Noise Level	**Oct, dB**			**44.6**			**27.8**			**17.5**			**8.6**			**2.4**
L_{max}	**dB(A)**	**8.1**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	KAT-P1-3
Location:	Residential premises near Kai Tak Station
Assessed Floor	2
Item:	45

Train Speed: 70 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	55	15	57
Down Track	70	15	72

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	KAT-P1-5

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			-14.7	2.3	-1.4	-8.9	-13.7	-12.3	-18.6	-24.6	-28.4	-30.9	-30.5	-35.9	-29.8	-36.9	-38.9
Up Track Vib. Level	dB re $10^{-6}in/sec$			17.6	38.7	34.0	24.5	18.6	24.1	20.7	15.7	12.0	5.5	4.8	-1.6	1.5	-4.6	-9.6
Down Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			-18.8	0.1	-3.6	-11.6	-17.4	-16.3	-22.9	-29.2	-32.9	-34.4	-32.9	-37.7	-30.5	-37.4	-39.5
Down Track Vib. Level	dB re $10^{-6}in/sec$			13.5	36.4	31.8	21.7	15.0	20.1	16.5	11.1	7.5	1.9	2.4	-3.4	0.9	-5.1	-10.2
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				19.0	40.7	36.0	26.3	20.2	25.5	22.1	17.0	13.3	7.1	6.8	0.6	4.2	-1.8	-6.8
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**33.0**	**54.7**	**50.0**	**40.3**	**34.0**	**38.9**	**35.3**	**30.0**	**26.1**	**19.1**	**17.8**	**10.6**	**13.2**	**6.9**	**1.9**
Predicted Noise Level	**Oct, dB**			**56.1**			**41.4**			**31.7**			**19.7**			**8.7**
L_{max}	**dB(A)**	**20.7**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: KAT-P1-4
Location: Residential premises near Kai Tak Station
Assessed Floor 2
Item: 46

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	80	15	81
Down Track	65	15	67

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	KAT-P1-5

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-20.9	-1.0	-4.7	-13.0	-19.2	-18.3	-25.0	-31.6	-35.1	-36.2	-34.1	-38.6	-30.8	-37.6	-39.8
Up Track Vib. Level	dB re 10^{-6}in/sec			8.8	32.7	28.0	17.7	10.5	15.4	11.7	6.1	2.6	-2.5	-1.4	-6.9	-2.1	-7.9	-13.1
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-17.6	0.8	-2.9	-10.8	-16.2	-15.0	-21.6	-27.8	-31.5	-33.3	-32.2	-37.2	-30.3	-37.3	-39.3
Down Track Vib. Level	dB re 10^{-6}in/sec			12.1	34.5	29.8	19.9	13.4	18.7	15.1	9.9	6.2	0.4	0.5	-5.5	-1.6	-7.6	-12.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				13.8	36.7	32.0	22.0	15.2	20.3	16.8	11.4	7.8	2.2	2.7	-3.1	1.2	-4.7	-9.9
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**27.8**	**50.7**	**46.0**	**36.0**	**29.0**	**33.7**	**30.0**	**24.4**	**20.6**	**14.2**	**13.7**	**6.9**	**10.2**	**4.0**	**-1.2**
Predicted Noise Level	**Oct, dB**			**52.1**			**36.2**			**26.2**			**15.9**			**6.3**
L_{max}	**dB(A)**	**16.0**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	KAT-P1-5
Location:	Mun Ching House, Kai Ching Estate
Assessed Floor	1
Item:	47

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	13	14	19
Down Track	25	14	29

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	KAT-P1-5

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			4.6	12.8	9.0	4.1	3.5	6.5	1.5	-2.8	-7.2	-14.2	-19.3	-27.7	-26.9	-34.8	-36.0
Up Track Vib. Level	dB re 10^{-6}in/sec			38.6	50.8	46.0	39.1	37.5	44.5	42.5	39.2	34.8	23.8	17.7	8.3	6.1	-0.8	-5.0
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-2.8	8.7	5.0	-0.9	-3.1	-0.7	-6.3	-11.2	-15.3	-20.6	-23.7	-30.9	-28.0	-35.6	-37.1
Down Track Vib. Level	dB re 10^{-6}in/sec			31.2	46.7	42.0	34.1	30.9	37.3	34.7	30.8	26.7	17.4	13.3	5.1	5.0	-1.6	-6.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				39.3	52.2	47.4	40.3	38.4	45.3	43.1	39.7	35.4	24.7	19.0	10.0	8.6	1.8	-2.5
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**55.3**	**68.2**	**63.4**	**56.3**	**54.2**	**60.7**	**58.3**	**54.7**	**50.2**	**38.7**	**32.0**	**22.0**	**19.6**	**12.5**	**8.2**
Predicted Noise Level	**Oct, dB**			**69.7**			**63.3**			**56.1**			**32.7**			**14.1**
L_{max}	**dB(A)**	**42.1**														
$L_{eq,30mins}$	**dB(A)**	**30.9**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	KAT-P1-6
Location:	Tower H3, De Novo
Assessed Floor	1
Item:	48

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	93	15	94
Down Track	80	15	81

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	KAT-P1-5

Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
				Frequency (Hz)														
Up Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TOC	dB	Type	1	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
LSR	dB re $10^{-6} in/s*in^{0.5}/lb$			-23.5	-2.4	-6.1	-14.8	-21.6	-20.8	-27.7	-34.5	-38.0	-38.5	-35.6	-39.7	-31.2	-37.9	-40.2
Up Track Vib. Level	dB re 10^{-6}in/sec			16.7	41.8	37.2	26.5	18.7	23.4	19.5	13.7	10.3	5.8	7.6	2.5	8.0	2.3	-3.0
Down Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TOC	dB	Type	1	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
LSR	dB re $10^{-6} in/s*in^{0.5}/lb$			-20.9	-1.0	-4.7	-13.0	-19.2	-18.3	-25.0	-31.6	-35.1	-36.2	-34.1	-38.6	-30.8	-37.6	-39.8
Down Track Vib. Level	dB re 10^{-6}in/sec			19.3	43.2	38.6	28.2	21.0	26.0	22.2	16.7	13.1	8.0	9.1	3.7	8.4	2.6	-2.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				21.2	45.6	40.9	30.5	23.0	27.9	24.1	18.4	14.9	10.1	11.4	6.1	11.3	5.5	0.2
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**37.2**	**61.6**	**56.9**	**46.5**	**38.8**	**43.3**	**39.3**	**33.4**	**29.7**	**24.1**	**24.4**	**18.1**	**22.3**	**16.2**	**10.9**
Predicted Noise Level	**Oct, dB**			**63.0**			**45.7**			**35.3**			**27.1**			**17.4**
L_{max}	**dB(A)**	**26.3**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	KAT-P1-7
Location:	Residential premises near Kai Tak Station
Assessed Floor	2
Item:	49

Train Speed: 75 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	0	20	20
Down Track	0	20	20

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-7
Down Track	KAT-P1-7

		Frequency (Hz)														
Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	35.9	39.9	38.9	36.9	35.9	39.9	42.9	43.9	43.9	39.9	38.9	37.9	34.9	35.9	32.9
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	11.2	14.3	10.2	7.7	6.4	4.5	6.1	1.9	-1.9	-5.6	-12.8	-16.6	-24.5	-29.7	-36.5
Up Track Vib. Level	dB re 10^{-6}in/sec	47.1	54.2	49.1	44.7	42.3	44.4	49.0	45.8	42.1	34.3	26.1	21.3	10.5	6.2	-3.5
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	35.9	39.9	38.9	36.9	35.9	39.9	42.9	43.9	43.9	39.9	38.9	37.9	34.9	35.9	32.9
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	11.2	14.3	10.2	7.7	6.4	4.5	6.1	1.9	-1.9	-5.6	-12.8	-16.6	-24.5	-29.7	-36.5
Down Track Vib. Level	dB re 10^{-6}in/sec	47.1	54.2	49.1	44.7	42.3	44.4	49.0	45.8	42.1	34.3	26.1	21.3	10.5	6.2	-3.5
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		50.1	57.2	52.1	47.7	45.3	47.4	52.1	48.8	45.1	37.4	29.1	24.3	13.5	9.2	-0.5
BCF	dB Y/N 0															
BVR-up	dB Floor 2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**64.1**	**71.2**	**66.1**	**61.7**	**59.1**	**60.8**	**65.3**	**61.8**	**57.9**	**49.4**	**40.1**	**34.3**	**22.5**	**17.9**	**8.2**
Predicted Noise Level	**Oct, dB**			**72.7**			**67.3**			**63.4**			**41.2**			**18.4**
L_{max}	**dB(A)**	**48.5**														
$L_{eq,30mins}$	**dB(A)**	**36.3**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	TKW-1-1
Location:	Parc 22
Assessed Floor	1
Item:	50

Train Speed: 70 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	85	13	86
Down Track	90	20	92

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	DIH-P1-1

Description	Unit	Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-22.0	-1.6	-5.2	-13.7	-20.2	-19.3	-26.1	-32.8	-36.3	-37.1	-34.7	-39.0	-31.0	-37.7	-40.0
Up Track Vib. Level	dB re 10^{-6}in/sec	13.4	37.7	33.1	22.6	15.2	20.0	16.2	10.6	7.1	2.2	3.6	-1.7	3.4	-2.4	-7.6
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-4.6	6.4	-5.8	-9.7	0.2	4.5	-5.1	-14.5	-16.4	-12.6	-22.1	-32.4	-28.7	-37.7	-33.3
Down Track Vib. Level	dB re 10^{-6}in/sec	30.7	45.7	32.5	26.6	35.6	43.8	37.2	28.9	27.0	26.7	16.3	4.9	5.6	-2.3	-1.0
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		30.8	46.3	35.8	28.1	35.6	43.9	37.3	28.9	27.0	26.7	16.5	5.8	7.7	0.6	-0.2
BCF	dB Y/N 0															
BVR-up	dB Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**46.8**	**62.3**	**51.8**	**44.1**	**51.4**	**59.3**	**52.5**	**43.9**	**41.8**	**40.7**	**29.5**	**17.8**	**18.7**	**11.3**	**10.5**
Predicted Noise Level	**Oct, dB**			**62.8**			**60.6**			**47.1**			**30.1**			**14.1**
L_{max}	**dB(A)**	**37.1**														
$L_{eq,30mins}$	**dB(A)**	**25.2**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: TKW-1-2
Location: Sanford Mansion
Assessed Floor 1
Item: 51

Train Speed: 70 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	95	12	96
Down Track	95	23	98

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	DIH-P1-1

Description	Unit	Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-23.9	-2.6	-6.3	-15.0	-21.9	-21.2	-28.1	-34.9	-38.4	-38.8	-35.9	-39.9	-31.3	-38.0	-40.3
Up Track Vib. Level	dB re 10^{-6}in/sec	11.4	36.7	32.1	21.3	13.5	18.1	14.2	8.4	4.9	0.6	2.5	-2.5	3.1	-2.6	-7.9
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-5.3	6.2	-6.1	-10.0	0.1	4.4	-5.3	-14.9	-16.7	-12.9	-22.4	-32.9	-28.9	-38.1	-33.4
Down Track Vib. Level	dB re 10^{-6}in/sec	30.0	45.6	32.2	26.3	35.4	43.7	37.1	28.4	26.6	26.5	16.0	4.5	5.5	-2.8	-1.1
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		30.1	46.1	35.2	27.5	35.4	43.7	37.1	28.4	26.6	26.5	16.2	5.2	7.4	0.3	-0.3
BCF	dB Y/N 0															
BVR-up	dB Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**46.1**	**62.1**	**51.2**	**43.5**	**51.2**	**59.1**	**52.3**	**43.4**	**41.4**	**40.5**	**29.2**	**17.2**	**18.4**	**11.0**	**10.4**
Predicted Noise Level	**Oct, dB**			**62.5**			**60.5**			**46.7**			**29.8**			**13.9**
L_{max}	**dB(A)**	**36.9**														
$L_{eq,30mins}$	**dB(A)**	**25.0**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: TKW-2-1
Location: Skytower Tower 1
Assessed Floor 5
Item: 52

Train Speed: 70 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	140	13	141
Down Track	140	20	141

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-30.7	-6.3	-9.9	-19.6	-27.9	-27.8	-35.2	-42.6	-45.8	-44.6	-39.8	-42.8	-32.3	-38.7	-41.3
Up Track Vib. Level	dB re 10^{-6}in/sec			4.7	33.0	28.4	16.8	7.4	11.6	7.2	0.8	-2.5	-5.3	-1.4	-5.4	2.0	-3.4	-9.0
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-9.5	5.5	-7.5	-11.8	-0.8	3.5	-6.1	-17.7	-18.9	-14.3	-24.0	-35.6	-29.9	-40.7	-34.0
Down Track Vib. Level	dB re 10^{-6}in/sec			25.8	44.9	30.8	24.5	34.6	42.9	36.3	25.7	24.5	25.1	14.4	1.7	4.4	-5.4	-1.7
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				25.8	45.1	32.8	25.2	34.6	42.9	36.3	25.7	24.5	25.1	14.5	2.5	6.4	-1.3	-0.9
BCF	dB	Y/N	0															
BVR-up	dB	Floor	5	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**33.8**	**53.1**	**40.8**	**33.2**	**42.4**	**50.3**	**43.5**	**32.7**	**31.3**	**31.1**	**19.5**	**6.5**	**9.4**	**1.4**	**1.8**
Predicted Noise Level	**Oct, dB**			**53.4**			**51.7**			**36.5**			**20.1**			**5.9**
L_{max}	**dB(A)**	**27.8**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	TKW-2-2
Location:	Skytower Tower 2
Assessed Floor	5
Item:	53

