3.0 NOISE IMPACT ASSESSMENT

3.1 Introduction

This section presents an assessment of potential noise impacts associated with the construction and operation of the proposed Lei Yue Mun Road Underpass, modification at Junction with Yau Tong Road and associated improvement works.

The objective of the assessment is to identify and evaluate the potential noise impacts arising during construction and operation phases of the Project, and recommend any appropriate and practical noise mitigation measures to alleviate the identified impacts.

3.2 Environmental Legislation, Policies, Plans, Standards and Criteria

The Noise Control Ordinance (NCO) (Cap 400) and the Environmental Impact Assessment Ordinance (EIAO) (Cap 499) provide the statutory framework for noise control. Five Technical Memoranda (TMs) issued under the NCO and EIAO for noise control approaches and criteria are listed below:

- Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM);
- Technical Memorandum on Noise from Percussive Piling (PP-TM);
- Technical Memorandum on Noise from Construction Work other than Percussive Piling (GW-TM);
- Technical Memorandum on Noise from Construction Work in Designated Area (DA-TM); and
- Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM).

Construction Noise

General Construction Activities

Noise impact associated with construction works excluding piling during normal working hours (0700-1900 hours on any day not being a Sunday or public holiday) at the openable windows of buildings is guided by the EIAO-TM. The noise standards recommended in the EIAO-TM are given in Table 3.1.

Table 3.1 Construction Noise Standards During Normal Working Hours [L_{eq} 30min dB(A)]

Noise Sources Noise Standards Uses	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 3)
Hotels and hostels	75	
Educational Institutions including kindergartens, nurseries and all others where unaided voice communication is required	70 65 (During examination)	

Notes:
(1) The above standards apply to uses which rely on opened windows for ventilation.
(2) The above standards shall be viewed as the maximum permissible noise levels assessed at 1 m from the external façade.
(3) The criteria laid down in the relevant technical memoranda under the Noise Control Ordinance 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 the construction work during the period.

Under the NCO, the use of powered mechanical equipment (PME) for carrying out construction works during the restricted hours (1900 and 0700 hours and at any time on Sundays and public holidays) is prohibited unless a Construction Noise Permit (CNP) is obtained. The EPD is guided by the GW-TM when assessing for such an application.

In accordance with the GW-TM, a CNP will be granted provided that the Corrected Noise Level (CNL) at the NSRs is equal to or less than the Acceptable Noise Level (ANL). The relevant ANLs are derived from Basic Noise Levels (BNLs), which are assigned dependent upon the Area Sensitivity Rating (ASR). The BNLs are presented in Table 3.2 below.

Table 3.2 Basic Noise Levels (BNLs)

Time Period	Basic Noise Level (BNLs), dB(A)		
	ASR A	ASR B	ASR C
All days during the evening (1900 to 2300 hours), and general holidays (including Sundays) during daytime and evening (0700-2300 hours)	60	65	70
All days during the night-time (2300 to 0700 hours)	45	50	55

Apart from the GW-TM, a more stringent scheme is stated in the DA-TM, which intends to deal with the control of noise generated by the use of Specific Powered Mechanical Equipment (SPME) and three types of Prescribed Construction Work (PCW) in the identified Designated Areas (DAs) during the restricted hours. The SPME and PCW include the following:

SPME

- Hand-held breaker
- Bulldozer
- Concrete lorry mixer
- Dump truck
- Hand-held vibratory poker

PCW

- Erection or dismantling of formwork or scaffolding
- Loading, unloading or handling or rubble, wooden boards, steel bars, wood or scaffolding material
- Hammering

During the daytime (0700 to 1900), non-statutory criteria of 75 dB(A) for domestic premises, and 70 and 65 dB(A) for schools during normal and examination periods, respectively, as shown in Table 3.1 are applicable.

Based on information and factors known at this stage, no nightworks is anticipated for the completion of the project to meet the works programme. However, if any situation is found changed during detailed design and construction stages rendering nightworks unavoidable, Construction Noise Permit (CNP) under Noise Control Ordinance (NCO) should be obtained from relevant authority before carrying out any nightworks.

Road Traffic Noise

Road traffic noise impacts are assessed using the methodology given in EIAO-TM, which recommends that noise limit of 70 dB(A) L_{10} peak hour for residential areas and 65 dB(A) L_{10} for schools. These are used as the target levels for all 'direct' forms of mitigation (i.e. those that can be applied to the road itself). Any predicted levels exceeding the EIAO-TM levels are considered to constitute significant impacts and practicable direct mitigation measures are required in order to alleviate the noise impact to the acceptable levels.

In cases where practicable and effective direct mitigation measures are not available or the identified measures cannot provide adequate protection to reduce the noise levels to be within the EIAO-TM levels, provision of indirect technical remedies to existing sensitive receivers, in the form of acoustic insulation and air-conditioning should be considered under the EIAO-TM. The eligibility criteria to be tested for consideration of providing existing NSRs with indirect technical remedies are:

(i) the predicted overall noise level from the new road together with other traffic noise in the vicinity must be above the specified noise levels (L_{10}, peak hour 65 dB(A) for educational institution and 70 dB(A) for residential dwellings);

(ii) the predicted overall noise level is at least 1.0 dB(A) more than the 'prevailing traffic noise level', i.e. the total traffic noise level existing before the works to construct are commenced;

(iii) the contribution to the increase in the predicted overall noise level from the new road must be at least 1.0 dB(A).

3.3 Description of the Environment

Baseline Conditions

The area surrounding the proposed road works consists of high-rise residential buildings and educational institutions, which are located mainly on the eastern side of the proposed underpass. The existing noise environment is dominated by heavy road traffic along the existing Lei Yue Mun Road, Kai Tin Road and Yau Tong Road. The prevailing traffic noise levels at the existing noise sensitive receivers (NSRs) along Lei Yue Mun Road and Kai Tin Road are in the range of 50-82 dB(A) (Appendix 3.1). With the proposed Lei Yue Mun Road Underpass and associated improvement works, the noise levels at these NSRs are expected to be higher, if unmitigated.

Noise Sensitive Receivers

Existing Noise Sensitive Receivers

The Study Area is generally urban-residential in nature and some of the noise sensitive receivers (NSRs) are likely to be affected by the construction works and traffic from the proposed road.

Planned Sensitive Development

Housing developments at the eastern side of Eastern Harbour Crossing (EHC) and the Yau Tong Estate Redevelopment will be located at the southern end of our project limit as identified on the draft Cha Kwo Ling, Yau Tong, Lei Yue Mun Outline Zoning Plan No. S/K15/12.

Based on the latest available information, these planned NSRs will be occupied at the time of construction and therefore, they have been included in the construction noise impact assessment.

In accordance with the Study Brief, noise sensitive areas located within 300m from the proposed roadwork have been identified and are illustrated in Figure 3.1. A number of representative NSRs, which are the closest to the proposed road works, have been designated to represent the worst case scenario. The representative NSRs are tabulated in Table 3.3 and shown in Figure 3.2.

For the purpose of this study, the latest available development layout plans for EHC housing site and Yau Tong Estate Redevelopment have been obtained from Hong Kong Housing Authority. All the relevant noise mitigation measures as recommended in the noise assessment studies for EHC housing site and Yau Tong Road Redevelopment have been taken into account in the traffic noise calculation for both unmitigated and mitigated scenarios, which includes the following measures:

Final Environmental Assessment Study for Potential Public Housing Sites East of EHC, Lei Yue Mun (December 1998)

- Blank gable end walls for the residential blocks;
- 6m high and 3m horizontal cantilevered barrier at the podium deck along the Yau Tong Road, New Yau Tong Road and Cha Kwo Ling Road;
- 6m high and 4m horizontal cantilevered barrier at the northwest podium deck along EHC;
- 3m high purpose-built noise barriers along the boundary of the schools;
- Maximized setback distance from main roads;
- Decking over section of New Yau Tong Road;
- All affected noise sensitive rooms exceeding the noise criterion, upgrading windows and air-conditioning to be provided to mitigate the residual noise impact.

Environmental Assessment for Ko Chiu Road/Yau Tong/Lei Yue Mun Comprehensive Development (April 1998)

- Non-sensitive shielding structures such as the commercial centre in Yau Tong Estate;
- Mounting of HOS blocks facing Lei Yue Mun Road on podium, and setting buildings back from the podium edge;
- Blank facades of residential blocks orientated toward the noise source;
- 3m wide noise canopies projecting from the edge of podia along Lei Yue Mun Road;
- Indirect technical remedies in the form of Type I insulation (6mm glazing and provision of air conditioning) for affected HOS blocks.

