8 Airborne Noise Impact Assessment

8.1 Introduction

This chapter presents the findings of the airborne noise assessment of the Project during both construction and operational phases.

Construction noise impacts associated with the use of Powered Mechanical Equipment (PME) and operational noise impacts associated with fixed noise sources and railways have been evaluated. Practical mitigation measures would be recommended appropriately to control construction and operational noise impacts at all noise sensitive uses to acceptable levels.

8.2 Legislation and Standards

8.2.1 Construction Noise

The Noise Control Ordinance (NCO) (Cap. 400)[8-1] provides the statutory framework for noise control in Hong Kong. Assessment procedures and standards are set out in the respective Technical Memoranda (TM) promulgated under the NCO. The following TMs are applicable to the assessment and control of construction noise.

- TM on Noise from Construction Work other than Percussive Piling (TM-GW)[8-2];
- TM on Noise from Percussive Piling (TM-PP)[8-3]; and
- TM on Noise on Construction Work in Designated Areas (TM-DA)[8-4].

For construction activities, there is no statutory limit on daytime construction noise under the NCO and related TMs. To ensure a better environment, the Annex 5 of TM-EIAO[8-5] promulgated under the Environmental Impact Assessment Ordinance (EIAO) (Cap. 499) has imposed more stringent criteria for daytime construction activities of designated projects. A summary of noise standards for construction activities of designated projects are shown in **Table 8.1**.

Table 8.1: Noise Standards for Construction Activities

Uses	Noise Standards [1] , $L_{eq\ (30\ mins)}$ dB(A)	
	0700 to 1900 hours on any day not being a Sunday or general holiday	1900 to 0700 hours or any time on Sundays or general holiday
All domestic premises including temporary housing accommodation	75	(See Note 2)
Hotels and hostels	75	
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	70 65 (During examinations)	

Notes:
[1] The above standards apply to uses that rely on opened windows for ventilation.
[2] The criteria laid down in the relevant technical memoranda under the NCO for designated areas and construction works other than percussive piling may be used for planning purpose. A Construction Noise Permit (CNP) shall be required for the carrying out of construction work during the period.

8.2.1.1 Construction Noise during Restricted Hours

The NCO also provides statutory control on general construction works during restricted hours (i.e. 1900 to 0700 hours (of the next day) from Monday to Saturday and at any time on Sundays or public holidays). The use of Powered Mechanical Equipment (PME) for construction works during restricted hours would require a Construction Noise Permit

(CNP). The TM-GW details the procedures adopted by EPD for assessing such application. The granting of a CNP is subject to conditions stated in the CNP and it may be revoked at any time for failure to comply with the permit conditions.

In addition to the general controls on the use of PME during restricted hours, the use of Specified Powered Mechanical Equipment (SPME) and the undertaking of Prescribed Construction Work (PCW) during the restricted hours in a designated area are controlled by the TM-DA. Construction plant or equipment classified as SPME under the TM-DA includes hand-held breakers, bulldozers, concrete mixer lorries, dump trucks and poker vibrators. The PCW includes the erection or dismantling of formwork or scaffolding, hammering, handling of rubble, wooden boards, steel bars, or scaffolding material, and the disposal of rubble through plastic chutes.

The TM-DA details the procedures that should generally be adopted by the Authority for assessing the use of SPME during restricted hours and for determining whether a CNP would be issued.

Maximum noise levels from construction activities during restricted hours at affected NSRs are controlled under the TMs and shall not exceed the specified Acceptable Noise Levels (ANLs). These ANLs are stipulated in accordance with the Area Sensitivity Ratings established for the NSRs. The ANLs for construction works in Designated Areas are more stringent than those given in the GW-TM and summarised in **Table 8.2**.

Table 8.2: Acceptable Noise Levels for Construction during Restricted Hours

Time Period	Acceptable Noise Levels for Area Sensitivity Ratings, dB(A)		
	A	B	C
All weekdays during the evening (1900 to 2300 hours), and general holidays (including Sundays) during the day and evening (0700 to 2300 hours)	60 (45)	65 (50)	70 (55)
All days during the night-time (2300 to 0700 hours)	45 (30)	50 (35)	55 (40)

Note: Figures in brackets are ANLs for SPME construction work in designated areas

Despite any description made in this EIA, there is no guarantee that a CNP will be issued for the Project construction. The Noise Control Authority will consider a well-justified CNP application, once filed, for construction works within restricted hours as guided by the relevant TMs issued under the NCO. The Noise Control Authority will take into account contemporary conditions / situations of adjoining land uses and any previous complaints against construction activities at the site before making a decision in granting a CNP. Nothing in the EIA Report shall bind the Noise Control Authority in making a decision. If a CNP is to be issued, the Noise Control Authority shall include in it any conditions demand. Failure to comply with any such conditions will lead to cancellation of the CNP and prosecution under the NCO.

8.2.1.2 Percussive Piling

Under the TM-PP, CNPs are also required for percussive piling involving the use of diesel, pneumatic and / or steam hammer. This TM specifies the permitted hours and other conditions for percussive piling. **Table 8.3** lists the acceptable percussive piling noise levels for various types of NSR.

Table 8.3: Acceptable Noise Levels for Percussive Piling

NSR Window Type or Means of Ventilation	ANL (dB(A))
(i) NSR (or part of NSR) with no window or other opening	100
(ii) NSR with central air conditioning system.	90
(iii) NSR with windows or other openings but without central air conditioning system	85

Depending on the numbers and types of piling machines and the separation from NSRs, percussive piling may be restricted to 12, 5 or 3 hours per day. For NSRs that are particularly sensitive to noise, such as hospitals, medical clinics, educational institutions and courts of law, a further reduction of 10 dB(A) shall be applied to the above ANLs.

8.2.2 Operational Noise

The TM-EIAO has stipulated the noise standards for various noise sources as shown in the following table.

Table 8.4 Noise Standards for Operational Phase

Common Uses	Noise Standards [1]				
	Aircraft Noise (Noise Exposure Forecast: NEF)	Helicopter Noise L_{max} dB(A)	Road Traffic Noise $L_{10\ (1hour)}$ dB(A)	Rail Noise[2]	Fixed Noise Sources
All domestic premises including temporary housing accommodation	25	85	70	(a) The appropriate Acceptable Noise Levels shown in Table 2 of the Technical Memorandum for the Assessment of Noise from Places Other than Domestic Premises, Public Places or Construction Sites (b) L_{max} (2300-0700 hours) = 85dB(A) and (c) $L_{eq\ 24hrs}$ =65dB(A)	(a) 5dB(A) below the appropriate Acceptable Noise Levels (ANL) shown in Table 2 of the Technical Memorandum for the Assessment of Noise from Places Other than Domestic Premises, Public Places or Construction Sites, or (b) the prevailing background noise levels (For quiet areas with level 5 dB(A) below the ANL)
Hotels and hostels	25	85	70		
Offices	30	90	70		
Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required	25	85	65		
Places of public worship and courts of law	25	85	65		
Hospitals, clinics, convalescences and homes for the aged, diagnostic rooms, wards	25	85	55		

Notes:

[1] The above standards apply to uses that rely on opened windows for ventilation.

[2] Rail noise is under the control of the Noise Control Ordinance and shall comply with the Acceptable Noise Levels laid down in the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites. The criteria for noise transmitted primarily through the structural elements of the building or buildings should be 10dB(A) less than the relevant acceptable noise level.

8.2.2.1 Railway Noise

Noise from railway, station plant items, train stabling sidings and ventilation building is controlled under the NCO and the associated Technical Memorandum on Noise from Places Other Than Domestic Premises, Public Places or Construction Sites (TM-Places), and the relevant noise criteria are listed in Table 1A, Annex 5 of TM-EIAO. In accordance with the Hong Kong Planning Standards and Guidelines (HKPSG), a 24-hour averaged noise level of 65 dB(A) $L_{eq\ 24\ hr}$ has been specified.

Table 8.5 below summarises the noise standards for railway noise as given in Table 1A, Annex 5 of TM-EIAO.