Train Speed: 70 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	140	12	141
Down Track	140	23	142

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-30.7	-6.3	-9.9	-19.6	-27.9	-27.8	-35.2	-42.6	-45.8	-44.6	-39.8	-42.8	-32.3	-38.7	-41.3
Up Track Vib. Level	dB re 10^{-6}in/sec			4.7	33.0	28.4	16.8	7.4	11.6	7.2	0.8	-2.5	-5.3	-1.4	-5.4	2.0	-3.4	-9.0
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-9.6	5.5	-7.6	-11.8	-0.8	3.5	-6.1	-17.7	-18.9	-14.3	-24.0	-35.7	-30.0	-40.8	-34.0
Down Track Vib. Level	dB re 10^{-6}in/sec			25.7	44.8	30.8	24.5	34.5	42.9	36.3	25.6	24.4	25.1	14.3	1.6	4.4	-5.5	-1.7
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				25.8	45.1	32.8	25.2	34.5	42.9	36.3	25.6	24.4	25.1	14.5	2.4	6.4	-1.3	-0.9
BCF	dB	Y/N	0															
BVR-up	dB	Floor	5	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**33.8**	**53.1**	**40.8**	**33.2**	**42.3**	**50.3**	**43.5**	**32.6**	**31.2**	**31.1**	**19.5**	**6.4**	**9.4**	**1.4**	**1.8**
Predicted Noise Level	**Oct, dB**			**53.4**			**51.6**			**36.5**			**20.1**			**5.9**
L_{max}	**dB(A)**	**27.7**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	TKW-2-3
Location:	Skytower Tower 7
Assessed Floor	5
Item:	54

Train Speed: 70 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	235	15	235
Down Track	260	27	261

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-15.4	4.5	-9.6	-14.3	-2.0	2.4	-7.2	-21.5	-21.9	-16.2	-26.2	-39.5	-31.4	-44.4	-34.8
Up Track Vib. Level	dB re 10^{-6}in/sec			14.9	38.9	23.8	17.1	28.3	36.7	30.2	16.8	16.5	18.1	7.1	-7.2	-2.1	-14.1	-7.4
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			35.3	39.3	38.3	36.3	35.3	39.3	42.3	43.3	43.3	39.3	38.3	37.3	34.3	35.3	32.3
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-16.6	4.3	-10.0	-14.8	-2.2	2.2	-7.4	-22.3	-22.5	-16.6	-26.7	-40.3	-31.7	-45.2	-34.9
Down Track Vib. Level	dB re 10^{-6}in/sec			13.7	38.6	23.3	16.5	28.1	36.5	29.9	16.0	15.9	17.7	6.7	-8.0	-2.4	-14.8	-7.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				17.4	41.8	26.6	19.8	31.2	39.6	33.1	19.5	19.2	20.9	9.9	-4.5	0.8	-11.4	-4.5
BCF	dB	Y/N	0															
BVR-up	dB	Floor	5	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**25.4**	**49.8**	**34.6**	**27.8**	**39.0**	**47.0**	**40.3**	**26.5**	**26.0**	**26.9**	**14.9**	**-0.5**	**3.8**	**-8.7**	**-1.8**
Predicted Noise Level	**Oct, dB**			**49.9**			**48.4**			**31.3**			**15.3**			**2.5**
L_{max}	**dB(A)**	**24.2**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	TKW-3-1
Location:	Prince Ritz
Assessed Floor	5
Item:	55

Train Speed: 20 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	235	23	236
Down Track	255	23	256

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit	Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	24.5	28.5	27.5	25.5	24.5	28.5	31.5	32.5	32.5	28.5	27.5	26.5	23.5	24.5	21.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-15.5	4.5	-9.6	-14.3	-2.0	2.4	-7.2	-21.5	-21.9	-16.2	-26.2	-39.5	-31.4	-44.4	-34.8
Up Track Vib. Level	dB re 10^{-6}in/sec	4.0	28.0	12.9	6.2	17.5	25.8	19.3	5.9	5.6	7.2	-3.8	-18.1	-13.0	-25.0	-18.3
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	24.5	28.5	27.5	25.5	24.5	28.5	31.5	32.5	32.5	28.5	27.5	26.5	23.5	24.5	21.5
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	-16.4	4.3	-9.9	-14.7	-2.2	2.2	-7.4	-22.1	-22.4	-16.6	-26.6	-40.2	-31.7	-45.0	-34.9
Down Track Vib. Level	dB re 10^{-6}in/sec	3.0	27.8	12.5	5.8	17.3	25.7	19.1	5.3	5.1	6.9	-4.1	-18.7	-13.2	-25.6	-18.5
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		6.5	30.9	15.7	9.0	20.4	28.8	22.2	8.6	8.4	10.1	-0.9	-15.4	-10.1	-22.3	-15.4
BCF	dB Y/N 0															
BVR-up	dB Floor 5	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**14.5**	**38.9**	**23.7**	**17.0**	**28.2**	**36.2**	**29.4**	**15.6**	**15.2**	**16.1**	**4.1**	**-11.4**	**-7.1**	**-19.6**	**-12.7**
Predicted Noise Level	**Oct, dB**		**39.1**				**37.5**			**20.4**			**4.5**			**0.3**
L_{max}	**dB(A)**	**13.3**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	TKW-3-2
Location:	Prosperity House
Assessed Floor	2
Item:	56

Train Speed: 45 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	250	23	251
Down Track	270	23	271

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			31.5	35.5	34.5	32.5	31.5	35.5	38.5	39.5	39.5	35.5	34.5	33.5	30.5	31.5	28.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-16.2	4.4	-9.8	-14.6	-2.2	2.2	-7.3	-22.0	-22.2	-16.5	-26.5	-40.0	-31.6	-44.9	-34.9
Up Track Vib. Level	dB re 10^{-6}in/sec			10.3	34.9	19.7	12.9	24.3	32.7	26.2	12.5	12.3	14.0	3.0	-11.5	-6.1	-18.4	-11.4
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			31.5	35.5	34.5	32.5	31.5	35.5	38.5	39.5	39.5	35.5	34.5	33.5	30.5	31.5	28.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-17.1	4.2	-10.1	-15.0	-2.3	2.1	-7.5	-22.6	-22.7	-16.8	-26.8	-40.6	-31.8	-45.4	-35.0
Down Track Vib. Level	dB re 10^{-6}in/sec			9.4	34.7	19.4	12.5	24.2	32.6	26.0	11.9	11.8	13.7	2.7	-12.1	-6.3	-18.9	-11.5
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				12.9	37.8	22.5	15.7	27.3	35.7	29.1	15.2	15.1	16.9	5.8	-8.8	-3.2	-15.6	-8.4
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**26.9**	**51.8**	**36.5**	**29.7**	**41.1**	**49.1**	**42.3**	**28.2**	**27.9**	**28.9**	**16.8**	**1.2**	**5.8**	**-6.9**	**0.3**
Predicted Noise Level	**Oct, dB**			**52.0**			**50.4**			**33.1**			**17.3**			**3.6**
L_{max}	**dB(A)**	**26.2**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	TKW-P1-1
Location:	Residential premises near To Kwa Wan Station
Assessed Floor	1
Item:	57

Train Speed: 45 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	35	22	41
Down Track	15	22	27

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

				Frequency (Hz)														
Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			31.5	35.5	34.5	32.5	31.5	35.5	38.5	39.5	39.5	35.5	34.5	33.5	30.5	31.5	28.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			4.7	7.9	-2.6	-5.8	2.2	6.3	-3.4	-8.4	-11.6	-9.5	-18.5	-26.3	-26.3	-31.9	-32.1
Up Track Vib. Level	dB re 10^{-6}in/sec			31.2	38.4	26.9	21.7	28.7	36.8	30.1	26.1	22.9	21.0	11.0	2.2	-0.8	-5.4	-8.6
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			31.5	35.5	34.5	32.5	31.5	35.5	38.5	39.5	39.5	35.5	34.5	33.5	30.5	31.5	28.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.5	8.8	-1.0	-3.8	3.1	7.3	-2.4	-5.3	-9.2	-7.9	-16.7	-23.1	-25.1	-28.9	-31.5
Down Track Vib. Level	dB re 10^{-6}in/sec			36.0	39.3	28.5	23.7	29.7	37.8	31.1	29.2	25.3	22.6	12.8	5.4	0.4	-2.4	-8.0
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				37.3	41.9	30.8	25.8	32.2	40.3	33.6	31.0	27.3	24.9	15.0	7.1	2.8	-0.6	-5.3
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**53.3**	**57.9**	**46.8**	**41.8**	**48.0**	**55.7**	**48.8**	**46.0**	**42.1**	**38.9**	**28.0**	**19.1**	**13.8**	**10.1**	**5.4**
Predicted Noise Level	**Oct, dB**			**58.3**			**57.1**			**48.0**			**28.7**			**11.7**
L_{max}	**dB(A)**	**34.9**														
$L_{eq,30mins}$	**dB(A)**	**24.9**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-6-1
Location:	Fok On Building
Assessed Floor	2
Item:	58

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	18	15	23
Down Track	12	24	27

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit	Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	11.4	9.1	-0.3	-3.0	3.5	7.6	-2.1	-4.1	-8.2	-7.3	-16.0	-21.9	-24.7	-27.7	-31.2
Up Track Vib. Level	dB re 10^{-6}in/sec	46.1	47.8	37.4	32.7	38.2	46.3	39.6	38.6	34.5	31.4	21.7	14.8	9.0	7.0	0.5
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	9.5	8.8	-1.0	-3.8	3.1	7.3	-2.4	-5.3	-9.2	-7.9	-16.7	-23.1	-25.1	-28.9	-31.5
Down Track Vib. Level	dB re 10^{-6}in/sec	44.2	47.5	36.7	31.9	37.8	46.0	39.3	37.4	33.5	30.8	21.0	13.6	8.6	5.8	0.2
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		48.3	50.6	40.1	35.3	41.0	49.2	42.4	41.1	37.0	34.1	24.4	17.2	11.8	9.5	3.4
BCF	dB Y/N 0															
BVR-up	dB Floor 2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**62.3**	**64.6**	**54.1**	**49.3**	**54.8**	**62.6**	**55.6**	**54.1**	**49.8**	**46.1**	**35.4**	**27.2**	**20.8**	**18.2**	**12.1**
Predicted Noise Level	**Oct, dB**			**65.1**			**63.9**			**55.9**			**36.1**			**19.2**
L_{max}	**dB(A)**	**42.2**														
$L_{eq,30mins}$	**dB(A)**	**30.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-6-2
Location:	HK Society for the Protection of Children
Assessed Floor	0
Item:	59

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	10	15	18
Down Track	17	24	29

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			5.6	13.3	9.5	4.8	4.3	7.5	2.5	-1.8	-6.2	-13.4	-18.8	-27.3	-26.7	-34.7	-35.8
Up Track Vib. Level	dB re 10^{-6}in/sec			40.3	52.0	47.2	40.5	39.0	46.2	44.2	40.9	36.5	25.3	18.9	9.4	7.0	0.0	-4.1
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.7	8.6	-1.2	-4.1	3.0	7.1	-2.6	-5.8	-9.6	-8.2	-17.0	-23.7	-25.3	-29.4	-31.6
Down Track Vib. Level	dB re 10^{-6}in/sec			43.4	47.3	36.5	31.6	37.7	45.8	39.1	36.9	33.1	30.5	20.7	13.0	8.4	5.3	0.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				45.1	53.2	47.5	41.0	41.4	49.0	45.3	42.4	38.2	31.7	22.9	14.6	10.7	6.4	1.5
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**63.1**	**71.2**	**65.5**	**59.0**	**59.2**	**66.4**	**62.5**	**59.4**	**55.0**	**47.7**	**37.9**	**28.6**	**23.7**	**19.1**	**14.2**
Predicted Noise Level	**Oct, dB**			**72.5**			**68.4**			**60.9**			**38.5**			**20.4**
L_{max}	**dB(A)**	**47.0**														
$L_{eq,30mins}$	**dB(A)**	**38[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.