Table 3.3 Representative Noise Sensitive Receivers

NSR	Description	No. of Floors	Land Uses
SG1	Block 9, Sceneway Garden	28	R
SG2	Block 8, Sceneway Garden	31	R
SG3	Block 7, Sceneway Garden	32	R
HTC1	Kei Hong House, Hong Tin Court	32	R
HTC2[1]	Kei Hong House, Hong Tin Court	32	R
PTE1	Ping Sin House, Ping Tin Estate	38	R
PTE2	Ping Shun House, Ping Tin Estate	38	R
PTE3[1]	Ping Yan House, Ping Tin Estate	38	R
PTE4[1]	Ping Wong House, Ping Tin Estate	38	R
STH1	Five Districts' Business Welfare Association Szeto Ho Secondary School	6	E
STH2	Five Districts' Business Welfare Association Szeto Ho Secondary School	6	E
SKH1	S.K.H. Kei Hau Secondary School	6	E
SKH2	S.K.H. Kei Hau Secondary School	6	E
HPC1	Chung Pak House, Hong Pak Court	34	R
HPC2	Lung Pak House, Hong Pak Court	33	R
HPC3[1]	Cheung Pak House, Hong Pak Court	34	R
EHC1	Block A, EHC Housing Development Phase 1	46	R
EHC2	Block A, EHC Housing Development Phase 1	46	R
EHC3[1]	Block E, EHC Housing Development Phase 1	46	R
EHC4[1]	Block G, EHC Housing Development Phase 2	40	R
EHC5[1]	Block C, EHC Housing Development Phase 2	46	R
SAG1	St. Antonius Girls College	5	E
YT1	Block B, Yau Tong Housing Development Phase 3	36	R
YT2	Block D, Yau Tong Housing Development Phase 3	36	R
YT3[1]	Block E, Yau Tong Housing Development Phase 3	36	R
HNK1	Buddhist Ho Nam Kam Prevocational College	5	E
SAP1	St. Antonius Primary School	5	E

Note: R – Residential
E – Educational Institutions
[1] – the NSR use for traffic noise impact assessment only

3.4 Description of Assessment Methodologies

Construction Phase

The assessment for construction noise associated with the proposed road works has been conducted based on the procedures given in the GW-TM. To predict the construction noise at NSRs, the distance attenuation has been estimated using the following formula:

Distance Attenuation in dB(A) = 20 log D + 8 [where D is the distance in metres]

In general, the methodology outlined in the GW-TM is adopted and summarized below:

- Locate the NSRs which will be most affected by noise from the construction work;
- Determine the items of Powered Mechanical Equipment (PME) for respective construction activities, based on available information or agreed plant inventories;
- Assign sound power levels (SWLs) to the proposed PME according to the GW-TM or other sources;
- Calculate distance attenuation and screening effects to NSRs from notional noise source;
- Predict construction noise levels at NSRs in the absence of any mitigation measures;
- Add +3 dB(A) façade correction to the predicted noise levels in order to account for the facade effect at each NSR.

Operation Phase

Road traffic noise levels, in terms of L_{10} (1-hr) dB(A), have been calculated using our in-house noise model which was developed on the basis of the U.K. Department of Transport procedure described in the "Calculation of Road Traffic Noise", Welsh Office 1988. The noise levels are predicted at 1m from the external facades of representative noise sensitive receivers with direct line of sight of the road.

In order to determine the prevailing conditions prior to the proposed road works, AM peak traffic flows for year 2004 as shown in Figure 3.3, being the commencement year of the construction works, have been adopted to calculate the prevailing road traffic noise levels.

For the future traffic conditions, the EIAO-TM recommends that the road traffic noise should be predicted based on the maximum traffic forecast within 15 years upon the operation of the proposed roadwork. Year 2022 is considered to be the maximum traffic forecast and has been adopted for assessment. Transport Department, in principle, has no objection on the adopted traffic figures.

Projected AM and PM peak hour traffic flows and vehicle composition for 2022 are shown in Figure 3.4. Since the AM peak traffic flow along Lei Yue Mun Road is slightly more dominant than the PM peak flow, AM peak flow has been adopted as the basis of the noise impact assessment.

In accordance with the Study Brief, "new road" is defined when an existing road section undergoes major modification which will directly result in 25% increase in lanes or substantial changes in alignment or characters (e.g. change to a high speed road) of the existing road. As a result, the widened Lei Yue Mun Road, the proposed underpass and Northern Approach, and the proposed junctions at Kai Tin Road, Northern Approach and Lei Yue Mun/Yau Tong Roads are considered new roads. The remaining portions of the local roads are considered existing roads. Appendix 3.2 illustrates the extent of the defined new roads and existing roads.

In the modelling of canopy type barriers, an approach similar to that of modelling a vertical barrier was adopted except for the barrier, in this case, was positioned horizontally rather than vertically with respect to the road. As there is no panels proposed to separate the two-way traffic inside the canopy, no strong horizontal directivity effects are anticipated. However, reverberation effect may be evident in the case of canopies and relevant calculations are given in Appendix 3.2A. In order to take this effect into account, +1dB(A) for road segments under the canopies has been added in the Basic Noise Level of those segments.

3.5 Construction Noise Impact Assessment

Identification, Prediction and Evaluation of Construction Noise Impacts

The proposed road improvement works are scheduled to be carried out from December 2004 to the end of 2007 and are likely to involve a number of noisy activities including excavation, filling, concreting, piling operations and haulage of construction materials. No percussive piling is anticipated.

The proposed road works have been divided into five main construction activities as follows:

1. preliminary works;
2. earthworks/slope works;
3. road, drainage and utilities works;
4. junction improvement; and
5. structures.

Groups of PME have been assigned for each of these construction activities. Details of the proposed construction programme and PME for various construction activities should be further reviewed during the detailed design stage. A preliminary construction programme and PME list for various construction activities are presented in Appendices 2.1 and 3.3, respectively.

As broadly illustrated in the construction programme, various construction activities may be carried out on an individual basis or concurrently during a particular period. In order to assess the possible cumulative effect of construction noise from different activities at various work sites, ten representative scenarios have been identified based on the construction

programme and are presented in Table 3.4. For the purpose of this assessment, the noisiest construction stage for a particular activity has been selected to represent the worst-case scenario.

Table 3.4 Representative Construction Scenarios

Scenario	Site	Construction Activities
1	All sites	P
2	Section A – Yau Tong Road	E, R
	Section B – Kai Tin Road	E
	Section C – Northern Approach	E
3	Section A – Yau Tong Road	R
	Section C – Northern Approach	E
	Retaining Wall	S
	Footbridge	S
4	Section A – Yau Tong Road	R
	Section C – Northern Approach	E
	Yau Tong Road/Lei Yue Mun Road	J
	Footbridge	S
5	Section C – Northern Approach	E
	Southern Portal	S
	Footbridge	S
6	Section B – Kai Tin Road	R
	Section C – Northern Approach	E
	Southern Portal	S
7	Section B – Kai Tin Road	R
	Section C – Northern Approach	R
	Southern Portal	S
8	Section B – Kai Tin Road	R
	Section C – Northern Approach	R
	Underpass Construction	S
9	Section B – Kai Tin Road	R
	Northern Approach Road	J
	Kai Tin Road	J
	Underpass Construction	S
10	Kai Tin Road	J
	Northern Portal	S
	Underpass Construction	S

Note: P – Preliminary preparation works
E – Earthworks & slope works
R – Road, drainage and utilities works
J – Junction improvement
S – Structure

The unmitigated construction noise levels for each single construction activity at the representative NSRs have been predicted and are presented in Table 3.5. The predicted construction noise levels at the NSRs range between 51 and 88dB(A), exceeding the noise criteria of 75dB(A) for residential dwellings, and 70 and 65 dB(A) for schools during normal school hours and examination period respectively. S.K.H. Kei Hau Secondary School (SKH2) and St Antonius Primary School (SAP1) are the most affected and their noise levels are predicted to exceed the noise criterion for schools during examination period by up to 18dB(A). The results also indicate that the noise arising from earthworks/slope works are likely to be the dominant noise source for most of the NSRs except for those in Hong Pak Court, Yau Tong Estate Redevelopment and Buddhist Ho Nam Kam Prevocational College, which are mainly affected by noise emitted from junction improvement works at Yau Tong Road/Lei Yue Mun Road and preliminary preparation works.