Table 8.5: Noise Criteria for Railway Noise

Area Sensitivity Rating	Time Period [1]	Acceptable Noise Levels (ANL), $L_{Aeq, 30\ mins}$, dB(A)	Maximum A-weighted sound pressure level, L_{max} (2300-0700hrs) dB(A)
A	Day & evening	60	85
	Night	50	
B	Day & evening	65	
	Night	55	
C	Day & evening	70	
	Night	60	

Note: [1] Day: 0700 to 1900 hours, Evening: 1900 to 2300 hours, Night: 2300 to 0700 hours

8.2.2.2 Fixed Noise Sources

Operational noise from fixed noise sources including station plant building and ventilation shafts is controlled under the NCO's Technical Memorandum on Noise from Places other than Domestic Premises, Public Places or Construction Sites[8-6]. To plan for a better environment, the TM-EIAO has specified the following requirements.

- 5 dB(A) below the appropriate ANLs in the Technical Memorandum on Noise from Places other than Domestic Premises, Public Places or Construction Sites; or
- the existing noise levels (For quiet areas with level 5dB(A) below the ANL).

The ANLs for different Area Sensitivity Ratings during different periods are summarized in the following table.

Table 8.6: Acceptable Noise Levels (ANL) for Fixed Noise Sources stated in TM-Places

Time Period	ANL, dB(A)*		
	ASR A	ASR B	ASR C
Day (0700 to 1900 hours)	60	65	70
Evening (1900 to 2300 hours)	60	65	70
Night (2300 to 0700 hours)	50	55	60

Note: ASR – Area Sensitivity Rating
* 5 dB(A) below the appropriate ANLs in the TM-Places will be taken as the assessment criterion

8.2.2.3 Existing Noise Levels

Noise measurements have been conducted to establish the existing noise levels in the vicinity of the proposed ventilation shafts and stations where fixed noise sources are anticipated. **Appendix 8.1** shows the measurement locations for existing noise levels. A summary of the results is given in **Table 8.7**.

Table 8.7: Measurements of Existing Noise Levels

Measurement Location	Existing Noise Levels [2], dB(A) L_{eq}	
	Day & Evening [1]	Night [1]
Hung Hom – HHS (PNM-5)	67 – 75	64 – 66
Hung Hom – HHS (PNM-6)	68 – 71	62 – 66
Hung Hom – HHS (PNM-7)	65 – 66	61 – 65
Hung Hom – HHS (PNM-8)	72 – 76	65 – 72

Measurement Location	Existing Noise Levels [2], dB(A) L_{eq}	
Hung Hom – HHS (PNM-9)	64 – 68	64 – 66
Kai Tak-KAT (PNM-4)	70 – 73	56 – 59
Diamond Hill-DIH (PNM-1)	69 – 73	62 – 65
Diamond Hill-DIH (PNM-2)	76 – 79	71 – 73
Diamond Hill-DIH (PNM-3)	72 – 74	63 – 66

Note:
[1] Day: 0700 to 1900 hours, Evening: 1900 to 2300 hours, Night: 2300 to 0700 hours
[2] Measurements conducted in March 2009 and July 2011

8.2.2.4 Noise Criteria

A summary of the noise criteria at representative NSRs which would be subject to the impact of fixed plant noise is given in the following table. The existing noise level at each NSR would be determined based on measurement results at the nearest location as shown in **Appendix 8.1**.

Table 8.8: Summary of Noise Criteria at NSRs for Fixed Noise Sources

Area (NSR No.)	Time Period [1]	Existing Noise Levels, dB(A) [2]	ASR	ANL-5 dB(A) [3]	Criteria dB(A) [4]
Royal Peninsula Block 2 (HUH-3-1)	Day & evening	68	C	65	65
	Night	62	C	55	55
University Student Halls of Residence (HUH-11-1), Harbour Place Block 6 (HUH-12-1)	Day & evening	65	C	65	65
	Night	61	C	55	55
The Metropolis Residence Tower 2 (HUH-4-1), The Metropolis Residence Tower 1 (HUH-4-2)	Day & evening	72	B	60	60
	Night	65	B	50	50
Harbourfront Horizon HUH-10-1	Day & evening	64	B	60	60
	Night	64	B	50	50
Planned NSR (KAT-P1-1, KAT-P1-2, KAT-P1-3 & KAT-P1-4)	Day & evening	70	B	60	60
	Night	56	B	50	50
Galaxia (DIH-12-1 & DIH-12-2), Lung Wan House (DIH-11-1),	Day & evening	69	C	65	65
	Night	62	C	55	55
Shek On Building(DIH-9-1), Hong Kong Sheng Kung Hui Nursing Home (DIH-10-1)	Day & evening	76	B	60	60
	Night	71	B	50	50
Canossa Primary School (San Po Kong) (DIH-14-4), Rhythm Garden Block 1 (DIH-14-5), Planned NSR (DIH-P3-1 & DIH-P3-2)	Day & evening	72	C	65	65
	Night	63	C	55	55

Note:
[1] Day: 0700 to 1900 hours, Evening: 1900 to 2300 hours, Night: 2300 to 0700 hours.
[2] Existing noise level determined based on the measurement result recorded at the representative location nearest to the respective NSR.
[3] A 5 dB(A) has been deducted from ANL as specified in requirement of TM-EIAO.
[4] The Minimum of [2] & [3] is adopted.

8.3 Potential Concurrent Projects

The concurrent projects that would have cumulative environmental impacts during the construction and operational phases of SCL (HHS) are given in **Section 1**. As discussed in **Section 1.5.12**, the following concurrent projects are relevant for cumulative noise assessment.

Table 8.9 Summary of Cumulative Noise Issues from Concurrent Projects

Item	Project	Issues During Project Stage	
		Construction	Operation
1.	SCL – Tai Wai to Hung Hom Section (SCL (TAW-HUH))	• Construction noise	• Railway noise
2.	SCL – Mong Kok East to Hung Hom Section (SCL (MKK-HUH)) & SCL – Hung Hom to Admiralty Section (SCL (HUH-ADM))	• Construction noise	• Railway noise and fixed noise
3.	Housing Authority Development Sites 1A & 1B within Kai Tak Development	• Construction noise	• Nil
4.	Other Infrastructure within Kai Tak Development	• Construction noise	• Nil
5.	Kwun Tong Line Extension (Including EPIW) (KTE with EPIW)	• Construction noise	• Nil
6.	Tsz Wan Shan Pedestrian Link	• Construction noise	• Nil
7.	Central Kowloon Route (CKR)	• Construction noise	• Nil

According to the project proponent of SCL (TAW-HUH), the SCL (TAW-HUH) project is scheduled to commence concurrently with the Project. All the construction works, including site clearance, ground excavation, cu-&-cover tunnel section, etc. presented in the EIA report for SCL (TAW-HUH) would be included in this assessment to account for the cumulative impacts. However, noise sources from construction of Diamond Hill Stabling Siding (DHS), KAT and DIH based on the scheme assessed in the SCL (TAW-HUH) would not be included in the cumulative assessment as it is assumed in this EIA that the HHS options would be adopted and emissions from the construction of these elements would be assessed based on the scheme proposed under the Project.

Hung Hom Area

SCL – Tai Wai to Hung Hom Section

As mentioned above, the construction activities in the vicinity of HHS and HUH presented in the SCL (TAW-HUH) EIA Report would be included in the cumulative impact assessment.

SCL – Mong Kok East to Hung Hom Section and Hung Hom to Admiralty Section

The SCL (MKK-HUH) and SCL (HUH-ADM) projects in the Hung Hom Area are scheduled to commence concurrently with the Project. Cumulative construction noise impact is therefore anticipated. SCL (MKK-HUH) will include the realignment work for the existing East Rail Line tracks from south of Mong Kok East to the modified HUH. SCL (HUH-ADM) will include the construction of the section across the harbour from Hung Hom to Admiralty. As this EIA addresses the HHS option, noise sources from the construction of HUH based on the scheme assessed in the SCL (MKK-HUH) would not be included in the cumulative assessment. Noise impact induced from the construction of HUH would be assessed as per the scheme proposed under this Project.

Central Kowloon Route

According to the project proponent of CKR, the CKR project is scheduled to commence concurrently with the Project. As the construction impacts from CKR at the identified NSRs

would be screened by nearby buildings, cumulative impact from construction of CKR and the Project is therefore not anticipated.

Kwun Tong Line Extension with EPIW

With reference to the approved EIA Study "Kwun Tong Line Extension" (AEIAR-154/2010), construction works under KTE project would occur concurrently with the Project. KTE project will include construction of an approximately 3km extension of the existing Kwun Tong Line from Yau Ma Tei Station to a new railway station at Whampoa and an interchange with SCL (TAW-HUH) at Ho Man Tin Station. Three EPIW items, namely Oi Man Estate and Ho Man Tin Estate Connections, Public Transport Facilities and Chatham Road North Covered Footbridge, would also occur concurrently. Cumulative construction noise impact from construction of KTE with EPIW and HHS and modification of HUH is anticipated.