[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-6-3
Location:	Chung Nam Mansion
Assessed Floor	2
Item:	60

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	20	15	25
Down Track	20	27	34

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

		Frequency (Hz)														
Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	10.4	8.9	-0.7	-3.4	3.3	7.4	-2.3	-4.7	-8.7	-7.6	-16.4	-22.5	-24.9	-28.3	-31.4
Up Track Vib. Level	dB re 10^{-6}in/sec	45.1	47.6	37.0	32.3	38.0	46.1	39.4	38.0	34.0	31.1	21.3	14.2	8.8	6.4	0.3
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	6.9	8.3	-1.9	-4.9	2.6	6.7	-2.9	-7.0	-10.5	-8.8	-17.7	-24.9	-25.8	-30.5	-31.8
Down Track Vib. Level	dB re 10^{-6}in/sec	41.6	47.0	35.8	30.8	37.3	45.4	38.8	35.7	32.2	29.9	20.0	11.8	7.9	4.2	-0.1
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		46.7	50.3	39.5	34.6	40.7	48.8	42.1	40.0	36.2	33.5	23.7	16.2	11.4	8.4	3.1
BCF	dB Y/N 0															
BVR-up	dB Floor 2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Predicted Noise Level	**1/3 Oct, dB**	**60.7**	**64.3**	**53.5**	**48.6**	**54.5**	**62.2**	**55.3**	**53.0**	**49.0**	**45.5**	**34.7**	**26.2**	**20.4**	**17.1**	**11.8**
Predicted Noise Level	**Oct, dB**			**64.8**			**63.6**			**55.0**			**35.4**			**18.3**
L_{max}	**dB(A)**	**41.5**														
$L_{eq,30mins}$	**dB(A)**	**30.0**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Project: SCL(TAW - HUH)
NSR Ref.: MTW-6-4
Location: Pok Oi Lau
Assessed Floor 0
Item: 61

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	12	15	19
Down Track	12	27	30

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
				Frequency (Hz)														
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			13.6	9.4	0.4	-2.1	4.0	8.1	-1.7	-2.6	-7.1	-6.6	-15.1	-20.5	-24.1	-26.3	-30.9
Up Track Vib. Level	dB re 10^{-6}in/sec			48.3	48.1	38.1	33.6	38.7	46.8	40.0	40.1	35.6	32.1	22.5	16.2	9.6	8.4	0.8
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.3	8.5	-1.4	-4.3	2.9	7.0	-2.7	-6.1	-9.8	-8.3	-17.2	-23.9	-25.4	-29.6	-31.6
Down Track Vib. Level	dB re 10^{-6}in/sec			43.0	47.2	36.3	31.4	37.6	45.7	39.0	36.6	32.9	30.4	20.5	12.8	8.3	5.1	0.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				49.4	50.7	40.3	35.7	41.2	49.3	42.6	41.7	37.5	34.4	24.7	17.9	12.0	10.0	3.4
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**67.4**	**68.7**	**58.3**	**53.7**	**59.0**	**66.7**	**59.8**	**58.7**	**54.3**	**50.4**	**39.7**	**31.9**	**25.0**	**22.7**	**16.1**
Predicted Noise Level	**Oct, dB**			**69.2**			**68.1**			**60.5**			**40.5**			**23.6**
L_{max}	**dB(A)**	**46.5**														
$L_{eq,30mins}$	**dB(A)**	**34.9**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-7-1
Location:	Geranium House
Assessed Floor	1
Item:	62

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	13	17	21
Down Track	13	28	31

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			12.4	9.2	0.0	-2.5	3.7	7.8	-1.9	-3.4	-7.7	-6.9	-15.6	-21.2	-24.4	-27.1	-31.1
Up Track Vib. Level	dB re 10^{-6}in/sec			47.1	47.9	37.7	33.2	38.4	46.5	39.8	39.3	35.0	31.8	22.1	15.5	9.3	7.6	0.6
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.8	6.5	-0.5	-6.2	-7.6	-9.0	-11.6	-7.4	-4.3	-8.3	-6.9	-8.2	-1.7	-6.2	-13.2
Down Track Vib. Level	dB re 10^{-6}in/sec			43.5	45.2	37.2	29.5	27.1	29.7	30.1	35.3	38.4	30.4	30.8	28.5	32.0	28.5	18.5
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				48.7	49.8	40.5	34.7	38.8	46.6	40.2	40.8	40.0	34.1	31.3	28.7	32.0	28.5	18.6
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**64.7**	**65.8**	**56.5**	**50.7**	**54.6**	**62.0**	**55.4**	**55.8**	**54.8**	**48.1**	**44.3**	**40.7**	**43.0**	**39.2**	**29.3**
Predicted Noise Level	**Oct, dB**			**66.4**			**63.5**			**58.7**			**47.7**			**39.6**
L_{max}	**dB(A)**	**45.7**														
$L_{eq,30mins}$	**dB(A)**	**34.1**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-8-1
Location:	Horae Palace
Assessed Floor	3
Item:	63

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	15	17	23
Down Track	15	28	32

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

			Frequency (Hz)														
Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																	
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.1	6.7	0.2	-5.0	-6.3	-8.2	-8.6	-3.7	-2.9	-7.6	-6.0	-6.1	0.6	-4.7	-12.2
Up Track Vib. Level	dB re 10^{-6}in/sec			43.8	45.4	37.9	30.7	28.4	30.5	33.1	39.0	39.8	31.1	31.7	30.6	34.3	30.0	19.5
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.8	6.5	-0.6	-6.3	-7.7	-9.0	-11.9	-7.8	-4.5	-8.4	-7.0	-8.4	-2.0	-6.4	-13.3
Down Track Vib. Level	dB re 10^{-6}in/sec			43.5	45.2	37.1	29.4	27.0	29.7	29.8	34.9	38.2	30.3	30.7	28.3	31.7	28.3	18.4
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.6	48.3	40.5	33.1	30.7	33.1	34.7	40.4	42.1	33.8	34.2	32.6	36.2	32.3	22.0
BCF	dB	Y/N	0															
BVR-up	dB	Floor	3	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**58.6**	**60.3**	**52.5**	**45.1**	**42.5**	**44.5**	**45.9**	**51.4**	**52.9**	**43.8**	**43.2**	**40.6**	**43.2**	**39.0**	**28.7**
Predicted Noise Level	**Oct, dB**			**61.1**			**49.3**			**55.5**			**47.3**			**39.4**
L_{max}	**dB(A)**	**43.3**														
$L_{eq,30mins}$	**dB(A)**	**31.8**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-9-1
Location:	Majestic Park
Assessed Floor	3
Item:	64

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	35	18	39
Down Track	35	30	46

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
				Frequency (Hz)														
Up Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re $10^{-6} in/s*in^{0.5}/lb$			8.5	6.2	-1.3	-7.4	-8.9	-9.8	-14.7	-11.2	-5.8	-9.1	-7.9	-10.3	-4.1	-7.8	-14.2
Up Track Vib. Level	dB re $10^{-6} in/sec$			43.2	44.9	36.4	28.3	25.8	28.9	27.0	31.5	36.9	29.6	29.8	26.4	29.6	26.9	17.5
Down Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re $10^{-6} in/s*in^{0.5}/lb$			8.3	6.1	-1.7	-8.0	-9.6	-10.2	-16.2	-13.1	-6.5	-9.5	-8.4	-11.3	-5.3	-8.7	-14.8
Down Track Vib. Level	dB re $10^{-6} in/sec$			43.0	44.8	36.0	27.7	25.1	28.5	25.5	29.6	36.2	29.2	29.3	25.4	28.4	26.0	16.9
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.1	47.9	39.2	31.0	28.5	31.8	29.3	33.7	39.6	32.4	32.6	29.0	32.1	29.5	20.2
BCF	dB	Y/N	0															
BVR-up	dB	Floor	3	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**58.1**	**59.9**	**51.2**	**43.0**	**40.3**	**43.2**	**40.5**	**44.7**	**50.4**	**42.4**	**41.6**	**37.0**	**39.1**	**36.2**	**26.9**
Predicted Noise Level	**Oct, dB**			**60.5**			**46.3**			**51.9**			**44.4**			**36.7**
L_{max}	**dB(A)**	**40.3**														
$L_{eq,30mins}$	**dB(A)**	**28.7**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-10-1
Location:	18 Farm Road
Assessed Floor	3
Item:	65

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	15	18	23
Down Track	15	30	34

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz)														
				20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.1	6.7	0.2	-5.0	-6.3	-8.2	-8.6	-3.7	-2.9	-7.6	-6.0	-6.1	0.6	-4.7	-12.2
Up Track Vib. Level	dB re 10^{-6}in/sec			43.8	45.4	37.9	30.7	28.4	30.5	33.1	39.0	39.8	31.1	31.7	30.6	34.3	30.0	19.5
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.7	6.4	-0.8	-6.6	-8.0	-9.2	-12.6	-8.6	-4.8	-8.6	-7.2	-8.8	-2.4	-6.7	-13.5
Down Track Vib. Level	dB re 10^{-6}in/sec			43.4	45.1	36.9	29.1	26.7	29.5	29.1	34.1	37.9	30.1	30.5	27.9	31.2	28.0	18.2
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.6	48.3	40.5	33.0	30.6	33.1	34.6	40.2	42.0	33.7	34.2	32.5	36.0	32.1	21.9
BCF	dB	Y/N	0															
BVR-up	dB	Floor	3	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**58.6**	**60.3**	**52.5**	**45.0**	**42.4**	**44.5**	**45.8**	**51.2**	**52.8**	**43.7**	**43.2**	**40.5**	**43.0**	**38.8**	**28.6**
Predicted Noise Level	**Oct, dB**			**61.1**			**49.2**			**55.4**			**47.1**			**39.2**
L_{max}	**dB(A)**	**43.2**														
$L_{eq,30mins}$	**dB(A)**	**31.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-11-1
Location:	Farm Road Government Primary School
Assessed Floor	0
Item:	66

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	65	18	67
Down Track	65	30	72

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
			Frequency (Hz)														
Up Track Calculation																	
FDL	dB re 1 $lb/in^{0.5}$		34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type 0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$		8.0	5.8	-2.5	-9.3	-11.0	-11.1	-19.7	-17.4	-8.1	-10.4	-9.5	-13.7	-7.9	-10.5	-15.9
Up Track Vib. Level	dB re 10^{-6}in/sec		42.7	44.5	35.2	26.4	23.6	27.6	22.0	25.3	34.6	28.3	28.2	23.0	25.8	24.2	15.8
Down Track Calculation																	
FDL	dB re 1 $lb/in^{0.5}$		34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type 0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$		7.9	5.8	-2.7	-9.6	-11.3	-11.3	-20.4	-18.2	-8.5	-10.5	-9.7	-14.1	-8.4	-10.8	-16.2
Down Track Vib. Level	dB re 10^{-6}in/sec		42.6	44.5	35.0	26.1	23.3	27.4	21.3	24.5	34.2	28.2	28.0	22.6	25.3	23.9	15.5
Total of Up and Down Tracks Calculation																	
Total Vibration Level Outside Building			45.6	47.5	38.1	29.2	26.5	30.5	24.7	27.9	37.4	31.3	31.1	25.8	28.6	27.1	18.7
BCF	dB	Y/N 0															
BVR-up	dB	Floor 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB		6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**63.6**	**65.5**	**56.1**	**47.2**	**44.3**	**47.9**	**41.9**	**44.9**	**54.2**	**47.3**	**46.1**	**39.8**	**41.6**	**39.8**	**31.4**
Predicted Noise Level	**Oct, dB**			**66.0**			**50.2**			**55.4**			**48.1**			**40.4**
L_{max}	**dB(A)**	**43.9**														
$L_{eq,30mins}$	**dB(A)**	**35[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.