The cumulative construction noise levels resulting from the construction scenarios given in Table 3.4 have also been assessed and are presented in Table 3.6. The predicted overall construction noise levels at the representative NSRs for different scenarios range from 54 to 90dB(A). Due to the cumulative effect, the overall noise levels at most of the NSRs would exceed the noise criteria. At the representative domestic NSRs (SG1-SG3, HTC1, PTE1, PTE2, HPC1, HPC2, EHC1, EHC2, YT1 and YT2), the noise levels are predicted to exceed 75dB(A) by up to 12dB(A). At the representative educational NSRs (STH1, STH2, SKH1, SKH2, SAP1, SAG1, and HNK1), the noise levels are expected to exceed the noise criteria during normal period by up to 20dB(A).

Table 3.5 Predicted Construction Noise Levels for Single Construction Activity (Unmitigated)

Construction Activities	Site	NSR																		
		SG1	SG2	SG3	HTC1	PTE1	PTE2	STH1 *	STH2 *	SKH1 *	SKH2 *	HPC1	HPC2	EHC1	EHC2	SAG1 *	YT1	YT2	HNK1 *	SAP1 *
Preliminary Preparation Works		73	73	74	75	**80**	**80**	**75**	**83**	**81**	**85**	70	70	**79**	**82**	**83**	**83**	**85**	**76**	**83**
Earthworks/ Slopeworks	Section A	--	--	--	--	--	--	--	--	--	--	71	71	74	**86**	**73**	74	73	58	**88**
	Section B	73	**76**	**80**	**84**	**84**	**84**	**--**	**86**	**--**	**88**	70	--	70	--	--	--	--	--	--
	Section C	**80**	**80**	74	74	75	**78**	**81**	--	**84**	--	--	--	69	--	--	--	--	--	--
Road, Drainage and Utilities Works	Section A	--	--	--	--	--	--	--	--	--	--	67	67	70	**82**	68	70	69	54	**84**
	Section B	69	72	**76**	**80**	**80**	**80**	**--**	**82**	--	**84**	66	--	66	--	--	--	--	--	--
	Section C	**76**	**76**	70	70	71	73	**77**	--	**80**	--	--	--	65	--	--	--	--	--	--
Junction Improvement	Yau Tong Road/Lei Yue Mun Road	--	--	--	--	--	--	--	--	--	--	**76**	75	**76**	**86**	**75**	**76**	75	69	**88**
	Kai Tin Road	73	73	62	71	74	**81**	**74**	64	**80**	69	72	--	72	--	--	--	--	--	70
	Northern approach Road	74	74	73	72	75	**79**	65	64	**81**	70	70	--	71	--	--	--	--	--	70
Structures	Southern Portal	--	--	--	--	--	70	--	--	--	--	**76**	**77**	**82**	**79**	**77**	73	72	61	**85**
	Northern Portal	**79**	**79**	64	**76**	**76**	**78**	69	--	**84**	**--**	--	--	70	--	--	--	--	--	--
	Footbridge	67	68	68	67	72	**79**	--	70	--	**76**	64	--	66	--	--	--	--	--	64
	Retaining Wall	63	63	51	60	63	67	53	--	69	**--**	60	--	62	--	--	--	--	--	60

Note: -- The noise level at this particular NSR is negligible since it is more than 300m away from the construction activity or is shielded from the construction activity.
* Denotes school
Bold figures indicate an exceedance of the EIAO-TM noise criteria of 75dB(A) for Residential and 70dB(A) for schools during normal school hours

Table 3.6 Predicted Construction Noise Levels for Different Scenarios (Unmitigated)

Scenarios	NSR																	
	SG1	SG2	SG3	HTC1	PTE1	PTE2	STH1*	STH2*	SKH1*	SKH2*	HPC1	HPC2	EHC1	EHC2	SAG1 *	YT1	YT2	HNK1*	SAP1*
1	73	73	74	75	**80**	**80**	**75**	**83**	**81**	**85**	70	70	**79**	**82**	**83**	**83**	**85**	**76**	**83**
2	**81**	**82**	**81**	**84**	**85**	**85**	**81**	**86**	**84**	**88**	74	73	**77**	**87**	**74**	**76**	74	60	**90**
3	**80**	**81**	74	75	**77**	**82**	**81**	70	**84**	**76**	69	67	73	**82**	68	70	69	54	**84**
4	**80**	**81**	75	75	**77**	**81**	**81**	70	**84**	**76**	**77**	**76**	**78**	**87**	**76**	**77**	**76**	70	**90**
5	**80**	**81**	75	75	**77**	**82**	**81**	70	**84**	**76**	**77**	**77**	**83**	**79**	**77**	73	72	61	**85**
6	**80**	**81**	**78**	**81**	**81**	**82**	**81**	**82**	**84**	**84**	**77**	**77**	**83**	**79**	**77**	73	72	61	**85**
7	**76**	**77**	**77**	**80**	**80**	**81**	**77**	**82**	**80**	**84**	**77**	**77**	**83**	**79**	**77**	73	72	61	**85**
8	**76**	**77**	**77**	**80**	**80**	**80**	**77**	**82**	**80**	**84**	66	--	68	--	--	--	--	--	--
9	**77**	**78**	**78**	**81**	**82**	**85**	**74**	**82**	**83**	**84**	75	--	75	--	--	--	--	--	**73**
10	**80**	**80**	66	**77**	**78**	**82**	**75**	64	**86**	69	72	--	74	--	--	--	--	--	70

Note: -- The noise level at this particular NSR is negligible since it is more than 300m away from the construction activity or is shielded from the construction activity.

* Denotes school

Bold figures indicate an exceedance of the EIAO-TM noise criteria of 75dB(A) for residential and 70dB(A) for schools during normal school hours

Construction Noise Mitigation Measures

In order to alleviate the construction noise impacts, practicable mitigation measures have been considered. The following mitigation measures are considered practical and effective, and therefore should be incorporated into the Contract Specifications:

- good site practice;
- use of quieter plant and working methods; and
- use of temporary and movable noise barriers.

In addition, percentage 'on-time' of each PME (the time when the PME is in operation within a 30 minutes time slot) has been taken into account to give a more realistic calculation. Details of the above-mentioned mitigation measures are described in the following sections.

Good Site Practices

Good site practices and noise management can provide considerable benefits in noise reduction. The following site practices should be followed during each phase of construction:

- Use of well-maintained and regularly-serviced plant during the construction works;
- Machines and plant that may operate on intermittent basis should be shut down between work periods or should be throttled down to a minimum;
- Plant that is known to emit noise strongly in one direction, should, where possible, be orientated to direct noise away from the NSRs;
- Noisy equipment and activities should be sited as far away from NSRs as possible; and
- Stockpiles of excavated materials and other structures should be effectively utilized, where practicable, to screen noise from on-site construction activities.

Use of Quieter Plant and Working Methods

To minimize the noise nuisance generated by construction works, noisy plant or method shall be replaced by quieter alternatives where commercially available. The Contractor would be able to obtain particular models of plant that are quieter than the noise levels stated in the GW-TM. The noise reduction achieved in this way will depend on the Contractor's chosen construction methods and it is considered that specifying particular plant models would be too restrictive to Contractors' preferred construction methods. Hence, it is preferable and practical to specify the overall noise performance specification of all plant on site in terms of the total SWL so that the Contractor is allowed some flexibility to select plant to suit his needs.

Quiet plant is defined as a PME having actual SWL lower than the value specified in the GW-TM. Examples of quiet PME taken from the British Standard *Noise Control on Construction and Open site, BS5228: Part 1:1997* are given in Table 3.7.

Table 3.7 Sound Power Levels for Specific Quiet Powered Mechanical Equipment

Quiet PME	BS5228	Maximum SWL dB(A)
Mobile crane	Table C.7, item 110	106
Excavator	Table C.3, item 97	105
Air compressor	Table C.7, item 25	98
Hand-held breaker	Table C.2, item 10	110
Hydraulic breaker, excavator mounted	Table C.8, item 13	110
Dump Truck	Table C.9, item 29	109
Backhoe	Table C.3, item 97	105
Concrete mixer truck	Table C.6, item 35	100
Poker Vibrator	Table C.6, item 32	100
Road roller	Table C.8, item 27	104
Asphalt paver	Table C.8, item 24	101

It should be noted that various types of silenced equipment could be found in Hong Kong. However, the EPD, when processing a CNP application, will apply the SWL of a particular plant specified in the GW-TM unless the noise emission of a particular piece of equipment can be validated by a certificate or demonstration. The onus is placed on the Contractor to prove that his plant deployment meets the quiet plant noise level.