Kai Tak Area

SCL – Tai Wai to Hung Hom Section

The construction works proposed for SCL(TAW-HUH) in the Kai Tak area would be located at within 300m from the nearest representative NSRs identified for this Project. As mentioned above, all the construction works in the vicinity of DIH presented in the EIA report for SCL (TAW-HUH) would be included in this assessment to account for the cumulative impacts. However, noise sources from construction of Diamond Hill Stabling Siding (DHS), KAT and DIH based on the scheme assessed in the SCL (TAW-HUH) would not be included in the cumulative assessment as it is assumed in this EIA that the HHS options would be adopted and emissions from the construction of these elements would be assessed based on the scheme proposed under the Project.

Diamond Hill Area

SCL – Tai Wai to Hung Hom Section

As mentioned above, all the construction works in the vicinity of DIH presented in the EIA report for SCL (TAW-HUH) would be included in this assessment to account for the cumulative impacts. However, noise sources from construction of Diamond Hill Stabling Siding (DHS), KAT and DIH based on the scheme assessed in the SCL (TAW-HUH) would not be included in the cumulative assessment as it is assumed in this EIA that the HHS options would be adopted and emissions from the construction of these elements would be assessed based on the scheme proposed under the Project.

Tsz Wan Shan Pedestrian Link

Tsz Wan Shan Pedestrian Link is a covered walkway as well as lifts/escalators proposed to connect the Tsz Wan Shan residential to the DIH Station. Based on the current construction programme, the associated construction works would likely interface with the major construction of the Project, cumulative construction noise impact is anticipated.

8.4 Noise Sensitive Receivers

8.4.1 Noise Sensitive Receivers

With reference to Annex 13 of the TM-EIAO, NSRs include residential uses (all domestic premises including temporary housing), institutional uses (educational institutions including kindergarten and nurseries), hospitals, medical clinics, homes for the aged, convalescent homes, places of worship, libraries, court of law, performing arts centres, auditoria and amphitheatres, country park and others. All hospitals and performance venues are air-conditioned and do not rely on openable windows for ventilation.

Representative NSRs within a distance of 300m from either side of the project boundary have been identified. The first layer of NSRs has been identified and selected for assessment. These NSRs will cover all existing sensitive developments (including those

occupied before completion of the construction) for construction noise assessment, and both the existing and planned developments for operational noise assessment.

The existing NSRs are identified by means of topographic maps, aerial photos, land status plans and several site surveys. Planned/committed NSRs are identified by making reference to relevant Outline Zoning Plans, Outline Development Plans, Layout Plans and other published plans in relation to the Planning and Development.

The existing and planned NSRs in the vicinity, which may be affected by the proposed SCL (HHS) are summarised in the following **Table 8.10** and **Table 8.11**. The locations of the NSRs are shown on **Figures 8.1.1** to **8.1.3**. Details and photos of NSRs are given in **Appendices 8.2** and **8.3** respectively.

Table 8.10: Existing NSRs

NSR ID	NSR Description	Landuse [1]	No. of Storey
DIH-9-1	Shek On Building	E + W	5
DIH-10-1	Hong Kong Sheung Keung Hui Nursing Home	H	9
DIH-11-1	Lung Poon Court – Lung Wan House	R	34
DIH-12-1	Galaxia Tower B	R	44
DIH-12-2	Galaxia Tower E	R	43
DIH-13-1	Canossa Primary School	E	5
DIH-14-1	Rhythm Garden Block 2	R	22
DIH-14-3	Rhythm Garden Block 8	R	22
DIH-14-4	Canossa Primary School (San Po Kong)	E	6
DIH-14-5	Rhythm Garden Block 1	R	22
DIH-15-1	Choi Hung Estate - Kam Wan House	R	20
DIH-15-2-A	Choi Hung Estate - Pik Hoi House	R	20
HUH-1-3	Wing Fung Building	R	8
HUH-3-1	Royal Peninsula Block 2	R	42
HUH-3-2	Royal Peninsula Block 1	R	35
HUH-4-1	The Metropolis Residence Tower 2[2]	S	18
HUH-4-2	The Metropolis Residence Tower 1[2]	S	18
HUH-8-1	No. 2, Gillies Avenue South	R	6
HUH-10-1	Harbourfront Horizon[3]	C + S	22
HUH-11-1	The Hong Kong Polytechinic University Jockey Club Student Hostel	R	20
HUH-12-1	Harbour Place Block 6	R	35

Notes:

[1] R– residential premises; E – educational institutions; W – worship; H – clinic / home for the aged; S – Service Apartment; C – Commercial

[2] Metropolis Residence is a service apartment and shall not rely on openable windows for ventilation. Nonetheless, for conservative consideration that occupier might open window under special circumstances, this premise has been considered as an assessment point.

[3] Harbourfront Horizon shall not rely on openable windows for ventilation. Nonetheless, for conservative consideration that occupier might open window under special circumstances, this premise has been considered as an assessment point.

Table 8.11: Planned NSRs

NSR ID	NSR Description	Landuse [1]	No. of Storey
DIH-P3-1 to P3-2	Future receivers in the CDA Site	R/GIC	[2]
KAT-P1-1 to 6	Residential premises near KAT	R	14 - 57

Notes:

[1] R– residential premises; GIC – government, institution and community

[2] To be determined by respective project proponents

8.5 Construction Noise Assessment

8.5.1 General Assessment Procedure

Construction noise assessment has been conducted based on the following procedures:

- Determine the assessment area, and identify representative NSRs that may be affected by the works;
- Obtain the construction method and work sequence for the construction period;
- Obtain the plant items for each corresponding construction work sequence;
- Determine the sound power levels of the plant items according to the information stated in the TM-GW or other recognised sources of reference, where appropriate;
- Calculate the correction factors based on the distance between the NSRs and the notional noise source positions of the work sites;
- Apply corrections for façade, distance, barrier attenuation, acoustic reflection where applicable;
- Quantify the level of impact at the NSRs, in accordance with TM-GW;
- Predict the cumulative noise impacts by any concurrent construction works in the vicinity; and
- For any exceedance of noise criteria, all practical mitigation measures such as alternative construction methodology, quiet plant, silencer, enclosure, etc, shall be examined to alleviate the predicted noise impacts as much as practicable. Details of mitigation measures are discussed in **Section 8.5.6**.

8.5.2 Construction Noise Sources

Based on the construction methodologies, the major construction works would include the following activities for construction of HHS, KAT and DIH and modification works at HUH:

- Site clearance and formation activities;
- Structure dismantling, if required;
- Station, ventilation shafts and train stabling sidings construction;
- Tunnel and refuge sidings construction (including bored tunnelling, cut-&-cover and open cut)
- Diversion of utilities; and
- Backfilling and reinstatement works.

These construction activities would be carried out with the use of Powered Mechanical Equipment (PME) including breakers, pipe pile rigs, excavators, lorries, mobile cranes, concrete pumps, concrete mixers, pokers, rollers, etc. Sound Power Levels (SWLs) for each PME would be established according to TM-GW and other relevant information as appropriate.

The plant inventory for the above activities is provided by the Project Proponent and is given in **Appendix 8.4**.

8.5.3 Utilisation Rates of Powered Mechanical Equipment

Practically, the PMEs will not be operating for all times within a work site. The utilization rates would depend on the construction sequences, work fronts scale and construction nature. In this assessment, the utilization rates for each work front during different periods have been reviewed by the Project Proponent and have been concluded to be practicable for the purpose of this EIA. **Appendix 8.4** summarises the adopted utilisation rates and the associated SWL for different construction sequences. **Appendix 8.5** shows the sketch of typical temporary noise barrier / enclosure.

8.5.4 Noise Assessment Tool

An in-house program has been used for construction noise calculations. Initially, the program runs were conducted without any mitigation measures (i.e. the “Unmitigated

Scenario"). Where noise level exceedance was identified, further runs would be made assuming different combinations of mitigation measures to be incorporated (i.e. the "Mitigated Scenario").