[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-12-1
Location:	Yuet Fai Mansion
Assessed Floor	1
Item:	67

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	11	22	25
Down Track	11	33	35

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.0	6.7	0.0	-5.3	-6.7	-8.4	-9.5	-4.8	-3.3	-7.8	-6.2	-6.7	-0.1	-5.1	-12.5
Up Track Vib. Level	dB re 10^{-6}in/sec			43.7	45.4	37.7	30.4	28.0	30.3	32.2	37.9	39.4	30.9	31.5	30.0	33.6	29.6	19.2
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.7	6.4	-0.8	-6.7	-8.1	-9.3	-12.8	-8.9	-4.9	-8.6	-7.3	-9.0	-2.7	-6.9	-13.6
Down Track Vib. Level	dB re 10^{-6}in/sec			43.4	45.1	36.9	29.0	26.6	29.4	28.8	33.8	37.8	30.1	30.4	27.7	31.0	27.8	18.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.5	48.2	40.3	32.7	30.4	32.9	33.9	39.3	41.7	33.5	34.0	32.0	35.5	31.8	21.7
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**62.5**	**64.2**	**56.3**	**48.7**	**46.2**	**48.3**	**49.1**	**54.3**	**56.5**	**47.5**	**47.0**	**44.0**	**46.5**	**42.5**	**32.4**
Predicted Noise Level	**Oct, dB**			**65.0**			**52.8**			**58.9**			**50.8**			**42.9**
L_{max}	**dB(A)**	**46.8**														
$L_{eq,30mins}$	**dB(A)**	**35.2**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: MTW-12-2
Location: Delight Court
Assessed Floor 3
Item: 68

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	18	20	27
Down Track	18	30	35

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	HOM-2-2

Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
				Frequency (Hz)														
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.5	8.8	-1.0	-3.8	3.1	7.3	-2.4	-5.3	-9.2	-7.9	-16.7	-23.1	-25.1	-28.9	-31.5
Up Track Vib. Level	dB re 10^{-6}in/sec			44.2	47.5	36.7	31.9	37.8	46.0	39.3	37.4	33.5	30.8	21.0	13.6	8.6	5.8	0.2
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.7	6.4	-0.8	-6.7	-8.1	-9.3	-12.8	-8.9	-4.9	-8.6	-7.3	-9.0	-2.7	-6.9	-13.6
Down Track Vib. Level	dB re 10^{-6}in/sec			43.4	45.1	36.9	29.0	26.6	29.4	28.8	33.8	37.8	30.1	30.4	27.7	31.0	27.8	18.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.8	49.4	39.8	33.7	38.2	46.1	39.6	39.0	39.2	33.5	30.9	27.9	31.1	27.8	18.2
BCF	dB	Y/N	0															
BVR-up	dB	Floor	3	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**58.8**	**61.4**	**51.8**	**45.7**	**50.0**	**57.5**	**50.8**	**50.0**	**50.0**	**43.5**	**39.9**	**35.9**	**38.1**	**34.5**	**24.9**
Predicted Noise Level	**Oct, dB**			**62.0**			**58.9**			**53.4**			**43.0**			**35.0**
L_{max}	**dB(A)**	**40.8**														
$L_{eq,30mins}$	**dB(A)**	**29.3**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-12-3
Location:	Lucky Mansion
Assessed Floor	3
Item:	69

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	15	20	25
Down Track	15	30	34

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	HOM-2-2

Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
				Frequency (Hz)														
Up Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re $10^{-6} in/s*in^{0.5}/lb$			10.4	8.9	-0.7	-3.4	3.3	7.4	-2.3	-4.7	-8.7	-7.6	-16.4	-22.5	-24.9	-28.3	-31.4
Up Track Vib. Level	dB re 10^{-6} in/sec			38.7	41.2	30.6	25.9	31.6	39.7	33.0	31.6	27.5	24.6	14.9	7.7	2.3	-0.1	-6.1
Down Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re $10^{-6} in/s*in^{0.5}/lb$			8.7	6.4	-0.8	-6.6	-8.0	-9.2	-12.6	-8.6	-4.8	-8.6	-7.2	-8.8	-2.4	-6.7	-13.5
Down Track Vib. Level	dB re 10^{-6} in/sec			36.9	38.7	30.5	22.7	20.3	23.0	22.7	27.7	31.5	23.7	24.0	21.4	24.8	21.5	11.7
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				40.9	43.1	33.6	27.6	31.9	39.8	33.4	33.0	33.0	27.2	24.5	21.6	24.8	21.5	11.8
BCF	dB	Y/N	0															
BVR-up	dB	Floor	3	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**52.9**	**55.1**	**45.6**	**39.6**	**43.7**	**51.2**	**44.6**	**44.0**	**43.8**	**37.2**	**33.5**	**29.6**	**31.8**	**28.2**	**18.5**
Predicted Noise Level	**Oct, dB**			**55.7**			**52.6**			**47.4**			**36.7**			**28.7**
L_{max}	**dB(A)**	**34.6**														
$L_{eq,30mins}$	**dB(A)**	**23.8**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: MTW-12-4
Location: 352-354 Ma Tau Wai Road
Assessed Floor 2
Item: 70

Train Speed: 40 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	15	20	25
Down Track	15	30	34

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	HOM-2-2

Description	Unit		Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																	
FDL	dB re 1 $lb/in^{0.5}$		30.5	34.5	33.5	31.5	30.5	34.5	37.5	38.5	38.5	34.5	33.5	32.5	29.5	30.5	27.5
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type 0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$		10.4	8.9	-0.7	-3.4	3.3	7.4	-2.3	-4.7	-8.7	-7.6	-16.4	-22.5	-24.9	-28.3	-31.4
Up Track Vib. Level	dB re $10^{-6}in/sec$		35.9	38.4	27.8	23.1	28.8	36.9	30.2	28.8	24.8	21.9	12.1	4.9	-0.4	-2.8	-8.9
Down Track Calculation																	
FDL	dB re 1 $lb/in^{0.5}$		30.5	34.5	33.5	31.5	30.5	34.5	37.5	38.5	38.5	34.5	33.5	32.5	29.5	30.5	27.5
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type 0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$		8.7	6.4	-0.8	-6.6	-8.0	-9.2	-12.6	-8.6	-4.8	-8.6	-7.2	-8.8	-2.4	-6.7	-13.5
Down Track Vib. Level	dB re $10^{-6}in/sec$		34.2	35.9	27.7	19.9	17.5	20.3	19.9	24.9	28.7	20.9	21.3	18.7	22.0	18.8	9.0
Total of Up and Down Tracks Calculation																	
Total Vibration Level Outside Building			38.1	40.3	30.8	24.8	29.1	37.0	30.6	30.3	30.2	24.4	21.8	18.9	22.1	18.8	9.0
BCF	dB	Y/N 0															
BVR-up	dB	Floor 2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB		6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**52.1**	**54.3**	**44.8**	**38.8**	**42.9**	**50.4**	**43.8**	**43.3**	**43.0**	**36.4**	**32.8**	**28.9**	**31.1**	**27.5**	**17.7**
Predicted Noise Level	**Oct, dB**			**54.9**			**51.9**			**46.6**			**36.0**			**27.9**
L_{max}	**dB(A)**	**33.9**														
$L_{eq,30mins}$	**dB(A)**	**24.4**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-12-5
Location:	Seng Cheong Building
Assessed Floor	1
Item:	71

Train Speed: 50 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	18	18	25
Down Track	18	29	34

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	DIH-P1-1

Description	Unit		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
			Frequency (Hz)														
Up Track Calculation																	
FDL	dB re 1 lb/in$^{0.5}$		32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb		-0.2	10.1	6.4	0.9	-0.8	1.8	-3.5	-8.3	-12.5	-18.4	-22.1	-29.7	-27.6	-35.4	-36.7
Up Track Vib. Level	dB re 10^{-6}in/sec		32.2	46.6	41.8	34.3	31.6	38.3	35.9	32.1	27.9	18.0	13.3	4.7	3.8	-2.9	-7.3
Down Track Calculation																	
FDL	dB re 1 lb/in$^{0.5}$		32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb		6.9	8.3	-1.9	-4.9	2.6	6.7	-2.9	-7.0	-10.5	-8.8	-17.7	-24.9	-25.8	-30.5	-31.8
Down Track Vib. Level	dB re 10^{-6}in/sec		39.3	44.7	33.5	28.5	35.0	43.2	36.5	33.4	29.9	27.6	17.7	9.5	5.6	1.9	-2.4
Total of Up and Down Tracks Calculation																	
Total Vibration Level Outside Building			40.1	48.7	42.4	35.3	36.7	44.4	39.2	35.8	32.0	28.1	19.0	10.8	7.8	3.1	-1.2
BCF	dB	Y/N 0															
BVR-up	dB	Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB		6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**56.1**	**64.7**	**58.4**	**51.3**	**52.5**	**59.8**	**54.4**	**50.8**	**46.8**	**42.1**	**32.0**	**22.8**	**18.8**	**13.8**	**9.5**
Predicted Noise Level	**Oct, dB**			**65.8**			**61.5**			**52.7**			**32.7**			**15.3**
L_{max}	**dB(A)**	**39.4**														
$L_{eq,30mins}$	**dB(A)**	**29.0**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-12-6
Location:	Great Wall Building
Assessed Floor	3
Item:	72

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	30	18	35
Down Track	30	30	42

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.7	6.4	-0.8	-6.7	-8.1	-9.3	-12.8	-8.9	-4.9	-8.6	-7.3	-9.0	-2.7	-6.9	-13.6
Up Track Vib. Level	dB re 10^{-6}in/sec			43.4	45.1	36.9	29.0	26.6	29.4	28.8	33.8	37.8	30.1	30.4	27.7	31.0	27.8	18.1
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.5	6.2	-1.3	-7.4	-8.9	-9.8	-14.7	-11.2	-5.8	-9.1	-7.9	-10.3	-4.1	-7.8	-14.2
Down Track Vib. Level	dB re 10^{-6}in/sec			43.2	44.9	36.4	28.3	25.8	28.9	27.0	31.5	36.9	29.6	29.8	26.4	29.6	26.9	17.5
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.3	48.0	39.7	31.7	29.2	32.2	31.0	35.8	40.4	32.9	33.1	30.1	33.4	30.4	20.8
BCF	dB	Y/N	0															
BVR-up	dB	Floor	3	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**58.3**	**60.0**	**51.7**	**43.7**	**41.0**	**43.6**	**42.2**	**46.8**	**51.2**	**42.9**	**42.1**	**38.1**	**40.4**	**37.1**	**27.5**
Predicted Noise Level	**Oct, dB**			**60.7**			**47.2**			**53.0**			**45.3**			**37.5**
L_{max}	**dB(A)**	**41.2**														
$L_{eq,30mins}$	**dB(A)**	**29.7**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: MTW-12-7
Location: 197-199 Ma Tau Wai Road
Assessed Floor 2
Item: 73

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	15	18	23
Down Track	15	30	34

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.1	6.7	0.2	-5.0	-6.3	-8.2	-8.6	-3.7	-2.9	-7.6	-6.0	-6.1	0.6	-4.7	-12.2
Up Track Vib. Level	dB re 10^{-6}in/sec			43.8	45.4	37.9	30.7	28.4	30.5	33.1	39.0	39.8	31.1	31.7	30.6	34.3	30.0	19.5
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.7	6.4	-0.8	-6.6	-8.0	-9.2	-12.6	-8.6	-4.8	-8.6	-7.2	-8.8	-2.4	-6.7	-13.5
Down Track Vib. Level	dB re 10^{-6}in/sec			43.4	45.1	36.9	29.1	26.7	29.5	29.1	34.1	37.9	30.1	30.5	27.9	31.2	28.0	18.2
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.6	48.3	40.5	33.0	30.6	33.1	34.6	40.2	42.0	33.7	34.2	32.5	36.0	32.1	21.9
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**60.6**	**62.3**	**54.5**	**47.0**	**44.4**	**46.5**	**47.8**	**53.2**	**54.8**	**45.7**	**45.2**	**42.5**	**45.0**	**40.8**	**30.6**
Predicted Noise Level	**Oct, dB**			**63.1**			**51.2**			**57.4**			**49.1**			**41.2**
L_{max}	**dB(A)**	**45.2**														
$L_{eq,30mins}$	**dB(A)**	**33.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-12-8
Location:	Pak Tai Mansion
Assessed Floor	1
Item:	74

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	12	18	22
Down Track	12	30	32

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.1	6.8	0.3	-4.8	-6.1	-8.0	-8.2	-3.2	-2.7	-7.4	-5.8	-5.8	0.9	-4.4	-12.0
Up Track Vib. Level	dB re 10^{-6}in/sec			43.8	45.5	38.0	30.9	28.6	30.6	33.5	39.5	40.0	31.3	31.9	30.9	34.6	30.3	19.7
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.8	6.5	-0.6	-6.3	-7.7	-9.0	-11.9	-7.8	-4.5	-8.4	-7.0	-8.4	-2.0	-6.4	-13.3
Down Track Vib. Level	dB re 10^{-6}in/sec			43.5	45.2	37.1	29.4	27.0	29.7	29.8	34.9	38.2	30.3	30.7	28.3	31.7	28.3	18.4
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.7	48.3	40.6	33.2	30.9	33.2	35.0	40.8	42.2	33.8	34.3	32.8	36.4	32.4	22.1
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**62.7**	**64.3**	**56.6**	**49.2**	**46.7**	**48.6**	**50.2**	**55.8**	**57.0**	**47.8**	**47.3**	**44.8**	**47.4**	**43.1**	**32.8**
Predicted Noise Level	**Oct, dB**			**65.1**			**53.5**			**59.8**			**51.4**			**43.5**
L_{max}	**dB(A)**	**47.5**														
$L_{eq,30mins}$	**dB(A)**	**35.9**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Project:	SCL(TAW - HUH)				**Train Speed:**	65 kph
NSR Ref.:	MTW-12-9		Horizontal Dist, m	Vertical Dist, m	Slant Dist, m	
Location:	Residential premises along Hung Kwong Street	Up Track	12	19	22	
Assessed Floor	2	Down Track	12	32	34	
Item:	75					