Use of Temporary and Movable Noise Barriers

Based on site geometry, the adoption of temporary noise barriers located along the site boundary is not effective and practical to protect the NSRs in the vicinity of the work site. Instead, movable barriers with a skid footing and a cantilevered upper portion are considered to be very effective in screening NSRs from noise generated from a particular plant. It is expected that a movable noise barrier placed closely to the noise generating part of the PME such that the line of sight could be blocked when viewed from the NSRs, at least 10dB(A) screening can be produced for stationary plant and 5dB(A) for mobile plant. The noise screening benefit for each plant considered in this study is listed as follows:

(i) **Stationary plant** - assuming 10dB(A) reduction for PME such as poker vibrator, hand-held breaker and hand-held rock drill

(ii) **Mobile plant** – assuming 5dB(A) reduction for PME such as excavator, dump track, excavator mounted hydraulic breaker, mobile crane, backhoe, and power rammer

Evaluation of the effectiveness of the Recommended Mitigation Measures

Good Site Practices

Whilst the effects are not easily quantifiable, good site practices and noise management could considerably reduce the impact of construction activities on nearby NSRs. The noise benefits of these techniques can vary according to specific site conditions and operations.

Use of Quieter Plant and Working Methods

With the adoption of the quiet PME, the total SWLs for each construction activity are presented in Appendix 3.4. The mitigated noise levels for both single construction activity and the cumulative construction noise levels at the representative NSRs have been predicted and are shown in Tables 3.8 and 3.9, respectively. The results indicate that with the use of the quiet PME, up to 12dB(A) noise reduction could be achieved.

As shown in Table 3.8, the mitigated noise levels for single construction activity are in the range of 46-80dB(A). The noise levels at all the domestic NSRs are predicted to be below the noise with the exception of EHC2, YT1 and YT2 where exceedances are predicted during preliminary preparation works and earthworks/slopeworks. On the other hand, due to the close proximity of the schools to the worksites and the stricter noise criteria, the noise levels at the schools are still likely to exceed the noise criteria during most of the construction activities even with the use of the proposed quiet equipment.

Table 3.9 indicates that the worst-case scenario would be scenario 2 generating a high noise level of 81 dB(A) at SAP1. With the adoption of the quiet equipment, the cumulative noise levels at SG1-3, HPC1-2 and EHC1 could be mitigated to below the noise criterion, whereas exceedances are still predicted at other residential NSRs such as HTC1, PTE1-2, EHC2 and YT1-2. Due to the cumulative effect, the noise levels at the schools during most of the construction period are still predicted to exceed the noise criteria. The result indicates that the most affected educational façade would be SAP1 where up to 11dB(A) exceedance of the noise criterion for schools during normal period is predicted.

As discussed above, the use of the quiet equipment is still insufficient to mitigate the noise levels at some of the NSRs, in particular the schools, to be within the noise criteria. Therefore, further mitigation would be required.

Table 3.8 Mitigated Construction Noise Levels for Single Construction Activity (With the use of quiet PME)

Construction Activities	Site	NSR																		
		SG1	SG2	SG3	HTC1	PTE1	PTE2	STH1 *	STH2 *	SKH1 *	SKH2 *	HPC1	HPC2	EHC1	EHC2	SAG1 *	YT1	YT2	HNK1 *	SAP1 *
Preliminary Preparation Works		66	66	67	69	73	73	68	**77**	**74**	**78**	63	64	72	75	**77**	**77**	**78**	70	**77**
Earthworks/ Slopeworks	Section A	--	--	--	--	--	--	--	--	--	--	62	63	65	**77**	64	66	65	50	**80**
	Section B	65	68	72	75	75	75	--	**77**	--	**80**	61	--	61	--	--	--	--	--	--
	Section C	71	72	66	66	67	69	**73**	--	**75**	--	--	--	61	--	--	--	--	--	--
Road, Drainage and Utilities Works	Section A	--	--	--	--	--	--	--	--	--	--	58	59	62	73	60	62	61	46	**76**
	Section B	61	64	68	72	72	72	--	**73**	--	**76**	58	--	58	--	--	--	--	--	--
	Section C	67	68	62	62	63	65	69	--	**72**	--	--	--	57	--	--	--	--	--	--
Junction Improvement	Yau Tong Road/Lei Yue Mun Road	--	--	--	--	--	--	--	--	--	--	65	64	65	75	64	65	64	59	**77**
	Kai Tin Road	62	62	51	60	63	70	63	53	69	58	61	--	61	--	--	--	--	--	60
	Northern approach Road	63	63	62	61	64	68	54	53	70	59	60	--	60	--	--	--	--	--	59
Structures	Southern Portal	--	--	--	--	--	57	--	--	--	--	64	64	70	67	65	60	60	49	**73**
	Northern Portal	67	67	52	63	63	65	57	--	**72**	--	--	--	57	--	--	--	--	--	--
	Footbridge	56	57	57	56	61	68	--	60	--	65	54	--	55	--	--	--	--	--	54
	Retaining Wall	62	62	50	59	62	66	52	--	68	--	59	--	61	--	--	--	--	--	59

Note: -- The noise level at this particular NSR is negligible since it is more than 300m away from the construction activity or is shielded from the construction activity.

* Denotes school

Bold figures indicate an exceedance of the EIAO-TM noise criteria of 75dB(A) for Residential and 70dB(A) for schools during normal school hours

Table 3.9 Mitigated Construction Noise Levels for Different Scenarios (With the use of quiet PME)

Scenarios	NSR																		
	SG1	SG2	SG3	HTC1	PTE1	PTE2	STH1*	STH2*	SKH1 *	SKH2 *	HPC1	HPC2	EHC1	EHC2	SAG1 *	YT1	YT2	HNK1 *	SAP1*
1	66	66	67	69	73	73	68	**77**	**74**	**78**	63	64	72	75	**77**	**77**	**78**	70	**77**
2	72	73	73	**76**	**76**	**76**	**73**	**77**	**75**	**80**	66	64	69	**79**	65	67	66	51	**81**
3	72	72	66	67	69	73	**73**	60	**76**	65	60	59	65	73	60	62	61	46	**76**
4	72	72	66	66	68	72	**73**	60	**75**	65	66	66	68	**77**	65	67	66	59	**80**
5	72	72	66	66	68	72	**73**	60	**75**	65	64	64	71	67	65	60	60	49	**73**
6	72	73	70	73	73	74	**73**	**73**	**75**	**76**	65	64	71	67	65	60	60	49	**73**
7	68	69	69	72	72	73	69	**73**	**72**	**76**	65	64	71	67	65	60	60	49	**73**
8	68	69	69	72	72	72	69	**73**	**72**	**76**	58	--	60	--	--	--	--	--	--
9	67	68	69	72	73	75	63	**74**	**72**	**76**	64	--	65	--	--	--	--	--	62
10	68	68	54	65	66	71	64	53	**74**	58	61	--	63	--	--	--	--	--	60

Note: -- The noise level at this particular NSR is negligible since it is more than 300m away from the construction activity or is shielded from the construction activity.

* Denotes school

Bold figures indicate an exceedance of the EIAO-TM noise criteria of 75dB(A) for Residential and 70dB(A) for schools during normal school hours

Use of Temporary and Movable Noise Barriers

With the adoption of the quiet PME together with the movable noise barriers, the total SWL for each construction activity is presented in Appendix 3.5. The mitigated noise levels for single construction activity and the cumulative construction noise levels resulting from the ten scenarios at the representative NSRs are presented in Tables 3.10 and 3.11, respectively.

The results show that with the use of both PME and the movable noise barriers, all the residential NSRs could be sufficiently protected to be within the noise criterion. Hence, no further mitigation would be required for the residential NSRs.

On the other hand, exceedances of 1-4 dB(A) are still predicted at the schools. In order to minimise the potential noise impact, it is recommended that the particularly noisy construction activities should be scheduled to avoid the examination periods and simultaneous construction activities.

It is considered that all the practicable direct noise mitigation measures have been exhaustively employed to mitigate the construction noise impact. Hence, further direct noise mitigation measures would not be considered. Site survey has revealed that all these schools have already been noise insulated. It is expected that with the windows kept closed during the construction activities, about 10dB(A) noise reduction could be achieved. However, mitigation measures to control noise emission from construction activities should be considered at the first place and employed on-site so as to minimise the potential noise nuisance.