8.5.5 Assessment Results - Unmitigated Scenario

According to the latest engineering design, the construction would mainly comprise of the activities as described in **Section 8.5.2**. The corresponding Sound Power Levels (SWLs) of these activities have been estimated according to the PME's SWLs and the assessment methodology in the GW-TM. **Appendix 8.7A** to **Appendix 8.10A** present the PME inventory adopted in each construction works area, including HUH and HHS, KAT and DIH. **Appendix 8.7B** to **Appendix 8.10B** present the distance between the notional sources and the NSRs and screening effects due to terrains etc. **Appendix 8.7C** to **Appendix 8.10C** present the monthly unmitigated noise contribution during the construction period. **Appendix 8.7D** to **Appendix 8.10D** also present the unmitigated construction noise impacts at selected representative NSRs. The predicted construction noise impacts on the NSRs are summarised in the tables below.

Table 8.12: Predicted Maximum Unmitigated Construction Noise Levels at Noise Sensitive Receivers

NSR ID	NSR Description	Uses	Criterion [1] dB(A)	Unmitigated Noise Level [2] dB(A)	Exceedance dB(A)
Works Area – HUH and HHS					
HUH-1-3	Wing Fung Building	R	75	**78**	3
HUH-3-1	Royal Peninsula Block 2	R	75	**81**	6
HUH-3-2	Royal Peninsula Block 1	R	75	**81**	6
HUH-4-1	The Metropolis Residence Tower 2	S	75	**81**	6
HUH-4-2	The Metropolis Residence Tower 1	S	75	**80**	5
HUH-8-1	No. 2, Gillies Avenue South	R	75	75	0
HUH-10-1	Harbourfront Horizon	C + S	75	**84**	9
Works Area – KAT					
KAT-P1-5-A	Residential premises near KAT	R	75	75	0
KAT-P1-5-B	Residential premises near KAT	R	75	**90**	15
KAT-P1-5-C	Residential premises near KAT	R	75	**76**	1
KAT-P1-5-D	Residential premises near KAT	R	75	**81**	6
KAT-P1-6	Residential premises near KAT	R	75	**78**	3
Works Area – DIH					
DIH-9-1	Shek On Building	E + W	70 (65)	**77**	7 (12)
DIH-10-1	Hong Kong Sheung Keung Hui Nursing Home	H	75	**77**	2
DIH-11-1	Lung Poon Court – Lung Wan House	R	75	**88**	13
DIH-12-1	Galaxia Tower B	R	75	**81**	6
DIH-12-2	Galaxia Tower E	R	75	**82**	7
DIH-13-1	Canossa Primary School	E	70 (65)	**75**	5 (10)

NSR ID	NSR Description	Uses	Criterion [1] dB(A)	Unmitigated Noise Level [2] dB(A)	Exceedance dB(A)
DIH-14-1	Rhythm Garden Block 2	R	75	75	0
DIH-14-3	Rhythm Garden Block 8	R	75	62	0
DIH-14-4	Canossa Primary School (San Po Kong)	E	70 (65)	**78**	8 (13)
DIH-14-5	Rhythm Garden Block 1	R	75	**77**	2
DIH-15-1	Choi Hung Estate - Kam Wan House	R	75	67	0
DIH-15-2A	Choi Hung Estate - Pik Hoi House	R	75	62	0

Notes:
[1] Values in parentheses indicate the noise criterion during examination period of educational institution.
[2] Bolded values mean exceedance of the noise criteria.

Results show that, without any mitigation measures, the predicted construction noise levels during non-restricted hours would exceed the corresponding noise criteria at most of the selected NSRs by 2 to 15dB(A) and 5 to 13dB(A) for residential premises and educational institution respectively, especially for those NSR very close to cut-&-cover station construction. Mitigation measures are therefore considered necessary to reduce the adverse construction noise impact associated with the Project at all works area.

8.5.6 Mitigation Measures

The predicted construction noise levels show that the unmitigated construction noise impacts would exceed the daytime noise criteria. Mitigation measures are therefore required. The following mitigation measures have been considered:

- Good site practices to limit noise emissions at the source;
- Use of quiet plant and working methods;
- Use of site hoarding as noise barrier to screen noise at ground level of NSRs;
- Use of shrouds / temporary noise barriers to screen noise from relatively static PMEs;
- Use of large full enclosure to screen all the plant;
- Scheduling of construction works outside school examination periods in critical area; and
- Alternative use of plant items within one worksite, wherever practicable.

The above mitigation measures would need to be implemented in all work sites as good practices. It should be noted that whilst "Good Practice" mitigation measures would help to alleviate the noise impacts, some of these measures have not be included in the quantitative assessment as discussed in the following sections. This would ensure a more conservative assessment.

Detailed descriptions of these mitigation measures are given in the following sections.

Good Site Practices and Noise Management Techniques

Good site practice and noise management techniques could considerably reduce the noise impact from construction site activities on nearby NSRs. The following measures should be followed during each phase of construction:

- only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme;

- machines and plant (such as trucks, cranes) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- plant known to emit noise strongly in one direction, where possible, be orientated so that the noise is directed away from nearby NSRs;
- silencers or mufflers on construction equipment should be properly fitted and maintained during the construction works;
- mobile plant should be sited as far away from NSRs as possible and practicable; and
- material stockpiles, site office and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

The benefits of these techniques can vary according to specific site conditions and operations. The environmental noise climate would certainly be improved through these control practices, although the improvement can only be quantified during implementation when specific site parameters are known. The assessment has therefore not taken into account the effectiveness of "Good Site Practices and Noise Management Techniques".

Use of Site Hoarding

Purpose built temporary noise barriers (approximately 2.5m high) located on the site boundaries between noisy construction activities and NSRs could generally reduce noise levels at low-level zone of NSRs through partial screening. In general, this would provide a minimum of 5 dB(A) attenuation for the low level receivers. It would be possible for the Contractor to provide these in the form of site hoardings to achieve this attenuation effect, provided that the barriers have no openings or gaps. Good site practice shall also be adopted by the Contractor to ensure the conditions of the hoardings are properly maintained throughout the construction period. As a conservative assumption, however, the site hoarding has not been taken into consideration in the construction noise assessments.

Use of Temporary Movable Noise Barrier & Enclosure (with Sufficient Ventilation) for Relatively Static Plant

Movable temporary noise barriers that can be located close to noisy plant and be moved concurrently with the plant along a worksite can be very effective for screening noise from NSRs. A typical design which has been used locally is a wooden framed barrier with a small-cantilevered on a skid footing with 25mm thick internal sound absorptive lining. This measure is particularly effective for low level zone of NSRs. A cantilevered top cover would be required to achieve screening benefits at upper floors of NSRs.

Movable barriers will be used for some PME (e.g. pipe pile rigs, auger). It is anticipated that suitably designed barriers could achieve at least 5 - 10dB(A) reduction. For a conservative approach, only a reduction of 5dB(A) is assumed. Acoustic mat will be used for other plant items such as trench cutter, piling, oscillator and drilling rig and a 10 dB(A) noise reduction is anticipated. This assumption has been adopted in other approved EIA Reports.

The use of enclosure (with sufficient ventilation) has been considered in this assessment to shelter relatively static plant including air compressor, generator. The enclosures barriers can provide about 10dB(A) noise reduction. For electric saw, movable noise barriers of 5dB(A) attenuation have been assumed.

A summary of the temporary movable barriers and enclosures adopted for various PMEs, and the associated noise reduction is given in **Appendix 8.4**.

Large Full Enclosure for Construction Site

Another possible mitigation measures is the use of large full enclosure for construction site during cut-&-cover tunnel and station construction. A larger enclosure for the construction site would provide better noise attenuation than the use of temporary noise barriers/ acoustic mats. However, the height of the enclosure would need to be at least 9m in order to accommodate all the plant. Given the nature of construction works, having such a tall barrier

would impose adverse visual impacts to the neighbouring receptors and pedestrians. Together with potential nuisance/ impacts on the access, the use of large enclosure for construction site would cause significant impacts and hence is not recommended.

Use of "Quiet" Plant and Working Methods

The use of quiet plant is a feasible solution to tackle adverse noise impacts associated with construction works. It is generally known (supported by field measurement) that particular models of construction equipment are quieter than standard types given in the TM-GW. Whilst it is generally considered as too restrictive to specify the specific models or items of plant to be used by the Contractor, it is reasonable and practicable to set plant noise performance specifications for specific PME so that some flexibility in selection of plant is allowed. A pragmatic approach would be to request that the Contractor to independently verify the noise level of the plant proposed to be used and demonstrates the plant proposed to be used on the site meets the requirements through furnishing of the results.