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	HOM-2-2

Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
				Frequency (Hz)														
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			11.9	9.2	-0.1	-2.8	3.6	7.7	-2.0	-3.7	-8.0	-7.1	-15.8	-21.6	-24.5	-27.4	-31.2
Up Track Vib. Level	dB re 10^{-6}in/sec			46.6	47.9	37.6	32.9	38.3	46.4	39.7	39.0	34.7	31.6	21.9	15.1	9.2	7.3	0.5
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.7	6.4	-0.8	-6.6	-8.0	-9.2	-12.6	-8.6	-4.8	-8.6	-7.2	-8.8	-2.4	-6.7	-13.5
Down Track Vib. Level	dB re 10^{-6}in/sec			43.4	45.1	36.9	29.1	26.7	29.5	29.1	34.1	37.9	30.1	30.5	27.9	31.2	28.0	18.2
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				48.3	49.7	40.3	34.4	38.6	46.5	40.1	40.2	39.6	33.9	31.1	28.1	31.3	28.0	18.3
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**62.3**	**63.7**	**54.3**	**48.4**	**52.4**	**59.9**	**53.3**	**53.2**	**52.4**	**45.9**	**42.1**	**38.1**	**40.3**	**36.7**	**27.0**
Predicted Noise Level	**Oct, dB**			**64.3**			**61.4**			**56.3**			**45.2**			**37.1**
L_{max}	**dB(A)**	**43.3**														
$L_{eq,30mins}$	**dB(A)**	**31.8**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-12-10
Location:	Lucky Building
Assessed Floor	2
Item:	76

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	15	18	23
Down Track	15	28	32

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			11.4	9.1	-0.3	-3.0	3.5	7.6	-2.1	-4.1	-8.2	-7.3	-16.0	-21.9	-24.7	-27.7	-31.2
Up Track Vib. Level	dB re 10^{-6}in/sec			39.6	41.3	30.9	26.3	31.8	39.9	33.2	32.2	28.0	25.0	15.3	8.3	2.6	0.5	-6.0
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.6	8.4	-1.6	-4.6	2.7	6.9	-2.8	-6.5	-10.2	-8.6	-17.4	-24.4	-25.6	-30.1	-31.7
Down Track Vib. Level	dB re 10^{-6}in/sec			35.8	40.7	29.6	24.7	31.0	39.1	32.4	29.7	26.1	23.7	13.8	5.8	1.6	-1.8	-6.5
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				41.1	44.0	33.3	28.5	34.4	42.5	35.8	34.1	30.2	27.4	17.6	10.3	5.1	2.5	-3.2
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**55.1**	**58.0**	**47.3**	**42.5**	**48.2**	**55.9**	**49.0**	**47.1**	**43.0**	**39.4**	**28.6**	**20.3**	**14.1**	**11.2**	**5.5**
Predicted Noise Level	**Oct, dB**			**58.5**			**57.3**			**49.0**			**29.3**			**12.5**
L_{max}	**dB(A)**	**35.4**														
$L_{eq,30mins}$	**dB(A)**	**24.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-12-11
Location:	Jing Ming Building
Assessed Floor	2
Item:	77

Train Speed: 50 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	19	20	28
Down Track	19	30	36

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.1	8.7	-1.1	-3.9	3.1	7.2	-2.5	-5.5	-9.4	-8.0	-16.9	-23.4	-25.2	-29.1	-31.5
Up Track Vib. Level	dB re 10^{-6}in/sec			36.5	40.1	29.3	24.5	30.5	38.6	31.9	29.9	26.0	23.4	13.6	6.0	1.2	-1.7	-7.1
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			6.2	8.2	-2.1	-5.2	2.5	6.6	-3.1	-7.4	-10.9	-9.0	-18.0	-25.3	-26.0	-30.9	-31.9
Down Track Vib. Level	dB re 10^{-6}in/sec			33.6	39.6	28.3	23.3	29.9	38.0	31.3	28.0	24.6	22.4	12.5	4.1	0.5	-3.5	-7.5
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				38.3	42.9	31.9	26.9	33.2	41.3	34.6	32.0	28.4	25.9	16.1	8.2	3.8	0.5	-4.3
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**52.3**	**56.9**	**45.9**	**40.9**	**47.0**	**54.7**	**47.8**	**45.0**	**41.2**	**37.9**	**27.1**	**18.2**	**12.8**	**9.2**	**4.4**
Predicted Noise Level	**Oct, dB**			**57.3**			**56.1**			**47.1**			**27.7**			**10.8**
L_{max}	**dB(A)**	**33.9**														
$L_{eq,30mins}$	**dB(A)**	**23.5**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-12-12
Location:	One Elegance
Assessed Floor	3
Item:	78

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	12	18	22
Down Track	12	30	32

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			9.1	6.8	0.3	-4.8	-6.1	-8.0	-8.2	-3.2	-2.7	-7.4	-5.8	-5.8	0.9	-4.4	-12.0
Up Track Vib. Level	dB re 10^{-6}in/sec			43.8	45.5	38.0	30.9	28.6	30.6	33.5	39.5	40.0	31.3	31.9	30.9	34.6	30.3	19.7
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.8	6.5	-0.6	-6.3	-7.7	-9.0	-11.9	-7.8	-4.5	-8.4	-7.0	-8.4	-2.0	-6.4	-13.3
Down Track Vib. Level	dB re 10^{-6}in/sec			43.5	45.2	37.1	29.4	27.0	29.7	29.8	34.9	38.2	30.3	30.7	28.3	31.7	28.3	18.4
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				46.7	48.3	40.6	33.2	30.9	33.2	35.0	40.8	42.2	33.8	34.3	32.8	36.4	32.4	22.1
BCF	dB	Y/N	0															
BVR-up	dB	Floor	3	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**58.7**	**60.3**	**52.6**	**45.2**	**42.7**	**44.6**	**46.2**	**51.8**	**53.0**	**43.8**	**43.3**	**40.8**	**43.4**	**39.1**	**28.8**
Predicted Noise Level	**Oct, dB**			**61.1**			**49.5**			**55.8**			**47.4**			**39.5**
L_{max}	**dB(A)**	**43.5**														
$L_{eq,30mins}$	**dB(A)**	**31.9**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-13-1
Location:	Cheung Chuk Shan Memorial School
Assessed Floor	0
Item:	79

Train Speed: 65 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	10	20	22
Down Track	10	30	32

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	HOM-2-2

Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
				Frequency (Hz)														
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			11.9	9.2	-0.1	-2.8	3.6	7.7	-2.0	-3.7	-8.0	-7.1	-15.8	-21.6	-24.5	-27.4	-31.2
Up Track Vib. Level	dB re 10^{-6}in/sec			41.6	42.9	32.6	27.9	33.3	41.4	34.7	34.0	29.7	26.6	16.9	10.1	4.2	2.3	-4.5
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.7	38.7	37.7	35.7	34.7	38.7	41.7	42.7	42.7	38.7	37.7	36.7	33.7	34.7	31.7
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.8	6.5	-0.6	-6.3	-7.7	-9.0	-11.9	-7.8	-4.5	-8.4	-7.0	-8.4	-2.0	-6.4	-13.3
Down Track Vib. Level	dB re 10^{-6}in/sec			38.5	40.2	32.1	24.4	22.0	24.7	24.8	29.9	33.2	25.3	25.7	23.3	26.7	23.3	13.4
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				43.3	44.7	35.3	29.5	33.6	41.5	35.1	35.4	34.8	29.0	26.2	23.5	26.7	23.3	13.5
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**61.3**	**62.7**	**53.3**	**47.5**	**51.4**	**58.9**	**52.3**	**52.4**	**51.6**	**45.0**	**41.2**	**37.5**	**39.7**	**36.0**	**26.2**
Predicted Noise Level	**Oct, dB**			**63.3**			**60.4**			**55.5**			**44.5**			**36.5**
L_{max}	**dB(A)**	**42.5**														
$L_{eq,30mins}$	**dB(A)**	**34[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.

[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-14-1
Location:	PLK Lam Man Chan English Primary School
Assessed Floor	1
Item:	80

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	35	20	40
Down Track	35	30	46

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	HOM-2-2

Description	Unit	Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	5.0	8.0	-2.5	-5.7	2.2	6.4	-3.3	-8.2	-11.5	-9.4	-18.4	-26.1	-26.3	-31.7	-32.1
Up Track Vib. Level	dB re 10^{-6}in/sec	33.2	40.2	28.7	23.6	30.5	38.6	31.9	28.0	24.8	22.8	12.8	4.1	1.0	-3.4	-6.8
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	8.4	6.2	-1.5	-7.7	-9.3	-10.0	-15.6	-12.3	-6.2	-9.3	-8.2	-10.9	-4.8	-8.3	-14.5
Down Track Vib. Level	dB re 10^{-6}in/sec	36.6	38.4	29.7	21.5	18.9	22.3	19.6	23.9	30.0	22.9	23.1	19.4	22.5	19.9	10.7
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		38.3	42.4	32.3	25.7	30.8	38.7	32.2	29.5	31.2	25.9	23.5	19.5	22.5	19.9	10.8
BCF	dB Y/N 0															
BVR-up	dB Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**54.3**	**58.4**	**48.3**	**41.7**	**46.6**	**54.1**	**47.4**	**44.5**	**46.0**	**39.9**	**36.5**	**31.5**	**33.5**	**30.6**	**21.5**
Predicted Noise Level	**Oct, dB**			**58.9**			**55.5**			**48.9**			**39.1**			**31.1**
L_{max}	**dB(A)**	**36.9**														
$L_{eq,30mins}$	**dB(A)**	**29[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.
[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.
[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: MTW-15-1
Location: Hung Hom Lutheran Primary School
Assessed Floor 0
Item: 81

Train Speed: 50 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	10	20	22
Down Track	10	30	32

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	HOM-2-2

Description	Unit		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
			Frequency (Hz)														
Up Track Calculation																	
FDL	dB re 1 lb/in$^{0.5}$		32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb		11.9	9.2	-0.1	-2.8	3.6	7.7	-2.0	-3.7	-8.0	-7.1	-15.8	-21.6	-24.5	-27.4	-31.2
Up Track Vib. Level	dB re 10^{-6}in/sec		39.3	40.6	30.3	25.6	31.1	39.1	32.4	31.7	27.4	24.3	14.6	7.8	1.9	0.0	-6.7
Down Track Calculation																	
FDL	dB re 1 lb/in$^{0.5}$		32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N N															
TIL	dB	Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB		-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb		8.8	6.5	-0.6	-6.3	-7.7	-9.0	-11.9	-7.8	-4.5	-8.4	-7.0	-8.4	-2.0	-6.4	-13.3
Down Track Vib. Level	dB re 10^{-6}in/sec		36.2	37.9	29.8	22.1	19.7	22.4	22.5	27.6	30.9	23.0	23.4	21.0	24.4	21.0	11.1
Total of Up and Down Tracks Calculation																	
Total Vibration Level Outside Building			41.0	42.4	33.1	27.2	31.4	39.2	32.8	33.1	32.6	26.7	23.9	21.2	24.5	21.0	11.2
BCF	dB	Y/N 0															
BVR-up	dB	Floor 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB		6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**59.0**	**60.4**	**51.1**	**45.2**	**49.2**	**56.6**	**50.0**	**50.1**	**49.4**	**42.7**	**38.9**	**35.2**	**37.5**	**33.7**	**23.9**
Predicted Noise Level	**Oct, dB**			**61.0**			**58.1**			**53.2**			**42.2**			**34.2**
L_{max}	**dB(A)**	**40.2**														
$L_{eq,30mins}$	**dB(A)**	**33[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.
[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.
[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-16-1
Location:	SKH Good Shepherd Primary School
Assessed Floor	0
Item:	82

Train Speed: 45 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	10	20	22
Down Track	10	30	32

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			31.5	35.5	34.5	32.5	31.5	35.5	38.5	39.5	39.5	35.5	34.5	33.5	30.5	31.5	28.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			11.9	9.2	-0.1	-2.8	3.6	7.7	-2.0	-3.7	-8.0	-7.1	-15.8	-21.6	-24.5	-27.4	-31.2
Up Track Vib. Level	dB re $10^{-6}in/sec$			38.4	39.7	29.4	24.7	30.1	38.2	31.5	30.8	26.5	23.4	13.7	6.9	1.0	-0.9	-7.7
Down Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			31.5	35.5	34.5	32.5	31.5	35.5	38.5	39.5	39.5	35.5	34.5	33.5	30.5	31.5	28.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			7.6	8.4	-1.6	-4.6	2.7	6.9	-2.8	-6.5	-10.2	-8.6	-17.4	-24.4	-25.6	-30.1	-31.7
Down Track Vib. Level	dB re $10^{-6}in/sec$			34.1	38.9	27.9	22.9	29.2	37.4	30.7	28.0	24.3	21.9	12.1	4.1	-0.1	-3.6	-8.2
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				39.8	42.3	31.7	26.9	32.7	40.8	34.1	32.6	28.6	25.7	16.0	8.7	3.5	1.0	-4.9
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**57.8**	**60.3**	**49.7**	**44.9**	**50.5**	**58.2**	**51.3**	**49.6**	**45.4**	**41.7**	**31.0**	**22.7**	**16.5**	**13.7**	**7.8**
Predicted Noise Level	**Oct, dB**			**60.8**			**59.6**			**51.5**			**31.7**			**14.8**
L_{max}	**dB(A)**	**37.8**														
$L_{eq,30mins}$	**dB(A)**	**31[8]**														
Noise Criteria	**dB(A)**	**55[9]**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.