Table 3.10 Mitigated Construction Noise Levels for Single Construction Activity (Use of quieter PME and Movable noise barriers)

Construction Activities	Site	NSR												
		HTC1	PTE1	PTE2	STH1*	STH2*	SKH1*	SKH2*	EHC2	SAG1*	YT1	YT2	HNK1*	SAP1*
Preliminary Preparation Works		62	67	67	62	70	68	**72**	69	70	70	72	63	70
Earthworks/ Slopeworks	Section A	--	--	--	--	--	--	--	69	55	57	56	41	**71**
	Section B	67	67	67	--	69	--	**71**	--	--	--	--	--	--
	Section C	57	58	60	64	--	67	--	--	--	--	--	--	--
Road, Drainage and Utilities Works	Section A	--	--	--	--	--	--	--	68	55	57	56	41	**71**
	Section B	67	67	67	--	68	--	**71**	--	--	--	--	--	--
	Section C	57	58	60	64	--	67	--	--	--	--	--	--	--
Junction Improvement	Yau Tong Road/Lei Yue Mun Road	--	--	--	--	--	--	--	69	58	59	58	53	**71**
	Kai Tin Road	54	57	64	57	47	63	52	--	--	--	--	--	54
	Northern approach Road	55	58	62	48	47	64	53	--	--	--	--	--	53
Structures	Southern Portal	--	--	52	--	--	--	--	62	60	56	55	44	68
	Northern Portal	58	58	61	52	--	67	--	--	--	--	--	--	--
	Footbridge	56	61	68	--	60	--	65	--	--	--	--	--	54
	Retaining Wall	59	62	66	52	--	68	--	--	--	--	--	--	59

Note: -- The noise level at this particular NSR is negligible since it is more than 300m away from the construction activity or is shielded from the construction activity.
* Denotes school
Bold figures indicate an exceedance of the EIAO-TM noise criteria of 75dB(A) for Residential and 70dB(A) for schools during normal school hours

Table 3.11 Mitigated Construction Noise Levels for Different Scenarios (Use of quieter PME and movable Noise Barriers)

Scenarios	NSR											
	HTC1	PTE1	PTE2	STH1*	STH2*	SKH1*	SKH2*	EHC2	SAG1*	YT1	YT2	HNK1*	SAP1*
1	62	67	67	62	70	68	**72**	69	70	70	72	63	**70**
2	68	68	69	64	69	67	**71**	72	58	60	59	44	**74**
3	63	65	71	64	58	70	63	69	55	57	56	41	**71**
4	60	63	69	64	58	67	63	72	60	61	60	53	**74**
5	60	63	69	64	58	67	63	62	60	56	55	44	68
6	67	67	68	64	68	67	**71**	62	60	56	55	44	68
7	67	67	68	64	68	67	**71**	62	60	56	55	44	68
8	67	67	67	64	68	67	**71**	--	--	--	--	--	--
9	67	68	69	58	69	67	**71**	--	--	--	--	--	57
10	60	61	66	58	47	69	52	--	--	--	--	--	54

Note: -- The noise level at this particular NSR is negligible since it is more than 300m away from the construction activity or is shielded from the construction activity.
* Denotes school
Bold figures indicate an exceedance of the EIAO-TM noise criteria of 75dB(A) for Residential and 70dB(A) for schools during normal school hours

Residual Impacts

With the use of direct mitigation measures (quiet PME and movable noise barriers), the noise levels at all the residential NSRs could be reduced to be within the acceptable noise levels and therefore no residual impact is anticipated. For the schools, however, the use of the recommended mitigation measures is still insufficient to reduce the construction noise levels to below the criteria. Hence, residual impacts are anticipated and are summarised in Table 3.12.

Table 3.12 Details of Construction Noise Residual Impacts

NSR	Exceedance of the EIAO-TM Criterion dB(A)	Construction Activity Causing Exceedance	Approximate duration of exceedance
SKH2	1-2	Preliminary preparation works, earthworks/slopeworks and road drainage and utilities works at Kai Tin Road, and footbridge construction	11 months
SAP1	1-4	Preliminary preparation works, earthworks/slopeworks road drainage and utilities works at Yau Tong Road, junction improvement at Yau Tong Road/Lei Yue Mun Road, and Southern Portal construction	20 months

In order to reduce the potential noise impacts on the schools, the particularly noisy construction activities should be scheduled so as to avoid examination period and operating simultaneously. Liaison with ED & school authority will be carried out during detailed design and construction stages to obtain schedules of examination and due allowance will be included in the Contract for the contractor to observe and arrange appropriate activities at suitable time frame to minimize impacts. The on-site survey has revealed that the schools have already been noise-insulated. It is considered that if the windows kept closed during the construction activities, a noise reduction of about 10dB(A) can be achieved. However, direct mitigation measures to control noise emission from construction activities should be considered at the first place and employed on-site in order to minimise the potential noise nuisance.

To ensure that the mitigation measures propose in the EIA Report are properly implemented, it will be specified in the works contract that all impact mitigation measures, procedures and protocols as specified in the EIA Report shall be implemented. The works contract will also require the contractor to propose and implement clear, robust, enforceable and auditable procedures/provisions to ensure that the mitigation measures recommended in the EIA Report are properly implemented.

Cumulative Impact from Concurrent Projects

As the two housing sites, namely EHC housing site and Yau Tong Estate Redevelopment, will be completed prior to the commencement of this Project, no major concurrent construction activities are anticipated in the vicinity of the Project. Hence, assessment on the cumulative construction noise impacts of other projects in the vicinity is not considered necessary.

Construction Impacts on Open Space of Schools

Open space within the school boundary is not considered noise sensitive receivers and thus construction noise impacts are not assessed at the open space. However, students may use the open space for various activities and it is unfavourable to have high noise levels within the open space during construction phase. This section discusses the measures that may be considered to alleviate construction impacts on the open spaces within the schools in the vicinity of the work sites. However, it should be noted that as open space is not considered noise sensitive, measures suggested in this section are not required to fulfil the EIAO TM requirements on noise.

The recommended noise mitigation measure for St. Antonius Girls College is to provide a semi-enclosure (about 62m) for the section of Lei Yue Mun Road in front of St. Antonius Girls College.

This semi-enclosure is about 8m shorter than the noise canopy on the opposite lanes (northbound of Lei Yue Mun Road leaning against the podium of Yau Tong Estate Redevelopment). It is because any high noise barriers or semi-enclosures to be erected in front of the new extension of St. Antonius Girls College will potentially interfere with fire fighting and emergency vehicle access. Therefore the semi-enclosure on the southbound of Lei Yue Mun Road cannot extend to in front of the new extension of St. Antonius Girls College.

Among the schools in the vicinity of the work sites, only SKH Kei Hau Secondary School and St. Antonius Primary School have open spaces directly adjacent to the work sites. Open spaces in other schools are shielded from the work sites by buildings of the schools or other topographical features. Therefore only SKH Kei Hau Secondary School and St. Antonius Primary School are considered in this section.

<u>SKH Kei Hau Secondary School</u>

As the proposed alignment unavoidably cuts into a corner of this school, a temporary work platform will be set up adjacent to the open space of the school. Construction activities on the work platform include bored-piling works for new retaining wall formation and demolition of the existing retaining wall.

To mitigate construction impacts on the adjacent playground, a temporary barrier constructed at the boundary of the work platform can be considered. This barrier will reduce construction noise and dust impacts on students using the playground. The height of the barrier is suggested to be 4m such that all noise emitting parts of large equipment can be shielded from the direct line of sight of the students on the playground. The barrier may be cantilever type with the top 1m making a 45° angle with the vertical leaning towards the work site to increase its effectiveness. Gaps and openings at joints in the barrier material should be avoided where possible. Barrier material of surface mass in excess of 7 kg/m should be used.

To minimise construction impacts on the playground, this barrier should be constructed at the beginning of works before any major construction activities commence and removed only after all major construction works have been completed.

The suggested location of the barrier is shown in Figure 3.13. This barrier is effective in reducing noise at the open space. Furthermore, this barrier will reduce construction dust impacts and visual impacts due to construction activities. To enhance the visual acceptability of the barrier, the side facing the school may be designed taking into account any suggestions from the school.

St. Antonius Primary School

The construction activities adjacent to the open space of St. Antonius Primary School include the formation of the underpass portal and erection of permanent noise barrier. The erection of permanent noise barrier will have a more significant impact on the open space at the school as this activity will be conducted at a much closer location.

To reduce construction noise impacts on the open space at the school, a temporary noise barrier may be considered at the site boundary closest to the school. Similar to the barrier suggested at SKH Kei Hau Secondary School, the height of this barrier is suggested to be 4m such that all noise emitting parts of large equipment can be shielded from the direct line of sight of the students on the playground. The barrier may be cantilever type with the top 1m making a 45° angle with the vertical leaning towards the work site to increase its effectiveness. Gaps and openings at joints in the barrier material should be avoided where possible. Barrier material of surface mass in excess of 7 kg/m should be used.

The location of the suggested noise barrier is shown in Figure 3.14. This barrier will be effective in shielding noise from the construction of the permanent noise barrier footing. However, the barrier will not be effective in shielding noise from the construction of the underpass portal. Movable noise barriers placed close to the equipment as recommended in Section 3.5 will be required to mitigate noise from construction of the underpass portal.