The use of quiet plant associated with the construction works is prescribed in British Standard "Noise Control on Construction and Open Sites, BS5228: Part 1: 2009" which contains the SWLs for specific quiet PME. It should be noted that while various types of silenced equipment could be found in Hong Kong, when EPD is processing a CNP application for evening or night time works may apply the noise levels specified in the TM-GW and TM-DA. The Noise Control Authority may give special consideration to CNP applications which contain sufficient details of any particularly quiet items of PME or any special noise control measures which the CNP applicant proposes to employ on the site.

A summary of the "Quiet" PMEs adopted and the associated SWLs is given in **Appendix 8.4**.

Sequencing Operation of Construction Plant Equipment

In practice, some plant items will operate sequentially within the same work site, and certain reduction of the predicted noise impacts could be achieved. However, any additional control on the sequencing of plant will impose constraint to the Contractor on the operation and planning of plant items, and the implementation of the requirement would be difficult to be monitored. Hence, sequencing operation of PME has not been taken into consideration in the construction noise assessments

8.5.7 Assessment Results - Mitigated Scenario

With the implementation of the abovementioned mitigation measures, the construction noise levels at the affected NSRs are predicted and presented in the following tables. The predicted noise levels at all the NSRs would comply with the corresponding noise criteria. **Appendix 8.7E** to **Appendix 8.10E** present the monthly unmitigated noise contribution during the construction period. **Appendix 8.7F** to **Appendix 8.10F** also present the predicted mitigated construction noise levels at selected representative NSRs.

Appendices 8.10G, **8.10I** and **8.10J** presents the details of the mitigated construction noise assessment near DIH. **Table 8.13** below presents the mitigated noise levels at NSRs.

Table 8.13: Predicted Maximum Mitigated Construction Noise Levels at Noise Sensitive Receivers

NSR ID	NSR Description	Uses	Criterion [1] dB(A)	Mitigated Noise Level [2] dB(A)	Exceedance dB(A)
Works Area – HUH and HHS					
HUH-1-3	Wing Fung Building	R	75	62	0
HUH-3-1	Royal Peninsula Block 2	R	75	70	0
HUH-3-2	Royal Peninsula Block 1	R	75	68	0

NSR ID	NSR Description	Uses	Criterion [1] dB(A)	Mitigated Noise Level [2] dB(A)	Exceedance dB(A)
HUH-4-1	The Metropolis Residence Tower 2	S	75	73	0
HUH-4-2	The Metropolis Residence Tower 1	S	75	73	0
HUH-8-1	No. 2, Gillies Avenue South	R	75	65	0
HUH-10-1	Harbourfront Horizon	C + S	75	72	0
Works Area – KAT					
KAT-P1-5-A	Residential premises near KAT	R	75	61[5]	0
KAT-P1-5-B	Residential premises near KAT	R	75	75	0
KAT-P1-5-C	Residential premises near KAT	R	75	62	0
KAT-P1-5-D	Residential premises near KAT	R	75	66	0
KAT-P1-6	Residential premises near KAT	R	75	65	0
Works Area – DIH					
DIH-9-1	Shek On Building	E + W	70 (65)	63	0 (0)
DIH-10-1	Hong Kong Sheung Keung Hui Nursing Home	H	75	62	0
DIH-11-1	Lung Poon Court – Lung Wan House	R	75	74	0
DIH-12-1	Galaxia Tower B	R	75	69[3]	0
DIH-12-2	Galaxia Tower E	R	75	74[3]	0
DIH-13-1	Canossa Primary School	E	70 (65)	61	0
DIH-14-1	Rhythm Garden Block 2	R	75	66[4]	0
DIH-14-3	Rhythm Garden Block 8	R	75	55[4]	0
DIH-14-4	Canossa Primary School (San Po Kong)	E	70 (65)	64[4]	0 (0)
DIH-14-5	Rhythm Garden Block 1	R	75	65[4]	0
DIH-15-1	Choi Hung Estate - Kam Wan House	R	75	60[4]	0
DIH-15-2A	Choi Hung Estate - Pik Hoi House	R	75	63[4]	0

Notes:
[1] Values in parentheses indicate the noise criterion during examination period of educational institution.
[2] Bolded values mean exceedance of the noise criteria.
[3] Cumulative impact arisen from Tsz Wan Shan Pedestrian Link is considered.
[4] Cumulative impact arisen from SCL (TAW-HUH) near DIH is considered.
[5] Cumulative impact arisen from SCL (TAW-HUH) near DIH (**Appendix 8.10J**) and KAT (**Appendix 8.9F**) is included.

Results show that with the implementation of mitigation measures, the construction noise impact due to the Project alone during non-restricted hours would comply with the noise criterion of 75dB(A) for residential premises and 70 / 65dB(A) for educational institutions during normal or examination period respectively.

8.5.8 Assessment Results – Cumulative Construction Noise with Concurrent Projects

Amongst the NSRs considered, some of them would experience cumulative construction noise impacts from other concurrent projects (see **Section 8.3**). All NSRs identified in the vicinity of HHS and HUH would experience cumulative impact from the Project, SCL (MKK-HUH), SCL (HUH-ADM), SCL (TAW-HUH) and KTE with EPIW. **Table 8.13a** presents a summary of cumulative noise levels at NSRs and details of the calculation are given in **Appendix 8.8A** and **Appendix 8.8B.**

Table 8.13a: Predicted Mitigated Cumulative Construction Noise Levels at Noise Sensitive Receivers

NSR ID	NSR Description	Construction Noise Contribution [1] [2] dB(A)				Criteria dB(A)	Total [2] dB(A)	Exceedance dB(A)
		The Project	[3]	[4]	KTE			
HUH-1-3	Wing Fung Building	62	71	77	67[5]	75	**78**	3
HUH-3-1	Royal Peninsula Block 2	70	72	57	-	75	73	-
HUH-3-2	Royal Peninsula Block 1	68	66	57	-	75	69	-
HUH-4-1	The Metropolis Residence Tower 2	73	71	55	-	75	75	-
HUH-4-2	The Metropolis Residence Tower 1	73	73	55	-	75	75	-
HUH-8-1	No. 2, Gillies Avenue South	65	65	58	-	75	67	-
HUH-10-1	Harbourfront Horizon	72	72	54	-	75	73	-

Notes:

[1] Construction noise levels are predicted based on the programmes of different projects.

[2] Bolded values mean exceedance of the noise criteria.

[3] SCL (MKK-HUH) & SCL (HUH-ADM).

[4] SCL (TAW-HUH).

[5] Cumulative impacts arisen from EPIW are included.

Most of the cumulative construction noise levels at the NSRs would comply with the TM-EIAO criteria except for HUH-1-3 which would experience exceedance of 3 dB(A).

Residual Cumulative Impacts Exceeding the Construction Noise Criterion

From the above table, the cumulative noise impact at Wing Fung Building (HUH-1-3) is 78dB(A) with a maximum of residual impacts exceeding the construction noise criterion of 3dB(A). The noise impact due to the Project is only 62dB(A) which comply with the NCO daytime construction noise criterion. Residual cumulative impact exceeding the construction noise criterion would be contributed from the construction activities of SCL (TAW-HUH). However, the EIA study of SCL (TAW-HUH) indicated that all practicable mitigation measures have been fully explored and exhausted to reduce the noise impact arising from construction activities of SCL (TAW-HUH).

The magnitude of the residual impacts has been assessed in accordance with **Section 4.4.3** of the EIAO-TM in **Table 8.14** below.

Table 8.14: Assessment of Residual Impacts from Construction Noise

Criteria	Assessment
Effects on public health and health of biota or risk to life	The extent of noise nuisance would be unlikely to induce public health concern
Magnitude of the adverse	Residual impacts exceeding the construction noise criterion of between 1-

Criteria	Assessment
environmental impacts.	3dB(A) could occur at 1 NSR during the construction phase based upon worse case scenarios.
Geographic extent of the adverse environmental impacts.	The geographic extent of the adverse impacts from noise will not be large and is anticipated to be limited to within about 10m from the Project works area.
Duration and frequency of the adverse environmental impacts	The construction noise impacts of the Project will be from 1 to 8 months for the affected residential premises; and are, therefore, temporary and reversible.
Likely size of the community or the environment that may be affected by the adverse impacts	Minimal size of the community would be affected, and therefore be considered acceptable.
Degree to which the adverse environmental impacts are reversible or irreversible.	Construction phase impacts should be reversible.
Ecological context.	Not Applicable
Degree of disruption to sites of cultural heritage.	Not Applicable
International and regional importance.	The impacts are localized and not of international and regional importance.
Likelihood and degree of uncertainty of adverse environmental impacts.	The impacts predicted are based upon worst case assumptions and as such, would not occur to the extent predicted on all occasions. However, the assessment has been made using approved mathematical modelling techniques and the degree of certainty on the results is high.