[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-17-1
Location:	Loyal Mansion
Assessed Floor	3
Item:	83

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	20	17	26
Down Track	20	28	34

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			10.0	8.8	-0.8	-3.6	3.2	7.4	-2.4	-5.0	-8.9	-7.8	-16.5	-22.8	-25.0	-28.6	-31.4
Up Track Vib. Level	dB re 10^{-6}in/sec			43.2	46.1	35.4	30.7	36.5	44.6	37.9	36.3	32.3	29.5	19.7	12.4	7.2	4.6	-1.2
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			6.9	8.3	-1.9	-4.9	2.6	6.7	-2.9	-7.0	-10.5	-8.8	-17.7	-24.9	-25.8	-30.5	-31.8
Down Track Vib. Level	dB re 10^{-6}in/sec			40.1	45.5	34.4	29.4	35.8	44.0	37.3	34.2	30.7	28.5	18.5	10.4	6.4	2.7	-1.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				44.9	48.8	37.9	33.1	39.2	47.3	40.6	38.4	34.6	32.0	22.2	14.5	9.9	6.8	1.6
BCF	dB	Y/N	0															
BVR-up	dB	Floor	3	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**56.9**	**60.8**	**49.9**	**45.1**	**51.0**	**58.7**	**51.8**	**49.4**	**45.4**	**42.0**	**31.2**	**22.5**	**16.9**	**13.5**	**8.3**
Predicted Noise Level	**Oct, dB**			**61.3**			**60.1**			**51.4**			**31.9**			**14.8**
L_{max}	**dB(A)**	**38.0**														
$L_{eq,30mins}$	**dB(A)**	**27.2**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-18-1
Location:	Residential premises along Chi Kiang St
Assessed Floor	2
Item:	84

Train Speed: 50 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	45	17	48
Down Track	45	27	52

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			2.9	7.6	-3.2	-6.6	1.8	6.0	-3.7	-9.6	-12.5	-10.1	-19.2	-27.5	-26.8	-33.0	-32.4
Up Track Vib. Level	dB re 10^{-6}in/sec			30.3	39.0	27.2	21.9	29.2	37.4	30.7	25.8	22.9	21.3	11.2	1.9	-0.4	-5.6	-7.9
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			2.0	7.5	-3.6	-7.0	1.6	5.8	-3.9	-10.2	-13.0	-10.4	-19.6	-28.1	-27.0	-33.6	-32.5
Down Track Vib. Level	dB re 10^{-6}in/sec			29.4	38.9	26.8	21.5	29.0	37.2	30.5	25.2	22.4	21.0	10.8	1.3	-0.6	-6.2	-8.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				32.9	42.0	30.0	24.7	32.1	40.3	33.6	28.6	25.7	24.2	14.0	4.7	2.5	-2.9	-5.0
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**46.9**	**56.0**	**44.0**	**38.7**	**45.9**	**53.7**	**46.8**	**41.6**	**38.5**	**36.2**	**25.0**	**14.7**	**11.5**	**5.8**	**3.7**
Predicted Noise Level	**Oct, dB**			**56.3**			**55.1**			**44.1**			**25.6**			**8.6**
L_{max}	**dB(A)**	**32.2**														
$L_{eq,30mins}$	**dB(A)**	**21.7**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-18-2
Location:	No. 2 Kowloon City Road
Assessed Floor	2
Item:	85

Train Speed: 50 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	28	17	33
Down Track	28	27	39

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	DIH-P1-1

Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
				Frequency (Hz)														
Up Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			7.2	8.4	-1.8	-4.7	2.7	6.8	-2.9	-6.8	-10.3	-8.7	-17.6	-24.6	-25.7	-30.3	-31.8
Up Track Vib. Level	dB re $10^{-6}in/sec$			34.6	39.8	28.7	23.7	30.1	38.2	31.5	28.6	25.1	22.7	12.8	4.8	0.7	-2.9	-7.4
Down Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			5.3	8.0	-2.4	-5.6	2.3	6.4	-3.2	-8.0	-11.3	-9.3	-18.3	-25.9	-26.2	-31.5	-32.0
Down Track Vib. Level	dB re $10^{-6}in/sec$			32.7	39.5	28.0	22.9	29.7	37.9	31.2	27.4	24.1	22.1	12.1	3.5	0.2	-4.1	-7.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				36.8	42.6	31.4	26.3	32.9	41.1	34.4	31.1	27.6	25.4	15.5	7.2	3.5	-0.4	-4.5
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**50.8**	**56.6**	**45.4**	**40.3**	**46.7**	**54.5**	**47.6**	**44.1**	**40.4**	**37.4**	**26.5**	**17.2**	**12.5**	**8.3**	**4.2**
Predicted Noise Level	**Oct, dB**			**57.0**			**55.8**			**46.2**			**27.1**			**10.1**
L_{max}	**dB(A)**	**33.4**														
$L_{eq,30mins}$	**dB(A)**	**23.0**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	MTW-19-1
Location:	Holy Trinity Church
Assessed Floor	0
Item:	86

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	55	18	58
Down Track	65	25	70

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	DIH-P1-1

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-15.0	2.1	-1.5	-9.1	-14.0	-12.6	-18.9	-25.0	-28.7	-31.1	-30.7	-36.1	-29.9	-37.0	-38.9
Up Track Vib. Level	dB re 10^{-6}in/sec			18.2	39.4	34.7	25.2	19.3	24.7	21.3	16.3	12.5	6.1	5.5	-0.8	2.3	-3.7	-8.7
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-1.5	6.9	-4.8	-8.4	0.9	5.1	-4.5	-12.4	-14.8	-11.6	-20.9	-30.3	-27.9	-35.7	-32.9
Down Track Vib. Level	dB re 10^{-6}in/sec			31.8	44.1	31.5	25.8	34.1	42.4	35.7	28.8	26.5	25.7	15.4	4.9	4.3	-2.5	-2.7
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				32.0	45.4	36.4	28.5	34.3	42.4	35.9	29.1	26.7	25.7	15.8	5.9	6.5	0.0	-1.7
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**50.0**	**63.4**	**54.4**	**46.5**	**52.1**	**59.8**	**53.1**	**46.1**	**43.5**	**41.7**	**30.8**	**19.9**	**19.5**	**12.7**	**11.0**
Predicted Noise Level	**Oct, dB**			**64.0**			**61.2**			**48.9**			**31.4**			**15.0**
L_{max}	**dB(A)**	**38.0**														
$L_{eq,30mins}$	**dB(A)**	**27.2**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	HOM-1-1
Location:	Ko Shan Theartre
Assessed Floor	0
Item:	87

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	50	35	61
Down Track	50	40	64

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
		Frequency (Hz)														
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	8.1	5.9	-2.3	-9.0	-10.7	-10.8	-18.8	-16.2	-7.7	-10.1	-9.2	-13.0	-7.2	-10.0	-15.6
Up Track Vib. Level	dB re 10^{-6}in/sec	41.3	43.1	34.0	25.3	22.6	26.4	21.5	25.0	33.5	27.1	27.1	22.2	25.1	23.3	14.6
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	8.0	5.9	-2.4	-9.2	-10.9	-10.9	-19.2	-16.8	-7.9	-10.2	-9.3	-13.4	-7.5	-10.2	-15.8
Down Track Vib. Level	dB re 10^{-6}in/sec	41.2	43.1	33.9	25.1	22.4	26.3	21.0	24.4	33.3	27.0	26.9	21.9	24.7	23.0	14.5
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		44.3	46.1	36.9	28.2	25.5	29.4	24.3	27.7	36.4	30.1	30.0	25.1	27.9	26.2	17.6
BCF	dB Y/N 0															
BVR-up	dB Floor 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**62.3**	**64.1**	**54.9**	**46.2**	**43.3**	**46.8**	**41.5**	**44.7**	**53.2**	**46.1**	**45.0**	**39.1**	**40.9**	**38.9**	**30.3**
Predicted Noise Level	**Oct, dB**			**64.7**			**49.2**			**54.5**			**47.2**			**39.4**
L_{max}	**dB(A)**	**42.9**														
$L_{eq,30mins}$	**dB(A)**	**32.1**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	HOM-2-1
Location:	Faerie Court
Assessed Floor	2
Item:	88

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	20	18	27
Down Track	20	29	35

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	HOM-2-2

		Frequency (Hz)														
Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	9.5	8.8	-1.0	-3.8	3.1	7.3	-2.4	-5.3	-9.2	-7.9	-16.7	-23.1	-25.1	-28.9	-31.5
Up Track Vib. Level	dB re 10^{-6}in/sec	42.8	46.0	35.3	30.5	36.4	44.5	37.8	36.0	32.1	29.3	19.6	12.1	7.1	4.4	-1.2
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	8.7	6.4	-0.8	-6.7	-8.1	-9.3	-12.8	-8.9	-4.9	-8.6	-7.3	-9.0	-2.7	-6.9	-13.6
Down Track Vib. Level	dB re 10^{-6}in/sec	41.9	43.6	35.4	27.6	25.1	28.0	27.4	32.3	36.3	28.6	28.9	26.2	29.6	26.4	16.6
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		45.4	48.0	38.4	32.3	36.7	44.6	38.2	37.5	37.7	32.0	29.4	26.4	29.6	26.4	16.7
BCF	dB Y/N 0															
BVR-up	dB Floor 2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**59.4**	**62.0**	**52.4**	**46.3**	**50.5**	**58.0**	**51.4**	**50.5**	**50.5**	**44.0**	**40.4**	**36.4**	**38.6**	**35.1**	**25.4**
Predicted Noise Level	**Oct, dB**			**62.5**			**59.5**			**54.0**			**43.5**			**35.5**
L_{max}	**dB(A)**	**41.4**														
$L_{eq,30mins}$	**dB(A)**	**30.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: HOM-2-2
Location: Lee Wing Building
Assessed Floor 2
Item: 89

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	0	24	24
Down Track	0	34	34

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

		Frequency (Hz)														
Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	8.2	5.9	-0.7	-6.0	-7.3	-9.1	-9.9	-5.1	-3.9	-8.5	-6.9	-7.2	-0.6	-5.7	-13.2
Up Track Vib. Level	dB re 10^{-6}in/sec	41.5	43.1	35.5	28.2	25.9	28.1	30.4	36.2	37.3	28.7	29.3	28.0	31.6	27.5	17.1
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	8.7	6.4	-0.8	-6.6	-8.0	-9.2	-12.6	-8.6	-4.8	-8.6	-7.2	-8.8	-2.4	-6.7	-13.5
Down Track Vib. Level	dB re 10^{-6}in/sec	41.9	43.7	35.5	27.7	25.3	28.0	27.7	32.7	36.5	28.7	29.0	26.4	29.8	26.5	16.7
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		44.7	46.4	38.5	31.0	28.6	31.1	32.2	37.8	39.9	31.7	32.2	30.3	33.8	30.1	19.9
BCF	dB Y/N 0															
BVR-up	dB Floor 2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**58.7**	**60.4**	**52.5**	**45.0**	**42.4**	**44.5**	**45.4**	**50.8**	**52.7**	**43.7**	**43.2**	**40.3**	**42.8**	**38.8**	**28.6**
Predicted Noise Level	**Oct, dB**			**61.2**			**49.1**			**55.2**			**47.0**			**39.2**
L_{max}	**dB(A)**	**43.1**														
$L_{eq,30mins}$	**dB(A)**	**32.2**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	HOM-2-3
Location:	Wing Lam Mansion
Assessed Floor	2
Item:	90

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	15	20	25
Down Track	15	30	34

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			9.0	6.7	0.0	-5.3	-6.7	-8.4	-9.5	-4.8	-3.3	-7.8	-6.2	-6.7	-0.1	-5.1	-12.5
Up Track Vib. Level	dB re $10^{-6}in/sec$			42.3	43.9	36.2	28.9	26.6	28.9	30.8	36.5	38.0	29.5	30.0	28.6	32.2	28.1	17.8
Down Track Calculation																		
FDL	dB re 1 $lb/in^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re $10^{-6}in/s*in^{0.5}/lb$			8.7	6.4	-0.8	-6.6	-8.0	-9.2	-12.6	-8.6	-4.8	-8.6	-7.2	-8.8	-2.4	-6.7	-13.5
Down Track Vib. Level	dB re $10^{-6}in/sec$			41.9	43.7	35.5	27.7	25.3	28.0	27.7	32.7	36.5	28.7	29.0	26.4	29.8	26.5	16.7
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				45.1	46.8	38.9	31.3	29.0	31.5	32.5	38.0	40.3	32.1	32.6	30.6	34.1	30.4	20.3
BCF	dB	Y/N	0															
BVR-up	dB	Floor	2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**59.1**	**60.8**	**52.9**	**45.3**	**42.8**	**44.9**	**45.7**	**51.0**	**53.1**	**44.1**	**43.6**	**40.6**	**43.1**	**39.1**	**29.0**
Predicted Noise Level	**Oct, dB**			**61.6**			**49.4**			**55.5**			**47.4**			**39.5**
L_{max}	**dB(A)**	**43.4**														
$L_{eq,30mins}$	**dB(A)**	**32.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Project:	SCL(TAW - HUH)
NSR Ref.:	HOM-2-4
Location:	Tak Lee Court
Assessed Floor	1
Item:	91

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	50	35	61
Down Track	55	45	71