To minimise construction impacts on the school, the temporary barrier should be constructed before the construction of the permanent noise barrier and removed only after the permanent roadside barrier has been completed. Construction of the permanent noise barrier should also be completed as early as possible as this 7.7m barrier can also mitigate construction noise impacting St. Antonius Primary School.

3.6 Traffic Noise Impact Assessment

Identification, Prediction and Evaluation of Traffic Noise Impacts

The existing sensitive receivers are already adversely affected by noise generated from traffic on Lei Yue Mun Road, Kai Tin Road and Yau Tong Road. Upon the commencement of operation of new roads, the future noise environment is likely to deteriorate. As a base case, all of the relevant noise mitigation measures recommended in the previous studies as summarized in Section 3.3 have been included in the noise calculation of the noise levels. Table 3.13 presents the unmitigated noise levels at the representative NSRs and Appendix 3.6 gives a breakdown of the noise contribution from the existing and new roads.

As indicated in Table 3.13, the overall noise levels are predicted to be in the range of 52-84dB(A) due to varying setbacks of the NSRs from the noise

sources. Apart from a few NSRs, noise levels at the majority of the existing and planned NSRs are predicted to exceed the EIAO-TM noise criteria of 70dB(A) for residential dwellings and 65 dB(A) for educational institutions. Table 3.14 summarizes the potential traffic noise impacts associated with the project. The following sub-sections detail the potential traffic noise impacts at each sensitive area:

Sceneway Garden

Sceneway Garden, comprising seventeen high-rise towers, is located above Lam Tin MTRC Station. The predicted noise levels at Blocks 7 to 9 (SG1 to SG3) are in the range of 68-76dB(A). The result indicates that apart from the first floor of SG3, the noise levels at all the NSRs are predicted to experience noise levels above the EIAO-TM criterion of 70dB(A).

A breakdown of the overall noise levels shows that the main traffic noise contributor for these NSRs would be existing roads. At all the NSRs the noise levels from new roads are predicted to be below 70dB(A) and contribute less than 1dB(A) to the overall noise levels. This indicates that the exceedances are attributable to the existing roads. It is considered that any mitigation applied to the proposed alignment would not be effective to protect the NSRs to be within the criterion. Hence, mitigation measures for these NSRs would not be considered.

Hong Tin Court

Hong Tin Court, comprising three high-rise residential towers, is located adjacent to Sceneway Garden. The predicted overall noise levels at the representative NSRs (HTC1 and HTC2) are in the range of 73-81dB(A), exceeding the criterion by up to 11dB(A).

A breakdown of the overall noise levels shows that the exceedances of the EIAO-TM criterion are primarily due to noise from traffic on existing roads. The noise levels from new roads at the NSRs would be all well below 70dB(A) and contribute less than 1dB(A) to the overall noise levels. It is considered that any mitigation applied to the proposed alignment would not be effective to protect the NSRs to be within the criterion. Hence, mitigation measures for these NSRs would not be considered.

Ping Tin Estate

Ping Tin Estate consists of seven high-rise residential buildings, and is located uphill on the eastern side of Kai Tin Road. The predicted overall noise levels at these NSRs (PTE1-PTE4) vary from 56 to 76dB(A). The result indicates that apart from PTE1 and the first floor of PTE3, the noise levels at all the NSRs are predicted to exceed the criterion by 1-6dB(A).

A breakdown of the overall noise levels shows that the major traffic noise contributor would be existing roads. The noise levels contributed from new roads at all the NSRs would be below 70dB(A) and the new road contributions to the overall noise levels would be less than 1dB(A). Hence, mitigation measures for these NSRs would not be considered.

Hong Pak Court

Hong Pak Court is located uphill, and consists of seven high-rise residential buildings. The overall noise levels at the representative NSRs (HPC1-HPC3) are predicted to vary from 66 to 71dB(A). With the exception of the upper floors of HPC1, the noise levels at all the NSRs are predicted to be within the noise criterion. A breakdown of the noise levels indicates that the exceedances are partially attributable to the new roads. Therefore, mitigation measures for these NSRs would be considered.

FDBWA Szeto Ho Secondary School and S.K.H. Kei Hau Secondary School

FDBWA Szeto Ho and SKH Kei Hau Secondary Schools are located opposite to the Ping Tin Estate. Both of them have already been insulated against road traffic noise. The predicted overall noise levels at the FDBWA Szeto Ho Secondary School (STH1 and STH2) and SKH Kei Hau Secondary School (SKH1 and SKH3) are in the range of 59-83dB(A) and 72-84dB(A), respectively. As indicated in Appendix 3.6, the main traffic noise contributor would be existing roads. It is considered that any mitigation applied to the proposed alignment would not be effective to protect the NSRs to be within the criterion. Therefore, mitigation measures would not be considered.

St. Antonius Primary School

St. Antonius Primary School is located adjacent to the proposed junction at Lei Yue Mun Road/Yau Tong Road. The school has been insulated against road traffic noise. The overall noise levels at the school (SAP1) are predicted to exceed the noise criterion by 9-10dB(A). A breakdown of the overall levels indicates that the new road would be the main noise contributor. Hence, mitigation measures would be considered.

St. Antonius Girls College and Buddhist Ho Nam Kam Prevocational College

The two colleges are located opposite to the site of Yau Tong Estate Redevelopment. These schools have already been insulated against road traffic noise. The overall noise levels at St. Antonius Girls College (SAG1) and Buddhist Ho Nam Kam Prevocational College (HNK1) are predicted to exceed the criterion by 12dB(A) and 6-7dB(A), respectively.

A breakdown of the overall noise levels shows that the main traffic noise contributor for HNK1 would be the existing road. At HNK1, the noise levels from new roads are predicted to be below 56dB(A) and contribute less than 1dB(A) to the overall noise levels. Therefore, mitigation measures would not be considered.

For St. Antonius Girls College, the noise levels are contributed from new road and existing roads equally. Therefore mitigation measures would be considered.

With the adoption of the proposed semi-enclosure, SAG1 would still experience noise exceedance of up to 2 dB(A). A breakdown of the overall noise levels in the above table indicates that the main traffic noise contributor would be from the existing roads. In fact, the noise levels from new roads are well below 65dB (A) and contribute less than 1dB(A) to the overall noise level. It is therefore considered that the exceedances are attributable to the existing roads and any

further mitigation applied to the new road would not be effective to protect the NSRs to be within the criterion. Further mitigation measures would not be considered.

Though the overall noise level at SAG1 still exceeds the noise criterion, the school itself has already been provided with Type II noise insulation and air conditioning. Hencem the residual impact should be acceptable.

With the adoption of the semi-enclosure in front of St. Antonius Girls College, the effectiveness of the recommended mitigation measures and the assessment of this noise sensitive receiver eligible for indirect technical remedies are summarized in Table 3.17.

Eastern Harbour Crossing (EHC) Housing Development

The EHC housing site, comprised nineteen high-rise residential blocks, is located at the eastern side of Eastern Harbour Crossing. Predicted noise levels at the representative NSRs (EHC1-EHC5) are in the range of 58dB(A) to 77dB(A). The result indicates that apart from the lower floors of these NSRs, the noise levels at these NSRs are predicted to exceed the noise criterion by up to 6dB(A). A breakdown of noise levels indicates that the majority of the exceedances would be attributable to new roads and hence mitigation measures would be required.

Yau Tong Estate Redevelopment

Yau Tong Estate Redevelopment is located at the southern end of the project limit and is now under construction. The result shows that the predicted overall noise levels at the representative NSRs (YT1 and YT3) range from 69 to 75dB(A). A breakdown of noise levels indicates that the exceedances of the noise criterion are partially attributable to new roads. Hence, mitigation measure would also be required.

The addition of the semi-enclosure in front of St. Antonius Girls College will further reduce noise levels at the opposite Yau Tong Estate Redevelopment. The predicted noise levels at the Yau Tong Estate Redevelopment as shown in Table 3.16 are therefore calculated from a conservative noise model. However, even without this semi-enclosure, noise levels from new roads are already well below 70dB(A0 and contribute less than 1dB(A) to the overall noise levels at the dwellings with overall noise levels exceeding the noise criterion. Therefore this semi-enclosure in front of St. Antonius Girls College will only slightly lower the overall noise levels at Yau Tong Estate Redevelopment.