Housing Authority Development Sites 1A & 1B

As discussed in **Section 1**, the construction of the Housing Authority Development Sites 1A and 1B (i.e. KAT-P1-5-A, KAT-P1-5-B, KAT-P1-5-C, KAT-P1-5-D and KAT-P1-6) would be concurrent with the construction of the KAT for about 1 year since the intake year for Sites 1A and 1B would be occurred in October 2012.

However, the site formation of the Sites 1A and 1B have been completed, the noise impacts caused by these superstructure works on the nearest receivers at Rhythm Garden and Choi Hung Estate i.e DIH-14-3 at more than 300m away would not be significant as compared to the construction noise generated by the construction of KAT and DIH. Besides, it is anticipated that the project proponent of the Sites 1A and1B would implement effective good site practices such as quiet plant and temporary movable noise barriers for some of the mobile PME. Therefore, the cumulative construction noise impacts due to the construction of Sites 1A and 1B would not be significant.

Other Infrastructure Development within Kai Tak Development

As discussed in **Section 1**, the construction of some of the other infrastructure development within Kai Tak Development would be concurrent with the construction of the KAT. However, the site formation of these infrastructure have been completed, the noise impacts caused by these superstructure works on the nearest receivers at Rhythm Garden, Choi Hung Estate and residential premises near KAT (i.e. KAT-P1-5-A, KAT-P1-5-B, KAT-P1-5-C, KAT-P1-5-D and KAT-P1-6) at more than 920m, 730m, 620m, 840m and 490m respectively away would not be significant as compared to the construction noise generated by the construction of KAT. Besides, it is anticipated that the project proponent of other infrastructure developments would implement effective good site practices such as quiet plant and temporary movable noise barriers for some of the mobile PME. Therefore, the

cumulative construction noise impacts due to the construction of other infrastructure development within Kai Tak Development would not be significant.

8.6 Operational Noise Assessment

8.6.1 Operational Airborne Noise Source

The KAT, DIH are underground stations and HUH will be covered by the existing podium. The alignment near to DIH would be in the form of a tunnel. Therefore, there would not be any adverse airborne noise impact resulting from their operation.

The HHS fan and other associated launching and retrieval tracks for connecting the stabling sidings to the SCL (TAW-HUH) alignment will extend outside the north and south of the podium. These tracks would be in the form of non-ballast or ballast at-grade tracks which are exposed and may result in airborne train noise impacts at nearby NSRs. As a conservative approach, non-ballast tracks were assumed for these tracks in the assessment.

The emergency tracks of HHS would need to connect to the tracks for the new SCL (TAW-HUH), this would require removal of a short length of trough wall as compared with the design assessed under the SCL(TAW-HUH) EIA. This modification has been considered in the calculation of airborne train noise impacts from SCL (TAW-HUH) during cumulative impact assessment.

The ventilation system required for operation of stations and stabling sidings would be fixed noise sources that needs to be considered.

8.6.2 Noise Sensitive Receivers

Among the NSRs identified in **Section 8.4.1**, the NSRs that would be affected by operation of the Project are summarized in **Table 8.15**. The Area Sensitive Ratings and the night-time assessment goal, which is the most critical period for operational train noise assessment, are summarised in **Table 8.15**.

Table 8.15: Summary of noise sensitive receivers and area sensitivity ratings

NSR ID	NSR Description	Type [2]	ASR	Assessment Goal
HUH-1-3	Wing Fung Mansion	R	C	50[1]
HUH-3-1	Block 2, Royal Peninsula	R	C	50[1]
HUH-4-1	Tower 2, The Metropolis Residence[3]	S	B	45[1]
HUH-4-2	Tower 1, The Metropolis Residence[3]	S	B	45[1]
HUH-8-1	2 Gillies Avenue South	R	C	50[1]
HUH-10-1	Harbourfront Horizon[4]	C + S	B	55

Notes:

[1] A 10dB(A) is assumed as the noise contribution from existing East Rail Line and Intercity Train. To take into account the cumulative airborne noise impacts from the existing East Rail Line and Intercity Train, an assessment goal of ANL – 10 dB(A) is adopted.

[2] R– Residential; S – Service Apartment; C – Commercial

[3] Metropolis Residence is a service apartment and shall not rely on openable windows for ventilation. Nonetheless, for conservative consideration that occupier might open window under special circumstances, this premise has been considered as an assessment point.

[4] Harbourfront Horizon shall not rely on openable windows for ventilation. Nonetheless, for conservative consideration that occupier might open window under special circumstances, this premise has been considered as an assessment point.

8.6.3 Assessment Methodology – Operational Noise

8.6.3.1 Railway Noise

The proposed methodology for predicting the airborne train noise impacts is given below.

Assessment Software

Arup's train noise model (OveRail) will be used to predict and assess the propagation of airborne train noise. The modelling methodology for propagation is based on the prediction procedures in Calculation of Railway Noise 1995 (CRN)[8-8] and it has been validated against the examples listed in CRN handbooks.

Airborne Noise Source Term

Whilst the propagation model would be based on CRN, the train noise (both rolling noise and A/C noise) source term would base upon the noise level measured during the commissioning of SP1900 train[8-9] and is based on a disc braked Electric Multiple Unit (EMU). The source term measurement report is given in **Appendix 8.11**. A description of the noise source term is given below.

Parameters	On Ballast Track
L_{max}	75.3 dB(A)
Rail	Continuously weld rail
Trackform	Ballasted track
Speed	130kph
Distance	25m

The calculation of SEL (single train event) from L_{max} is based on the following equation

$$SEL = L_{max} + 10 \log (L/V) + 10.5 - 10 \log (4D / (4D^2+1) + 2 \tan^{-1} (1/2D))$$

Where L = train length, m (200m for SCL (TAW-HUH) train, the same as MOL 8-car configuration)

V = train speed, kph

d = Distance from track, m (reference distance at 25m)

$D = d / L$

SEL for 8 car	82.7 dB(A)

For non-revenue trains (e.g. engineering trains) of HHS, noise will also be generated by rolling stock operating during the non-revenue hours of the railway typically between 0200 and 0500. These will be used to support maintenance operations in the transporting of personnel and plant for inspection and remedial works. As overhead line power supply may need to be turned off for safety and other requirements, the rolling stock will be independently powered locomotives. These will typically trail a short rake of wagons or self-propelled ballast tamping machines and rail grinding apparatus.

Noise from non-revenue trains would be governed by Construction Noise Permit and hence would not be quantified in this EIA.

Correction Factors

The tracks would be modelled as segments such that the variation of noise contribution within the track segment is less than 2 dB(A), which is in line with CRN. For each segment, corrections would be applied to compute its noise contribution to NSRs. The total noise levels at receivers would then be computed by combining the noise contributions from all the segments.

Along the launching tracks and the north fan area to the north and south of HHS respectively, 6 trains/direction/hour are assumed during the nighttime period. For train shunting along the section between Hung Hom bypass and Chatham Road North (i.e. the shunt neck), movements of trains would be assumed to be double that along the launching tracks.

A summary of other correction factors to be included in the airborne train noise prediction model is given below.

Table 8.16: Summary of correction factors

Parameters	Assumptions	Remarks
Rail deterioration	+3dB(A)	The source term measurement was taken with typical rail condition. The adopted +3 dB(A) correction is a conservative approach to account for the deviation from typical rail condition.
Train speed	Change of SEL with speed = 20 log (V / V_{ref}) dB(A)	V and V_{ref} are the average train speeds Maximum train speed within HHS is 25kph; Maximum train speed for SCL (TAW-HUH) near HHS is 50kph.
Distance	Change of L_{max} with distance = 10 log (d_1 / 25) dB(A)	d_1 is the distance between track and receiver
Deck Reflection	• At-Grade non-ballast track = 2.5 dB(A)	Consistent with MOL[8-10]
Barrier effects	As per Chart 6(a) of CRN[8-8]	
Joints / Crossovers	7dB(A)	To represent the augmentation in noise due to thermal expansion joints. Average value of 5 dB(A) is summarised in Ref. [8-11]. A conservative correction of 7 dB(A) which is consistent with MOL[8-10] EIA is adopted. 2m long rail segment is used to represent a joint.
Air absorption	0.2 – 0.008*d*	
Train Frequency	10log(N_1)	N_1 is the train frequency in 30 minutes Frequency (trains / direction / 30 minutes) 24/12 trains per hour in each direction during daytime/nighttime for the main alignment of SCL(TAW-HUH) 6 trains per hour in each direction during daytime/nighttime along the launching/retrieval tracks extending to the north and south of the podium
View Angle	10 log ($\pi\theta$/180-cos2α sinθ) – 5 dB(A)	α is the acute angle between a line drawn through the receiver point, parallel to the track and the line bisecting the angle view θ. θ is the view angle.
Façade Reflection	2.5dB(A)	
To $L_{eq, 30\ min}$	10 log(1 / 1800)	

Cumulative Airborne Railway Noise Impacts

The surrounding environmental at Hung Hom has been reviewed. There would be cumulative air-borne train noise impacts at the following locations.