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.2	6.0	-2.0	-8.5	-10.1	-10.5	-17.6	-14.8	-7.1	-9.8	-8.8	-12.2	-6.3	-9.4	-15.2
Up Track Vib. Level	dB re 10^{-6}in/sec			42.2	44.0	35.0	26.5	23.9	27.5	23.4	27.2	34.9	28.2	28.2	23.8	26.7	24.6	15.8
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.0	5.8	-2.5	-9.3	-11.0	-11.0	-19.5	-17.2	-8.1	-10.3	-9.4	-13.6	-7.8	-10.4	-15.9
Down Track Vib. Level	dB re 10^{-6}in/sec			42.0	43.8	34.5	25.7	23.0	27.0	21.5	24.8	33.9	27.7	27.6	22.4	25.2	23.6	15.1
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				45.1	46.9	37.8	29.1	26.5	30.2	25.6	29.2	37.4	30.9	30.9	26.2	29.0	27.2	18.5
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**61.1**	**62.9**	**53.8**	**45.1**	**42.3**	**45.6**	**40.8**	**44.2**	**52.2**	**44.9**	**43.9**	**38.2**	**40.0**	**37.9**	**29.2**
Predicted Noise Level	**Oct, dB**			**63.5**			**48.2**			**53.5**			**46.2**			**38.4**
L_{max}	**dB(A)**	**42.0**														
$L_{eq,30mins}$	**dB(A)**	**30.8**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	HOM-2-5
Location:	Chat Ma Mansion
Assessed Floor	1
Item:	92

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	45	20	49
Down Track	45	30	54

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
				Frequency (Hz)														
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.3	6.1	-1.7	-8.0	-9.6	-10.2	-16.2	-13.1	-6.5	-9.5	-8.4	-11.3	-5.3	-8.7	-14.8
Up Track Vib. Level	dB re 10^{-6}in/sec			41.6	43.4	34.6	26.3	23.7	27.1	24.0	28.1	34.7	27.8	27.9	23.9	27.0	24.6	15.5
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.2	6.0	-1.9	-8.4	-10.0	-10.4	-17.2	-14.3	-7.0	-9.7	-8.7	-12.0	-6.0	-9.2	-15.1
Down Track Vib. Level	dB re 10^{-6}in/sec			41.5	43.3	34.3	25.9	23.3	26.8	23.0	26.9	34.3	27.5	27.6	23.3	26.2	24.1	15.2
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				44.5	46.3	37.5	29.1	26.5	30.0	26.6	30.6	37.5	30.6	30.7	26.6	29.6	27.4	18.3
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**60.5**	**62.3**	**53.5**	**45.1**	**42.3**	**45.4**	**41.8**	**45.6**	**52.3**	**44.6**	**43.7**	**38.6**	**40.6**	**38.1**	**29.0**
Predicted Noise Level	**Oct, dB**			**62.9**			**48.2**			**53.7**			**46.3**			**38.6**
L_{max}	**dB(A)**	**42.1**														
$L_{eq,30mins}$	**dB(A)**	**31.3**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	HOM-2-6
Location:	Chatham Mansion
Assessed Floor	1
Item:	93

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	3	19	19
Down Track	3	30	30

Selected LSR Details:

	LSR Ref.
Up Track	DIH-P1-1
Down Track	HOM-2-2

Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
				Frequency (Hz)														
Up Track Calculation																		
FDL	dB re 1 lb/in^0.5			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			13.6	9.4	0.4	-2.1	4.0	8.1	-1.7	-2.6	-7.1	-6.6	-15.1	-20.5	-24.1	-26.3	-30.9
Up Track Vib. Level	dB re 10^{-6}in/sec			46.8	46.7	36.7	32.2	37.2	45.3	38.6	38.6	34.1	30.7	21.1	14.8	8.1	6.9	-0.7
Down Track Calculation																		
FDL	dB re 1 lb/in^0.5			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.8	6.5	-0.4	-6.1	-7.5	-8.9	-11.3	-7.0	-4.2	-8.2	-6.8	-7.9	-1.5	-6.1	-13.1
Down Track Vib. Level	dB re 10^{-6}in/sec			42.1	43.8	35.8	28.2	25.8	28.4	29.0	34.2	37.1	29.0	29.4	27.3	30.8	27.2	17.2
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				48.1	48.5	39.3	33.6	37.5	45.4	39.0	40.0	38.9	32.9	30.0	27.5	30.8	27.2	17.2
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**64.1**	**64.5**	**55.3**	**49.6**	**53.3**	**60.8**	**54.2**	**55.0**	**53.7**	**46.9**	**43.0**	**39.5**	**41.8**	**37.9**	**27.9**
Predicted Noise Level	**Oct, dB**			**65.1**			**62.2**			**57.7**			**46.4**			**38.3**
L_{max}	**dB(A)**	**44.5**														
$L_{eq,30mins}$	**dB(A)**	**33.7**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	HOM-3-1
Location:	Fook Sing Mansion
Assessed Floor	1
Item:	94

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	85	35	92
Down Track	100	40	108

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.7	5.6	-3.1	-10.3	-12.1	-11.7	-22.3	-20.5	-9.3	-11.0	-10.3	-15.4	-9.8	-11.8	-16.8
Up Track Vib. Level	dB re 10^{-6}in/sec			40.9	42.9	33.1	23.9	21.1	25.5	18.0	20.7	31.9	26.2	26.0	19.8	22.4	21.4	13.4
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.5	5.5	-3.6	-11.0	-12.9	-12.2	-24.0	-22.7	-10.2	-11.5	-10.8	-16.6	-11.2	-12.7	-17.4
Down Track Vib. Level	dB re 10^{-6}in/sec			40.8	42.7	32.7	23.2	20.3	25.0	16.2	18.5	31.1	25.8	25.4	18.6	21.1	20.5	12.9
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				43.9	45.8	35.9	26.6	23.7	28.3	20.2	22.8	34.5	29.0	28.7	22.3	24.8	24.0	16.2
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**59.9**	**61.8**	**51.9**	**42.6**	**39.5**	**43.7**	**35.4**	**37.8**	**49.3**	**43.0**	**41.7**	**34.3**	**35.8**	**34.7**	**26.9**
Predicted Noise Level	**Oct, dB**			**62.3**			**45.5**			**50.5**			**43.3**			**35.4**
L_{max}	**dB(A)**	**39.0**														
$L_{eq,30mins}$	**dB(A)**	**28.1**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	HOM-3-2
Location:	Marigold Mansion, Block A
Assessed Floor	1
Item:	95

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	85	45	96
Down Track	110	45	119

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.7	5.6	-3.2	-10.5	-12.3	-11.8	-22.6	-20.9	-9.5	-11.1	-10.4	-15.6	-10.1	-12.0	-16.9
Up Track Vib. Level	dB re 10^{-6}in/sec			40.9	42.8	33.0	23.8	21.0	25.4	17.7	20.3	31.7	26.1	25.9	19.6	22.1	21.3	13.3
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.4	5.4	-3.8	-11.3	-13.3	-12.4	-24.8	-23.7	-10.6	-11.7	-11.1	-17.2	-11.8	-13.2	-17.7
Down Track Vib. Level	dB re 10^{-6}in/sec			40.7	42.6	32.5	22.9	20.0	24.8	15.4	17.5	30.7	25.6	25.2	18.1	20.4	20.1	12.6
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				43.8	45.7	35.8	26.4	23.5	28.1	19.7	22.1	34.2	28.9	28.5	21.9	24.4	23.7	16.0
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**59.8**	**61.7**	**51.8**	**42.4**	**39.3**	**43.5**	**34.9**	**37.1**	**49.0**	**42.9**	**41.5**	**33.9**	**35.4**	**34.4**	**26.7**
Predicted Noise Level	**Oct, dB**			**62.2**			**45.3**			**50.2**			**43.0**			**35.1**
L_{max}	**dB(A)**	**38.7**														
$L_{eq,30mins}$	**dB(A)**	**27.9**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: HOM-4-1
Location: Yee Fu Building
Assessed Floor 1
Item: 96

Train Speed: 55 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	40	45	60
Down Track	70	45	83

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.1	5.9	-2.2	-8.8	-10.4	-10.7	-18.3	-15.6	-7.5	-10.0	-9.0	-12.7	-6.8	-9.7	-15.4
Up Track Vib. Level	dB re 10^{-6}in/sec			36.3	38.2	29.1	20.5	17.8	21.5	17.0	20.6	28.8	22.2	22.2	17.5	20.4	18.5	9.8
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			33.2	37.2	36.2	34.2	33.2	37.2	40.2	41.2	41.2	37.2	36.2	35.2	32.2	33.2	30.2
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.8	5.7	-3.0	-10.1	-11.8	-11.6	-21.5	-19.7	-9.0	-10.8	-10.0	-14.9	-9.3	-11.4	-16.6
Down Track Vib. Level	dB re 10^{-6}in/sec			36.0	37.9	28.3	19.2	16.4	20.7	13.7	16.6	27.2	21.4	21.2	15.3	17.9	16.8	8.7
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				39.2	41.1	31.7	22.9	20.2	24.2	18.6	22.1	31.1	24.9	24.8	19.6	22.4	20.8	12.3
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**55.2**	**57.1**	**47.7**	**38.9**	**36.0**	**39.6**	**33.8**	**37.1**	**45.9**	**38.9**	**37.8**	**31.6**	**33.4**	**31.5**	**23.0**
Predicted Noise Level	**Oct, dB**			**57.6**			**41.9**			**47.1**			**39.8**			**32.0**
L_{max}	**dB(A)**	**35.6**														
$L_{eq,30mins}$	**dB(A)**	**24.8**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	HOM-5-1
Location:	271 Chatham Road North
Assessed Floor	2
Item:	97

Train Speed: 35 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	75	45	87
Down Track	75	45	87

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit	20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
		Frequency (Hz)														
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	29.3	33.3	32.3	30.3	29.3	33.3	36.3	37.3	37.3	33.3	32.3	31.3	28.3	29.3	26.3
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	7.8	5.7	-3.0	-10.1	-11.8	-11.6	-21.5	-19.7	-9.0	-10.8	-10.0	-14.9	-9.3	-11.4	-16.6
Up Track Vib. Level	dB re 10^{-6}in/sec	32.1	34.0	24.4	15.3	12.5	16.8	9.8	12.7	23.3	17.5	17.3	11.4	14.0	12.9	4.8
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	29.3	33.3	32.3	30.3	29.3	33.3	36.3	37.3	37.3	33.3	32.3	31.3	28.3	29.3	26.3
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	7.5	5.5	-3.5	-10.9	-12.7	-12.1	-23.6	-22.2	-10.0	-11.4	-10.7	-16.3	-10.9	-12.5	-17.3
Down Track Vib. Level	dB re 10^{-6}in/sec	31.9	33.8	23.9	14.4	11.6	16.2	7.7	10.1	22.3	17.0	16.6	10.0	12.4	11.8	4.1
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		35.0	36.9	27.1	17.9	15.1	19.5	11.9	14.6	25.8	20.2	20.0	13.8	16.3	15.4	7.4
BCF	dB Y/N 0															
BVR-up	dB Floor 2	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**49.0**	**50.9**	**41.1**	**31.9**	**28.9**	**32.9**	**25.1**	**27.6**	**38.6**	**32.2**	**31.0**	**23.8**	**25.3**	**24.1**	**16.1**
Predicted Noise Level	**Oct, dB**			**51.4**			**34.8**			**39.8**			**32.6**			**24.7**
L_{max}	**dB(A)**	**28.3**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.