Table 3.13 Predicted Traffic Noise Levels for Year 2022 (Unmitigated)

NSR	Floor	Floor Levels mPD	Predicted Noise Levels in dB(A)
SG1	1	47.8	**74**
	10	73	**76**
	20	101	**75**
	28	123.4	**74**
SG2	1	54.8	**72**
	10	80	**73**
	20	108	**72**
	30	136	**73**
	31	138.8	**73**
SG3	1	50.4	68
	10	75.6	**72**
	20	103.6	**73**
	30	131.6	**73**
	32	137.2	**73**
HTC1	1	72.7	**78**
	10	97.9	**76**
	20	125.9	**74**
	30	153.9	**73**
	32	159.9	**73**
HTC2	1	72.7	**81**
	10	97.9	**77**
	20	125.9	**75**
	30	153.9	**73**
	32	159.9	**73**
STH1	1	53.9	59
	6	68.9	**72**
STH2	1	56.9	**83**
	6	71.9	**81**
SKH1	1	52.2	**72**
	6	67.2	**75**
SKH2	1	52.2	**84**
	6	67.2	**80**
PTE1	1	80.5	56
	10	105.7	67
	20	133.7	70
	30	161.7	69
	38	184.1	69
PTE2	1	80.5	**72**
	10	105.7	**75**
	20	133.7	**75**
	30	161.7	**74**
	38	184.1	**74**
PTE3	1	80.5	68
	10	105.7	**75**
	20	133.7	**74**
	30	161.7	**74**
	38	184.1	**74**

NSR	Floor	Floor Levels mPD	Predicted Noise Levels in dB(A)
PTE4	1	86.5	**75**
	10	111.7	**76**
	20	139.7	**75**
	30	167.7	**75**
	38	190.1	**74**
HPC1	1	101.2	66
	10	126.4	70
	20	154.4	**71**
	30	182.4	**71**
	34	193.6	**71**
HPC2	1	100.2	67
	10	125.4	70
	20	153.4	70
	30	181.4	70
	33	189.8	70
HPC3	1	98.7	66
	10	123.9	69
	20	151.9	70
	30	179.9	70
	34	191.1	70
SAG1	1	36.1	**77**
	5	48.1	**77**
HNK1	1	50.2	**72**
	5	62.2	**71**
SAP1	1	41.2	**74**
	5	53.2	**75**
EHC1	1	39.2	61
	10	64.4	**72**
	20	92.4	**75**
	30	120.4	**74**
	40	148.4	**73**
	46	165.2	**73**
EHC2	1	39.2	62
	10	64.4	**75**
	20	92.4	**73**
	30	120.4	**72**
	40	148.4	**71**
	46	165.2	**71**
EHC3	1	39.2	60
	10	64.4	**76**
	20	92.4	**74**
	30	120.4	**73**
	40	148.4	**72**
	46	165.2	**72**
EHC4	1	39.2	58
	10	64.4	**74**
	20	92.4	**73**
	30	120.4	**72**
	40	148.4	**71**

NSR	Floor	Floor Levels mPD	Predicted Noise Levels in dB(A)
EHC5	1	39.2	63
	10	64.4	**77**
	20	92.4	**75**
	30	120.4	**74**
	40	148.4	**73**
	46	165.2	**72**
YT1	1	52.5	**71**
	10	77.2	**71**
	20	104.7	70
	30	132.2	69
	36	148.7	69
YT2	1	52.5	**75**
	10	77.2	**73**
	20	104.7	**71**
	30	132.2	70
	36	148.7	69
YT3	1	52.5	**73**
	10	77.2	**73**
	20	104.7	**71**
	30	132.2	70
	36	148.7	69

Table 3.14 Potential Traffic Noise Impacts

Residential Premises/Schools	Exceedance of the Noise Criteria[1], dB(A)	Estimated Number of dwellings /classrooms	
		Exceed the Noise Criteria	Exceed the Noise Criteria with New Roads Contribution > 1dB(A)
Sceneway Garden	1-6	350	0
Hong Tin Court	3-11	160	0
Ping Tin Estate	2-6	520	0
Five Districts' Business Welfare Association Szeto Ho Secondary School	7-18	25*	0
S.K.H. Kei Hau Secondary School	7-19	25*	2*
Hong Pak Court	1	35	35
St. Antonius Primary School	9-10	30*	30*
St. Antonius Girls College	12	25*	15*
Buddhist Ho Nam Kam Prevocational College	6-7	25*	0
EHC Housing Site	1-7	740	590
Yau Tong Estate Redevelopment Phase 3	1-4	415	130
Total		**2220/130***	**755/47***

Note:
[1] 70dB(A) for residential dwellings and 65dB(A) for schools
* denotes classroom

Traffic Noise Mitigation Measures

As presented in the above section, some of the NSRs would be exposed to excessive noise level from the proposed road alignment in 2022. Therefore mitigation schemes where feasible should be provided to reduce these impacts to acceptable levels. A list of direct noise mitigation measures stated in Annex 13, Section 6 of EIAO-TM have been considered and their practicability for the Project are summarized in Table 3.15 below.

Table 3.15 Summary of Practicability of Various Direct Noise Mitigation Measures

Noise Mitigation Measures	Evaluation
1. Alternative Land Use Arrangement	Not applicable to this project.
2. Alternative Siting	Please refer to Chapter 2.
3. Screening by Noise Tolerant Building	All noise sensitive receivers in the vicinity of the proposed road alignment are existing receivers or currently under construction. Hence, no control measures at the receivers could be applicable.
4. Setback of Building	Same reason as item 3
5. Decking Over	Lack of building support on both sides of the road to build a deck over, but an alternative in the form of a canopy is considered.
6. Extended Podium	Same reason as item 3
7. Building Orientation	Same reason as item 3
8.Treatment of Source	Outside our scope
9. Alternative Alignment	Alternative alignments have been considered in the prior options evaluation. The proposed alignment is considered the most optimal in engineering feasibility and environmental friendliness.
10. Noise Barrier/ Enclosure	Roadside noise barriers/enclosures are considered practicable and applicable to this project.
11. Special Building Design	Same reason as item 3
12. Architectural Features/Balcony	Same reason as item 3
13. Open-Textured Road Surfacing	Low noise surfacing materials (LNSM) are applicable to all new roads.

Having considered the direct mitigation measures recommended in the EIAO-TM and the environmental setting of the site and the source-receiver configuration, an extensive mitigation package has been developed and evaluated for effectiveness. The recommended noise mitigation measures are described below:

- Two sections of noise canopies (about 105m) and a noise semi-enclosure (about 50m) for the section of Lei Yue Mun Road in front of EHC Housing Site Phase 1;

- A 7.7m high and 3m horizontal cantilevered noise barrier of about 115m for the northbound carriageway of Lei Yue Mun Road in front of St. Antonius Primary School;

- A semi-enclosure (about 62m) for the section of Lei Yue Mun Road in front of St. Antonius Girls College as shown in the attached figure;

- A 70 m noise canopy for northbound of Lei Yue Mun Road leaning against the podium of Yau Tong Estate Redevelopment Phase 3; and

- Low Noise Road Surfacing on new roads.

It is noted that the pedestrian access in Yau Tong Estate Redevelopment Phase 3 has been taken into account in the design of the proposed noise canopy. Locations of the above-mentioned mitigation measures are illustrated in Figure 3.5. Typical cross-sections of the proposed noise canopy, noise semi-enclosure, and cantilevered noise barrier are shown in Figures 3.6 to 3.8 respectively. In order to maintain water supply for fire fighting operation for St. Antonius Primary School, fire hydrants should be provided along Yau Tong Road so that water supply can be assessed and detailed arrangement should be considered in detailed design stage.

Effectiveness Evaluation of the Recommended Mitigation Measures

With the implementation of the recommended cantilevered barrier, canopies and semi-enclosures, the mitigated noise levels at the corresponding NSRs have been predicted and are presented in Table 3.16. Appendix 3.7 gives the detailed breakdown of the contributions from existing and new roads.

As indicated in Table 3.16, the mitigated noise levels at most of the NSRs are still predicted to exceed the EIAO-TM noise criteria despite the proposed cantilevered noise barrier, noise canopies and semi-enclosures. However, the exceedances are mainly due to contributions from traffic along existing roads. The effectiveness of the recommended mitigation measures for the corresponding NSR areas is summarized in the following paragraphs.

Hong Pak Court

The mitigated noise levels at the representative NSRs (HPC1-HPC3) are predicted to vary from 65 to 70dB(A). The result indicates that the noise levels at all the NSRs could be reduced to be within the noise criterion. Therefore, no further mitigation measures would be required.