Location	Cumulative Train Noise Sources
Hung Hom	• Existing East Rail within HUH • SCL (TAW – HUH) • SCL (MKK – HUH)

Following the opening of HHS, the cumulative noise impact from East Rail Line have been addressed by considering an assessment goal of 10 dB(A) lower than the ANL. This approach would ensure that noise contribution from the operation of HHS is insignificant and is considered appropriate for NSRs which would experience noise impact from existing East Rail Line and Intercity Train. **Appendix 8.12** shows the typical section of the alignment of HHS.

8.6.3.2 Fixed Noise Sources

Noise Sources

A summary of key fixed noise sources within the SCL (HHS) include:

- Ventilation systems for stabling sidings at Hung Hom Freight Yard;
- Ventilation systems for KAT and DIH;
- Ventilation systems for the HUH.

All the noise sources (see **Figure 8.2.1** to **Figure 8.2.3** for locations) mentioned above would be accommodated inside solid buildings with louvers. Maximum allowable Sound Power Level (SWL) for above-grade louvers will be established by considering the following:

- Separation distances and orientation from the nearest NSR(s); and
- Cumulative noise impacts from noise sources of concurrent projects(e.g. cooling tower of SCL(MKK-HUH) and North Ventilation Shaft of SCL (HUH-ADM)) on the NSR.

Assessment Methodology

The following general procedures have been adopted for the operation noise assessment.

- Identify and locate representative NSRs that may be affected by the noise sources;
- Determine the noise criteria for both daytime and nighttime;
- Use standard acoustic principle for attenuation and directivity;
- Determine the maximum sound power levels (SWLs) of the fixed noise sources;

8.6.4 Assessment Results – Operational Phase

8.6.4.1 Railway Noise – Night-time Noise Impacts

The NSRs near HHS would be affected by the train running on tracks. Assessment results indicate that the unmitigated impact would be 4 dB(A) above the assessment goal for some NSRs (Refer to **Table 8.17**).

It is therefore necessary to consider mitigation measures to reduce the noise impacts from the operation of HHS. The following mitigation measures were proposed:

- 7m high semi-enclosure extending from the edge of the podium to the realigned Cheong Wan Road (P1) Bridge with a structural separation to allow independent movement between the two structures;
- Approximate 35m long of noise barrier at a height of 5m from Cheong Wan Road towards north (P2); and

- Approximate 45m long of noise barrier at a height of 5m from Chatham Road North towards south (P3).

Note: Height of noise barrier is measured from the track level.

The extent and location of the mitigation mentioned above are shown in **Appendix 8.13**. The proposed semi-enclosure mentioned above will also need to achieve operational ventilation requirements. The noise enclosure is open-sided towards the west and also incorporates openings in the roof to provide natural ventilation provisions. The design of the roof openings will ensure that there is no line of sight from the neighbouring sensitive receivers to the tracks in the north fan area. Exact dimension of the structural separation to be determined during detailed design stage.

The predicted daytime and night-time noise levels are summarised in **Table 8.17a** and **Table 8.17b** respectively.

Table 8.17a: Summary of predicted night-time railway noise levels for NSRs at Hung Hom

Noise Sensitive Receivers	Predicted Unmitigated Noise Level, dB(A)			Predicted Mitigated Noise Level, dB(A)			Predicted Cumulative Noise Level, dB(A) – Mitigated Scenario	Assessment Goal, dB(A)
	The Project	SCL (TAW-HUH) [2]	SCL (MKK-HUH)	The Project	SCL (TAW-HUH) [2]	SCL (MKK-HUH)		
HUH-1-3 (Wing Fung Mansion)	53	40	35	47	40	35	48 (1/F)	50[1]
HUH-3-1 (Royal Peninsula)	47	48	-	37	48	-	48 (29/F)	50[1]
HUH-4-1 (Tower 2, The Metropolis Residence)	40	43	-	13	43	-	43 (1/F)	45[1]
HUH-8-1 (No. 2, Gillies Avenue South)	41	47	-	38	47	-	47 (1/F)	50[1]
HUH-10-1 (Tower 2, Harbourfront Horizon)	38	47	-	38	47	-	47 (1/F)	55

Note: [1] A 10 dB(A) has been deducted from the ANL to take into account noise level from the East Rail Line and Intercity Train.

[2] The tracks to both north and south of HHS would need to connect to the tracks for new SCL (TAW-HUH). This has also been taken into account in the assessment.

Table 8.17b: Summary of predicted daytime railway noise levels for NSRs at Hung Hom

Noise Sensitive Receivers	Predicted Unmitigated Noise Level, dB(A)			Predicted Mitigated Noise Level, dB(A)			Predicted Cumulative Noise Level, dB(A) – Mitigated Scenario	Assessment Goal, dB(A)
	The Project	SCL (TAW-HUH) [2]	SCL (MKK-HUH)	The Project	SCL (TAW-HUH) [2]	SCL (MKK-HUH)		
HUH-1-3 (Wing Fung Mansion)	53	43[3]	36	47	43[3]	36	49 (1/F)	60[1]
HUH-3-1 (Royal Peninsula)	47	51[3]	-	37	51[3]	-	51 (29/F)	60[1]
HUH-4-1 (Tower 2, The Metropolis	40	46[3]	-	13	46[3]	-	46 (1/F)	55[1]

Noise Sensitive Receivers	Predicted Unmitigated Noise Level, dB(A)			Predicted Mitigated Noise Level, dB(A)			Predicted Cumulative Noise Level, dB(A) – Mitigated Scenario	Assessment Goal, dB(A)
	The Project	SCL (TAW-HUH) [2]	SCL (MKK-HUH)	The Project	SCL (TAW-HUH) [2]	SCL (MKK-HUH)		
Residence)								
HUH-8-1 (No. 2, Gillies Avenue South)	41	50[3]	-	38	50[3]	-	50 (1/F)	60[1]
HUH-10-1 (Tower 2, Harbourfront Horizon)	38	50[3]	-	38	50[3]	-	50 (1/F)	65

Note: [1] A 10 dB(A) has been deducted from the ANL to take into account noise level from the East Rail Line and Intercity Train.

[2] The tracks to both north and south of HHS would need to connect to the tracks for new SCL (TAW-HUH). This has also been taken into account in the assessment.

[3] In SCL (TAW-HUH) EIA Report, 24 trains/direction/hour is assumed for the noise assessment. In addition, a sensitivity test has been conducted to examine the noise effect if the train frequency is increased in the future operation. As compared with the predicted daytime noise levels based on the assumption of 24/trains/direction/hour, an increase of 0.3 dB(A) and 0.7 dB(A) would be predicted respectively for 26 and 28 trains/direction/hour. Hence, the predicted noise levels of SCL (TAW-HUH) would still comply with the noise criterion even if 26 or 28 trains/direction/hour during day time periods are adopted.

Prior to the operational phase of the Project, a commissioning test will be conducted for verification of EIA predictions against the assessment goals and checking the compliance of the airborne noise levels with the NCO noise criteria.

8.6.4.2 Railway Noise – Maximum Noise Level L_{max}

As presented in **Section 8.6.3.1**, the reference maximum noise level (L_{max}) is 75.3 dB(A), for train speed of 130km/h and measured at 25m from track. This noise level is significantly lower than the statutory requirement of 85 dB(A). Among the identified NSRs, the setback distance is more than 25m and the train speed is about 25km/h. This setback distance is the same as that with the reference condition and operating speed of the trains are substantially lower than the reference condition.