[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	HOM-P2
Location:	HKPU Student Halls of Residence
Assessed Floor	1
Item:	98

Train Speed: 50 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	35	45	57
Down Track	65	45	79

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.2	6.0	-1.9	-8.4	-10.1	-10.5	-17.4	-14.5	-7.1	-9.8	-8.7	-12.1	-6.1	-9.3	-15.1
Up Track Vib. Level	dB re 10^{-6}in/sec			35.6	37.4	28.5	20.0	17.3	21.0	17.0	20.9	28.4	21.6	21.7	17.3	20.3	18.2	9.3
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.0	5.8	-2.5	-9.3	-11.0	-11.1	-19.7	-17.4	-8.1	-10.4	-9.5	-13.7	-7.9	-10.5	-15.9
Down Track Vib. Level	dB re 10^{-6}in/sec			35.4	37.2	27.9	19.1	16.4	20.4	14.7	18.0	27.3	21.1	21.0	15.8	18.5	17.0	8.5
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				38.5	40.3	31.2	22.6	19.9	23.7	19.0	22.7	30.9	24.4	24.3	19.6	22.5	20.6	11.9
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**54.5**	**56.3**	**47.2**	**38.6**	**35.7**	**39.1**	**34.2**	**37.7**	**45.7**	**38.4**	**37.3**	**31.6**	**33.5**	**31.3**	**22.6**
Predicted Noise Level	**Oct, dB**			**56.9**			**41.6**			**47.0**			**39.6**			**31.9**
L_{max}	**dB(A)**	**35.4**														
$L_{eq,30mins}$	**dB(A)**	**25.0**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)

NSR Ref.: HOM-P3-1

Location: Residential Building, HOM Station Development

Assessed Floor 1

Item: 99

Train Speed: 50 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	0	45	45
Down Track	0	45	45

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit	Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	8.4	6.2	-1.4	-7.7	-9.2	-9.9	-15.4	-12.1	-6.1	-9.3	-8.1	-10.7	-4.6	-8.2	-14.5
Up Track Vib. Level	dB re 10^{-6}in/sec	35.8	37.6	29.0	20.8	18.2	21.5	19.0	23.4	29.3	22.1	22.3	18.7	21.8	19.2	10.0
Down Track Calculation																
FDL	dB re 1 lb/in$^{0.5}$	32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB Y/N N															
TIL	dB Type 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB Type 0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb	8.4	6.2	-1.4	-7.7	-9.2	-9.9	-15.4	-12.1	-6.1	-9.3	-8.1	-10.7	-4.6	-8.2	-14.5
Down Track Vib. Level	dB re 10^{-6}in/sec	35.8	37.6	29.0	20.8	18.2	21.5	19.0	23.4	29.3	22.1	22.3	18.7	21.8	19.2	10.0
Total of Up and Down Tracks Calculation																
Total Vibration Level Outside Building		38.8	40.6	32.0	23.8	21.2	24.5	22.0	26.4	32.3	25.2	25.3	21.7	24.8	22.2	13.0
BCF	dB Y/N 0															
BVR-up	dB Floor 1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB	6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**54.8**	**56.6**	**48.0**	**39.8**	**37.0**	**39.9**	**37.2**	**41.4**	**47.1**	**39.2**	**38.3**	**33.7**	**35.8**	**32.9**	**23.7**
Predicted Noise Level	**Oct, dB**			**57.2**			**43.0**			**48.7**			**41.1**			**33.4**
L_{max}	**dB(A)**	**37.0**														
$L_{eq,30mins}$	**dB(A)**	**26.6**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)		**Train Speed:**	45 kph
NSR Ref.:	HUH-1-1			
Location:	Cartas Branchi College of Careers			
Assessed Floor	0			
Item:	100			

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	95	30	100
Down Track	125	30	129

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

				Frequency (Hz)														
Description	Unit			20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			31.5	35.5	34.5	32.5	31.5	35.5	38.5	39.5	39.5	35.5	34.5	33.5	30.5	31.5	28.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.6	5.5	-3.4	-10.8	-12.6	-12.0	-23.3	-21.9	-9.9	-11.3	-10.6	-16.1	-10.7	-12.4	-17.2
Up Track Vib. Level	dB re 10^{-6}in/sec			34.1	36.0	26.1	16.7	13.9	18.5	10.2	12.6	24.6	19.2	18.9	12.4	14.8	14.1	6.3
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			31.5	35.5	34.5	32.5	31.5	35.5	38.5	39.5	39.5	35.5	34.5	33.5	30.5	31.5	28.5
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			7.4	5.4	-3.8	-11.4	-13.4	-12.5	-25.1	-24.0	-10.7	-11.7	-11.2	-17.3	-12.0	-13.3	-17.8
Down Track Vib. Level	dB re 10^{-6}in/sec			33.9	35.9	25.7	16.1	13.1	18.0	8.4	10.5	23.8	18.8	18.3	11.2	13.5	13.2	5.7
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				37.0	39.0	28.9	19.4	16.5	21.3	12.4	14.7	27.3	22.0	21.6	14.8	17.2	16.7	9.1
BCF	dB	Y/N	0															
BVR-up	dB	Floor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Predicted Noise Level	**1/3 Oct, dB**			**55.0**	**57.0**	**46.9**	**37.4**	**34.3**	**38.7**	**29.6**	**31.7**	**44.1**	**38.0**	**36.6**	**28.8**	**30.2**	**29.4**	**21.8**
Predicted Noise Level	**Oct, dB**					**57.4**			**40.4**			**45.2**			**38.1**			**30.1**
L_{max}	**dB(A)**			**33.7**														
$L_{eq,30mins}$	**dB(A)**			**27[8]**														
Noise Criteria	**dB(A)**			**55[9]**														
Compliance				**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.
[8] A 3dB(A) upward adjustment is made to account for the daytime headway of 22 EMU trains within a 30 minutes period.
[9] Daytime criteria are used for educational buildings, church and temple.

Annex D - Detailed Operational Groundborne Noise Calculations

Project:	SCL(TAW - HUH)
NSR Ref.:	HUH-1-2
Location:	Lok Ka House
Assessed Floor	1
Item:	101

Train Speed: 50 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	55	18	58
Down Track	80	18	82

Selected LSR Details:

	LSR Ref.
Up Track	HOM-2-2
Down Track	HOM-2-2

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.1	6.0	-2.1	-8.7	-10.4	-10.7	-18.1	-15.4	-7.4	-10.0	-9.0	-12.6	-6.7	-9.6	-15.4
Up Track Vib. Level	dB re 10^{-6}in/sec			37.5	39.4	30.3	21.7	19.0	22.8	18.3	22.0	30.0	23.5	23.5	18.8	21.7	19.8	11.0
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			32.4	36.4	35.4	33.4	32.4	36.4	39.4	40.4	40.4	36.4	35.4	34.4	31.4	32.4	29.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			8.0	5.8	-2.5	-9.3	-11.0	-11.0	-19.5	-17.2	-8.1	-10.3	-9.4	-13.6	-7.8	-10.4	-15.9
Down Track Vib. Level	dB re 10^{-6}in/sec			37.4	39.3	30.0	21.1	18.4	22.4	16.9	20.2	29.4	23.1	23.0	17.9	20.6	19.0	10.5
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				40.5	42.3	33.1	24.4	21.8	25.6	20.7	24.2	32.7	26.3	26.2	21.4	24.2	22.4	13.8
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**56.5**	**58.3**	**49.1**	**40.4**	**37.6**	**41.0**	**35.9**	**39.2**	**47.5**	**40.3**	**39.2**	**33.4**	**35.2**	**33.1**	**24.5**
Predicted Noise Level	**Oct, dB**			**58.9**			**43.4**			**48.8**			**41.4**			**33.7**
L_{max}	**dB(A)**	**37.2**														
$L_{eq,30mins}$	**dB(A)**	**26.8**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.

[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.

[3] LSR based on the ground type. LSR data are interpolated against slant distance.

[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.

[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A) (3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)

[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.

[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(TAW - HUH)
NSR Ref.: HUH-1-3
Location: Wing Fung Building
Assessed Floor 1
Item: 102

Train Speed: 60 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	10	18	21
Down Track	25	18	31

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5
Down Track	KAT-P1-5

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			2.9	11.8	8.0	3.0	1.9	4.8	-0.4	-4.8	-9.1	-15.7	-20.4	-28.4	-27.1	-35.0	-36.2
Up Track Vib. Level	dB re 10^{-6}in/sec			33.9	46.8	42.0	35.0	32.9	39.8	37.6	34.2	29.9	19.3	13.6	4.6	2.9	-4.0	-8.2
Down Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			34.0	38.0	37.0	35.0	34.0	38.0	41.0	42.0	42.0	38.0	37.0	36.0	33.0	34.0	31.0
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-4.0	8.1	4.4	-1.6	-4.2	-1.8	-7.5	-12.5	-16.6	-21.6	-24.3	-31.4	-28.2	-35.8	-37.3
Down Track Vib. Level	dB re 10^{-6}in/sec			27.0	43.1	38.4	30.4	26.8	33.2	30.5	26.5	22.4	13.4	9.7	1.6	1.8	-4.8	-9.3
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				34.7	48.3	43.6	36.2	33.9	40.7	38.4	34.9	30.6	20.3	15.1	6.4	5.4	-1.4	-5.7
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Predicted Noise Level	**1/3 Oct, dB**	**50.7**	**64.3**	**59.6**	**52.2**	**49.7**	**56.1**	**53.6**	**49.9**	**45.4**	**34.3**	**28.1**	**18.4**	**16.4**	**9.3**	**5.0**
Predicted Noise Level	**Oct, dB**			**65.8**			**58.6**			**51.3**			**28.8**			**11.1**
L_{max}	**dB(A)**	**37.4**														
$L_{eq,30mins}$	**dB(A)**	**26.1**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins in each direction.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex D - Detailed Operational Groundborne Noise Calculations

Project: SCL(HHS)
NSR Ref.: HUH-1-3
Location: Wing Fung Building
Assessed Floor 1
Item: 102

Train Speed: 25 kph

	Horizontal Dist, m	Vertical Dist, m	Slant Dist, m
Up Track	45	0	45

Selected LSR Details:

	LSR Ref.
Up Track	KAT-P1-5

Description	Unit			Frequency (Hz) 20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Up Track Calculation																		
FDL	dB re 1 lb/in$^{0.5}$			26.4	30.4	29.4	27.4	26.4	30.4	33.4	34.4	34.4	30.4	29.4	28.4	25.4	26.4	23.4
CCF	dB	Y/N	N															
TIL	dB	Type	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TCF	dB			-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
TOC	dB	Type	0															
LSR	dB re 10^{-6}in/s*in$^{0.5}$/lb			-10.6	4.6	0.9	-6.1	-10.0	-8.2	-14.3	-19.9	-23.8	-27.3	-28.1	-34.2	-29.2	-36.5	-38.3
Up Track Vib. Level	dB re 10^{-6}in/sec			12.8	32.0	27.3	18.3	13.4	19.2	16.1	11.5	7.6	0.1	-1.7	-8.8	-6.8	-13.1	-17.9
Total of Up and Down Tracks Calculation																		
Total Vibration Level Outside Building				12.8	32.0	27.3	18.3	13.4	19.2	16.1	11.5	7.6	0.1	-1.7	-8.8	-6.8	-13.1	-17.9
BCF	dB	Y/N	0															
BVR-up	dB	Floor	1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
BVR - Resonance	dB			6.0	6.0	6.0	6.0	5.8	5.4	5.2	5.0	4.8	4.0	3.0	2.0	1.0	0.7	0.7
CTN	dB			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SAF	dB			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

		20	25	32	40	50	63	80	100	125	160	200	250	315	400	500
Predicted Noise Level	**1/3 Oct, dB**	**28.8**	**48.0**	**43.3**	**34.3**	**29.2**	**34.6**	**31.3**	**26.5**	**22.4**	**14.1**	**11.3**	**3.2**	**4.2**	**-2.4**	**-7.2**
Predicted Noise Level	**Oct, dB**			**49.4**			**37.0**			**28.1**			**12.6**			**2.5**
L_{max}	**dB(A)**	**15.8**														
$L_{eq,30mins}$	**dB(A)**	**<20**														
Noise Criteria	**dB(A)**	**45**														
Compliance		**Yes**														

Notes: [1] Linear interpolation has been applied to slant distance where appropriate.
[2] FDL based on 60kph data and adjusted by the correction factor of 20xlog(V/Vref), in line with FTA manual.
[3] LSR based on the ground type. LSR data are interpolated against slant distance.
[4] Lmax has incorporated a +0.5dB(A) correction to passby Leq as per measurement at Pat Heung Depot.
[5] $L_{eq,30mins}$ = L_{eq}(double passbys) + 10*log(Passby duration in sec) + 3dB(A) + 10*log(no. of events in 30mins per direction) - 32.6dB(A)
(3dB(A) correction is added to $L_{eq,30mins}$ for leading and trailing effect for conservative approaches.)
[6] $L_{eq,30mins}$ is based on train frequency of 6 trains per 30mins at tunnel section under Chatham Road North for turning around.
[7] Track Type 0 = Direct Fixation, 1 = Atl 1 Baseplate; Type 2 = Egg type baseplate; Type 3 = 12.5Hz FST.

Annex E

Cumulative Operational Ground-borne Noise Results

Annex E - Updated Cumulative Operational Ground-borne Noise Levels

Item	NSR	Location	Predicted $L_{eq\ 30min}$ (dB(A))				Cumulative Noise Level (dB(A))
			SCL (TAW-HUH)	SCL (HHS)	SCL (MKK-HUH)	KTE[4]	
96	HOM-4-1	Yee Fu Building	25	---	20[2]	<20	27
97	HOM-5-1	271 Chatham Road North	<20	---	20[2]	23	26
98	HOM-P2	HKPU Student Halls of Residence	25	---	<20	<20	27
99	HOM-P3-1	Residential Building, HOM Station Development	27	---	20[2]	36	37
100	HUH-1-1	Cartas Branchi College of Careers	30[1]	---	20[2]	26	32
101	HUH-1-2	Lok Ka House	27	---	20[2]	<20	28
102	HUH-1-3	Wing Fung Building	26	<20	<20[3]	<20	29

Notes:

[1] A 3dB(A) upward adjustment is made to account for the daytime headway of 12 EMU trains within a 30 minutes period per direction.

[2] Noise levels are estimated from predicted noise level of adjacent NSR.

[3] Noise levels presented in OGNMMP for SCL(MKK-HUH).

[4] According to Groundborne Noise Review Report for Kwun Tong Line Extension, there are no updated results for the NSRs presented above. Noise levels are thus reference from KTE EIA Report (Register No.: AEIAR-154/2010).