St. Antonius Primary School

The mitigated noise levels at the school are predicted to be around 69dB(A). The result indicates that with the adoption of the proposed cantilevered noise barrier, the noise levels at the school (SAP1) would still exceed the noise criterion by 4dB(A). However, the school has already shown to be within the shadow zone of the proposed cantilevered noise barrier as illustrated in Figure 3.9. Therefore, to propose more extensive mitigation measure in the form of noise semi-enclosure will not further reduce the noise impact as the noise contribution mainly comes from the junction of Yau Tong Road and Lei Yue Mun

Road. In light of the traffic contributions from the junction of Yau Tong Road and Lei Yue Mun Road, the most practicable measure in the form of canopy has been recommended. There is no other more practicable and effective measures can be recommended due to the traffic safety requirements.
In addition, as the school has already been provided with window insulation and air conditioning, the noise impact should be considered acceptable. Hence, no further mitigation would be considered.

Eastern Harbour Crossing (EHC) Housing Site

The mitigated noise levels at the representative NSRs (EHC1-EHC5) are predicted to range from 58dB(A) to 76dB(A). With the adoption of the proposed noise canopies and semi-enclosures, most of the NSRs would still experience excessive noise levels. A breakdown of the overall noise levels in Appendix 3.7 indicates that the main traffic noise contributor for most of the exceedances would be from the existing roads. In fact, the noise levels from new roads are below 70dB(A) and contribute less than 1dB(A) to the overall noise levels for those overall noise levels exceeding 70dB(A) except for 10/F of EHC1.

Having considered the engineering constraints and environmental setting of the site, all the practicable noise mitigation measures have been exhaustively employed to mitigate the noise impact. Any further mitigation applied to the proposed alignment is considered not practicable and not effective, and hence no further mitigation would be considered.

According to the *Environmental Assessment Study for Potential Public Housing Site at East of EHC, Lei Yue Mun Road, Ove Arup& Partners, December 1998*, noise insulation in the form of acoustic insulation and air conditioning will be provided for all the affected units in the development.

Yau Tong Estate Redevelopment

The mitigated noise levels at the representative NSRs (YT1 to YT3) range from 68 to 75dB(A). The result indicates that the noise levels at all the NSRs are predicted to be within the noise criteria with the exception of 1-20 floors of YT2 and YT3. A breakdown of the overall noise levels shows that the main traffic noise contributor for the exceedances would be from the existing roads. In fact, the noise levels from new roads are well below 70dB(A) and contribute less than 1dB(A) to the overall noise levels. It is therefore considered that the exceedances are attributable to the existing roads and any further mitigation applied to the new road would not be effective to protect the NSRs to be within the criterion. Further mitigation measures would not be considered.

According to the *Environmental Assessment Revision Study for Ko Chiu Road/Yau Tong/Lei Yue Mun Comprehensive Development*, completed in April 1998, noise insulation in the form of acoustic insulation and air conditioning would be provided for the affected units in this housing estate.

Table 3.16 Predicted Traffic Noise Levels for Year 2022 (Mitigated)

NSR	Floor	Floor Levels mPD	Predicted Noise Levels in dB(A)
HPC1	1	101.2	66
	10	126.4	69
	20	154.4	70
	30	182.4	70
	34	193.6	70
HPC2	1	100.2	66
	10	125.4	69
	20	153.4	69
	30	181.4	70
	33	189.8	70
HPC3	1	98.7	65
	10	123.9	68
	20	151.9	69
	30	179.9	69
	34	191.1	69
SAG1	1	36.1	**67**
	5	48.1	**67**
HNK1	1	50.2	**72**
	5	62.2	**71**
SAP1	1	41.2	**69**
	5	53.2	**69**
EHC1	1	39.2	61
	10	64.4	**72**
	20	92.4	**75**
	30	120.4	**74**
	40	148.4	**73**
	46	165.2	**73**
EHC2	1	39.2	60
	10	64.4	**72**
	20	92.4	70
	30	120.4	70
	40	148.4	69
	46	165.2	69
EHC3	1	39.2	60
	10	64.4	**76**
	20	92.4	**74**
	30	120.4	**73**
	40	148.4	**72**
	46	165.2	**71**
EHC4	1	39.2	58
	10	64.4	**74**
	20	92.4	**73**
	30	120.4	**72**
	40	148.4	**71**

NSR	Floor	Floor Levels mPD	Predicted Noise Levels in dB(A)
EHC5	1	39.2	63
	10	64.4	**76**
	20	92.4	**74**
	30	120.4	**73**
	40	148.4	**72**
	46	165.2	**71**
YT1	1	52.5	68
	10	77.2	70
	20	104.7	69
	30	132.2	68
	36	148.7	68
YT2	1	52.5	**75**
	10	77.2	**73**
	20	104.7	**71**
	30	132.2	70
	36	148.7	69
YT3	1	52.5	**73**
	10	77.2	**73**
	20	104.7	**71**
	30	132.2	70
	36	148.7	69

Residual Impacts

The direct mitigation measures stated in Annex 13, Section 6 of EIAO-TM have been considered, and the practicable mitigation package has been recommended and evaluated. The effectiveness of the recommended mitigation measures, in terms of the number of NSRs which will either be protected or benefited (by at least 1dB(A)), is summarized in Table 3.17.

Table 3.17 Effectiveness of Recommended Mitigation Measures

Area	Estimated Number of Residential Dwellings/Classrooms			
	Exceed the Noise Criteria[1]	Exceed the Noise Criteria with New Roads Contribution > 1dB(A)	Protected within Criteria[1]	Benefited by [3] 1dB(A)
Sceneway Garden	350	0	0	0
Hong Tin Court	160	0	0	0
Ping Tin Estate	520	0	0	0
Five Districts' Business Welfare Association Szeto Ho Secondary School	25*	0	0	0
S.K.H. Kei Hau Secondary School	25*	0	0	0
Hong Pak Court	0	0	35	10
St. Antonius Primary School	30*	30*	0	30*
St. Antonius Girls College	25*	0	0	25*
Buddhist Ho Nam Kam Prevocational College	25*	0	0	0
EHC Housing Site	620	15	120	250
Yau Tong Estate Redevelopment	320	0	95	280
Total	**1970/130***	**15/30***	**250**	**540/55***

Note:
[1] 70dB(A) for residential dwellings and 65dB(A) for schools
* denotes classroom

Due to engineering constraints and/or high noise levels from existing roads, traffic noise levels at some NSRs are still predicted to exceed the noise criteria even with the use of the recommended mitigation measures.

As indicated in Appendix 3.7, the mitigated noise levels from new roads at all residential NSRs are predicted to be below 70dB(A) and the new roads contribution at most of the residential NSRs are less than 1dB(A) to the overall noise levels. This indicates that the residual impacts are primarily attributable to existing road noise impact. Having considered the engineering constraints and environmental setting of the site, all the practicable noise mitigation measures have been exhaustively employed to mitigate the noise impact. Any further mitigation applied to the proposed alignment is considered not practicable and not effective, and hence further mitigation would not be considered.

The mitigated noise levels are still predicted to exceed the noise criterion at the majority of the educational NSRs. For FDBWA Szeto Ho Secondary School and S.K.H. Kei Hau Secondary School, the noise from existing roads dominates the overall traffic noise levels and the noise from new roads contributes less than 1dB(A) to the overall noise levels. It is therefore considered that these impacts are not attributable to new roads and any mitigation applied to the new road would not be effective to protect the NSRs to be within the criterion. On the other hand, the exceedances at St. Antonius Primary School and St. Antonius Girls College are primarily due to noise from new roads. On-site inspection

verified that all these schools have been noise-insulated with either Type I window or Type II window. It is considered that a noise reduction of less than 10dB(A) for Type I window and less than 15dB(A) for Type II window can be achieved if the windows are kept closed.

The residual impacts have been assessed against the noise insulation criteria as described in Section 3.4, and the result is summarized in Appendix 3.8. The results show that all residential dwellings and schools would not meet the criteria and therefore indirect technical remedies in the form of window insulation and air conditioning would not be required.

3.7 Environmental Monitoring and Audit

Construction Phase

It is recommended that construction noise monitoring be carried out at two monitoring locations as shown in Figure 3.10 during the construction period. The recommended mitigation measures, monitoring procedures and locations will be presented in the Environmental Monitoring and Audit Manual (EM&A). This enables the Contractor to have early warning and provide necessary action to reduce noise emissions at specific areas if the assessment criteria are approached. The effectiveness of on-site control measures could also be evaluated through the monitoring exercise. All the recommended mitigation measures should be incorporated into the EM&A program for implementation during construction.

Operation Phase

It is recommended that traffic noise monitoring be carried out at two proposed monitoring locations as shown in Figure 3.11 within one year of the road opening. The recommended mitigation measures, monitoring procedures and locations are presented in the Environmental Monitoring and Audit Manual (EM&A). The effectiveness of on-site control measures could also be evaluated through the monitoring exercise.