In consideration of the above comparison, exceedance of the statutory maximum noise level is not anticipated along the alignment.

8.6.4.3 Railway Noise – 24-Hour Average Noise Level $L_{eq,\ 24\ hour}$

Detailed schedule timetable is not available at the time of reporting. Based on available information, headway over 24 hours along the launching/retrieval tracks, the north fan area and shunt neck would not be more than 100 trains. Based on this assumption, the predicted 24-hour average railway noise levels would comply with the $L_{eq,\ 24hr}$ criterion and are summarized in **Appendix 8.13A**.

8.6.4.4 Fixed Noise Sources

Assessment has been conducted to evaluate the maximum Sound Power Level (SWL) for the ventilation shafts in HHS, HUH, KAT and DIH. Locations of assessment point for fixed noise sources are shown in **Figure 8.2.1 to 8.2.3**. The predicted maximum allowable SWL is summarised in **Table 8.18** below. Detailed calculations are presented in **Appendix 8.14**.

Table 8.18 : Maximum Allowable SWL for the Ventilation Building and Ventilation Shafts

Station/Location	Plant Item	Plant ID	Maximum allowable Sound Power Level, dB(A)		Remarks
			Daytime	Night-time	
HHS and HUH	Ventilation Shaft	HHS VS1	92	82	
		HHS VS2	91	81	
		HHS VS3	91	81	
		HHS VS4	91	81	
		HHS VS5	85	75	
		HHS VS6	86	76	
		HHS VS7	85	75	
		HHS VS8	85	75	
		HHS VS9	86	76	
		HHS VS10	86	76	
		HHS VS11	88	78	
		HHS VS12	85	75	
		HHS VS13	85	75	
		HHS VS14	88	78	
		HHS VS15	88	78	
		HUH VS7	96	86	
		HUH VS8	96	86	
		HUH VS9	96	86	
		HUH VS10	96	86	
		HUH VS11	96	86	
		HUH VS12	96	86	
		HUH VS13	95	85	
		HUH VS14	95	85	
		HUH VS15	99	89	
		HUH VS16	94	84	
		HUH VS17	94	84	
		HUH VS18	96	86	
		HUH VS19	97	87	
		HUH VS20	95	85	
		HUH VS21	96	86	
		HUH VS22	95	85	
		HUH VS23	94	84	
KAT	Ventilation Shaft	VS - KAT - 1 - 1	95	85	
		VS - KAT - 1 - 4	95	85	
		VS - KAT - 1 - 5	95	85	
		VS - KAT - 2 - 1	94	84	
		VS - KAT - 2 - 2	94	84	
		VS - KAT - 2 - 3	94	84	

Station/Location	Plant Item	Plant ID	Maximum allowable Sound Power Level, dB(A)		Remarks
			Daytime	Night-time	
		VS - KAT - 2 - 4	94	84	
		VS - KAT - 2 - 5	94	84	
		VS - KAT - 3 - 5	90	80	
		VS - KAT - 4 - 5	89	79	
		VS - KAT - 5 - 1	89	79	
		VS - KAT - 5 - 2	89	79	
		VS - KAT - 5 - 3	89	79	
		VS - KAT - 5 - 5	89	79	
		VS - KAT - 6 - 1	89	79	
		VS - KAT - 6 - 3	89	79	
		VS - KAT - 6 - 4	89	79	
		VS - KAT - 6 - 5	89	79	
		VS - KAT - 7 - 1	88	78	
		VS - KAT - 7 - 2	84	74	
		VS - KAT - 7 - 3	90	80	
		VS - KAT - 7 - 4	90	80	
		VS - KAT - 7 - 5	85	75	
DIH	Ventilation Shaft	VS - DIH - 1	83	73	
		VS - DIH - 2	82	72	
		VS - DIH - 3	82	72	
		VS - DIH - 4	78	68	
		VS - DIH - 5	82	72	
		VS - DIH - 6	84	74	
		VS - DIH - 7	82	72	
		VS - DIH - 8	92	82	
		VS - DIH - 9	85	75	
		VS - DIH - 10	94	84	
		VS - DIH - 11	83	73	
		VS - DIH – 12	86	76	
		VS - DIH – 13	77	67	
		VS - DIH – 14	75	65	
		VS - DIH – 15	79	69	
		VS - DIH – 16	92	82	
		VS - DIH – 17	85	75	
		VS - DIH – 18	80	70	
		VS - DIH – 19	85	75	
		VS - DIH – 20	90	80	
		VS - DIH - 21	83	73	
		VS - DIH - 22	78	68	

Station/Location	Plant Item	Plant ID	Maximum allowable Sound Power Level, dB(A)		Remarks
			Daytime	Night-time	
		VS - DIH – 23	83	73	
		VS - DIH – 24	88	78	
		VS - DIH – 25	81	71	
		VS - DIH – 26	81	71	
		VS - DIH – 27	85	75	
		VS - DIH – 28	92	82	
		VS - DIH – 29	85	75	
		VS - DIH – 30	78	68	
		VS - DIH – 31	87	77	
		VS - DIH – 32	92	82	
		VS - DIH – 33	87	77	
		VS - DIH – 34	80	70	

The equipment should be free of the characteristics of tonality, impulsiveness and intermittency. If the selected equipment could not be free of characteristics of tonality, impulsiveness and intermittency, the maximum SWL should be reduced in accordance with the correction factors, in the range of 3 to 6 dB(A), as given in Section 3.3 of TM-IND.

The contractor shall install acoustic silencers, noise barriers, acoustic louvers where appropriate to ensure that the specified maximum SWLs shown in **Table 8.18** will not be exceeded.

8.6.5 Mitigation Measures

8.6.5.1 Operational Phase

The detailed design should incorporate the following good practice in order to minimise the nuisance on the neighboring NSRs. In case the Contractor would change the design and locations of the vents, they would need to comply with the legislative maximum impacts at the receivers.

- Louvers should be orientated away from adjacent NSRs, preferably onto main roads which are less sensitive.
- Direct noise mitigation measures including silencers, acoustic louvers and acoustic enclosures should be allowed for in the design for the ventilation shafts, stations and stabling sidings.
- The façade for these plant areas/ ventilation shafts should have adequate sound insulation properties to minimise the noise emanating through the building fabric.

8.6.5.2 Residual Impacts exceeding the operational noise criterion and Constraints on Future Receivers

The operational noise generated by the proposed railway can be properly mitigated by implementing the proposed mitigation measures. Adverse residual impacts exceeding the operational noise criterion are not anticipated and no constraints could be identified on the future sensitive receivers at this stage.

8.7 Conclusion

Construction noise assessment has been conducted. Results indicate that the noise impacts after implementation of mitigation measures, including good site, optimisation of

construction methodology (i.e. schedule of using PME), quiet plant, temporary noise barrier, enclosure and acoustic mat, the construction noise impacts due to the Project are within the noise criterion at all sensitive receivers.

Airborne train noise assessment has been conducted. Mitigation measures including noise barrier and semi-enclosure were recommended for the open at-grade tracks. With the recommended mitigation measures in place, the predicted airborne train noise levels at nearby NSRs would comply with the noise criteria.

Maximum sound power levels allowed to be emitted from each fixed noise source were predicted. Good practice should be included in the detail design to ensure compliance with the NCO and other planning requirements.

8.8 References

[8-1] Noise Control Ordinance (Cap 400), HKSAR dated June 1997.

[8-2] Technical Memorandum on Noise from Construction Work other than Percussive Piling, EPD dated March 1996.

[8-3] Technical Memorandum on Noise from Percussive Piling, EPD dated June 1999.

[8-4] Technical Memorandum on Noise from Construction Work in Designated Areas, EPD dated June 1999.

[8-5] Technical Memorandum on Environmental Impact Assessment Process (EIA Ordinance), EPD dated September 1997.

[8-6] Technical Memorandum for the Assessment of Noise from Places Other Than Domestic Premises, Public Places or Construction Sites.

[8-7] Kwun Tong Line Extension: Environmental Impact Assessment, MTR Corporation Limited.

[8-8] Calculation of Railway Noise 1995, the Department of Transport, UK.

[8-9] SEL Source Term Measurement, MTR Corporation Limited.

[8-10] Tai Wai to Ma On Shan Extension: Environmental Impact Assessment, Kowloon-Canton Railway Corporation, October 1999.

[8-11] “Transportation Noise Reference Book” by P.M. Nelson, published by Butterworth & Co. (Publishers) Ltd, 1987.